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OF THE

COCOA RESEARCH INSTITUTE OF NIGERIA, IBADAN

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TABLE OF CONTENTS

COCOA PROGRAMME

Experimental Title: Evaluating Climate Smart Adaptation Practices on Cocoa Insect pests and Diseases Incidences among Farmers in Cross River State, Nigeria

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Introduction

Climate Smart Agriculture (CSA) is an approach that guides actions needed to transform and orient agricultural systems to effectively support development and ensure food security in a changing climate (FAO, 2017). CSA includes practices and technologies that sustainably increase productivity and incomes, support farmers' adaptation to climate change, ensure food security and reduce levels of greenhouse gases. CSA provides the means to help stakeholders at local, national or international levels choose the agricultural strategies that are the most readily adaptable to specific climate conditions.

Cocoa production in Nigeria is rain-fed and is very sensitive to changing weather conditions. CSA aims to mitigate the negative impact of climate change on cocoa production and to adapt farmers' agricultural practices where necessary. Climate change is causing global shifts in temperature, precipitation patterns and CO2 and non-CO2 greenhouse gases. It brings about unpredictable and extreme weather events such as torrential rainfall, drought, bush burning, deforestation and sea level rise. This scenario is impacting significantly on global crop yields and food security (Beddington*et al.* 2012 and Challinor*et al.* 2014).

Climate change is directly and indirectly influencing the distribution and severity of crop pests, including invasive species, which is further affecting crop production (Lamichhane et al. 2016, Macfadyen et al. 2018). Innovations in CSA help farmers to reach their production goals and build resilience. Barzman*et al.* (2015) reported that a global pattern of increasing latitudinal and altitudinal range of crop pests is anticipated, either through direct effects of climate change on the pests themselves or on the availability of host crops. Up to 40% of the world's food supply is already being lost to pests (Oerke, 2006) and, as climatic environments continue to change or create new pest threats; cocoa farmers in producing areas need to adapt smart solutions to their farm management practices.

Cocoa farmers are exposed to extreme climatic events which are expected to increase as climate change continue to affect crops, animals and man. Cocoa contributes significantly to farm income of producers, government foreign exchange and rural employment, climate smart adaptation has become necessary to ensure sustainability. The sensitivity of cocoa production to hours of sunshine, rainfall, soil conditions and temperature makes it vulnerable to climate change. Changing climate can also alter development of pests and diseases and change the host's resistance. Unfavorable climate promotes insect pest infestation and disease outbreak on cocoa farms. Newly planted cocoa plants and some cocoa trees shrivel because of drought (Anim-Kwapong and Frimpong, 2005). Extension services therefore needs to support farmers with the reorientation of pest management practices under climate change for effective performance. It is against this backdrop that the study seeks to access the climate smart adaptation practices used by farmers to mitigate insect pest and disease challenges of cocoa in Cross River State.

The specific objectives are to:

i Describe the socio-economic characteristics of cocoa farmers.

ii Identify the observed weather variables affecting insect pest and diseases in cocoa farming.

iii Examine the strategies used by cocoa farmers in adapting to climate change as a result of insect pests and diseases incidences.

iv Ascertain the constraints farmers encounter in adapting climate smart practices as a result of cocoa insect pest and diseases problems.

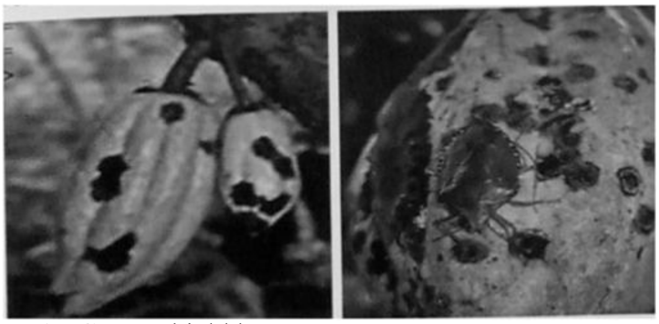
Methodology

Nigeria has a tropical climate with two different seasons known as wet and dry seasons. They have varying lengths of rainy and dry seasons depending on the geographical location. In the South South zone where the study was carried out, there is a longer period of rainy season commencing in March to November than the Northern zone (May to September). Cross River State is located on coordinates: 5°45'N 8°30'E. It is a coastal state located in the Niger Delta region, and occupies 20,156 square kilometers. It shares boundaries with Benue State to the north, Ebonyi and Abia States to the west, to the east by Sud-Ouest Province, and to the south by Akwa-Ibom and the Atlantic Ocean (Andem, *et al,* 2013).

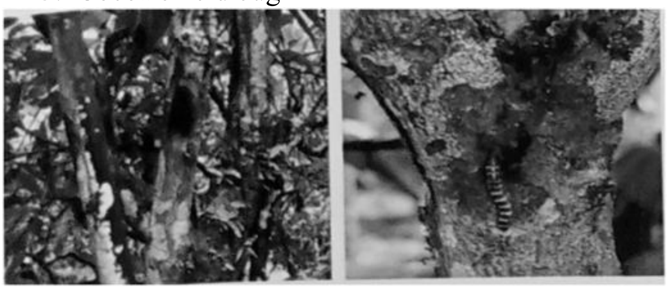
A multistage sampling procedure was used to select the sample for the study. Cross River State was purposively selected for the study due the predominance of cocoa production and the coastal nature of producing communities in the Southern State. At the first stage, we randomly selected three major cocoa growing Local Government Areas (LGAs): Boki, Etung and Ikom. The second stage involves random selection of two villages from each LGA. At the third stage, a list of registered farmers from the Cocoa Association of Nigeria was used to sample 55 farmers from Boki, 42 from Etung and 35 from Ikom making a total of 132 based on level of production. Structured interview schedule was used to collect field data. Descriptive and inferential statistics were used for data analysis. Farmers were showed samples and pictures of insect pests and diseases before data were collected from then. These include mirids/capsids, stem borer, mealybugs, pod husk borer, leaf defoliators, termites, tailor ants shield bugs and Psyllids. The diseases were black pod, thread blight (leaf disease), cherelle wilt, brown pod rot and cocoa swollen shoot virus. Some of these pictures are displayed in Figures 1-4.

1. Black pod disease

2. Cocoa mirids



3. Cocoa shield bug



4. Cocoa stem borer

Results and Discussion

Socio-economic characteristics of farmers

The variables in table 1 shows that the males were more than female respondents having 81.1%. It suggests that male respondents dominated cocoa production with respect to insect pest and diseases incidence. The mean age of farmers was about 46 years which gives an indication that they were still within the active production age of farming. This result is similar to that of Osarenren*et al*, (2016). They reported that cocoa farmers were in their middle ages which implied they were still in their economic active age and would result in positive effect on production. The respondents have one form of formal education with more of them having secondary education, 47% while 23,5% had the basic primary education. This will no doubt increase their knowledge in controlling the challenges of insect pest and diseases under a changing climate. In terms of cocoa farm size, majority (61.3%) of the respondents owned farm sizes of less than 5 hectares. This suggests that the farmers were smallholders which is the common farm sizes of cocoa farmers in Nigeria. This result agrees with Oluyole (2017). The mean age of most of the cocoa farms was a little above 18 years which indicates that the farm is still relatively young and within the productive years.

Table 1: Socio-economic characteristics of farmers N=132

Variables	Frequency	Percentage	Mean
Sex			
Male	107	81.1	
Female	25	18.9	
Age of respondents (Years)			45.05
≤ 25	12	9.1	
26-35	18	13.6	
36-45	42	31.8	
46-55	30	22.7	
56-65	21	15.9	
66 and above	9	6.8	
Educational Level			
No formal education	10	7.6	
Primary	31	23.5	
Secondary	62	47.0	
Tertiary	29	22.0	
Cocoa farm size (Hectare)			12.79
1-5	81	61.3	
6-10	31	23.5	
11-15	8	6.1	
16-20	7	5.3	
21 and above	5	3.8	
Age of cocoa farm (Years)			18.36
1-5	14	10.6	
6-10	31	23.5	
11-15	28	21.2	
16-20	30	22.7	
21-25	9	6.8	
26 and above	20	15.2	

Source: Field survey, 2019

Observed weather variables promoting insect pests and diseases incidences in cocoa production

Prolong rainfall (34.8%), rainfall (15.9%) and humidity (15.2%) were ranked by the respondents as the main observed weather variables promoting the incidence of insect pests and diseases in cocoa production (Table 2). It means that the study area experienced a lot of precipitation which could be due to the coastal nature of Cross River States of Nigeria. In Oyekale (2021), he found out that too much rainfall was largely perceived by farmers in promoting incidence of pest and diseases like black-pod.

Table 2: Ranked observed weather variables affecting insect pest and diseases in cocoa production N=132

Observed weather variables	Frequency	Percentage	Rank
a. Rainfall	21	15.9	2nd
b. Prolong rainfall	46	34.8	1st
c. Humidity	20	15.2	3rd
d. Prolong dry season	17	12.9	4th
e. Drought	12	9.1	6th
f. Temperature changes	16	12.1	5th

Source: Field survey, 2019

Climate smart adaptation practices of farmers towards cocoa insect pests and diseases incidences

The effectiveness of climate smart adaptation strategies practiced by farmers in managing the occurrence of insect pest and diseases of cocoa amidst climate change is explained in table 3. Removal of diseased and dried up cocoa pods from the tree regularly (66.7%), Fungicides and insecticides application to cocoa trees in raining season (60.6%), pruning of cocoa trees (59.1%), pesticide application to cocoa trees before commencement of rains (55.3%), weeding by hand slashing (54.5%) and use of improved cocoa varieties (51.5%) respectively were the most effective climate smart adaptation strategies used by farmers in coping with the challenges of insect pest and diseases in cocoa plantations. This result is in line with Dhakal*et al.* (2016)who reported that increased pesticide application was the principal strategy used by many farmers to handle climate-induced pest increases. Farmers need to spray their cocoa trees with fungicides before and during the raining season otherwise, they will end up getting nothing from cocoa because of high incidence of black pod diseases prevalence. However, the use of agro-meteorological and climatological services (29.5%) from the Nigeria Meteorological Agency (NIMET) shows the least adaptation option used by farmers. Also, 45.5% of the farmers claimed that this strategy was not effective. The implication of this is that farmers are not getting enough climate information from NIMET for their cocoa farming activities or they have limited knowledge about the use of agro climate information in the study area.

Table 3: Climate Smart Adaptation practices of farmers towards cocoa insect pests and diseases incidences N=132

Climate Smart Adaptation Practices of farmers	Not effective	Effective	Very effective
1. Fungicides and insecticides application to cocoa trees before commencement of rains	25(19.0)	34(25.8)	73(55.3)
2. Fungicides and insecticides application to cocoa trees in raining season	18(13.6)	3(25.8)	80(60.6)
3. Use of improved cocoa varieties	15(11.4)	49(37.1)	68(51.5)
4. Removal of diseased and dried up cocoa pods from the tree regularly	10(7.6)	34(25.8)	88(66.7)
5. Physical removal of insect pests from cocoa farm	28(21.2)	47(35.6)	57(43.2)
6. Pruning of cocoa trees	12(9.1)	42(31.8)	78(59.1)
7. Weeding by hand slashing	17(12.9)	43(32.6)	72(54.5)
8. Weeding by herbicides application	53(40.2)	48(36.4)	31(23.5)
9. Use of agro-meteorological and climatological services from NIMET	60(45.5)	33(25.0)	39(29.5)
10. Integrated Pest Management (IPM)	39(29.5)	40(30.3)	53(40.2)

Source: Field survey, 2019 Figures in parentheses are percentages

Constraints encounter by farmers in adapting climate smart practices as a result of insect pest and diseases problems

The result in Table 4 shows that high cost of pesticides (88.7%), financial problem (83.3%) and labour cost (75%) constituted very serious constraints to climate smart practices in terms of insect pest and diseases control of cocoa. What this means is that the constraints did not prevent the farmers from tackling the problem of insect pest and diseases. It shows the resilient nature of cocoa farmers in adapting to climate change.

Table 4: Ranked constraints encountered by farmers in adapting climate smart practices of cocoa insect pests and diseases N=132

Constraints	Not serious	Serious	Very serious	Rank
High cost of pesticides	2(1.5)	13(9.8)	117(88.7)	1st
Labour cost	1(0.8)	32(24.2)	99(75.0)	3rd
Financial problem	3(2.3)	19(14.4)	110(83.3)	2nd
Inadequate climate change information	21(15.9)	36(27.3)	75(56.8)	4th
Emerging or new pest problem	42(31.8)	34(25.8)	56(42.4)	5th

Source: Field survey, 2019 Figures in parentheses are percentages

Correlation between constraints encountered by farmers and climate smart adaptation practices towards insect pest and diseases of cocoa

There was a significant relationship between constraints farmers encountered and their climate smart adaptation practices in coping with insect pest and diseases problems of cocoa ($r=0.172$, $p=0.050$ at $p \leq 0.05$) Table 5. It means that despite the limiting constraints farmers continue to adapt climate smart practices in controlling insect pest and diseases. It goes to explain that farmers are taking cocoa farming as a serious business in order to sustain their livelihoods even in the daunting challenges of climate change. This is true because cocoa farming is a major business in Cross River State. The work of Cilas and Bastide (2020) agrees with the result of this study. They reported that the problem of insect pest and diseases could constraint cocoa production due to the use of pesticides.

Table 5: Correlation between constraints encountered by farmers and climate smart adaptation practices N=132

Variable	R	P
Constraints encounter by farmers in adapting climate smart strategies	0.172	0.05**

Source: Field survey, 2019

Conclusion and Recommendations

The study concludes that irrespective of limiting constraints encountered by cocoa farmers, they were able to adapt to the effects of changing climate associated with insect pests and diseases situation in cocoa farms. Fungicides and insecticides application to cocoa trees before and during raining season, pruning of cocoa tress, weeding by hand slashing and use of improved cocoa varieties respectively were the most effective climate smart adaptation strategies used by farmers in coping with the challenges of insect pests and diseases in cocoa plantations. The research clearly shows that the use of pesticides in controlling insect pests and diseases incidences of cocoa by farmers in Cross River State is a popular practice. It is recommended that farmers should sustain their current practices, ensure the use of approved pesticides and NIMET services.

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Experimental Title: Hypoglycemic potential of cocoa powder in Monosodium Glutamate-diet induced diabetic mice

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Introduction

Diabetes mellitus (DM) popularly called Diabetes is known as the world most common endocrine disorder (WHO, 1999). DM is a glucose metabolism disorder resulting from dysfunction of pancreatic beta cells and insulin resistance. It has become a serious problem of modern society due to severe long-term health complications associated with it. DM is associated with reduced life expectancy, significant morbidity due to specific diabetes related condition primarily defined by the rising level of hyperglycemia leading to increased risk of microvascular complications (retinopathy, nephropathy and neuropathy), increased risk of macrovascular complications (ischaemic heart disease, stroke and peripheral vascular disease), and diminished quality of life (WHO, 2003). Result from epidemiological data reveals that approximately 177 million people worldwide are suffering from this disease and there are postulations that this will be doubled and increase to up to 300 million by the year 2030 (WHO, 2016).About 14.2 M adults (20-79) years have diabetes in Africa. Nigeria, South Africa, Democratic Republic of Congo and Ethiopia are Africa 's most populous countries with highest diabetic patients with 1.6, 2.3, 1.8 and 1.3 million respectively. (International Diabetes Federation, 2015)

DM is not a single disease, it's group of heterogeneous syndromes such as heart attack, obesity, stroke and peripheral vascular disease (Porter and Barrett, 2005). Diabetes also resulting in reduced haemoglobin was reported and may as well be accompanied by a fall in the red blood cell count and packed cell volume (Moss, 1999; Muhammad and Oloyede, 2009).

Diabetes mellitus is divided into four categories. Type-1 diabetes is also called insulin-dependent DM because this disease is characterized by an absolute deficiency of insulin. Beta cells are destructed due to invasion by virus, action of chemical toxins or due to action of autoimmune antibodies. (Patel *et al*, 2011). Type-2 diabetes is a non-insulin dependent DM or Type-2 and frequently accompanied by target organ insulin resistance that limits responsiveness to both endogenous and exogenous insulin (Wang *et al,* 2011). Type-3 diabetes is a type of diabetes caused by chronic pancreatitis or chronic drug therapy with glucocorticoids, thiazide diuretics, diazoxide, growth hormone and with some protease inhibitors (e.g. saquinavir). Type-4 diabetes is observed in approximately 4-5% of all pregnancies, due to placental hormones that promotes insulin resistance (Bacha *et al*, 2010). At present time best and quickest way to induce diabetes is with use of chemicals (alloxan, streptozotocin, dithizone, monosodium glutamate), viruses and genetically diabetic rats. (Tripathi and Verma, 2014)

Monosodium glutamate (MSG) is a salt of the amino acid glutamate, (Pavlovic and Sarac, 2010; Egbuonu*et al*. 2010). It is reported to enhance flavourin certain dishes and processed foods, MSG is said to invoke a 'fifth taste' a complex, savoury flavour. (Yamaguchi and Ninomiya, 2000), through stimulation of the oro-sensory receptors (Fuke and Shimizu, 1993). There are assertions too, that MSG is a food additive and as a major constituent of Nigerian diets (Akpamu*et al*., 2011). It enhances appetite and palatability of meals (Yamaguchi, 1987). MSG remains a source of concern considering the controversies about their risks and benefits. Of a particular interest is the use of MSG, which, according to Eweka and Om'Niabohs, (2011) is popularly known in Nigeria as white maggi. Many studies have shown that MSG is toxic to humans and experimental animals (Egbuonu*et al.,* 2010). It induces seizures, liver damage (Egbuonu*et al.,* 2010), brain damage (Nwaopara*et al.,* 2011), diabetes, obesity and anemia (Akpamu*et al*; 2011).

Pharmacological treatment of Diabetes Mellitus is based on oral hypoglycemic agents and insulin which have many side effects. In diabetes, the causes and sites of intervention in biochemical process are diverse and high serum total triglyceride level, high level of transaminase; creatinine kinase and urea have been implicated (Azzez*et. al*., 2010). Alternative strategies to the current modern pharmacotherapy of diabetes mellitus are urgently needed, because of the inability of existing therapies to control all the pathological aspects of the disorder, as well as the enormous cost and poor availability for many rural populations in developing countries (WHO, 2003).

The evaluation of medicinal plants used traditionally in treating diabetes is of growing interest (Holman and Turner, 1991). The World Health Organization also recommended and encouraged this practice especially in countries where access to conventional treatment of diabetes is inadequate (WHO, 1999). It however emphasized the fact that safety should be the major criteria in the selection of herbal medicine for use in healthcare. Some plants used locally in managing diabetes include Neem, bitter leaf, okro, pawpaw, bitter cola, plantain, ginger among others (Savi, 2015)

In recent investigation, suggestions have been made that polyphenolics components from natural sources may act as antioxidants and also prevent disease process such as nausea, abnormal pain and so on. This is a driving force to intensify the search for alternative medicine from natural source which is relatively cheap with minimal side effects, thus necessitated the use of cocoa powder for this study.

Cocoa beans contain natural compounds such as polyphenols, methylxantines, peptides and minerals. The naturally occurring compounds were reported to have significant effect on certain health symptoms and contributed to various health promoting attributes such as high antioxidant properties, cardioprotective effects (Mathur *et al.,* 2002), hypocholestrolemic property (Abbe and Amin*,* 2009), glucose lowering property and to reduce severity of hepatocarcinogenesis (Amin *et al.,* 2004). Studies carried out also revealed that consumption of flavanol-rich cocoa powder may extend to the brain and have important implications for learning and memory and also as prophylactic against malaria (Bayard *et al*, 2007; Jayeola*et al*., 2011).

This study therefore, determines the effect of chronic ingestion of MSG on blood glucose level using mice as models and also the effect of cocoa powder in ameliorating diabetes in mice

Materials and methods

This experiment made use of mouse model to determine the anti-diabetic property of cocoa powder. Laboratory mice have been the most important non-human models for studying the effectiveness of new drug therapies and efficacy of medicinal plants.

The experiment was conducted at the animal house and at the departmental laboratory of the veterinary medicine, University of Ibadan. Oyo State, Nigeria

Mice: Adult Female Naïve BALB/C mice (N=60) of 14-16 weeks old (28-30g) were used for this study and they were purchased from Animal breeding house, University of Ibadan, Oyo State, Nigeria.

Cocoa: Natural flavanol-rich cocoa powder (non-alkalized) which was produced by an innovative industrial process and packaged by Cocoa Research Institute of Nigeria (CRIN), Idi-Ayunre, Ibadan, Oyo State, Nigeria, was used for this experiment. This is to evaluate its functionality in a short-term study through the use of an experimental rodent model for anti-diabetes.

MSG: Monosodium glutamate was purchased in local Bodija market and were packaged and sold in 3gram satchet. Enough quantity needed for this study was obtained from the market.

Substance of Study: Natural cocoa powder, Diabetes, Monosodiun Glutamate.

Modified experimental feed: The experimental feed was specially formulated on request to be made of the normal rat diet. The modified feed consisted of maize starch, sucrose, soybean oil, fibre (cellulose powder), mineral premix, choline bitartrate, tert-butyl-hydroquinone (Jayeola*et al*., 2011). This was made into rat feed pellet by Pfizer feed mill, Iwo road, Ibadan. The diet contained(g/kg): maize starch, 397·486; casein, 200·000; dextrinisedmaize starch, 132·000; sucrose, 100·000; soya bean oil,70·000; fibre (cellulose powder), 50·000; cocoa powder, 20.000; AIN-93G mineralmix, 35·000; AIN-93 vitamin mix,10·000; L-cystine, 3·000; choline bitartrate, 2·500; tert-butylhydroquinone,0·014, some with inclusion of 2% natural cocoa powder and some with 8% MSG for inducing diabetes.

Experimental animals: Mice were housed in polypropylene cages maintained at standard condition (12 hours light/dark cycle 25+ 3°C, 45-65% humidity). The animals had free access to modified standard mouse feed and water *ad libitum*. All the animals were acclimatized to laboratory condition for 3 days before commencement of the experiment as described by Karunakar*et al.* (2009).

Experimental design: Experimental mice were grouped into six groups (A to F) randomly containing 10 animals each, according to their weight.

Group A – Normal mice + normal mice feed
Group B – Diabetic mice with normal mice feed
Group C – Normal mice + 2% cocoa feed
Group D – Diabetic mice + 2% cocoa feed
Group E – Diabetic mice + 8% MSG + 2% cocoa feed
Group F – Diabetic mice + 8% MSG feed

Induction of Hyperglycaemia: Diabetes was inducted into the mice after been fed on MSG diet for 12 weeks. At the end of 12 weeks, body weight gain and mice with blood glucose level of above 200mg|dl and signs of polyuria, polydipsia were considered as diabetic and was used for this experiment for another 12 weeks

Sample Collection: The blood sample was collected through the tail vein using Acucheck glucometer weekly.

Determination of Body Weight: The body weight was determined using a standard digital scale. The body weight of mice was monitored and recorded weekly.

Blood Sample Collection Method for the Determination of Fasting Blood Glucose

The blood sample was collected through the tail vein to determine the fasting blood level glucose using glucometer (Acucheck advantage II). The fasting blood glucose level was monitored weekly.

Blood Sample Collection Method for the Determination of Haematological Parameters

The experimental mice were fasted overnight, anesthetized with ether, dissected and their blood was collected through cardiac puncture with a 2ml syringe into an Ethylene Diamine Tetra-Acetic Acid (EDTA) sample bottle for the determination of the haematological parameters. Total white blood cell count was determined manually using the improved Neubauer haemocytometer while the differential leucocytes counts were determined by morphological identification and counting of hundred leucocytes in Giemsa stained smears of each blood sample. Monocytes and eosinophil are expressed as percentages of the total white blood cell. Red blood cell (RBC) was counted with haemocytometer, the packed cell volume (PCV) by the microhaematocrit method and the haemoglobin (Hb) concentration by cyanmethaemoglobin method. Platelet count was determined by direct method using diluent solution. The MCV and MCHC were calculated from the values obtained for RBC, PCV and HB.

Data Analysis
Data was expressed as mean ± standard error of mean (SEM). One-way analysis of variance (ANOVA) was applied to determine differences between the groups while Duncan multiple range test.

Results

Table 1: Fasting blood glucose level of mice after 12 weeks of exposure to MSG diet (N=100)

Weeks	Group A (NF+8%MSG DIET)	Group B (CP +8%MSG)
1-2	74.2 ± 1.5	76.3± 2.5
2-4	111.7 ± 2.5*	80.7± 6.3
4-6	155.4 ± 4.1**	90.1 ± 4.5
6-8	193.3 ± 2.2**	108.2 ± 3.3##a
8-10	220.5 ± 3.2***	128.3 ± 2.1###a
10-12	254.6 ± 4.5****	130.6 ± 6.2###a

The fasting blood glucose was measured weekly. Values are expressed as mean ± SEM
Cp = Cocoa Powder
NF= Normal feed
MSG = Monosodium glutamate
***P˂ 0.001 is statistically different from the normal control
###P < 0.001 is statistically different from the diabetic control
[a]P˂0.05 is statistically different from initial

Table 2: Effect of cocoa powder on the fasting blood glucose level of mice after induction of diabetes

Groups	Initial fasting blood glucose (mg/dl)	Final fasting blood glucose (mg/dl)
Normal control	74.2 ± 1.5	83 ± 2.3
Diabetic control	252 ± 22.6***	277 ± 32.2***a
		90 ± 18.5###a
Cocoa powder feed control	130.6 ± 6.2 **	
Diabetic + 2% Cp	254 ± 26.5***	140 ± 32.8###a
Diabetic + MSG + 2% Cp	254 ± 30.7***	182.5 ± 21.4###a
Diabetic + MSG	252 ± 20.8***	286 ± 25.6####a

The fasting blood glucose was measured weekly. Values are expressed as mean ± SEM
Cp = Cocoa Powder
***P ˂ 0.001 is statistically different from the normal control
###P < 0.001 is statistically different from the diabetic control
[a]P˂0.05 is statistically different from initial

Table 3: Comparative body weight of the different groups of experimental mice

Groups	Initial weight (g)	Final weight (g)	Body weight gain (g)
Normal control	28±1.6	29±8.5	1.69* a
Diabetic control	28±8.6	35±7.0###a	6.84##
Cocoa powder feed control	28±4.2	27±3.1	-1.11
Diabetic + 2% Cp	28 ± 5.7	31 ± 1.5##**a	2.58** a
Diabetic + MSG + 2% Cp	28 ± 2.3	32 ± 4.8##** a	4.25##
Diabetic + MSG	28 ± 1.1	38 ± 1.2###	10.01###

The body weight was measured weekly. Values are expressed as mean ± SEM
**P ˂ 0.01 is statistically different from the normal control
***P < 0.001 is statistically different from the normal control
##P < 0.01 is statistically different from the diabetic control
###P < 0.001 is statistically different from the diabetic control
^{a}P˂0.05 is statistically different from initial

Table 4: Hematological parameters of diabetic mice fed with MSG and cocoa powder feed

Parameters	Normal feed Control	Diabetic Control	2% Cp feed Control	Diabetic + 2% Cp	Diabetic + 8 % MSG
RBC (X 10^2nm)	8.13±0.33	6.45 ± 1.24###	8.55± 1.02###	7.57±0.54**###	4.91±0.22***
MCV (fl)	61.2 ± 0.72	59.2 ± 2.14	69.1 ± 2.44	67.3 ± 4.63	52.5 ± 2.11
PCV (%)	44.2±1.22	40.3 ± 2.16###	46.3 ±1.25###	42.5 ± 2.92###	21.4±1.51***
Hb (g/dl)	15.2±1.32	11.1 ± 2.61##	15.4 ± 1.32	11.2 ± 1.25##	6.12±1.21***
MCHC (g/dl)	27.5 ± 1.22	30.3 ± 1.96	26.8 ± 2.32	27.1 ± 2.12	31.6 ± 0.12
Neutrophil	32.2 ± 1.15	40.8 ± 3.75###	17.6± 3.22###	34.1 ± 1.42###	48.2±2.22***
Monocyte	2.44 ± 1.23	2.20 ± 1.32	3.50 ± 1.18##	1.66 ± 0.52	1.12 ± 0.35*
Platelet	66121±3212	46040±2240###	74200±1372###	61500±1243##	30140±1145***
WBC (n/µl)	3367±360	4254±233###	3050±435###	3533±242##	6875±162***
Lymphocyte	59.2±1.33	57.2±5.19	78.4±2.16	62.5±4.27	50.1±2.44
Eosinophil	1.42 ± 0.51	1.52 ± 0.31	1.15 ± 1.42	1.62 ± 1.53	2.40 ± 1.17

All hematology parameters were measured at the end of the experiment. Values are expressed as mean ± SEM
Cp = Cocoa Powder, PCV = Packed Cell Volume, Hb = Hemoglobin, RBC = Red Blood Cell, MCV = Mean Corpuscular Volume, MCHC = Mean Corpuscular Hemoglobin Concentration, WBC = White Blood Cell
**P ˂ 0.01 is statistically different from the normal control
***P < 0.001 is statistically different from the normal control
##P < 0.01 is statistically different from the diabetic control
###P < 0.001 is statistically different from the diabetic control

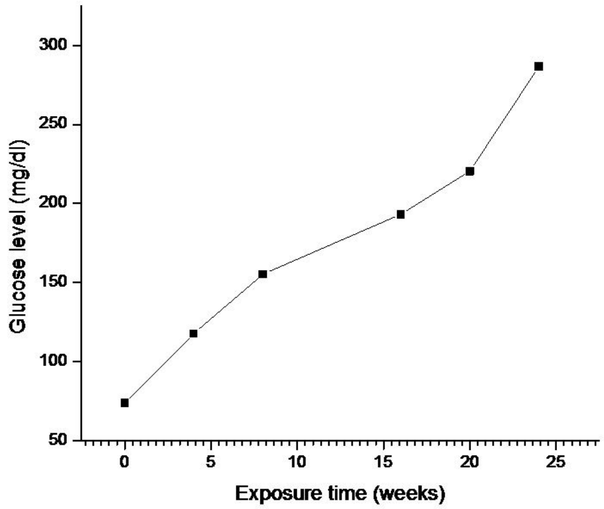

Figure 1: Rate of glucose level formation in mice as related to weeks of exposure to MSG diet

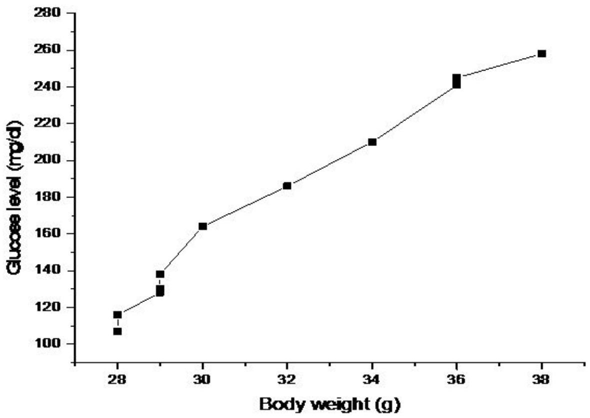

Figure 2: Body weight of mice as against blood glucose after 12 weeks of MSG diet

Discussion

Table 1 shows the fasting blood glucose level of mice after 12 weeks of exposure to 8% MSG diet. There was an upward trend in the blood glucose in mice fed with MSG diet as the day progresses. This was in an agreement with the report of Akpamu*et al*; 2011 that MSG consumption can lead to diabetes. According to Kate (2000) greater than 30mg/kg is a toxic dose of MSG, this correlate to about 2.1 grams in an average 70g animal. However, many individuals are considered to be allergic to or intolerant of, MSG, for these individuals, much smaller amounts (perhaps even as small as 50 or 100mg) may be considered to be a dangerous dose of MSG. When comparing group A (normal feed compounded with 8% MSG) with group B (cocoa powder diet with 8% MSG) the result indicated that though both showed increase in the blood glucose level but the rate of increase was far more higher in group A (254.6 ± 4.5) resulting to high threshold level. This showed that SG can induce diabetes, at the same time inclusion of cocoa powder in group B indicated that cocoa consumption might slow or prevent the formation of high blood glucose (130.6 ±6.2). The result obtained in group B is still within the normal range of blood glucose due to amelioration effect of cocoa powder in the diet. Table 2 result showed the effect of cocoa powder on the fasting blood glucose level of mice after induction of diabetes. Diet compounded with cocoa powder showed reduction in blood glucose level (90 ± 18.5) and this is an indication that cocoa has the ability to reduce blood glucose level and therefore can be termed as having hypoglycemic and prophylactic effect against diabetes in mice, this could be as a result of the polyphenolic contents present in cocoa powder. Consequently, the diabetic mice that was continued with 8% MSG has the highest incidence of blood glucose level (286 ± 25.6), this is an indication that prolong consumption due to addiction to use will result to diabetes. This report is in agreement with Eweka and Om'Niabohs, (2011) that reported that MSG is toxic when consumed in large quantities. Moreover, result as shown in Table 3 showed the comparative body weight of the different groups of experimental mice and their relative blood glucose levels, and the result indicated that mice with the highest body weight (38 g) has the highest blood glucose level (286 ± 25.6), surprisingly those mice fed with cocoa powder diet showed reduction in weight loosing (-1.11) as against diabetic mice fed with MSD diet with weight gain (10.01)and this showed that cocoa powder exhibit weight reduction property and this is in agreement with the work of Jayeola*et al*, 2014 that reported weight reduction in obese mice fed with cocoa powder incorporated feed.

Anecdotal reports have shown that cocoa powder consumption is effective in boosting imunity but the effect of cocoa powder on haematological parameters such as Red Blood Cells (RBC), Mean Corpuscular Volume, Mean Corpuscular Hemoglobin Concentration (MCHC), Packed Cell Volume(PCV), Hemoglobin(Hg), White Blood cells(WBC) and its differentials like Monocyte, eosinophil and lymphocytes are still very few. The result in Table 4 showed the hematological parameters of diabetic mice fed with MSG and cocoa powder feed. It was observed that cocoa powder fed diabetes mice showed significant increase in RBC, PCV, Hg, monocyte and slight increase in MCV, platelet and lymphocyte. This is in agreement with the report of Olasope*et al* 2016 that cocoa powder contains some phytochemical which is responsible for the stimulation of the above indices in cocoa powder fed diabetes mice. Moreover, it was observed that there is a significant decrease in white blood cells, eosinophil, MCHC and Neutrophils. This is an indication that cocoa powder exhibit some immune boosting properties that could fight against some infectious diseases as indicated on the table 4 results when comparison were made among cocoa fed diabetic group, Diabetic control group and that of MSG diet group.

The result of Figure 1 showed that as the duration of exposure of mice to MSG diet increases so also the blood glucose level in the mice increases. This is a pointer to the fact that prolong exposure to MSG diet will trigger high blood glucose and invariably diabetic conditions. The result observed in Figure 2 also revealed that there is constant increase in the body weight of the mice as the blood glucose level increases. This attested to the fact that increase in body weight tends to lead to diabetes often times.

The present study on the effect of MSG treatment on FBG, demonstrated that duration and dosage have significant effects on glycemic index. Monosodium glutamate Monosodium glutamate induces Type -2 diabetes without polyphagia.

Conclusion

Cocoa powder contains flavanol which are antioxidant that is beneficial to human diets. In this study, cocoa powder acted as prophylactic and therapeutic against diabetes and weight gain. It slows down on the formation of blood glucose level in mice and also against excessive weight gain. Cocoa powder also acted as immune booster through the increase in Red Blood cells count observed in cocoa fed mice and also by normalizing the high count of white blood cells as observed in MSG fed mice.

This study indicated that excessive consumption of Monosodium glutamate (MSG) which is the base for all bouillon condiments that is being used in our day to day cooking at homes and in parties for our daily diets can invariably be the cause of incessant predisposition of many people to diabetic conditions. It is therefore important to cut down the consumption of MSG in our diets in order to live a healthy lifestyle.

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Experimental Title: Cocoa Women Farmers' Agricultural Information Need and Search Behaviour in Ondo state Nigeria

Investigators: Williams OA, Adedeji RA, Adebiyi S, Oluyole KA. Abdulkarim IF

Introduction

Women farmers play immeasurable role in Nigerian food production, although motivation for participating in agriculture is first to contribute to household food security and income. The 2006 census puts women at fifty two percent out of which about forty-five percent (45%) live in the Nigerian rural areas. In agriculture, a United Nation's estimate puts women's domestic food production at 80% in Africa, 60% in Asia and the Pacific and 40% in Latin America (FAO, 1998); thus, revealing their high level of participation in agriculture especially in food production in African countries like Nigeria. In essence, women can be regarded as driving force for agricultural productivity. To sustain this productivity, it is necessary to understand their information need and searching behavior as this will help close the resource access gap between male and female farmers.The 2006 census puts women at fifty two percent out of which about forty-five percent (45%) live in the Nigerian rural areas. In. agriculture, a United Nation's estimate puts women's domestic food production at 80% in Africa, 60% in Asia and the Pacific and 40% in Latin America (FAO, 1998); thus, revealing their high level of participation in agriculture especially in food production in African countries like Nigeria. In essence, women can be regarded as driving force for agricultural productivity. In agriculture, new information and knowledge fuel innovation and increase productivity and competitiveness. It is then necessary for farmers to access information as this will contribute to both food security and economic growth. Agricultural information enhance farming decisions to sustain growth of agricultural activities. According to Mudukuti and Miller (2002), in the information age, dissemination of information and applying this information in the process of agricultural production will play a significant role in the development of farm settlements.

According to Agbamu (2006) they can be placed in the following categories: technical, commercial, socio-cultural and legal. In Nigeria Ozowa (1995) noted that farmers seldom feel the impact agricultural innovations either due to lack of access or poor dissemination of such vital information. This has become a key constraint or limitation to agricultural development. Nevertheless, for this approach to work, Nigerian government must first understand what women farmer's information needs are and then grow a dissemination and management strategy. Information needs can be diverse in nature but many times linked with individual's work activities; therefore, agricultural information needs of farm women is closely connected with their farming activities which is mainly cocoa production.

This cut across information on production, post planting, marketing and sales as well as policy oriented information. Nonetheless, it is insufficient to limit development effort to just understanding farmers' information needs; researchers need to explore women farmers' searching behavior as this will further enhance the development of better intervention programs. Paying more attention to the differences in how men and women farmers currently need and seek information may provide insight into how agricultural information can be disseminated more efficiently. This study will examine the information need and sourcing of women farmers.

Statements of the Problem

The role of women farmers in food production is immeasurable and their motivation for participating in agriculture is first to contribute to household food security and income. Unfortunately, minimal or non-provision of agricultural information is a key factor that has greatly limited agricultural development in Nigeria. Especially with women farmers who experience gender gap in accessing information which is a key productivity resource. Gullen (1994), opined that African women farmers labour without crucial support, that could raise their agricultural productivity. Scarce inputs like credit, improved seeds, among others rarely flow to women in the African country side. Generally, it is a known fact that male farmers have more access to agricultural extension services than women in Nigeria. Osuman (1997) observed, that agricultural extension services are mostly staffed by men and are inclined to helping men folk. According to Morna (1989), in Malawi, when agricultural extension workers visit rural areas to explain improved technologies or other access to inputs they usually interact with Men not women. To overcome this limitation program designers and the government need to understand the information need and seeking pattern of these women farmers. It is in the light of this that this study investigated Information need and searching behavior of cocoa women farmers in Ondo state Nigeria.

Objectives The following specific objectives guided the study to: 1. Describe the agricultural information needs of cocoa women farmers

2. Determine the extent to which agricultural information sources are accessible to the cocoa women farmers
3. Determines the sources cocoa women farmers in Ondo state consult for agricultural information.

Materials and Methods

The population for the study consisted of women farmers in Ondo State. A questionnaire made up of 42 items was designed and used as instrument for primary data collection. Some copies of the questionnaire were given to literate respondents to complete while enumerators were used to assist the illiterate respondents in completing the questionnaire. The women farmers' Socio-economic characteristics considered for the purpose of this study include age, marital status, religion, educational level, income level and farm size. They were measured using the conventional methods. Both descriptive and inferential statistics were used for the analysis of data collected. Chi-square was used to test the stated hypothesis. Multistage sampling techniques was employed two local governments (Idanre and Ondo East) areas were puposively selected and in each local government two communities (Owena, Orisunbare,)and (Paadi, Ilutuntun) were randomly selected for the interview respectively. In each community ten farmers were interviewed, giving rise to 40 cocoa women farmers in Ondo state. The Data entry has been carried out and data will be analyzed using both descriptive and inferential statistics. The analysis will be carried out using the Statistical Package for Social Science 22.

Table 1, states the pattern of rural women's agricultural information needs found in the study locale. A considerably high number of farm women expressed need for information on farm implements (2.57), improved seeds (2.43) closely followed by land management (2.38). On the other hand they seem to have less need for information on cropping system. This may reveal the participation pattern of women in agriculture which is more of planting, processing and marketing of farm sales. Findings here imply that women still lack adequate supply of agricultural information that are pertinent to improving their level of productivity. As women experience insufficient agricultural information supply, they might be forced to stick to traditional or old agricultural practices.

Table 2 reveals that women farmers have access to agricultural information sources. Their access to these sources although can be relatively described as average with just few sources being well accessed by the women. Specifically, women had greater access to extension agents/services (4.90), family members (3.60), radio (3.60) and other farmers (3.38). On the other hand, the least accessed sources by the women is the library(1.92) closely followed by the internet (2.02), film/slide projection (2.14) and Agricultural institutes/university (2.29).

This may imply that women had higher access to interpersonal and old Information and Communication Technology (ICT) based sources as compared to the little access to institutional and recent ICT based sources.

Discussion of Findings

From the analysis of the study, findings of (Okwu and Umoru, 2009; Zaid and Popoola, 2010; Saleh and Lasisi 2011). They identified various areas where rural women require information for the purpose of improving their productivity. They include: income generation, best farming practices, methods of fertilizer application, agricultural inputs, market prices, transportation, food processing and preservation and new agricultural technologies. It is also evident that various sources are relatively accessible to the women for obtaining agricultural information.

This is in agreement with past studies such as (Demiryurok 2000, Boz 2002; Ajayi, 2003; Yakin and Boz 2007 and Zaid and Popoola, 2010) where husbands, fellow women, mass media (radio, television), agricultural extension officers, friends and neighbours, agricultural faculties, farmers' union and input dealers were major agricultural information sources consulted.

Unfortunately, few expressed their use of recent ICT-based sources like the internet and institutional sources such as the library and agricultural institute. These sources unfortunately should have served as major sources for communicating agricultural information to these women farmers. This supports the challenge given by (Ofuoku, Emah and Itedjere, (2008) that research institutes and universities are not giving enough attention to carry out their responsibilities of information generation and delivery to farmers.

It is also worthy to note the relative use of the mobile phone for obtaining agricultural information. This commensurate with the submission of Banmeke and Ajayi (2007) who note that some of the women farmers in developing countries still depend on traditional sources of information.

Conclusion

In conclusion, information remains a key component in ensuring agricultural development and productivity in Nigeria. Since women are seen as major player in this sector it is important to understand their information need and seeking pattern as this is expected to influence the sector's productivity level as well as inform information service providers on what strategies to adopt for agricultural disseminating information. Also, in spite of the wide range of sources available to these women to consult and the observed average access to these sources, farm women still expressed relatively high need for agricultural information especially those that will enhanceincome generation and productivity. Similarly, they still consult more of interpersonal and media sources with little or no significant exploit of the modern Information and Communication Technologies with the exception of mobile phones.
Finally, it contributes to a growing body of literature that aims to understand to close gender gaps in agriculture and lead to more equitable opportunities for farmers.

Recommendations

Based on the findings of this study, the following recommendations were proposed:

I. Provision of productivity related information that takes into consideration farm women's agricultural information need including information on pricing, loan and resource acquisition, marketing and competition.

ii. Information service providers need to explore modern sources such as use of Information and communication Technologies for disseminating agricultural information. Although this might imply the establishment of Information Technology Centers in the communities.

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Experimental Title: Awareness and Use of Social Media by Cocoa Farmers in Nigeria. A Case Study of Cross Rivers State

Investigators: Ogunjobi T. E., Famuyiwa B.S., Adebiyi S and Awodumila D.J

Introduction

Social media are modern-day channel of digital communication that comprises of various tools for discussion, interaction and sharing of information among people. These digital tools include Facebook, Twitter, Farmbook, WhatsApp and Research Gate. Merriam-Webster (2015) defines social media as forms of electronic communication through which users can create online communities to share information, ideas and personal messages. To sum it up, Suchiradipta & Saravanan (2016) defined social media as web-based tools of electronic communication that allow users to interact, create, share, retrieve and exchange information and ideas in any form (text, pictures, video, etc.) that can be discussed upon, archived and used by anyone in virtual communities and networks.

Social media created an environment for individuals to interact with each other in a two-way communication pattern, allowing for the creation and maintenance of relationships (Rajagopalan and Subramani, 2003). This form of communication can benefit the information sender because it can affect how individuals react to messages. Social media is ICT based tool, which once used purely for entertainment, has great potential to be used for knowledge sharing and collaboration even in agriculture (Goyal, 2011). These ICT tools are easier to use and are gaining popularity in agriculture sector (Saravanan and Bhattacharjee, 2016). Through these tools, farming community can learn and share information in multiple ways in form of texts, photos, pictures, audio, audio-visuals and web links (Andres and Woodard, 2013). Social media gives opportunities to farmers for co-creating content and promotes co-learning among farmers (Jackson et al., 2009. Real time interaction through farmer clientele is easily possible through social media. Therefore, these tools help to communicate instantaneously and cheaply with stakeholders (Newbury et al., 2014 and Mains et al., 2013). For farming community, social media can be a good way of networking and gaining through social capital in form of trust, engagement and community involvement (Stanley, 2013 and Mains, 2013). Moreover, the issues of physical distance and isolation in agriculture can be reduced through these tools (Varner, 2013). Social media tools range from Facebook, WhatsApp, We-chat, QQ, Tumblr, Twitter, Pinterest, Blogs, YouTube, Instagram, Wikis, Facebook messenger, Snap chat etc. Out of these, under Indian context, Facebook, WhatsApp and YouTube can be considered as three most popular social media tools. Though there are slight differences in approach of these three forms of social media. Specifically, Facebook is a social networking site that allows people to build personal webpages and then connect with friends to share information. Facebook remains most popular social media platform by agricultural research and extension professional in India (Meena et al., 2013). WhatsApp specifically is an instant messaging platform that has made users much more connected. The nature of Facebook is more of a public platform and has higher viral content than WhatsApp which is a relatively closed medium. YouTube remains a content community in which videos are seen and shared. The possibilities of personal contacts of farmers with extension agents, thus, are very limiting in many countries. In India, for instance, of the 143,863 positions in the Department of Agriculture, only 91,288 posts are filled. Considering the large number of farm households in India, this small number of positions means that on average extension services only reach 6.8per cent of farmers but with the use of social media extension agents can reach all farmers without exemption.

Sokoya et al. (2012) opined that there is climbing increase in the use of social media among agricultural researchers, professionals and other stakeholders in the agricultural sector. Social media have ensured quick delivery and response to information between the receiver and sender. In the words of Mukhtar et al. (2015), social media has fostered a fast platform for information dissemination and interactive contact in this time. The degree of social media penetration is obviously growing faster than imagined, couple with the level of technology advancements that continue to bring world at everyone's fingertips and make information accessible without having to go through hiccups of travelling and delays. Stanley (2013) expressed that it is staggering to believe that in little as two short decades, the evolution of the internet and social media has taken place right before our very eyes. organizations such as the AgChat Foundation and American Farm Bureau Federation have encouraged the use of social media. The AgChat Foundation serves as an educational resource to help farmers and ranchers learn the skills necessary to participate in communication via social media channels (AgChat Foundation, 2014). The American Farm Bureau Federation has encouraged social media use, claiming that through the use of social media, farmers and ranchers can shape the future of their business (American Farm Bureau Federation, 2011). Katims (2010) reported a growing number of U.S. farmers use social media as a way to promote the agricultural industry by directly reaching the consumer. Farmers use social media on a personal level to tell their stories, give updates, promote their products and answer consumer questions (Baumgarten, 2012).

Utilising different social media platforms in delivering agricultural products and services by farmers provides both quick delivery and wider coverage in addition to enabling stakeholders' interaction and knowledge sharing. Social media platforms such as Facebook, YouTube, Blogs, Wikis and Podcasts offer colossal potential to farmers for reaching their end users.

Objectives of the Study

The main objective of the study is to determine the awareness and use of social media by cocoa farmers in Cross Rivers State, Nigeria. The specific objectives are to:

1. determine the level of awareness of social media by cocoa farmers in Cross Rivers State Nigeria,
2. identify various social media used by cocoa farmers in Cross River State Nigeria,
3. find out the purposes of using social media by cocoa farmers Cross River State Nigeria,
4. discover the accessibility of social media by cocoa farmers Cross River State Nigeria,
5. ascertain utilization of social media in cocoa farming activities in Cross River State Nigeria,
6. establish benefits/ relevance of using social media by cocoa farmers in Cross River State Nigeria,
7. find out the group that farmers belong to on social media in Cross River State Nigeria,
8. identify the constraints facing farmers in using social media in Cross River State, Nigeria.

Research Questions

1. What is the level of awareness of social media by cocoa farmers in Nigeria?
2. What are the various social media used by cocoa farmers in Cross River State, Nigeria?
3. What are the purposes of using social media by cocoa farmers in Cross River State, Nigeria?
4. How accessible are the social media to cocoa farmers in Cross River State, Nigeria?
5. What is the level of using social media in cocoa farming activities in Cross Rivers State, Nigeria?
6. What are the benefits/ relevance of using social media by cocoa farmers in Nigeria
7. Which group did farmers belong to on social media in Nigeria?
8. What are the constraints facing farmers in using social media in Cross River State Nigeria?

Methodology

This study used the descriptive research design with quantitative approaches. The study location was Cross river States in Nigeria. Three local governments were purposively sampled. The three local governments are These local governments were selected due to the huge number of cocoa farmers that are highly concentrated in the areas. One hundred cocoa farmers were used for the study. A questionnaire titled “awareness and use of social media by cocoa farmers was used to elicit information from respondents. Data were analysed” using descriptive statistics of frequency counts, percentages, mean and standard deviations.

Presentation of Results and Discussion of Data
Demographic Information of Respondents

Table 1: Age of the Respondents

	Response	Frequency	Percent
Age Group	20 to 30yrs	4	5.2
	31 to 40yrs	11	14.3
	41 to 50yrs	26	33.8
	51 to 60yrs	25	32.5
	61 yrs and above	11	14.3
	Total	77	100.0

Field survey, 2019

The result presented in Table 1 shows that majority of the respondents (62, 80.6%) are within the age range of 41 years and above age group. It can be deduced from the result that majority of the cocoa farmers surveyed are old people while only few young people who are actively engaged in cocoa farming. The category of people who are engaged in cocoa farming who are majorly old people may not have the required competencies to use social media in accessing and using information that could help them in improving their farming practices.

Table 2: Gender of the Respondents

	Response	Frequency	Percent
Sex	Male	52	67.5
	Female	25	32.5
	Total	77	100.0

Source: Field survey, 2019.

Table 2 presented information on the gender distribution of the cocoa farmers surveyed and it shows that majority of the respondents (67.5%) are Male while only few (32.5%) are female. This implies that there are more male than female among cocoa farmers in Cross Rivers State in Nigeria.

Table 3: Educational Background of the respondents

Variables		Frequency	Percent
Educational Background	No formal education	19	24.7
	Secondary School Certificate	36	46.8
	OND	6	7.8
	HND	6	7.8
	BSc.	8	10.4
	Msc.	2	2.6
	Total	77	100.0

Source: Field survey, 2019.

Results on the educational background of respondents shows that majority of the respondents surveyed (46.8%) were Secondary School Certificate holders just as only few (24.7%) respondents have no formal education. The results further revealed that only few of the respondents (28.6%) have tertiary education. This implies that majority of the cocoa farmers in Cross Rivers State, Nigeria are not sufficiently and properly educated for modern day farming practices which is mostly dependent on technology and mechanized systems.

Table 4: Membership of the Respondents

Variables		Frequency	Percent
Membership	Cocoa Farmers; Club	2	2.6
	Cooperative Societies	70	90.9
	FADAMA Project	3	3.9
	Others	2	2.6
	Total	77	100.0

Source: Field survey, 2019.

The membership of the respondents as regards associations and societies reveals that majority of the respondents surveyed (90.9%) belong only cooperative societies while few of the respondents (6.5%) belongs to farmers related associations such as FADAMA Project and Cocoa Farmers Club. The implication to be drawn from this result is that cocoa farmers in Cross Rivers State do not belong to farmers associations that can help their farming practices.

Table 5: Farming experience of the Respondents

Variables		Frequency	Percent
Farming Experience	6 to 10yrs	2	2.6
	11 to 15yrs	9	11.7
	16 to 20yrs	16	20.8
	21 to 25yrs	14	18.2
	26 to 30yrs	26	33.8
	31 yrs and above	10	13.0
	Total	77	100.0

Source: Field survey, 2019.

The table shows the result of the farming experience possessed by the respondents. From the information gathered 33.8% of the experience are between 26 to 30 years, while 20.8% are between 16 to 20 years and 18.2% are between 21 to 25 years while 13.0% are between 31 years and above while 11.7% are between 11 to 15 years and 2.6% are between 6 to 10years. Cumulatively, the result shows that majority of the cocoa farmers (50, 62.0%) had 21 years and above experience in their farming practices.

Table 6: Monthly Income of the Respondents

Variables		Frequency	Percent
Monthly Income	Less than N5,000	1	1.3
	N6,000 to 10,000	7	9.1
	N11,000 to 15,000	7	9.1
	N16,000 to 20,000	12	15.6
	N21,000 to 25,000	12	15.6
	N26,000 to 30,000	8	10.4
	N31,000 to 35,000	10	13.0
	N36,000 and above	20	26.0
	Total	77	100.0

Field survey, 2019.

The table shows the highest monthly income of the respondents. From the information gathered 26.0% of the respondents had monthly income are between N36,000 and above while 15.6% have monthly income of between N16,000 to 20,000 and N21,000 to 25,000 respectively Also, 13.0% of the respondent's monthly income is between N31,000 to 35,000 while 10.4% had between N26,000 to 30,000 monthly income and 9.1% have monthly income of between N6,000 to 10,000 and N11,000 to 15,000 respectively. Only 1.3% of the respondents have monthly income of Less than N5,000. Cumulatively, the result reveals that most of the cocoa farmers (46, 59.8%) monthly income fall within the range of N6,000 and N30,000. This implies that the monthly income derived by cocoa farmers in Cross River State is very poor.

Research Questions

Research question 1: What is the level of awareness of social media by cocoa farmers in Cross River State, Nigeria?

Table 7: Level of awareness of social media by cocoa farmers in Cross River State

Awareness of Social Media	SA	A	LA	NA	Mean	Std. Dev.	Decision
Facebook	23(29.9)	20(26.0)	12(15.6)	22(28.6)	2.57	1.20	Aware
WhatsApp	14(18.2)	13(16.9)	39(50.6)	11(14.3)	2.03	1.20	Aware
Google+	14(18.2)	10(13.0)	15(19.5)	38(49.4)	2.00	1.17	Aware
Twitter	8(10.4)	16(20.8)	12(15.6)	41(53.2)	1.88	1.08	Aware
Instagram	11(14.3)	5(6.5)	13(16.9)	48(62.3)	1.73	1.10	Less Aware
Telegram	12(15.6)	5(6.5)	10(13.0)	50(64.9)	1.73	1.13	Less Aware
YouTube	8(10.4)	6(7.8)	13(16.9)	50(64.9)	1.64	1.01	Less Aware
Drop box	2(2.6)	13(16.9)	5(6.5)	57(74.0)	1.48	.87	Less Aware
LinkedIn	5(6.5)	8(10.4)	5(6.5)	59(76.6)	1.47	.93	Less Aware
Research gate	5(6.5)	4(5.2)	6(7.8)	62(80.5)	1.38	.86	Less Aware
Weighted Mean					1.79		

Source: Field survey, 2019.

Decision Rule: Mean > 1.79 = Aware; Aware; Mean < 1.79 = Less Aware

Table 7 presents the result on the level of awareness of social media among the respondents. The result shows that most of the respondents indicated that they are aware of only Facebook and WhatsApp with response rates of 55 (45.9%) and 66 (85.7%). Also, in determining the overall level of awareness of social media among the respondents, the result reveals a low level of awareness of social media among the respondents since the weighted mean of 1.79 is lower that the criterion mean of 2.50 set for high level of social media awareness. The inference to be drawn from this result is that cocoa farmers in Cross Rivers State are only aware of facebook, WhatsApp, google and twitter as social media tools and that the level of awareness of social media among the farmers are low. The low level of awareness can be traced to the fact that the farmers only indicated their awareness of only facebook, WhatsApp, google and twitter out of the list of social media tools listed.

Research question 2: What are the various social media used by cocoa farmers in Cross River State, Nigeria?

Table 8: Social media used by cocoa farmers in Cross River State, Nigeria

Various Social Media	SA	A	D	SD	Mean	Std. Dev.
Facebook	35(45.5)	23(29.9)	11(14.3)	8(10.4)	3.10	1.01
WhatsApp	23(29.9)	30(39.0)	6(7.8)	18(23.3)	2.75	1.13
Google+	19(24.7)	20(26.0)	16(20.8)	22(28.6)	2.47	1.15
Twitter	14(18.2)	26(33.8)	12(15.6)	25(32.5)	2.38	1.12
Instagram	14(18.2)	16(20.8)	17(22.1)	30(39.0)	2.18	1.14
YouTube	9(11.7)	21(27.3)	18(23.4)	29(37.7)	2.13	1.06
Telegram	12(15.6)	13(16.9)	25(32.5)	27(35.1)	2.13	1.07
LinkedIn	6(7.8)	20(26.0)	24(31.2)	27(35.1)	2.06	.96
Drop box	3(3.9)	23(29.9)	25()32.5	26(33.8)	2.04	.90
Research gate	7(9.1)	12(15.6)	31(40.3)	27(35.1)	1.99	.94

Source: Field survey, 2019.

Table 8 presents information on the social media being used by the respondents and the result revealed Facebook (58, 75.4%), WhatsApp ((53, 68.9%) and Google+ (39, 50.7%) as the only major social media tools being used the respondents. This implies that cocoa farmers in Cross Rivers State made use of only Facebook, WhatsApp and Google+ in carrying out their activities. Consequently, while it can be said that the use of Facebook and WhatsApp are used mainly for information sharing among the farmers, the use of Google+ may be for the purpose of gathering location specific and geographic details of specific locations.

Research question 3: What are the purposes of using social media by cocoa farmers in Cross River State, Nigeria?

Table 9: Purposes of using social media used by cocoa farmers

Purpose/Reason of Social Media	SA	A	D	SD	Mean	Std. Dev.	Decision
For record keeping	50(64.9)	18(23.4)	6(7.8)	3(3.9)	3.49	.805	Agree
Get information on new varieties of seeds and seedling	49(63.6)	19(24.7)	3(3.9)	6(7.8)	3.44	.896	Agree
Verify methods of disease prevention and control	44(57.1)	26(33.8)	3(3.9)	4(5.2)	3.43	.802	Agree
Determine best processing methods	48(62.3)	18(23.4)	5(6.5)	6(7.8)	3.40	.921	Agree
Find out use of agro-chemicals	37(48.1)	33(42.9)	4(5.2)	3(3.9)	3.35	.757	Agree
Acquire farming skills	36(46.8)	32(41.6)	6(7.8)	3(3.9)	3.31	.782	Agree
Get information on market situation	41(53.2)	24(31.2)	6(7.8)	6(7.8)	3.30	.919	Agree
Determine quantities of chemical to use	38(49.4)	29(37.7)	3(3.9)	7(9.1)	3.27	.912	Agree
Get information on irrigation	32(41.6)	37(48.1)	4(5.2)	4(5.2)	3.26	.785	Agree
information on credit needs	37(48.1)	29(37.7)	4(5.2)	7(9.1)	3.25	.920	Agree
Improve seed variety	36(46.8)	30(39.0)	4(5.2)	7(9.1)	3.23	.916	Agree
Find out method of planting and improving new cocoa hybrids	35(45.5)	32(41.6)	3(3.9)	7(9.1)	3.23	.902	Agree
Determine use of fertilizer	27(35.1)	43(55.8)	5(6.5)	2(2.6)	3.23	.686	Agree

Find out best planting techniques	28(36.4)	40(51.9)	5(6.5)	4(5.2)	3.19	.779	Agree
Get information on pest and disease prevention and control	32(41.6)	35(45.5)	3(3.9)	7(9.1)	3.19	.889	Agree
Acquire information on weed control	30(39.0)	37(48.1)	3(3.9)	7(9.1)	3.17	.880	Agree
Weather forecasting	23(29.9)	43(55.8)	6(7.8)	5(6.5)	3.09	.798	Agree
Get information on best storage technique	24(31.2)	40(51.9)	9(11.7)	4(5.2)	3.09	.798	Agree

Field survey, 2019.
Decision Rule: 0.1-2.0 = Disagree; 2.1-4.0 = Agree

The results of the analysed data on the purposes of using social media by the revealed that majority of the cocoa farmers in Cross Rivers State affirmed that they make use of social media for all the purposes listed. Meanwhile, record keeping (68, 88.3%), getting information on new varieties of seeds and seedlings (68, 88.3%), verifying methods of disease prevention (70, 88.9%) and controlling and determining best processing methods (66, 85.7%) topped the list of purposes for which majority of the cocoa farmers in Cross Rivers State use social media for. Also, the mean distribution and decision on the purposes for which cocoa farmers use social media revealed that the farmers agree that they use social media for all the listed items on the scale. The implication to be drawn from this result is that social media have been veritable tools in getting information on best practices in farming among cocoa farmers in Cross River State, Nigeria.

Research question 4: How accessible are the social media to cocoa farmers in Cross River State, Nigeria?

Table 10: Access to social media by cocoa farmers in Cross River State, Nigeria

Accessibility of Social Media	VA	A	LA	NA	Mean	Std. Dev.	Decision
WhatsApp	12(15.6)	5(6.5)	18(23.4)	42(54.5)	1.83	1.11	Less Accessible
Facebook	10(13.0)	4(5.2)	23(29.9)	40(51.9)	1.79	1.03	Less Accessible
Google+	5(6.5)	5(6.5)	18(23.4)	49(63.6)	1.56	.88	Less Accessible
Instagram	5(6.5)	5(6.5)	16(20.8)	51(66.2)	1.53	.88	Less Accessible
YouTube	4(5.2)	6(7.8)	15(19.5)	52(67.5)	1.51	.85	Less Accessible
Telegram	4(5.2)	6(7.8)	15(19.5)	52(67.5)	1.51	.85	Less Accessible
Drop box	0(0.0)	8(10.4)	18(23.4)	51(66.2)	1.44	.68	Less Accessible
LinkedIn	2(2.6)	4(5.2)	19(24.7)	52(67.5)	1.43	.72	Less Accessible
Twitter	1(1.3)	4(5.2)	21(27.3)	51(66.2)	1.42	.66	Less Accessible
Research gate	4(5.2)	0(0.0)	13(16.9)	60(77.9)	1.32	.73	Less Accessible
Weighted Mean					1.53		

Field survey, 2019.
Decision Rule: 0.1-1.0 = Not Accessible; 1.1 -2.0 = Less Accessible; 2.1 - 3.0 = Accessible; 3.1 - 4.0 = Very Accessible

Table 10 presents the result of analysed data on the level of accessibility to social media by cocoa farmers in Cross Rivers State. Using the decision rule, the result shows that all the social media listed are less accessible to the respondents. This result is further established with the fact that the weighted mean of 1.53 recorded for the scale was lower than the criterion mean of 2.50 which is set as benchmark for high level of accessibility to social media by the cocoa farmers.

Research question 5: What is the level of using social media by cocoa farmers in Cross Rivers State, Nigeria?

Table 11: Level of using social media by cocoa farmers in Cross River State, Nigeria

Social Media	MU	U	LU	NU	Mean	Std. Dev.	Decision
Google+	6(7.8)	2(2.6)	60(77.9)	9(11.7)	1.40	.877	Less utilised
Facebook	2(2.6)	4(5.2)	54(70.1)	17(22.1)	1.40	.712	Less utilised
WhatsApp	7(9.1)	2(2.6)	62(80.5)	6(7.8)	1.40	.921	Less utilised
Twitter	3(3.9)	1(1.3)	61(79.2)	12(15.6)	1.30	.689	Less utilised
LinkedIn	5(6.5)	0(0.0)	66(85.7)	6(7.8)	1.27	.772	Less utilised
Instagram	3(3.9)	2(2.6)	66(85.7)	6(7.8)	1.25	.691	Less utilised
Youtube	2(2.6)	3(3.9)	66(85.7)	6(7.8)	1.23	.647	Less utilised
Telegram	2(2.6)	2(2.6)	66(85.7)	7(9.1)	1.22	.620	Less utilised
Research gate	2(2.6)	0(0.0)	68(88.3)	7(9.1)	1.17	.548	Less utilised
Drop box	1(1.3)	1(1.3)	70(90.9)	5(6.5)	1.13	.469	Less utilised
Weighted Mean					1.27		

Field survey, 2019.

Decision Rule: 0.1-1.0 = Not Utilised; 1.1 -2.0 = Less Utilised; 2.1 - 3.0 = Utilised; 3.1-4.0 = Mostly Utilised

The result of analysed data on the level of use of social media among the cocoa farmers in Cross Rivers State as presented in Table 11 shows a low level of utilisation of social media among the cocoa farmers surveyed. Using the mean scores and decision rule, the result shows that all the social media listed are less utilised by the respondents surveyed. This result is further established with the fact that the weighted mean of 1.27 recorded for the scale was lower than the criterion means of 2.50 which is set as benchmark for high level utilisation of social media by the cocoa farmers in Cross Rivers State, Nigeria.

Research question 6: What are the benefits of using social media by cocoa farmers in Cross Rivers State, Nigeria?

Table 12: Benefit of using social media by cocoa farmers in Cross Rivers State, Nigeria

Benefits of Social Media	SA	A	D	SD	Mean	Std. Dev.	Decision
Proffer solution to cocoa farmers problems	39(50.6)	35(45.5)	0(0.0)	3(3.9)	3.43	.70	Agree
Allowed collaboration between cocoa farmers and extension agents	32(41.6)	42(54.4)	3(3.9)	0(0.0)	3.38	.56	Agree
Increased time saving	47(61.0)	18(23.4)	1(1.3)	11(14.3)	3.31	1.06	Agree
Increased contacts between extension workers	24(31.2)	46(59.7)	3(3.9)	4(5.2)	3.17	.73	Agree

Field survey, 2019.

Decision Rule: 0.1-1.0 = Strongly Disagree; 1.1 -2.0 = Disagree; 2.1 - 3.0 = Agree; 3.1-4.0 = Strongly Agree

Results of analysed data on the benefits of using social media by the cocoa farmers revealed that most of the respondents affirmed proffering solution to cocoa farmers problems (96.1%), allowing collaboration between cocoa farmers and extension agents (96.0%), increased time saving (84.4%) and increased contacts between extension workers (90.9%) as major benefits derived from use of social media in carrying out their farming activities.

Research question 7: Which groups did farmers in Cross Rivers State in Nigeria belong to?

Table 13: Groups which cocoa farmers in Cross Rivers Belong To

Group	Yes	No	Mean	Std. Dev.
Farmers group on social media	19(24.7)	58(75.3)	1.26	.470
Cocoa Farmers Association of Nigeria	17(22.1)	60(77.9)	1.22	.417
Cocoa Association in Nigeria	10(13.0)	67(87.0)	1.16	.461
Cocoa Processors Association of Nigeria (CPAN)	9(11.7)	68(88.3)	1.12	.323
Farmer Management Association of Nigeria	9(11.7)	68(88.3)	1.12	.323
Agricultural Society in Nigeria	7(9.1)	70(90.0)	1.09	.289
Commercial Agriculture Development Associations	7(9.1)	70(90.9)	1.09	.289
Agriculture graduate Association of Nigeria	5(6.5)	72(93.5)	1.06	.248

Field survey, 2019.

The study further investigated the various social media groups to which the cocoa farmers surveyed belong to. The result reveals that most of the cocoa farmers surveyed in Cross Rivers State do not belong to any social media groups with response rate of 58 or 75.3%. This may due to the low level of awareness, access to and utilisation of social media among the farmers as reveal in the other results of this study. Furthermore, the cocoa farmers affirmed that they do not belong to any other groups such as Cocoa Farmers Association of Nigeria (77.9%), Cocoa Association of Nigeria (87.0%), Farmers Management Association of Nigeria (88.3%), Agricultural Society in Nigeria (90.0%), Commercial Agriculture Development Associations (90.9%) and Agriculture graduate Association of Nigeria (93.5%). This low membership of farmers association among the cocoa farmers can be traced to the poor educational background and membership of professional associations by the cocoa farmers as shown in the result of the demographic distribution of the cocoa farmers surveyed.

Research question 8: What are the constraints facing cocoa farmers in using social media in Cross River State Nigeria?

Table 14: Challenges facing cocoa farmer using social media

Challenges of Social Media	SA	A	D	SD	Mean	Std. Dev.	Decision
Irregular power supply	54(70.1)	17(22.1)	3(3.9)	3(3.9)	3.58	.750	Strongly Agree
Low internet connectivity	43(55.8)	28(36.4)	4(5.2)	2(2.6)	3.45	.717	Strongly Agree
High cost of buying data	45(58.4)	25(32.5)	3(3.9)	4(5.2)	3.44	.803	Strongly Agree
Few agricultural programmes available on social media	34(44.2)	40(51.9)	2(2.6)	1(1.3)	3.39	.610	Strongly Agree

Field survey, 2019.

Decision Rule: 0.1-1.0 = Strongly Disagree; 1.1 -2.0 = Disagree; 2.1 - 3.0 = Agree; 3.1-4.0 = Strongly Agree

Table 14 presents the result of the analysed data on the constraints facing the cocoa farmers surveyed in using social media. The result reveals that most of the respondents identified iregular power supply (92.2%),low Internet connectivity (92.2%),high cost of buying data (90.9%) and availability of few agricultural programmes on social media (96.1%) as major hindrance to their use of social media. The implication to be drawn from this result is that irregular power supply, low Internet connectivity, high cost of buying data and availability of few agricultural programmes on social media are the major constraints hindering cocoa farmers in Cross Rivers State from using social media in their farming activities.

Conclusion and Recommendations

The results revealed that most farmers are still lacking behind in terms of social media use. They have access to some of these social media but do not utilize it for farming activities. Low internet connectivity high cost of buying data are major constraint for cocoa farmers in Cross river State. Hence the following are therefore recommended:

1. Training of cocoa farmers in the use of social media in solving farmers problems. Training is recommended because it was discovered that some of them have good iphones that can be used to access various social media site but could not due to lack of media literacy. Such people need to be trained and retrained.
2. Cocoa farmers need to be assisted in getting good phones that are internet compliant so that it will be easy for them to surf the internet and social media for information relevant to their needs.

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Experimental Title: Development of Commercial High –grade Potassium Hydroxide crystals from Cocoa Pod Husk

Investigator: Yahaya L.E

Introduction

The Institute generates high volume of Cocoa pod husk as wastes resulting from the processing of cocoa. Most times, this has often been processed as ingredient for soap making. However, large volume of this material lies as waste under-utilized. There is need to convert this seemingly waste to other source of raw material for the soap industry, high grade crystals of potassium hydroxide which can readily be sold to retail soap makers and generating income for the Institute. The objectives of the study therefore include developing potassium hydroxide pellets from cocoa pod husk and purifying and characterizing the crystal.

Materials and Method: Cocoa pod husk was collected from the heaps in the fermentary unit of the cocoa Research Institute of Nigeria. These were dried to very low moisture content. The dried husks were subjected to ashing after which the potash was expressed. The expressed solution was crystallized using the methods of Yahaya et al, 2012 with slight modification. The resulting crystals was purified to standard grade and then subjected to characterization using standard methods of analysis according to AOCS (2005).

Results and Discussion

Potassium hydroxide crystals from cocoa pod husk were developed (Plate 1) and characterization was carried out. From the result shown in Table 1, it was obvious that crystals from CPH can be compared with conventional standard KOH. An appearance of off white was obtained from the CPH crystals whereas it is white for the standard. This can be as a result of the starting raw material, cocoa pod husk which is inherently dark colored. The resulting material was also found to be deliquescent which is characteristic of standard potassium hydroxide. The refractive index of the crystals obtained from CPH also compared favorably with the standard value of 1.41. There were also no significant differences in other parameters between the standard and the developed product with respect to melting point, boiling point and solubility in various solvents. Because of its high affinity for water, KOH serves as a desiccant used in the laboratory. It is often used to dry basic solvents, especially amines and pyridines. KOH from this source can thus find various applications such as an electrolyte in alkaline batteries, in food products, potassium hydroxide acts as a food thickener, pH control agent and food stabilizer. Results from the study shows that cocoa pod husk can serve a useful purpose as a source of producing potassium hydroxide crystals which serves a lot of industrial applications.

Plate 1. Potassium Hydroxide crystals from Cocoa pod husk

Table 1. Characterization of Potassium Hydroxide crystals from CPH

SN	Properties	KOH Crystals from CPH	Standard KOH
1	Molar mass	ND	56.11 g/mol-1
2	Appearance	Off white, deliquescent	White, deliquescent
3	Odor	Odorless	Odorless
4	Density	2.091g/cm3	2.044g/cm3 (20°C)
5	Melting point	363°C	360°C
6	Boiling point	ND	1,327 °C
7	Solubility		
	i. Water	123g/100ml (25°C)	121g/100ml (25°C)
	ii. Methanol	53g/100ml (28°C)	55g/100ml (28°C)
	iii. Isopropanol	16g/100ml (28°C)	14g/100ml (28°C)
8	Refractive index	1.40 (20°C)	1.41 (20°C)

Conclusion and Recommendations

Cocoa pod husk is laden with high amount of potash which when harnessed can be a source of foreign earnings to cocoa farmers. It therefore recommended that this area of end use utilization should be adequately explored and given attention as it can serve as IGR source for the institute.

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Experimental Title: Generation and establishment of cocoa germplasm materials at 7 zones in CRIN HQ and 4 Sub-stations (Owena, Uhonmora, Ibeku and Ajassor)

Investigators: Muyiwa, A.A., Adeigbe, O.O., Adenuga, O.O., Olaniyi, O.O; Adepoju F.; Mapayi, A.E., Olasupo,; Anagbogu C. and Keji Dada

Objectives and Justification

Following the fire outbreak in the Local Cocoa Germplasm Plot in 2016; leading to the loss of some trees, it became necessary to replicate these materials in other locations to keep the institute's cocoa diversity potential. It was recommended that the local clones along with others be replicated at the headquarters and substation on 0.5ha each (7zones at headquarters and 4 substation) to make a total of 5.5ha in all. The replication will include also the International and the RVT clones etc.

Methodology: The project commenced in May 2018 with generation of clonal seedling from germplasm materials in the field. This included raising of root stocks and grafting of local and international materials. This was followed by field clearing and shade crop (plantain) establishment and subsequently seedling distribution and establishment at CRIN, HQ. (Zone 1, 2, 3&4, 5, 6, 8, 9),Owena, Uhonmora, Ibeku and Ajassor substations.

Progress report: Root stocks raised. Grafting done. Grafted seedlings of local, international cocoa germplasm seedlings produced. 0.5 hectare each cleared in 7 zones and 4 substations and planted with plantain and clonal cocoa germplasm seedling.

Status: Completed.

Outlook: Need thorough maintenance and gapping up

KOLA PROGRAMME

Experimental Title: Introduction, Clonal propagation and development of high yielding Kola varieties

Investigators: Adenuga, O.O., Adebiyi, S., Oduwole, O.O., Ibiremo, O.S. and Ugioro, O.

Introduction

There is an urgent need for CRIN to assemble new kola germplasm and properly characterize its germplasm for optimum utilization. This is very important because the existing germplasm has a very narrow genetic base and is largely uncharacterized. Also, the existing germplasm consists of old and unfruitful trees. These two key factors make the existing germplasm unsuitable to solve the problems identified in kola production, which are self and cross incompatibilities and inefficient pollination, regarded as responsible for low yield. The gestation of the crop also needs to be reduced. Proffering solutions to these problems will encourage further farmer interest in the crop. The Institute at present does not have any improved or identified variety for distribution to farmers. Therefore, the use of vegetative propagation urgently need to be improved upon and perfected by the Institute in its attempts to solve the aforementioned problems. This study therefore aims to leverage upon and improve on the achievement of the previous year in which a small percentage of success was recorded in cloning techniques in the propagation of the species.

Materials and Methods

Collection of Scions: A pre-survey of kola farms with identified good accessions was carried out in selected locations in Okuku (Osun State) and Bamikemo (Ondo) States of Nigeria. These included two farms each in both States. Stem cuttings were collected from four accessions from each farm. This implies eight accessions from each of Okuku and Bamikemo. A total of fourteen accessions were used in the study. Stem cuttings were collected from the apical regions of the trees selected as mother trees which have diverse genetic origin. They are noted to fruit early and with good tree architecture and are also resistant to diseases. Collected scions were semi-hardwood flushes (greenish brown in colour) harvested from the mother tree. The scions were between 10cm - 20cm long and possessed enough buds including an active apical bud which should develop into a new shoot. The scions were harvested very early in the morning before sunrise, and the leaves around on the scions were trimmed to reduce leaf area and thus minimize moisture loss due to transpiration. The scions were wrapped in moist cotton wool to prevent scion dehydration and transported in an empty box from the farmers' plots to the site of the experiment at CRIN headquarters.

Setting of cuttings: Dressing of the cuttings involved the removal of their leaves except two or three leaves close to the apical bud are left. The detached end of the cutting was not dressed. The cuttings were planted directly into propagation structures (wooden boxes) filled with rooting medium. The rooting medium used was a mixture of river sand and rice husk in a ratio of 1:1. The entire cuttings together with the medium were covered with transparent polythene sheet after sowing. The entire medium and cuttings are then kept under shade. Cuttings are then watered every 2-3 days and inspected for rooting and leave development. A hundred cuttings of each accession

Grafting: The detached end of the scion is shaped like a wedge using a knife and grafted unto root stocks that were six months old. Grafted plants were covered with small transparent polythene sheets to create a humid environment around the leaves and helps reduce transpiration. The plants were arranged under shade and success checked periodically for about two months. Grafting tapes and transparent polythene covering on successful grafts were removed immediately. After six months, successful grafts were transplanted to the field.

Results and Discussion

Though 29.2% of the grafted materials remained green after two weeks of grafting, only 2% of the original population were successfully established into the germplasm plot. Sprouting among the *Cola* accessions was observed to have been inconsistent with the expectation of 3-4 weeks after grafting, as more than half the initial 29.2% that were green after two weeks remained green even beyond six weeks, and some sprouts were eventually recorded beyond eight weeks after grafting. A similar result was reported in 2018. These inconsistencies may be attributed to the timing of the grafting which lied between March and August. Humidity was high during this period, and could have accounted for the low success rate. Appropriate timing for ideal grafting activities (as observed with cacao) lies between October through Early December, and February through Early April.

Callus formation and eventually, root development occurred in some of the accessions used in the setting of cuttings, three months after setting of cuttings 36.84% of the original population of the cuttings set remained green after 12 weeks of setting (Figure 2a). 10% of these green produced new sprouts (Figure 2b), which are already developing through the juvenile stage at 12 weeks after setting (Figure 2c and 2d).

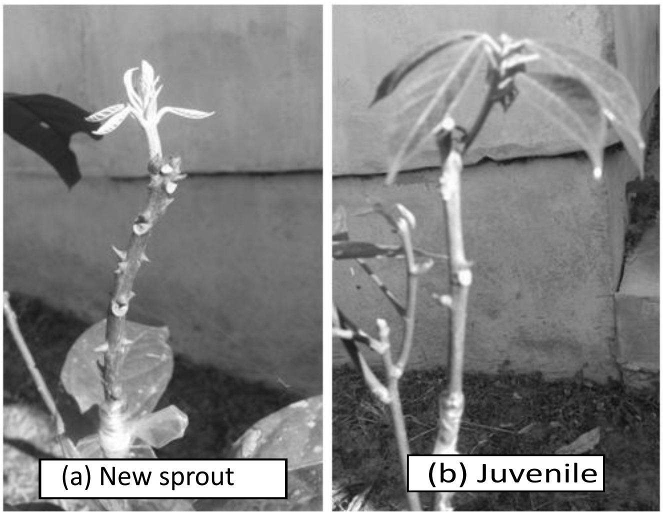

Figure 1: Successful grafting in *Cola* accessions

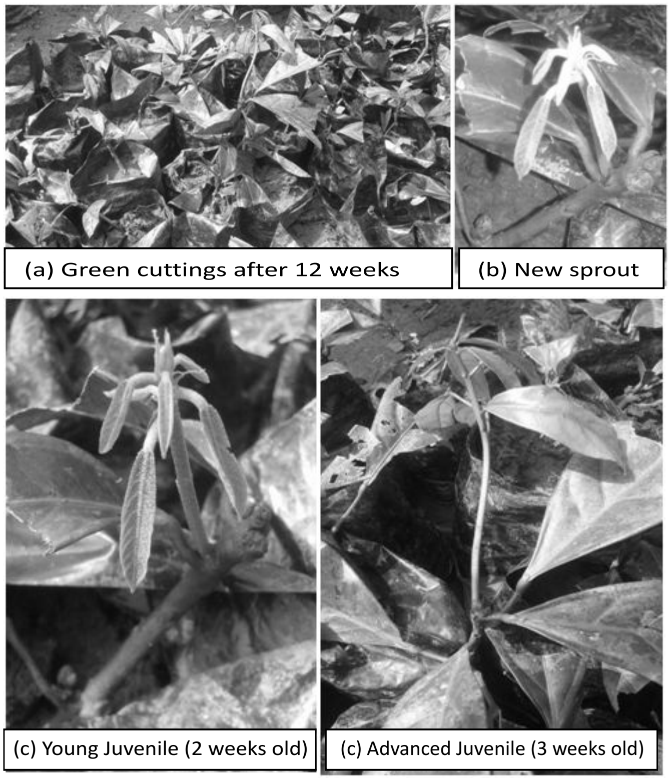

Figure 2: Sprouting, Leaf formation and development of juveniles in *Cola* cuttings

Conclusion

Many cuttings and grafted materials from this experiment were successfully established in a new *Cola* germplasm plot at CRIN Headquarters, Ibadan. The success obtained in the setting of the kola cuttings is significantly different from all the previous results obtained from cuttings of the various *Cola spp* set. This result indicates that with further efforts aided by improved availability of research materials, CRIN will be able to successfully establish clones of better performing kola genotypes in its germplasm collection, thereby paving way for the development of improved kola varieties for distribution to farmers.

Status: On-going.

Experimental Title: Extraction of Caffeine from Wholesome and Weevilled Kola Nut

Investigators: Mokwunye, F.C., Okunade, A.F., Jayeola C.O. and Yahaya, L.E.

Introduction

Kola nut is widely known, especially in Western and Northern part of Nigeria, as an economic crop and it has a major active ingredient known as caffeine (soluble substance). Many Africans consume kola nuts regularly, even daily, for the medicinal, stimulating and sustaining properties. Kola nut has very high caffeine content, smaller amounts of Theobromine and Kolanin, which dispel sleep, thirst and hunger and act as a stimulant and anti-depressant. They also reduce Fatigue, aid digestion and work as an aphrodisiac. Kola nuts are best known outside Africa as an ingredient in Cola beverages. Commercially produced Cola drinks were developed in the late 1800s. Then Kola nuts were used as ingredients in (Beverage and Tonics). Coca Cola, the most famous beverage in the World, was formulated from kola in 1886 by Atlanta druggist, Dr. John Pemberton and marketed as brain and nerve tonic. (Prevention's Healthy Ideas, 2002). Presently, the bulk of kola nuts being produced in Nigeria are either consumed fresh locally or exported as sun-dried nuts to drier areas of Africa where they are used as masticants or as a source of colorants for cloth dyeing with little or no industrial use in Nigeria. Globally, caffeine is widely consumed as psychoactive drug, because it's a central nervous system stimulant of the methyl xanthine class and it gives most people a temporary energy boost and elevates mood, but despite its importance caffeine is still underutilized. Therefore, the objectives of this work are to extract caffeine from hitherto discarded weevilled kola nut and to purify the extracted caffeine for commercial use as CRIN Caffeine.

Materials and Methods

Wholesome Kola nut (*Cola nitida*) was purchased from Ogunmakin Market in Ogun State. The kola nuts were separated into two batches, while one batch was sorted into the white, red and pink varieties

Kola nut Powder Production

A modification of the method used by Ogunwolu and Akinwale (2003) was adopted. Cured healthy Kola nuts *(Cola nitida),* sorted into three different varieties, were washed and soaked in warm water (about $50^{o}C$) and diced to $5mm^2$ separately. The Kola nut dices were then dried in a hot air oven at $90^{o}C$ for 3 hours and cooled. Each of these samples was milled with a Panasonic multipurpose blender and stored in tightly covered plastic jars and subsequently labelled as WKN for white coloured kola nut, RKN for red coloured kola nut and PKN for pink coloured kola nut. The 2nd batch of kola nut was not sorted into varieties but simply divided into two parts.

One part was milled fresh and labeled MFK while the other part was diced in hot water, dried at 90oC for 3 hours and milled with a blender and labeled as MDK. Both samples were separately stored in tightly covered plastic jars.

Chemical Composition of the fresh Kola nut

Proximate analysis for moisture, crude protein, ether extract, total ash, crude fiber and carbohydrate were determined using the fresh kola nut sample according to the methods of the Association of official Analytical chemist (AOAC) (2014). Estimation of caffeine was done by the method of Luigi (1968) as modified by Ogutuga (1975).

Caffeine Extraction

Two methods were used for the extraction of caffeine from the kola nut samples.

1) 400g 0f each of the kola nut samples was put into a 4 liter plastic bottle, into which 1600 ml of ethanol was added. The setup was shaken periodically for 2 hours and allowed to stand for 24 hours, then filtered using cheese cloth. The residue was further washed with 400ml of ethanol. 400g of magnesium oxide was later weighed out into another 4 liter bottle and acidified with 50 ml of 10% concentrated sulfuric acid. The filtrate was transferred into the 4 liter bottle containing the acidified magnesium oxide and shaken periodically for one hour and allowed to stand for 3 – 4 hours during which caffeine was adsorbed by magnesium oxide. The mixture was again shaken after 4 hours and then filtered using a vacuum pump. The filtrate was then transferred into a 4 liter bottle, into which 100 ml of chloroform was added, mixed thoroughly and allowed to stand for 2 hours. The supernatant was decanted while the fluid concentrate or sediment was centrifuged at 350xg for 5 mins. The supernatant was decanted, and caffeine was to be removed as silky residue, allowed to dry at room temperature. (Obidike et al, 2011)

2) Place 150g of kola nut sample into a separating funnel, add 150 ml of water and shake for 5min. then add 40 ml of Dichloromethane and place the stopper on the top of the funnel. Shake the funnel further for 2 minutes. Allow the two layers of liquid to separate and drain the lower Dichloromethane layer into a flask. Add a fresh 40 ml portion of Dichloromethane to the kola nut sample in the funnel, shaking the funnel for two mins. Allow the two layers to separate again then drain the lower layer into the flask that already contains the first portion of dichloromethane. Repeat this process the third time draining the solvent layer into the flask. Add 2g anhydrous sodium sulfate to the flask containing the dichloromethane, swirl the flask gently and allow to stand for 10 minutes. This will dry any water left in the funnel. Recover the caffeine by distillation using the apparatus. (Okoli et al 2012)

Purification of Crude Caffeine

The crude caffeine was transferred to a clean 50 ml beaker, followed by the addition of 5 ml of Toluene, and heated on a steam bath (or hot plate) to dissolve the caffeine. The beaker was then removed from the heating source, followed by the addition of 10 mls of petroleum ether (boiling point 60 – 90oC), and the caffeine was allowed to crystallize. The product was collected by vacuum filtration, washed with 1 ml of petroleum ether, allowed to dry and weighed. The melting point was determined, to confirm purity.

Results and Discussion

Chemical Composition

The chemical characteristics of the kola nut powder samples (WKN, RKN, PKN, MDK, MFK) are shown in Table 1. There were insignificant differences in the moisture contents of the four powder samples except for the fresh kola nut, MFK, which is significantly different. Results also showed no significant variations in the values obtained for fibre, ash, fat, protein and carbohydrate contents. Sample WKN was significantly different from the other samples in the caffeine content. The fibre and ash contents ranged from 2.480 to 2.580% and 3.460 to 3.680% respectively. Protein and caffeine content of the powders were 8.600 to 8.680% and 1.560 to 1.860%, except for the MFN which has significantly low levels.

Caffeine Extraction

Though White kola nut sample (WKN) yielded more during the estimation of caffeine, (table 1) mixed dried kola nut sample was utilized for caffeine extraction. First it came second in yield, also it be more readily available in the market. The method used by Obidike et al, 2011 for which many devices were procured, when employed yielded no caffeine. This method was adopted because it was meant to yield 8g of caffeine from 160g of dried kola powder which is quite high compared to the other methods in literature. Many workers found dichloromethane as the best solvent for the extraction of caffeine from most products. (Okoli et al, 2012). This method yielded only 5.4g of caffeine from 400g of dried kola sample.

Table 1: Chemical Analysis of Kola Nut Samples

	WKN	RKN	PKN	MFK	MDK
Moisture	3.080[b]	3.160[b]	3.150[b]	56.030[a]	3.160[b]
Fibre	2.560[a]	2.480[a]	2.520[a]	0.240[b]	2.490[a]
Ash	3.680[a]	3.660[a]	3.543[a]	0.750[b]	3.460[a]
Fat	1.010[a]	1.010[a]	0.990[a]	0.070[b]	0.940[a]
Protein	8.680[a]	8.660[a]	8.650[a]	2.730[b]	8.600[a]
Caffeine	1.860[a]	1.570[c]	1.750[b]	0.320[d]	1.760[b]
Carbohydrate	79.27[a]	79.27[a]	79.58[a]	42.37[b]	79.79[a]

Note: Means along horizontal rows with the same superscripts are not significantly different at $P < 0.05$. WKN = White, RKN = R ed, PKN = Pink kola varieties, MFK = Fresh and MDK = Dried kola samples.

Conclusion

The future plan is to extract caffeine from weevilled kola nut which is less expensive than wholesome kola, purify and identify the caffeine obtained by standard means.

Status: On-going.

Experimental Title: Effects of Cement Dust on Kola Productivity in Ewekoro and Sagamu L.G.A in Ogun State

Investigators: Adebowale L.A, Ogunlade M.O and Taiwo N.

Introduction

Kola plantations sited near cement factory have reported decreasing effect on yield in kola production due to the cement dust deposited on the soil and leaves of kola. Therefore, the present attempts to find means to look inward as cement dust its affect kola production and ameliorate the effects. The o**bjective of the study is t**o evaluate the effect of cement dust on kola soils, trees and the nuts production.

Materials and Methods

Soil and plant samples was collected at various kola plantations in the factory sited at Sagamu and Ewekoro L.G.As of Ogun State. Core soil sample at 0-15 and sub soil 15-30cm depth was collected randomly using soil auger. Ten core soil sample collected was bulked to form composite. Soil samples collected was air dried, crushed and sieves to pass through 2mm sieve. Eight kola trees were sampled from each location for their leaves. The leaves sampled collected was divided into two parts (washed and unwashed). Leaves' samples collected were air dried after washing before envelope and placed into oven for oven drying. Kola pod was also sampled. The N, P, K, Ca, Mg, Cu, Zn, Mn, Fe, Organic carbon and pH was determined. Representative leaf sample collected and analyzed for their content.

Status: On-going.

Title: Development of Bio-Pesticides for the Preservation of Stored Kola Nuts

Agbeniyi, S.O., Adedeji, A.R., Orisajo, S.B., Asogwa, E.U., Otuonye, A.H., Mokwunye, I.U., Kolawole, O.O., Ogundeji, B.A.and Olorunmota, R.T.

Introduction

Nigeria accounts for about 70% of the total world production of kola nuts. About 90% of the kola nuts produced in Nigeria is consumed within the country while 10% is exported. A major challenge associated with kola nuts storage is the attack by weevil and moulds. In order to address this issue, kola nuts farmers and traders use various types of chemical pesticides including banned ones. These pesticides in their characteristic nature have the ability to permeate plant cells and remain as residues. Several authors have reported the presence of pesticide residues in various foods, vegetables, soils, sediments and diverse environment. Besides, since kola nuts most often undergo primary processing before consumption, it is important to develop safe pesticides with minimal or no human and environmental health consequences. There are several documented evidences of the effectiveness of plant-based materials for the management of crop pests. These include powders, essential oils and aqueous extracts of *Curcuma longa, Acorus calamus, Hyptisspicigera*, *Cassia nigricans* and *Mentha spicala* which have been shown to be effective against bruchids, curulionids and the tenebrionid *Triboliumcastaneum* (Mishra *et al.*, 1984; Lambert *et al.*, 1985; Stoll, 1988). Seeds of *Azadirachta indica*, *Dennettiatripala* and the fruits of *Piper guineese* have pesticidal and behaviour modifying properties against various pests of stored products (Osisiogu and Agbakwuru, 1978; Ivbijaro and Agbaje 1986; Lale, 1992). This project attempts to explore and develop safe alternatives, such as biopesticides, for the control of storage pests of kola that can be easily administered and adopted by farmers.

Materials and Methods

Fresh and infested kola nuts (pods/unskinned nuts) for this experiment were purchased from local vendors and farmers in Ogun and Osun States, Nigeria. All the other experimental materials (baskets, poly bags, Whatman filter papers, petri dishes, camel hair brush, trays, plastic bowls etc.) were bought from reputable scientific suppliers in Ibadan, Nigeria. Stock culture of weevils was established for continuous supplies of weevils. Similarly, samples of these kola nuts have been cultured *in-vitro* and associated pathogens isolated and identified. Pathogenicity test have been conducted. Laboratory trials on the efficacy of six plant materials on weevils and rot organisms have been conducted also.

Status: On-going.

Experimental Title: Effects of Varying Nursery Periods on Kola Field Establishment
Investigators: Ugioro, O., Adeyemi, E.A., Nduka, B.A., Famaye, A.O., Ayegboyin, K., Oloyede. A., Mohammed I. and Adeosun. S.A.

Objectives
1) To determine the minimum nursery time require for maximum field survival rate in order to reduce nursery cost.
2) To evaluate the performance of kola when intercropped with *Cajanus cajan*and plantain at early stage of field establishment.
3) To determine the average yield of *Cajanus cajan.*
4) To harness local materials and using up to date agronomic research methods in the field to reduce the amount of fertilizer, herbicides and labour in order to reduce cost in the field and
5) To determine the effect of nutrient uptake on kola.

Materials and Methods
Study Area: This study was carried out in three locations; Cocoa Research Institute of Nigeria (CRIN) Headquarters, Owena and Ajassor Substation.

Collection of sample: *Cola nitida* was collected from farmers' field in Osun States of Nigeria where *C. nitida* is widely grown. 50 pods were collected from the farmers' field.

Pre-soil analysis on nursery and field establishment: The forest topsoil that was used for raising the planting materials was collected from the 0-15, 15-30, and 30-45cm depth at the three locations. Soil was then be mixed thoroughly and the bulk sample was taken to the laboratory, air dried and sieves to pass through a 2mm screen for chemical analysis. The soil pH (1:1 soil/water) and (1:2 soil/0.01MCaCl2 solutions) was determined using a glass calomel electrode system (Crockford and Nowell, 1956) while organic matter was determined by the wet oxidation chromic acid digestion method (Walkley and Black, 1934). The soil nitrogen was determined by the Micro-Kjedahl method (AOAC, 2000) while available phosphorus (P) was extracted by the Bray P1 extracted, measured by the Murphy blue colouration and determine on a spectronic 20 at 882Um (Murphy and Riley, 1962). Soil K, Ca, and Na was extracted with a 1M NH4OAC, PH7 solution, then analysed with a flame photometer while Mg was determined with an Atomic Absorption Spectrophotometers (AAS) (Jackson, 1958). The exchangeable acidity (H+ and Al3+) was measured from 0.1M HCl extracts by titrating with 0.1M NaOH (Mclean, 1965). Micro-nutrients (Cu, Zn, and Fe) were extracted with 0.1MHCl (Ogunwale and Udo, 1978) and read on a Perkin Elmer Atomic Absorption Spectrophotometer (AAS).

Raising nuts for seedlings: A total of fifty (50) fresh pods of *C. nitida* nuts was collected from the States listed above. Five seed boxes of (90x60x30cm) size each was filled with a mixture weathered sawdust and topsoil (ratio 50:50). The seedlings of *C. nitida* was sown on June, 2019. A shade was erected for the pre-nursery to prevent the nuts from desiccation and cultural practices such as weeding, watering and spray of pyrinex 0.5L/1L of water against termite infestation was carried out. They will thereafter be potted in polythene bags awaiting field establishment. *C. nitida* nuts collected from Osun state was sown in the nursery separately as follows 2 months, 4 months, 6 months and 8 months and thereafter will be transplanted to the field for establishment at the same time. Shade crop such as *Cajanus caja*and plantain will be used as inter-crop.

Data collection on planting materials: The nuts will be assessed for percentage survival which will be determined as the number of living plants per total planted, highest peak to emergence (days to emergence), root length, root girth. The measurement of growth parameter such as plant height, number of leaves, leaf area, stem diameter and number of branches will commence after the planting materials would have established in the field.

Field Establishment: All *C. nitida* raised separately at the nursery will be transplanted to the field at the same time.

Experimental design: The experimental design will be Randomized Complete Block Design (RCBD) consisting four (4) treatments replicated three (3) times making a total of 12. The treatments are:
Kola seedlings sole (No plantain) Kola seedlings + plantain
Kola seedlings + *Cajanus caja*
Kola seedlings + Plantain + *Cajanus caja*

Statistical analysis: The average data obtained for the growth parameters, leaves and soil chemical composition of kola seedlings for the two experiments will be analysed using ANOVA with an F-test. The treatment means will be compared.
Status: On-going.

Experimental title: Physical and chemical means of breaking seed dormancy of *C. nitida* for uniformity, faster growth and enhanced yield

Investigators: Ugioro, O., Idrisu M., Ayegboyin K., and Asowata F.E ., Adeosun S.A

Introduction/Background

Kola is an important economic cash crop to a significant proportion of Nigerian population who are involved in kola farming, trading and industrial utilization. However, Nigeria accounts for about 70% of the total world production of kolanuts (Quarco, (1973)

One of the major challenges of *C. nitida* is dormancy which had led to non-uniformity of its seedlings and slow growth rate. This study is therefore carryout to see the various ways of breaking the seed dormancy in other to have uniform and well-developed seedlings.

Key performance indicators, baseline and target

Kola nut, one of the major cash crops in Nigeria undergoes dormancy which results in non-uniformity in their growth rate. In addition, the relative growth rate of kola is slow which necessitated the potential use of plant growth hormones on *C. nitida* seedlings. This study is aimed at i) looking at the possibilities to find out the various ways of breaking the dormancy of kola using plant growth substances, ii) Evaluating the effect these possibilities on morphology of *C. nitida* seedlings and iii) determining the yield components of *C. nitida* seedlings.

Implementation up-date- financial

The sum of nine hundred and thirty-eight thousand, four hundred naira was budgeted for but because of the scarcity of fund, only three hundred thousand was released accounting for 42% of the total sun requested for.

Materials and Methods

Key activities of implementation deliverables Collection of *C nitida* nut. Freshly harvested kola pods were collected from mature and high yielding trees from a known farmer's farm in Osun State.

Raising of seedlings from nut

A total of five hundred (300) fresh nuts was collected and extracted by splitting matured pods with a sharp knife, the nuts were soak and washed in water to remove the testa on them. The intact & mechanically broken seeds were surface sterilized with 0.1% mercuric chloride ($HgCl_2$) for 10 min and thoroughly washed with distilled water. Different treatments used to break the dormancy are: Plant hormones (IBA., GA_3, IBA+GA_3, kinetin, kinetin + GA_3), soaking in cold water for 24 hrs and scarification. Nuts were analyzed before and after each treatment before planting.

Soil sampling and pre-soil analysis

Soil samples was randomly collected from 0-15 cm depth on the site, mix thoroughly and the bulked sample was taken to the laboratory, air dried and sieved to pass through a 2mm screen for chemical analysis. The soil pH (1:1 soil/water) was determined using pH meter. Organic matter was determined by the wet oxidation method (Walkley and Black, 1934). Soil phosphorus (P) was extracted by the BrayP1 and measured by the Murphy blue coloration and determined by Spectronic 20 at 882 um (Murphy and Riley, 1962). Soil potassium (K), calcium (Ca), and magnesium (Mg) were determined with flame photometer, Mg was determined with an Atomic Absorption Spectrophotometer. The total Nitrogen (N) was determined by the microjedah method (AOAC, 1990).

Nursery and field establishment

Kola seedlings was transplanted into polythene bag, one per pot and thereafter was taken to the field. The experiment was arranged in Completely Randomized Block Design (CRBD) replicated three times in Owena CRIN sub- station. Shade crop like plantain was erected to prevent the kola seedlings from desiccation.

The parameters such as plant height, number of leaves, leaf area, stem girth and numbers of branches was recorded from four weeks after germination. Growth parameters was measured every four weeks for 6 months after planting. There after other treatments was applied.

Statistical analysis

The average data obtained was analyzed using ANOVA. The treatment means was compared using a Duncan Multiple Range Test at the 5% probability level.

Results

Table1: Mean plant height (cm) and stem girth of *C. nitida* seedlings treated with different concentrations of Phytohormones ranged between 2MAP to 6MAP

	2MAP		4MAP		6MAP	
Treatment	Plant height	Stem girth	Plant height	Stem girth	Plant height	Stem girth
Indo-butyric acid 50mg/L	40.53b	0.72aa	46.79bc	1.07b	60.17ab	1.17a
Gibberellic acid 50mg/L	34.83c	0.65b	41.88bc	0.93b	48.26bc	1.04a
IBA+GA_3 50mg/L	39.92bc	0.76a	44.91bc	1.04a	57.87b	1.05a
Kinetin + GA_3 50mg/L	56.54a	0.78a	73.30a	1.13a	106.02a	1.28a
Kinetin 50mg/L	53.80a	0.77a	61.19b	1.09a	73.60ab	1.27a
Scarification method	44.40b	0.64c	49.09bc	0.87b	54.94b	0.97a
Soaking in water method	37.29bc	0.6b	37.64c	0.84c	44.59c	0.93a

Means followed by the same letters on the same column are not significantly different at 5% probability level using Duncan Multiple Range Test

Table 1 showed increase in plant height and stem girth of all the treatment as the number of months increases. Kinetin in combination with gibberrelic acid at 50mg/L recorded the highest number of plant height and stem girth at 6 months after planting, followed by kinetin while soaking in water recorded the least. These results also conform to those of Geekiyanage*et al. (*2006) and Sasaki, (1989). Similar results of plant height stimulation were observed by Currah& Thomas (1979) upon application of 100mg/L GA3 on carrot plant.

Table2: Mean number of leaves and leaf area of *C. nitida* seedlings treated with different concentrations of Phytohormones ranged between 2MAP to 6MAP

	2MAP		4MAP	6MAP		
Treatment	Number of Leaves	Leaf area	Number of leaves	Leaves area	Number of Leaves	Leaf area
Indo-butyric acid 50mg/L	16.58a	52.01bc	27.25b	54.51ab	34.92bc	57.57ab
Gibberellic acid 50mg/L	13.67a	43.41c	24.33bc	53.66ab	36.67b	64.63ab
IBA+GA_3 50mg/L	15.33a	60.89b	25.67b	57.65ab	37.67b	58.56ab
Kinetin + GA_3 50mg/L	19.62a	71.78ab	38.67a	78.79a	52.90a	84.57a
Kinetin 50mg/L	18.92a	83.50a	36.75a	71.77a	48.00a	82.68a
Scarification method	16.67a	43.54c	36.75a	48.	26.33c	48.34b
Soaking in water method	17.08a	66.36b	17.17c	39.75c	20.83c	39.88c

Means followed by the same letters on the same column are not significantly different at 5% probability level using Duncan Multiple Range Test

Increased leaf number of all the treatment of *C. nitida* seedlings were observed as the number of aged increases. Significant differences were obtained in 4 and 6MAP (Table 2). Highest number of leaves at 6MAP was recorded for seedling treated with 50 mg/L gibberellic acid in combination with kinetic acid (52.90). With respect to the hormone treatments, the highest leaf area at 6MAP was observed in seedling treated with 50 mg/L gibberellic acid in combination with kinetin (84.57) while soaking in water (39.88) recorded the least. Similar results were obtained by Alamu and Mc David (1979), in his report with tannin (*Xanthosomasagittifolium*) where they observed that application of GA3, auxin and cytokinins increased the leaf number of the plant by promoting the development of auxillary leaf systems. Ebofin*et al.* (2004) similarly recorded enhanced leaf number and plant height in *Prosopis Africana* and *Albizialebbeck.* This

Table 3: Mean fresh weight of root, shoot, leaves and fre sh weight of whole plant of *C. nitida* seedlings treated with different concentrations of Phytohormones at 6MAP

Treatment	Root fresh weight (g)	Shoot fresh weight (g)	Leaf fresh weight (g)	Total weight of whole plant (g)
Indo-butyric acid 50mg/L	59.63b	96.43bc	53.70c	209.77a
Gibberellic acid 50mg/L	48.17bc	106.33bc	91.77b	246.27a
IBA+$GA_3$50mg/L	59.50b	118.43b	69.00bc	246.93
Kinetin + GA_3 50mg/L	77.17a	200.00a	102.20ab	347.03a
kinetin 50mg/L	76.57a	166.50ab	122.30a	345.27a
Scarification method	37.70c	80.17c	56.60c	298.37a
Soaking in water method	31.47c	66.10d	24.00d	129.57b

Means followed by the same letters on the same column are not significantly different at 5% probability level using Duncan Multiple Range Test

Fresh weight of root (g), shoot (g), leaves (g), and fresh weight of whole plant (g) of the treated seedlings of *C. nitida* increases significantly (Table 3). The highest mean value of fresh weight of shoot for seedlings given hormone treatments at 6MAP was observed in seedlings treated with 50mg/L gibberellic acid with kinetin (200.00 g), followed by 50mg/L kinetin (166.50 g) and the lowest mean value was obtained in soaking in water method 66.10 g. Fresh weight of leaves also showed that seedlings treated with 100mg/L kinetic acid had the highest mean value of (122.30 g), followed by 50mg/L gibberellic acid in combination with kinetin (102.20 g) and the lowest mean value was obtained in soaking in water method (24.00 g). (Table 3). This result is contrary with Heijari*et al.* (2005) who observed seedling diameter, shoot fresh weight, root fresh weight and root length were affected by low MJ concentration in Scots pines

Table 4: Mean dry weight of root, shoot, leaves and dry weight of whole plant of C. nitida seedlings treated with different concentrations of Phytohormones at 6MAP

Treatment	Root dry weight (g)	Shoot dry weight (g)	Leaf dry weight (g)	Total dry weight of whole plant (g)
Indo-butyric acid50mg/L	19.88a	32.32b	17.90bc	69.92bc
Gibberellic acid 50mg/L	16.06a	35.45b	30.59ab	82.09b
IBA+GA_3at 50mg/L	19.83a	39.48b	23.00b	82.31b
Kinetin + GA_3 50mg/L	25.72a	69.06a	33.73a	125.68a
Kinetin 50mg/L	25.52a	58.84ab	40.77a	125.09a
Scarification method	12.57a	26.72bc	18.87bc	100.01a
Soaking in water method	10.49a	23.04c	9.67c	43.19c

Means followed by the same letters on the same column are not significantly different at 5% probability level using Duncan Multiple Range Test

Table4 showed that kinetin in combination with gibberrelic at 50mg/L acid recorded the highest mean value in root dry weight, shoot dry weight and total dry weight of whole plant except for kinetin which recorded the highest mean value in leaf dry weight. Nuts Soaked in water recorded the least in all the treatment.Rahimi*et al.* (2011) reported that seed yield was strongly influenced by various growth components, i.e., plant height, seeds capsule-1, capsules plant-1 and branches plant-1. For vegetative growth and dry weight, each dose of IAA alone showed promotory effect in field, as well as in pot conditions. Quaderi*et al.* (2006) reported that IAA increases dry matter by increasing photosynthesis activity in mungbean. Ibrahim *et al*. (2007) reported that the application of bioregulators (GA3, IAA, benzyl adenine, ancymidol) significantly increased the total dry weight of shoot system in fababean.

Conclusion and recommendation

This study shows that gibberrelic acid in combination the kinetin at 50mg/L recorded the highest mean value in all the parameters taken and therefore be recommended.

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Experimental Title: Evaluation of Kola Nut Supply Chain in Nigeria

Investigators: Yahaya, A.T, Orisasona, T.M, Lawal, J.O, Obatolu, B.O, Taiwo O.A, Akinpelu, A,

Introduction

Globalization, urbanization and agro- industrialization puts increasing demands on the organization of agro- food chains and network. Food and agribusiness supply chain and networks which was once characterized by autonomy and independence of actors are now swiftly moving towards globally interconnected systems with large varieties of complex relationships which affect the ways food is produced, processed and delivered at the market (Ruerd Ruben, 2006; Readon and Barrett 2000) and also the revenue accruable from this agricultural produce. The market exerts a dual pressure on agro- food chains, forcing towards continuous innovation and agency coordination. Agricultural produce is being offered at a fairly competitive price, prices and quality issues are more important than ever, consumers can choose from an increasing number of products offered by competing chain.

Kola nut one of the major cash crops in Nigeria, has contributed largely to the GDP of the country, to maximize the full potential of the economic returns; there is need for the value chain to be properly developed; hence, an evaluation of the value chain in Nigeria become necessary.

Objectives

i. map out Kola value chain in order to give the functional analysis of the actors in each of the stages of the chain in the study areas
ii. analyze the competitiveness and the effects of policies on competitiveness at each stage of Kola value chain
iii. determine the comparative advantage of the nodes of Kola value chain in Southwestern Nigeria
iv. estimate the effects of price distortions on consumers' and producers' welfare in the study areas

Methodology

The study was carried out in two Kola producing states namely (Osun, Oguni) of Nigeria. Multistage sampling techniques were used to select three (3) local governments from each from the state namely: Ife South, Oriade and Osogbo and Sagamu, Ijebu South and Ijebu North. Second stage involved selection of one hundred and fifty (150) respondents from each state in the proportion of fifty (50) from each LGA. Information was elicited through the use of structured questionnaire and focus group discussion. Returned questionnaire was sorted and analyzed.

Results and Discussion

Table 1 show the socio-economic characteristics of the respondent in Osun and Ogun states respectively. It shows that majority of the respondent are in their active years 48.67% and 61.33% respectively. The table also shows that majority of them are females 76.67% and 90% respectively. Majority 80% of the marketers in Ogun had basic education with only 26.67% Osun state. This informed their efficiency in trade. Majority (50% and 54.67%)of the marketers had more than thirty years of Kola trading respectively. This is a good indicator for improved productivity and efficiency.

Table1. Social Economic Characteristic of the respondents

Variable	Osun		Ogun	
Age	Freq.	percent	Freq.	Percent
= 40	20	13.33	6	4
40-50	22	14.66	12	8
51-60	73	48.67	92	61.33
>60	35	23.33	40	26.67
Total	150	100.00	150	100.00
Gender				
Male	35	23.33	15	10
Female	115	76.67	135	90
Total	150	100.00	150	100.00
Educational Status				
No Education	100	66.67	20	13.33
Primary Education	40	26.67	120	80
Secondary Education	10	6.66	10	6.67
Total	150	100.00	150	100.00
Marketing Experience				
≤10	10	6.67	12	8
11-20	20	13.33	24	16
21-30	45	30	32	21.33
≥30	75	50	82	54.67
Total	150	100	150	100
Marital Status				
Single	10	6.7	2	1.33
Married	128	85.33	136	90.67
Divorced	5	3.3	8	5.33
Widow	7	4.67	4	2.67
Total	150	100	150	100
Religion				
Christianity	54	36	45	30
Islam	86	57.33	102	70
Traditionist	10	6.6	73	2
Total	150	100	150	100

Source: Field Survey 2019

Table 2 show the supply chain of kola-nut in Osun and Ogun respectively. The table shows that most 66.67% and 57.33% kola traders buy kola for trade directly from farmers. This help in improving their returns and in getting fresh produce. The table also shows that all 150% of the traders deals in both wet and dry kola-nuts. Majority of the traders in Osun sell their products within cities like Kebbi, Zaria, Sokoto, Kano.While marketers in Ogun trade as far as Maiduguri, Zamfara and extent their trading to Saudi- Arabia Dubai, Central Africa. Also, majority 73.33% and 66.67% of the marketers used family credit in their business. This is an indication that there is bottle neck in accessing external credit as protocol involved as well as the interest is high.

Table 2 Marketing and Sales

Variables	Osun		Ogun	
	Freq.	percent	Freq.	Percent
Who are your suppliers?				
Farmers	100	66.67	86	57.33
Processor	30	20	50	33.33
Retailers	20	13.33	14	9.33
Total	150	100	150	100
Where do you sell to?				
Kebbi	50	33.33	13	8.67
Sokoto	20	13.33	30	20
Kano	80	53.33	27	18
Zaria	-	-	18	12
Maiduguri	-	-	20	13.33
Zamfara	-	-	-	-
Saudi-Arabia	-	-	14	9.33
Dubai	-	-	16	10.67
Central Africa	-	-	12	8
Total		150	100	
Which type of kola nut do you sell?				
Dried	-	-	-	-
Wet	-	-	-	-
Processed	-	-	-	-
Unprocessed	-	-	-	-
Both	150	100	150	100

Field survey 2019

Table 3 Sources of Finance

	Osun		Ogun	
Variable	freq	percent	freq	percent
Loan	27	18	32	21.33
Family	110	73.33	100	66.67
Friend	13	8.67	18	12
Total	150	100	150	100

Field survey 2019

Conclusion and Recommendations

Kola supply chain in the study areas revolved around southwest to the northern state and nearby countries. Wet nuts are purchased from farmers and processed into dry for sales. Most of the traders are in their active working age. The marketers are carrying out their business effectively though with basic education. Their access to credit is limited as most of the marketers use family funds in their business. It is recommended that government boost kola business to derive the maximum gain. Also, government should help the marketers in areas of access to credit.

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Experimental Title: Soil fertility evaluation of some kola plantations in Edo and Cross River States, Nigeria
Investigators: M.O. Ogunlade ,O.S. Ibiremo, C.I. Iloyanomon, L.A. Adebowale, and N. Taiwo

Introduction
Kola production levels over the years have been reported to decline due to old age, incompatibility and soil nutrient depletion. The continuous land use without adequate and balanced fertilizer use have caused severe soil fertility deterioration and low yield. Information about the nutrient status of the kola plantation is highly essential to recommending appropriate soil fertility management strategies that will enhance kola yield on sustainable basis.Fertilizer is seldom used in Kola plantations in Nigeria. Nutrient removal from soil through pod harvest results in "nutrient mining" which necessitates replacement of soil nutrients removed. This can be achieved through fertilizer application. Knowledge of the soil nutrient status of the kola plantations will give credence to judicious and guided fertilizer recommendation and application for increased productivity. Therefore, the objective of this study was to assess the soil fertility status of kola plantations in Edo and Cross River States with a view to determine their nutrients status

Materials and methods
Soil samples were collected in kola plantations across some local government areas (LGA) in Edo (Ugbiyaya in Uhunmmode LGA, Uhonmora in Owan West LGA, Iruekpen in Esan West LGA and Otuo in Owan East) and Cross River States(Effraya and Ajassor in Etung LGA, Biakwan in Boki LGA, and Adijinkpon in Ikom LGA). In each of the plantations visited, 10 core soil samples at 0-20 cm and 20-40 cm were randomly collected using soil auger and bulked into composite samples to obtain representative soil samples for each kola plantation. The labelled samples were brought to the laboratory for processing and analysis. The soil samples were air dried, sieved through 2mm sieve and somephysico-chemical properties determined following standard laboratory methods.

Results and Discussion
Soil pH in both states were slightly acidic with those of Cross River State being more acidic at 0-20cm soil depth (Table 1). Therefore, any activities that will further acidify the soil should be avoided.

Organic carbon content of the soil was low in kola plantations evaluated in Edo State with mean value of 16.4g/kg but moderate in Cross River State with values ranging from 17.1 and 28.5 g/kg with a mean value of 25.28g/kg.

Total nitrogen was low in kola plantation soils of Edo state. The mean value (0.87g/kg) was below the critical nitrogen soil content required by kola as reported by Egbe *et al*., 1989. Therefore, there will be need for nitrogen application in all the kola plantations evaluated in Edo state. The soil nitrogen content in kola plantations assessed in Cross River State were adequate and would not require nitrogen fertilizer application.

Soil available phosphorus content was adequate for kola in all the farms evaluated in both states. Soil available P was well above the soil critical level of 6mg/kg P required for kola production (Egbe *et al*., 1989) and this was similar to the report of Iloyanomon*et al*., 2011, that high Phosphorus content in the leaf litter resulted into high P in the soil as a result of the fast decomposition of the Kola leaves. Therefore, no application of phosphorus fertilizer is required.

The exchangeable potassium soil contents in both Edo and Cross River states was well below the soil critical K level of 1.2cmol/kg soil required by kola as reported by (Egbe*et al.,*1989). This could be attributed to mining of K through the harvesting of kola pod husk without nutrient replenishment. Kola pod husk contains about 3.5% K and where the method of harvesting of kola involves discarding of these pod husk without nutrient replenishment, there is mining of K from the plantations. Kola in these plantations received no nutrient supplementation in form of fertilizer. This is typical of kola plantations in Nigeria. This is of concern because K is important in fruiting of Kola and its deficiency leads to decrease kola quality and yield. There is therefore need to replenish K lost from the kola plantation.

Calcium and magnesium were sufficient in the soils of kola plantations evaluated, but this is in contrast to the findings of Lombin and Fayemi 1979 who reported that some highly leached soils are near deficiency levels and requires magnesium fertilization and in contrast to Ipinmoroti*et al. (*2009) which reported low magnesium in soilss of some cocoa plantations in Ibadan, Nigeria. Similarly, Obatolu and Chude (1987) reported Mg deficiency in cocoa soils.

Table 1: Ranges and mean values of kola soil properties at 0-20cm depth across Edo and Cross River States

Parameters	Edo State			Cross River State		
	Min	Max	mean	Min	Max	Mean
pH	6.2	6.85	6.56	5.6	5.82	5.70
O.C(g/kg)	9.0	24.9	16.4	17.1	28.5	25.28
Total N (g/kg)	0.4	1	0.87	1.2	2.5	1.98
Avail P (mg/kg)	15	27.8	20.24	13.8	18.9	16.03
Exch K (cmol/kg)	0.08	0.42	0.22	0.13	0.32	0.21
Exch Ca (cmol/kg)	13.33	18.61	15.69	15/.28	18.77	17.21
Exch Mg (cmol/kg)	0.92	2.81	1.69	1.15	3.02	2.21
Exch Na (cmol/kg)	0.79	0.98	0.90	0.83	0.92	0.88
Sand (g/kg)	655.2	815.2	731.87	375.2	755.2	565.20
Silt (g/kg))	12.8	192.8	96.13	92.8	232.8	177.80
Clay (g/kg)	132	232	172.00	152	392	257.00

Similar trend was observed in the sub-soil (20-40cm) as shown in Table 2.

Table 2: Ranges and mean values of kola soil properties at 20-40 cm across Edo and Cross River States

	Edo State			Cross River State		
Parameters	Min	Max	Mean	min	Max	Mean
pH	5.8	6.9	6.49	5.52	5.9	5.69
Oc(g/kg)	4.1	27.6	12.22	13.5	26.9	17.75
N(g/kg)	0.4	1.1	0.75	1.2	2.2	1.53
P(mg/kg)	14.23	24.43	18.35	14.23	17.83	15.34
K(cmol/kg)	0.06	0.4	0.18	0.14	0.27	0.20
Ca(cmol/kg)	12.31	20.21	15.44	17.66	19.68	18.62
Mg(cmol/kg)	0.69	2.56	1.44	1.15	2.65	1.82
Na(cmol/kg)	0.76	0.92	0.84	0.89	1.08	0.97
Sand(g/kg)	595.2	775.2	695.2	275.2	675.2	440.2
Clay(g/kg)	172	292	212	232	552	412
Silt(g/kg)	32.8	192.8	92.8	92.8	172.8	147.8

Field survey, 2019

Conclusion

The study was carried out in Edo and Cross River states, Nigeria to evaluate the soil nutrient status of some selected kola plantations. Soil pH in both states were slightly acidic with those of Cross River State being more acidic. Therefore, any activities that will further acidify the soil should be avoided. Total nitrogen was low in kola plantation soils evaluated in Edo state but adequate in kola plantations assessed in Cross River State. While soil available phosphorus, exchangeable calcium and magnesium contents were adequate in kola plantations evaluated in both states, exchangeable potassium content was grossly inadequate and would require potassium fertilizer application. The study is highly essential to recommending appropriate soil fertility management strategies that will enhance kola yield on sustainable basis in the study areas.

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CASHEW PROGRAMME

Experimental Title: Marketing of Raw Cashew Nuts for Income Generation among Farmers in Kogi Stateof Nigeria

Investigators: Agbongiarhuoyi, A. E., Orimogunje, O. A., Awodumila, D. J., Uwagboe., E. O., Lawal, J. O.and Ibiremo, O. S.

Introduction

Agricultural marketing is the performance of all the activities involved in the flow of agricultural products and services from the initial points of production until they reach the hands of the ultimate consumers. Poor trading systems of some crops and their products partly leads to the inherent inefficient agricultural commodity marketing in Nigeria. Cashew earned Nigeria N144.7 billion ($402 million) from the export of raw cashew nuts (RCNs) to Vietnam and other countries in 2017 and the country exported 220,000 tonnes of RCNs in 2017 (Adeniji, 2018). This is about 90 percent of its total production when compared with 160,000 tonnes exported in 2016. Nigeria produced between 200,000 to 240,000 MT of raw cashew nut annually while 20,000 MT are processed within the country (AgWeek, 2020). Nigeria is a major and growing player in the cashew industry with rising market share in global cashew production, with an annual average production increase of 5% (NEPC, 2018). The export value of cashew nuts supplements the income of about 50,000 farmers and an additional 55,000 people who are employed along the value chain (Adeigbe*et al,* 2015). Cashew nuts worth N5.26 billion were exported in Nigeria in the fourth quarter of 2020.

The marketing of RCNs involves several players and channels in the value chain. Major players consist of farmers, local buying agents, processors, exporters, sub sector associations, cooperative societies and other service providers. It starts from the sale of raw cashew nuts by gatherers and farmers to the local buying agents, retailers, wholesalers, processors and the exporters. Majority of raw cashew nuts are exported. There are around 11 Nigeria based exporters of raw cashew nuts. They buy nuts from licensed buyers and exporters, make arrangements with License Buying Agents (LBAs) in different locations before start of a new cashew season. Olam Nigeria Limited is the largest exporter of cashew from Nigeria that accounts for more than 30% of the total raw nuts exports. Century Exporters Ltd, Elephant Group, Colossus Investments and ITP Ltd are the other emerging raw cashew nuts exporters among others.

The marketing of raw cashew nuts is not well organized in Nigeria due to the activities of middle men and the liberalization policy of the commodity value chains. This results in market failure and price volatility. Market failure is a condition in which a market does not efficiently allocate resources to achieve the greatest possible consumer satisfaction. It manifests in four forms; public good, market control, externality and imperfect information (NSW Market failure guide, 2017). In Nigeria, foreigners' encroachment at the farm gates is posing serious limitations in the proper marketing of cashew nuts. Foreign buyers are mostly exporters which influences the local buyers to exploit the farmers. This has led to price chaos that destabilises the procurement system and improper post-harvest practices particularly drying of raw nuts.

Farmers are compelled to sell their nuts to buyers at reduced prices dictated by local traders. However, products of cashew tree (kernel and apple) are grossly under utilised for income generation, food and nutrition security. In Nigeria, farm gate price of traded nuts in 2021 lies between 380-450 Naira per kg (AfriCashewSplits, 2021). However, the aforementioned price range is a bit better than the situation two years back when cashew was sold at around N20,000 per 80kg bag which discouraged most cashew producers. This study was demand driven because of recent interaction with cashew farmers in Kogi State. The farmers complained of low pricing of raw cashew nuts, search for reliable buyers during harvesting. In the 4th edition of the World Cashew Convention and Exhibition held in Macau China 2018, it was reported by Adeniji that Nigerian farmers were among those paid low price for RCNs when compared with other major producing countries. If this trend and imbalance continues, farmers will shift attention from cashew production to other businesses and this will affect market supply. This scenario is likely to lead to drop in quality and destroy the overall value chain of cashew.

It is against this backdrop that the study was designed to address the factors affecting marketing of raw cashew in order to enhance income of farmers in their farming enterprise.

The specific objectives were to:

1. Describe the socio-economic characteristics of farmers in the study area.
2. Examine income generation trend of farmers from raw cashew nuts.
3. Investigate the factors affecting marketing of raw cashew nuts.

Statement of Hypothesis: H_O: There is no significant relationship between the activities of middle men buying raw cashew nuts and income realised from the sales of cashew nuts by farmers.

Material and Methods

Study Area: The study was conducted in Kogi State and it is well known for cashew production. Other farm produce grown include: cocoa, oil palm, maize, cassava, yam, melon and rice. Agriculture is the mainstay of the state with capital at Lokoja. The State is located on the intersecting point of longitude 70 49'N and latitude 60 44'E on the map of Nigeria. Kogi State Government (2021).

A multistage sampling technique was adopted. Kogi State was chosen because it is the highest cashew producing State in Nigeria. The next stage was to select three Local Government areas from the eastern zone of the state due to the high concentration of cashew production and marketing activities in these areas. A systematic random sampling was used to select 48 farmers from Dekina, 44 from Ofu and 40 from Ankpa Local Government areas based on a list of cashew production from the Kogi State branch of the National Cashew Farmers Association of Nigeria (NCAN). Farmers were selected from two villages each from the

LGAs. In all, 132 respondents were selected. Data were collected from the respondents with interview schedule and analysed using descriptive and inferential statistics.

Results and Discussion

Socio-economic characteristics of respondents

Table 1 reveals that greater percentage of the respondents (61.3%) were between the age categories of 31-50 years, while minority of the respondents (21.2%) were above 50 years of age. The mean age of respondents was 44 years. This age distribution implies that most respondents were still in their youthful age in producing cashew. It was discovered that 67.4% of the respondents were males with 32.6% female. Male farmers dominating cashew production is probably due to the nature of intense and time consuming activities. A large proportion of the respondents were married (95.5%). This is expected as majority of the respondents were adults. Thirty percent of the respondents had no formal education while 23.5% and 37.1% had primary and secondary education respectively with 10.6% of the respondents having tertiary education. This result is supported by Adebayo *et al*, (2020). They reported that age and educational qualification had influence on the marketing of raw cashew nuts among cashew farmers in Kwara State of Nigeria. A mean of about 18 years of farming experience was obtained. This shows that cashew farmers in the study area were experienced in the business. The mean household for the farmers was 9 persons with average farm size of 6.6 hectares. Household size provides cheap labour for agricultural activities.

Table 1: Socio-economic characteristics of respondents N=132

Variables	Frequency	Percentage	Mean
Age in Years			44.2
≤ 30	22	16.7	
31-40	40	30.3	
41-50	39	29.5	
51-60	17	12.9	
Above 61	14	10.6	
Sex			
Male	89	67.4	
Female	43	32.6	
Marital Status			
Single	4	3.0	
Married	126	95.5	
Widowed	2	1.5	
Educational Status			
No Formal Education	40	30.3	
Primary Education	31	23.5	
Secondary Education	49	37.1	
Tertiary Education	12	9.1	
Farming Experience in Years			17.5
< 10	35	26.5	
11-20	67	50.8	
21-30	28	21.2	
Above 31	2	1.50	
Household size			9.27
1-5	20	15.2	
6-10	74	56.1	
11-15	27	20.5	
Above 16	11	8.40	
Farm size(ha)			6.65
1-5	72	54.6	
6-10	32	24.2	
11-15	20		15.2

Source: Field survey, 2019

In Table 2, majority (61.3%) of the farmers sold bag of raw cashew nuts for N50,000-59,000, in 2017, 34.9% of farmers sold bag of cashew for N30,000-39,000 and majority (90.1%) sold bag of cashew below N20,000 in 2019. This is reflected in the mean of N13,607 which is also low for 2019. This suggests that there was a sharp drop in the prices of cashew in the study area in the years under consideration. This is low especially when compared with the cost of production coupled with rising inflation affecting goods and services. The implication of this result could be as a result of major factors identified in this study which was reflected in Table 4. It could also be related to cheap price paid for Nigerian RCNs at the international market. This attests to why Indians and Vietnamese buyers are always in the country during every cashew trade season. The finding was supported by Adeniji (2018) in the 4th edition of the World Cashew Convention and Exhibition held in Macau China.

Table 2: Money sold per bag of raw cashew nuts in 2017, 2018 and 2019

Price per 80kg bag of raw cashew nuts in Naira (₦)	2017		2018		2019	
	F	%	F	%	F	%
≤ 20,000	6	4.50	6	4.50	123	93.1
21,000-29,000	1	0.80	34	25.8	2	1.50
30,000-39,000	7	5.30	45	34.1	3	2.30
40,000-49,000	39	29.5	35	26.5	1	0.80
50,000-59,000	78	59.1	9	6.80	2	1.50
≥ 60,000	1	0.80	3	2.30	1	0.80
Mean price (₦)	45,780		37,984		13,607	

Source: Field survey, 2019 F= Frequency % Percentage

Factors affecting marketing of raw cashew nuts

The distribution of respondents according to factors determining marketing of raw cashew nuts is shown in table 3. The result revealed that majority of the respondents had mean values of 1.88, 1.80, 1.76, 1.74 and 1.66 which follows the respective order: fraud from local buyers, no organized market for selling cashew nuts, poor marketing information, lack of training on cashew nuts marketing and no value addition to raw nuts as major factors determining marketing of raw cashew nuts in Cross River State. The result suggests that the aforementioned variables impact marketing of raw cashew nuts in the study area. This result is supported by a market information system (MIS) expert with the African Cashew Alliance (ACA), Fitzpatrick, (2021). He reported that poor market information in cashew causes low farm gate prices which affect the income and livelihood of farmers.

Table 3: Factors affecting marketing of raw cashew nuts N=132

Factors	Major Factor		Minor Factor		Not a Factor		Mean
	F	%	F	%	F	%	
a. Fraud/insincerity from local buyers	120	90.9	8	6.10	4	3.00	1.88
b. Poor quality of raw cashew nuts	30	22.7	34	25.8	68	51.5	0.71
c. No value addition to raw cashew nuts	103	78.0	13	9.80	16	12.1	1.66
d. Lack of training on cashew nuts marketing	95	72.0	21	15.9	16	12.1	1.74
e. Poor marketing information	106	80.3	15	11.4	11	8.3	1.76
f. No organized market for selling cashew nuts	113	85.6	12	9.10	7	5.30	1.80
g. Poor farm road network to transport cashew nuts	68	51.5	34	25.8	30	22.7	1.35

Source: Field survey, 2019 F Frequency % Percentage

Activities of middlemen buying raw cashew nuts from farmers

The result of the activities of middlemen buying raw cashew nuts from farmers shows that buyers motivate farmers to sell raw cashew nuts to them coupled with insincerity and buying cashew nuts at lower prices (Table 4). The motivation is in form of providing inputs and loan advance which is a commitment for selling RCNs to the buyers during harvesting season. This system makes farmers to accept whatever price they are offered. This finding is in line with Premium Times (2021) who reported that middlemen decide the priced they are willing to buy cashew nuts from farmers. Also, Fitzpatrick (2021) added that buyerstake advantage of the uncoordinated system to exploit cashew farmers by offering them lesser prices for RCNs during purchase.

Table 4: Activities of middlemen buying raw cashew nuts from farmers

Activities of middlemen	Percentage
1. Insincerity of cashew buyers	92.4
2. Buyers motivating farmers to sell raw cashew nuts	98.5
3. Buyers pre-funding cashew farmers	48.5
4. Buying raw cashew nuts at lower prices	97.7

Source: Field survey, 2019

Correlation between activities of middlemen marketing raw cashew nuts and income realised by farmers

The result in table 5, shows that a significant relationship exists between the activities of middle men buying raw cashew nuts and income realized from sales of cashew nuts by farmers. This implies that the more the middlemen were insincere in buying cashew nuts from farmers, the lesser the income that will be realized by farmers. This finding is also similar to a study conducted by Adebayo et *al,* (2020). They reported that unstable price was a major challenge to cashew marketing in Nigeria. Also, Agbongiarhuoyi*et al,* (2020) reported that low prices offered to farmers could affect sustainability of cashew in Nigeria. In terms of household size which was also significant, means that the higher the household size, the more the income that will be used for labour to do cashew farm operations. However, the income realized by farmers in this study was low.

Table 5: Correlation between activities of middlemen marketing raw cashew nuts and income realised by farmers

Variables	r value	P value
Activities of middlemen buying cashew	-0.146	0.038**
Household size	0.188	0.009**

Source: Field survey, 2019

Conclusion and recommendation

It could be inferred from the study that most cashew farmers had primary and secondary education with small scale farm sizes. The major factors affecting raw cashew nuts marketing of farmers were fraud from cashew buyers, lack of organized market for selling raw cashew nuts, poor marketing information, and lack of training on cashew nuts marketing respectively. The role of the middlemen in the cashew marketing process is responsible for low pricing of RCNs which reduced the income accruable to farmers. It is therefore recommended that NCAN and the Federal Government should help monitor activities of middle men during marketing. They should be empowered by the two bodies to add value to RCNs in order to improve farmers' livelihood.

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Experimental Title: On –farm demonstration of CRIN Perfected (Cashew milk) toward sustainable livelihood.
Investigators: Yahaya L.E, Jayeola C.O, Ogunwolu S.O, Igbinadolor, R.O

Introduction
Nigeria is endowed with a lot of natural resources. Among these is cashew which is planted across the cashew ecological zone. The need to diversify is also of the Nigerian economy. Cashew is produced mainly for its kernel and embedded in it is cashew milk which can be harnessed to supplement the known conventional milks. Milk production from cashew is one of CRIN perfected technologies. Farmers need income to supplement what they get from cashew production and thus sustain self as they engage in cashew business. Milk production from cashew kernel can be one of such sources of income. This project seeks to train farmers on this perfected technology of CRIN.

Objectives
i.To train farmers on cashew milk production.
ii. To transfer cashew juice production technology to stakeholders
iii. Increase income generation for farmers
iv. Adding value to cashew

Methodology
Selected farmers from different locations in Ejigbo LG of Osun state were trained on cashew milk production according to the standard methods. Participatory method was used. This involved group participation whereby each farmer was given opportunity to participate in the milk production process.

Results
At the end of the training, 52 farmers from the different locations of the LG were trained. Each farmer can now demonstrate how to produce cashew milk starting from cashew raw nut. With the training, farmers anticipated increased level of income with the consequent improvement of their livelihood through additional income from the cottage production of cashew apple juice. The farmers showed appreciation for the training that was extended to them. They however stressed the need for further training on other areas of cashew processing especially where it will further add value to their crop. The need for processing machines for cashew was also mentioned and the team assured them of linking them up with fabricators of some of these machines.
Conclusion: The training was only carried out in one LG area of the state. There is need to visit other LGs where cashew is been grown for such training as this in the long run enhance the living standards of these stakeholders.

Experimental Title: Training of farmers on Good Agricultural Practices (GAP) in Cashew production in Ekiti and Anambra States
Investigators: Agbongiarhuoyi, A. E., Dr Ibiremo, O.S., Dr Agbeniyi, S.O., Dr Ogunwolu, S.O., Ogunlade M.O., Dr Yahaya, L.A., Dr Oluyole, K.A., Adeyemi, E.A., Iloyanomo C. I. Otuonye, A. H., Adeigbe, O.O., Olasupo, F.O., Nduka, B. A. and Lawal. J.O.

Introduction
Good Agricultural Practices (GAP) are a collection of principles and activities applied to on-farm production and post-production processes. These processes result in safe, healthy food, and non-food agriculture products, while taking into account economic, social and environmental sustainability according to FAO (2010). Good Agricultural Practices are globally accepted practices for farmers and other stakeholders in the cashew value chain for adoption. In cashew production, GAP training has contributed towards improving yield, income, quality and livelihood of farmers in producing areas in Nigeria. This is evident in the high demand for Nigerian cashew nuts in local and international market. The Cashew Department of Cocoa Research Institute of Nigeria CRIN has been playing a key role in training cashew farmers, processors, marketers, Agricultural Development Programme (ADP) Extension agents and other stakeholders in enhancing optimum production across the country. The training programme was declared opened by Dr. Ibiremo, Director in charge of Cashew and Kola Research Department. He represented the Executive Director of CRIN.

Objective
The objective of this training was to train farmers and other stakeholders on the best practices of producing cashew for increased yield, value addition, income, quality and create job opportunities in Ekiti and Anambra States.

Methodology
Cashew GAP training was carried out in Ekiti and Anambra States of Nigeria. The training was designed for cashew farmers, local processors, marketers and some staff of the Agricultural Development Programme (ADPs) in both States. These States were purposively selected for the training due to dominance in cashew production. Forty participants (male and female) were randomly selected across Ekiti State while fifty participants were selected in Anambra State with the assistance of the ADP Extension personnel and village contact farmers. Participants selected include cashew farmers, representatives of farmers' associations, processors, ADP Extension agents, processors, buyers and marketers. A total of 90 participants were chosen and participated in the training. The training was held in Ode-Ekiti, Ekiti State from 8-9th May, 2018 while the other

took place in Ojoto, Anambra State from 5-6th September, 2019. The whole training workshop was facilitated by the Extension arm of the Institute.

Mode of Training

Participants were trained with the aid of:

1. Power point presentations and discussion
2. Cashew training manual
3. Practical farm demonstration

Approach and activities during training

Participatory approach was adopted using Training of Trainers (TOT). Cashew farmers, processors and ADP staff were trained and they were expected to further train other farmers and stakeholders. A practical farm demonstration of soil requirements and management, insect pests and disease management, and post-harvest practices were shown to participants. A cashew training manual was developed by the Cashew Research Department with inputs from Subject Matter Specialists in different disciplines. The following modules from the training material were used for the training programme:

Table 1: Modules used for Cashew GAP Training

S/No	Modules	Subject Matter Specialists
1	Cashew soil requirements and fertilizer management for optimum productivity	Dr. Ibiremo, O. S. and Iloyanomon, C. I.
2	Nursery practices for sustainable cashew cultivation	Dr. Olasupo, F.O. and Dr. Adeigbe, O.O.
3	Sustainable cashew cultivation through Good Agronomic Practices	Adeyemi, E.A. and Dr. Nduka, B.A.
4	Disease management and cashew health strategy for safe crop and improve yield	Dr. Agbeniyi, S.O. and Dr. Adeniyi, D. O.
5	Management of cashew insect pest	Asogwa, E.U. and I.U. Mokwunye
6	Cashew post-harvest practices, processing, and value addition	Dr. Ogunwolu, S. O. and Dr. Yahaya, L. E.
7	Marketing and farm records for sustainable cashew value chain in Nigeria	Dr. Oluyole, K.A. and Dr. Lawal, J.O.
8	Role of farmers' organizations and extension methodologies in cashew production	Agbongiarhuoyi, A. E.

Benefits of the training

The training updated participants' knowledge and skills on good agricultural practices in cashew production in both States. Certificate of participation were issued to all participants. Participants commended CRIN for the free GAP training. Cashew training manual were given to the beneficiaries free of charge to guide them in their practices. A WhatsApp group was created for participants to improve information dissemination, feedback, facilitate demand driven research and solve participants' production problems.

Conclusion

The training was successfully carried out by the Cashew Research Department. The knowledge and skills of farmers and other stakeholders were enhanced. It is expected that the training will boost cashew production, increase income, value addition, quality and create job opportunities for producers and other members of the value chain involved in cashew business in Ekiti and Anambra States.

Experimental Title: Assessment of emerging production constraints encountered in cashew production in Kogi State, Nigeria.

Investigators: Awodumila., D.J., Orimogunje A.O., Ogunjobi., T.E and Oloyede A.A

Introduction

The Cashew plant Anacardium occidentale belongs to the family of Anacardiaceae is a native of central and South America with its main centre of variation in eastern Brazil. Its importance as an agricultural commodity lies in the values derivable from its fruit (nut) and apple. products from the whole fruit include the edible kernel, cashew nut shell liquid (C N S L) and the apple which can be consumed fresh as well as prepared into syrup, jams, jellies, beverages or candied fruits. (1) Cashew nut production trends have varied over the decades. Currently, 75 to 80% of cashew nuts produced in Nigeria are exported, as only very few companies are involved in local processing of the produce (2)

The annual world production of cashew nuts was about 3,186,039 tons and Nigeria was rated the second among the top ten producers with 660,000 tons making the sector a major contributor to Nigeria's non-oil GDP. Vietnam is the highest producer with 961,000 tons (3). The estimated export value varies from US$ 25- 35 million annually, and supplements the income of about 50,000 farmers and an additional 55,000 people who are employed down its value chain (4 ,5). Out of 2.6 million tonnes of raw cashew nuts produced in the world, 42% of it come from Africa out of which 90% is exported while only 10% is left for domestic consumption (6)

Nigerian nuts have consistently served the Indian and Vietnamese cashew factories and in recent years have added the Brazilian market. The kernels are well accepted in the United State of America and Western Europe because of the high quality of the produce (2) The constraints militating against cashew production are production constraints biotic, environmental, breeding, climatic and land; marketing constraints and processing constraints. Production constraints results from damages from different insect species at different stages of production. These result into high loss of yield. It attacks the leaf causing black leasion on petioles or the leaf surface. it also attacks the stem which appears as a discolored and lesion which also occurs on fruits and developing nuts. In situation of high infestation of these insect on a farm. It eats up the whole shoot and it dies or the entire tree looks burnt. This brings about great loss of income to farmers (7)

According to (8) Cashew grows almost everywhere in Nigeria with production spanning across 27 out of 36 States in all the geo-political zones. Irrespective of the predominance of this crop in many states, yield per hectare is not encouraging. There is abandonment and significant decline in yield of cashew production in most growing areas of Nigeria as a result of discovery of crude oil by federal government in early 1970s (9).

According to (10) The problems of cashew production include; old trees, deforestation, low yield varieties, dominance of small holdings and wild varieties, land acquisition, high cost of inputs, climatic conditions, diseases and pests, fire outbreaks, post-harvest losses, infrastructural constraints, poor qualities, market price of the product and the competition amongst the local buying agents. Apart from this, several authors had worked on the problems facing cashew production in Nigeria. for instance, (2) worked on constraints to cashew production in Nigeria. (8) considered factors associated with low yield of cashew among farmers in growing areas of Nigeria. Also, (11) investigated constraints in cashew production among cashew farmers in Southwestern Nigeria. While (12) considered constraints of farmers in cashew production, a case study of Orire L.G.A of Oyo state Nigeria.

In order to solve some of these cashew production constraints, Cocoa Research Institute of Nigeria (CRIN) with research mandate in cocoa, kola, cashew, coffee and tea has recommended some cashew production technologies that if farmers adhere strictly to it will reduce some of these production constraints. These are regular pruning, maintenance of recommended spacing (6m x 6m or 9m x9m), cashew rehabilitation techniques, replacement of death/ missing stands, prompt harvesting of ripe cashew apples, regular weeding and planting of improved varieties of cashew nuts and seedlings

The main objective of the study was to assess the constraints limiting cashew production among farmers in Kogi- State. The specific objectives were to describe socioeconomic characteristics of the respondents, ascertained some agronomic practices, identify constraints to cashew production, identify sources of input and determine attitudes of farmers towards cashew production constraints. The hypothesis of the study was stated in the null form; there is no significant relationship between socioeconomic characteristics of the respondents and the constraints to cashew production.

Materials and methods

A multi-stage sampling procedure was used to select respondents for the study. Stage1: Kogi State was randomly selected from North Central. Stage 2: two Local Government Areas (LGAs) noted for cashew production were chosen. These are Dekina and Ankpa. Two villages per LGA where cashew is well produced were selected. Stage 3: Fifteen farmers were selected in each village to make a total number of sixty respondents. A list of cashew farmers was obtained from the Tree Crop Units (TCU) in the State ministry of Agriculture. A structured interview schedule was used for field data collection from cashew farmers in the study areas. Descriptive statistics and chi-square were used in data analysis. The variables were measured at 0.05 Level of probability.

Results and Discussion

The socioeconomic characteristics of the respondents

The socioeconomic characteristics of the respondents are shown in Table 1. The result revealed that greater percent (70%) of the respondents are male while 30% were female. This result is in agreement with (12) who found out that 84.5% of cashew farmers in orire local government area of Oyo State are male. The result also shows the mean age of farmers as 48 years with 73.3% married. It indicates that farmers are still very energetic and they are still in their productive age. Also, the greater numbers of married farmers in the study areas was as a result of the tedious nature of cashew farming that cannot be done alone. The mean household size was 9.7 persons. The implication of this is that farmers with higher numbers of household size tends to enjoy cheap labour for farm enterprise. This is in agreement with (13) who explained that household labour help in solving labour related issues on farm. Eighty-two percent of the respondents had primary school leaving and above, it shows that greater percentage of the respondents can read and write, this may be as a result of influxes young school leaver into the profession. According to the table, 66.6% of the respondents cultivated above 5 hectares while the mean farm size is 11.1hectares. This result contradicts the result of (8) where only 47% of farmers had above 5 hectares

Constraints encountered in cashew production

Table 3 presents the various production constraints faced by cashew farmers and their corresponding degree of severity. Constraints such as no access to credit facility (76.7%), price fluctuation (70%), farmers-herders' clashes (66.7%) and sharp practices of middlemen (65.0%) were found to be major constraints faced by the respondents. Credit is very important in cashew production as farmers need money to purchased so many things like improved seedlings/nuts, agrochemicals, some farm equipment, paid wages to laborers. (14) explained that it is difficult for farmers to get loan from banks as a result of stringent and high interest rate demanded by commercial bank. In addition, transportation problem (73.3%), unavailability of labour (66.6%), irregular rainfall (55.0%) and prolonged draught (53.3%) were considered as minor constraints affecting cashew production in the study areas. This result is similar to the report of (11) who found out that farm activities, age of farm , inadequacy of labour, access to market information and inadequate credit are part of many challenges of cashew production in Nigeria In clear term, no access to credit facilities, price fluctuation, and farmers-herders' clashes ranked 1st, 2nd, and 3rd respectively as the most serious production constraints facing cashew production while transportation problem(13th), and irregular rainfall (14th) ranked least among production constraints in this study.

Sources of inputs

Table 4 shows that majority (95% and 78%) of the farmers got their cashew nuts and cashew seedlings respectively from research institutes (CRIN) while only 10% farmers got their cashew nuts from input dealers and 40% got cashew seedlings from family and friends. Eighty percent (80%) of the farmers got fertilizer from input dealers while 60% of farmers got it from farmers' cooperatives society. Majority (90%) of farmers got chemicals from input dealers while only 10% got same chemicals from cashew farmers association of Nigeria (CFAN). All the farmers got farm implements from friends and family. The major sources of loan to farmers is friends and relatives (88%), and farmers' cooperatives (64%) while only 9% farmers procure loan from agric bank. High interest rate and collateral security demanded by agric banks discouraged farmers from taken loan from the bank

Farmers attitudinal disposition to cashew production constraints

The results of farmers' attitudinal disposition to cashew production constraints is shown in table 5. According to the table, all the farmers (100%) agreed that credit facilities are not readily available to farmers; 78%, 63.3% and 80% also agreed that unstable government policies affect cashew production, farm labour is not cheap and affordable and farmer-herders' clashes are big challenges to cashew production respectively. However, 75%, 71.6%, and 86.6% disagreed with the statement that information on GAP are readily available, pest and diseases do not affect cashew production and it is cheap to transport cashew nuts

Farmers level of attitudinal disposition to cashew production constraints

Farmers attitudinal disposition was categorized into positive and negative (Table 5b). This was determined as the mean attitude scores was computed and used as the benchmark, such that respondents whose scores are below the mean attitude scores were categorized as negative attitudinal disposition, while scores equal to or greater than the mean score were categorized as having positive attitudinal disposition. The result shows that majority (58.3%) of the respondents had positive disposition to cashew production constraints while 41.7% had negative disposition

Hypothesis testing

Chi-square result of the relationship between respondents selected socioeconomic characteristics and constraints to cashew production as revealed in table 6. It shows a significant relationship occurred between educational level (X^2 =-11.622; P< 0.011), primary occupation (X^2= 7.360; P< 0.061) and constraints to cashew production. It implies that education inversely influences constraints faced by respondents. The implication of this is that the more educated farmers experienced lesser constraints as compared to those who are not educated. in other to solve emerging constraints faced by cashew farmers, education is very important. Also, the positive significant relationship between primary occupation and constraints indicates that respondents whose primary occupation is farming are more constraint in their farming activities compared with those who took farming as their secondary occupation. However, Marital status and Religion did not have any significant relationship with constrains to cashew production

Conclusion and Recommendations

The study concludes that cashew farmers are still in their productive age. Farmers frequently utilized most cashew agronomic practices. This study had revealed array of constraints facing cashew farmers which might affect cashew production in commercial purposes these include; lack of access to credit, price fluctuation, farmers-herders' clashes, sharp practices of middlemen, price fluctuation etc Based on the importance of cashew production and its products to Nigerian populace, it is therefore necessary to encourage cashew farmers so that production can be increased. Farmers need to be encouraged by making available for them credit facilities as most of them depend on personal savings and money gotten from family and friends to finance their farming operation. Inputs should be subsidized by government and made available to farmers in large quantity so that farmers can be motivated to continue and increase production

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Table 1: Distribution of respondents based on socioeconomic characteristics n=60

Variable	Frequency	Percentage	Mean	Std
Age(years)				
20-30	7	21.7	48.1	14.1
31-40	13	25.0		
41-50	15	18.3		
51-60	11	16.7		
Above 61	14	22.3		
Sex				
Male	42	70		
Female	18	30		
Marital Status				
Single	6	10.0		
Married	44	73.3		
Divorced	3	5.0		
Widowed	7	11.7		
Religion				
Christianity	28	46.7		
Islam	29	48.3		
Traditional worship	3	5.0		
House hold size (numbers)				
1-5	30	50.0		
6-10	19	31.7	9.7	
11-25	6	10.0		
Above 15	5	8.3		
Level of education				
No formal education	11	18.3		
Primary	14	23.3		
Secondary	18	30.3		
Tertiary	17	28.4		
Primary occupation				
Farming	25	46.7		
Business	11	18.3		
Civil servant	17	28.3		
Artisan	4	6.7		
Farm size(hectares)				
1-5	20	33.3	11.1	
6-10	27	45.0		
11-15	8	13.3		
Above 15	5	8.3		

Source: Field survey, 2019

Table 2: Percentage distribution of respondents based on constraints encounteredri cashew production

Constraints	Major	Constraint	Minor	constraint	Nota	Constraint		
	Freq	%	Freq	%	Freq	%	Mean	Rank
No access to credit	46	76.7	10	16.7	4	6.7	2.70	1st
Unavailability of labour	16	26.7	40	66.6	4	6.7	2.20	12th
Transportation problem	11	18.3	44	73.3	5	8.3	2.10	13th
Land tenure systems	27	45.0	30	50.0	3	5.0	2.41	7th
Prolonged drought	26	43.3	32	53.3	2	3.4	2.39	9th
Soil erosion	23	38.3	31	51.7	6	10.0	2.27	10th
Irregular rainfall	16	26.7	33	55.0	11	18.3	2.08	14th
Unstable govt.policy	21	35.0	31	51.7	8	13.3	2.26	11th
Theft	31	51.7	22	36.7	7	11.7	2.40	8th
Sharp practices of middlemen	39	65.0	14	23.3	7	11.7	2.59	4th
Price fluctuation	42	70.0	15	25.0	3	5.0	2.68	2nd
Pests and diseases	34	56.7	24	40.0	2	3.3	2.53	5th
Farmers-herders clashes	40	66.7	14	23.3	6	10.0	2.60	3rd
Inadequate information	37	61.7	14	23.3	9	15	2.49	6th

Source: Field survey, 2021

Table 3: Percentage distribution of respondents based on sources of input

			Inputs			
Sources	Fertilizer	Cashew nuts	Cashew seedlings	Chemicals	Loan	Farm implements
Research Institute(CRIN)	0.0	95.0	78	0.0	0.0	0.0
CFAN	0.0	0.0	0.0	20.0	0.0	0.0
Input dealers	80.0	10.0	0.0	90.0	0.0	25.0
Farmers cooperatives	60.0	0.0	0.0	0.0	64.0	10.0
Agric bank	0.0	0.0	0.0	0.0	9.0	0.0
Friends and family	0.0	0.0	40.0	0.0	88.0	100

Multiple responses
Source: Field survey, 2021

Table 4a: Farmers attitude towards constraints encountered in cashew production

Statement on attitudes	SA	A	U	D	UD
	F (%)	F (%)	F (%)	F (%)	F(%)
Credit facilities are not readily available	35 (58.3)	25(41.7)	Nill	Nill	Nill
Unstable govt. policies	9 (15.0)	38 (63.0)	3 (5.0)	8 (13.3)	2(3.3)
Farm labour is not cheap and affordable	14(23.3)	24(40.0)	16 (26.7)	3(5.0)	3(5.0)
Pilfering is a problem	12(20.0)	31 (51.7)	12 (20.0)	4(6.7)	1(1.7)
Farmers –herders clashes are big challenges	45(75.0)	3 (5.0)	10 (16.7)	1 (1.7)	1 (1.7)
Information on GAP is readily available	1 (1.7)	4(6.7)	10 16.7	15(25.0)	30(50.0)
Pests and diseases do not affect cashew	9(15.0)	6(10.0)	2 3.3	20(33.3)	23(38.3)
Middlemen make more gain than farmers	44(73.3)	5 (8.3)	1 1.7	5(8.3)	5(8.3)
Climate change is not a problem	21(35.0)	23 (38.3)	5 8.3	5(8.3)	6(10)
It is cheap to transport cashew	4(6.7)	4 (6.7)	Nill	26(43.3)	26(43.3)

Source: Field survey, 2021

Table 4b: Categorization of farmers' level of attitude towards constraints in cashew production

Categorization	Frequency	Percentage
Negative	35	58.3
Positive	25	41.7
Total	60	100

Source: Filed Survey 2021.

Minimum =10.00. Maximum =31.00. Mean =20.27. Standard Deviation =4.43. N =60

Table 5: Chi -square analyses between respondents' socioeconomic characteristics, attitude and constraints in cashew production

Variable	X^2	Df	r-value	p-value	Decision
Marital status	3.573	3	-	0.311	NS
Religion	1.195	2	-	0.550	NS
Education	-11.622	3	-	0.011	S
Primary occupation	7.360	3	-	0.061	S

Field Survey, 2019

COFFEE PROGRAMME

Experimental Title: Re-establishment of coffee germplasm at sub-station, Ibeku (Abia state)
Investigators: Odey C. F., Dada K. E., Adepoju, A. F., Baba Nitsa, M. and Okeniyi M. O.

Introduction

Coffee is an important foreign exchange earner, contributing in varying degrees to the national income of the producing countries. According to Osorio (2002), about 125 million people worldwide make their living from coffee. Also, about 33 million people in 25 African countries derived their livelihoods by growing coffee on their subsistence farms on about 4.5 million square kilometers of land (Surendra, 2002), coffee genetic resource conservation is paramount to sustainable coffee improvement and production. Coffee genotypes in Nigeria are conserved both in the higher institution and research institution. In Cocoa Research Institute of Nigeria (CRIN), coffee genotypes are conserved both at the headquarters and substations. Ibeku, in Abia State harbours one of the *Coffea canephora* genotypes assumed to be Togolese. There is need to improve this genotype as well as devising a proper conservation and maintenance of coffee conserved in Ibeku to avoid loss of this material.

Objectives

1. Assessment of the current status of the existing coffee germplasm at Ibeku through data collection
2. Initiating sustainable propagation and maintenance system

Materials and Methods

1. Assessment of the plot: The coffee germplasm at substation Ibeku in Abia State was assessed by virtual observation.
2. Maintenance of the plot: The plot was cleared manually
3. Multiplication of genotypes: The young shoot of conserved genotypes were obtained from the germplasm and multiplied through stem cutting procedured developed at Cocoa Research Institute of Nigeria and in vitro technique according to Anagbogu et al. (2018).

Results and discussion

The coffee germplasm at Ibeku was in a deplorable state presently with over grown coffee trees bearing little or no fruit. The plot was bushy (figure 1) and can be likely destroyed by fire outbreak especially during dry season.

Fig. 1: Ibeku coffee germplasm plot

2. Multiplication of coffee genotypes

The two multiplication techniques used were stem cutting (fig2aand b) and tissue culture (fig 2c and d) were effective in generating large number of plantlets for replacement of old coffee trees in the germplasm.

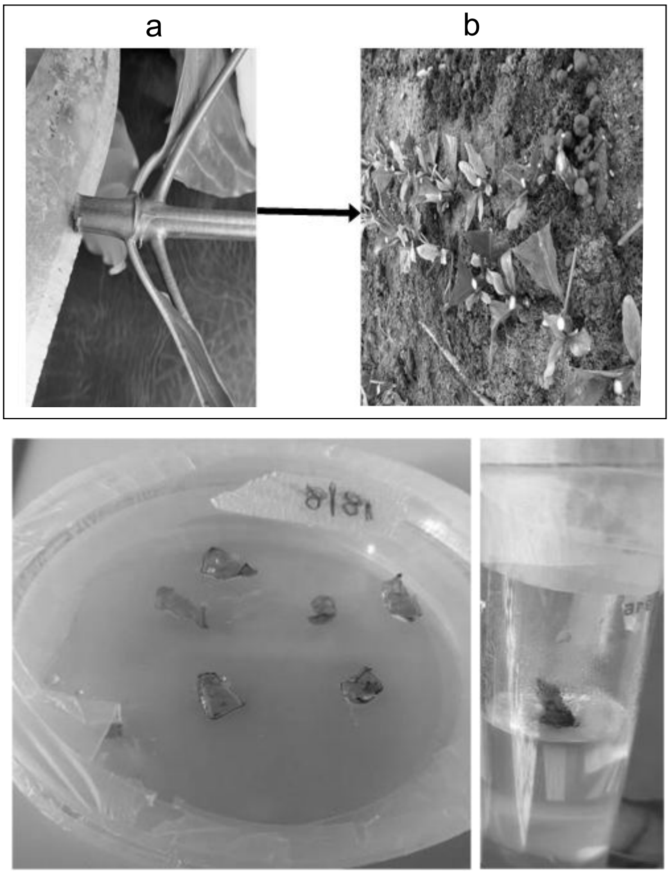

Fig. 2: Stem cutting and tissue culturing methods of coffee multiplication

Conclusion

Maintenance of the plot should be continuous to avoid eroding of the genetic materials in the germplasm and for the sustainable utilization of the genetic resources. The replacement of old and unproductive coffee tree should be recommended through the use of both multiplication techniques.

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Experimental Title: Determinants of Farmers' Adoption of Standard Practices in Coffee Production in Kogi State, Nigeria

Investigators: Abdul-karim, I. F. and Orisasona, T. M.

Introduction

Agriculture was the leading sector in the 1950s, 1960s and 1970s, it then accounted for 63 percent of the Gross Domestic Product (GDP, 1960-1964), and 54 percent in 1965-1969 (Williams, 2008). Cash crops such as coffee, cocoa, cashew, oil palm, gum Arabic, and rubber were major sources of employment and livelihood to farmers and the agricultural sector contributed to the nation's foreign exchange. In recent times, the Nigerian economy, in terms of revenue and foreign exchange, is undoubtedly dominated by the oil sector but agriculture holds the key to sustained development of the country with respect to provision of employment opportunities, as a source of income for rural families, food for the population and for the provision of raw materials for industry. Nigeria has a highly diversified agro-ecological condition which makes possible the production of a wide range of agricultural produce.

There are standard practices of coffee recommended by research institutes in order to meet up with international standard practices. According to Cocoa Research Institute of Nigeria (CRIN, 2004), Good Agricultural practices (GAPs) need to be adopted by the farmers in coffee production and need to be followed strictly, this will help the farmer in their production as well as livelihood.

There are two broad problems that have been identified in African agriculture which explain why yields are low. The first is lack of appropriate technology and the second is lack of adoption (Dether & Effenberger, 2013). In Nigeria for instance, the vast majority of producers, who are smallholder farmers, often rely on the traditional farming practices with consequential results of low output and income (Darwah & Verter, 2014). The institute had at various times developed relevant technologies and had also recommended improved practices especially in the area of Good Agricultural Practices (GAP) as well as processing of coffee. Meanwhile, coffee undergoes both primary and secondary processing before it is exported.

Thus, it is pertinent to determine farmers' adoption of standard practices on routine GAPs/ field practices that would improve the productivity and sustainability of existing coffee farms and plantation in Nigeria, hence this might ameliorating the coffee farmers' suffering.

Research Questions

Hence, this study sought to provide answers to the following questions:

- What are the standard practices of coffee production available to farmers' in the study area?
- What are the sources of information on coffee export standard practices in the study area?
- What is the respondents' knowledge level on coffee export standard practices?

Objectives of the study

The general objective of the study is to investigate the determinants of farmers' adoption of standard practices in coffee production in Kogi State, Nigeria. While the specific objectives were to:

- Identify standard practices of coffee production available to farmers in the study area;
- Examine the sources of information on the coffee export standard practices available in the study area;
- Determine farmers' knowledge level on coffee export standard practices in the study area;

Materials and Methods

The study was carried out in Yagba South East LGA of Kogi State of Nigeria. Kogi state is purposively selected for this study because the state is the highest producer of coffee in Nigeria (Akinpelu and Oluyole, 2020; Idrisu*et al.* 2012).

A multistage random sampling technique will be employed in the data collection. Yagba South East was purposively selected for the study because of their high production of Coffee among the LGAs in the State. Thereafter ten communities (Aginmi-Oke, Aiyegunde-Oke, Alu, Ejuku, Ife-Olukotun, Igbo-Ero, Igbagun, Oranre, Takete-Isao and Odo-Amu) were randomly selected from twenty two communities producing coffee in the LG Area of the study area. From each community ten respondents were randomly selected based on the lists of coffee farmers received from the Agricultural Development Programmee in the State for the study area making a total sum of one hundred participants or respondents for the study.

Results and Discussion

No results and discussion yet because the projects is ongoing. The administration of questionnaire and analysis of data for the result will be carried out in due courses when the next fund is release.

Recommendation

The study is essential for coffee farmers because it will broaden their experience more on post-harvest handling of coffee produce, educate them on current way of harvesting and processing of coffee for internationally accepted produce.

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Experimental Title: Genetic diversity assessment of thirty nine accessions of Robusta coffee using morphological markers

Investigators: Baba Nitsa, M., Idrisu, M. and Balogun, S. T.

Introduction

Variability in crop plants is vital for crop improvement and the production of improved varieties (Deslegn Alemayehu 2019). In crop plants, morphological markers have been used to assess variation. Plants with comparable physical characteristics showed that they are related. Based on physical characteristics, (plant height, branching pattern, leaf shape, internode length, stem girth among others) different plant species have been recognized. Variability in observable traits has been employed to choose coffee species for improvement programs (Gessese*et al*., 2015). Success during an improvement effort is largely determined by population diversity and the levels at which desired traits are heritable. As a result, morphological characteristics of cultivated coffee must be collected and evaluated for proper selection and future enhancement projects (Lemi*et al*., 2021).

Justification

Variability in Robusta coffee should be established prior to improvement initiatives and the creation of new varieties. The majority of robusta coffee landraces have not been examined for morphological variability with germplasm accession. The number of bearing branches, the proportion of bearing nodes, and the amount of berries per branch are all factors to consider while selecting coffee for high yield (Van der Vossen, 1958: Desalegn Alemayehu, 2017). As a result, the goals of this study were to estimate the extent of diversity that exists among robusta coffee using morphological attributes (growth parameters) in order to identify variations among cultivated robusta coffee.

Objectives

The objectives of this study were to:

1. investigate the variability presence among coffee accessions
2. identify accessions with desirable characters
3. classify coffee based on their relatedness

Materials and Methods

This study was carried using thirty-nine accessions of robusta coffee obtained from farmer's farm and coffee germplasm. Field establishment was done at CRIN

Ibadan and CRIN Owenasubstation and maintained from year 2018 to 2019. The experiment was laid out in lattice design with three blocks replicated three times. Data were collected on each accession from the three randomly tagged trees per plot. Seven quantitative characters were measured These were plant height (cm), stem diameter (cm) inter node length of main stem (cm), number of plagiotropic branches, leaf length (cm) and Leaf width (cm). Traits were measured using the standard coffee descriptor of IGPRI (1996). All quantitative data was subjected to analysis of variance using the SAS software version 9.3 (SAS, 2014).

Results

Results of growth characters in 2018 and 2019 at Ibadan are presented in Table 1. Significant effects on growth parameters were observed between the years 2018 and 2019. Plant height 422.93 cm, stem girth 176.75 cm, number of plagiotropic branches 222.67, number of leaves 231.76, internode length 184.23 cm, leaf length 208.62 cm and leaf width 59.25 cm, were all significant between years 2018 and 2019. Treatments showed similar trends with significant difference in growth characters across all the treatments. Plant height 80.77 cm, stem girth 0.14 cm, number of plagiotropic branches 63.25, number of leaves 81.30, internode length 5.46 cm, leaf length 37.29 cm and leaf width 11.13 cm were all significant between 2018 and 2019. However, treatment interacted with year did not show significant difference with regards to growth characters except on plant height, number of leaves, internode length and leaf length. Significant different was observed on growth parameters on years nested on replicate with exception of numbers of plagiotropic branches, internode length and leaf length. Year interacted with replicated nested on blocks had no significant effects on number of leaves and leaf width.

Growth characters in the years 2018 and 2019 at Owena are presented in Table 2. Significant differences were revealed in growth characters from the year 2018 and 2019 growth season. Plant height 3331.76 cm, stem girth 34.86 cm, number of plagiotropic branches 105.03, number of leaves 694.56, internode length 578.60 cm, leaf length 284.37 cm and leaf width 822.44 cm were all significant between the year 2018 and 2019. There were significant differences in growth characters across all the treatments as they developed from seedling stage to vegetative stage. Plant height 698.96 cm, stem girth 0.11 cm, number of plagiotropic branches 25.32, number of leaves 312.68, internode length 3.64 cm, leaf length 55.03 cm and leaf width 13.98 cm were all significant between the year 2018 and 2019. Year interacted with treatment showed significant effect on plant height, number of leaves, internode length and leaf length. Other parameters did not show significant effects with regards to year interacted with treatments. Year nested on replicate as well as year interacted with replicate nested on block indicated significant effects on growth characters except on leaf length and leaf width while year interacted with replicate nested on block had no significant effect only on leaf width.

Discussion

The significant difference observed between years 2018 to 2019 indicated relatively increase in growth characters and plant development along the year. Plant height ranged from 331.76 cm at Owena to 411.93 at Ibadan between the year 2018 and 2019. This implies the influence of environment on the growth characters of coffee plants. The observed wide range between values for each trait between the locations indicates the existence of considerable variation among the accessions (Lemi*et al.*, 2021). The significant differences observed on all the measured quantitative characters, across the accessions, showed the existence of variability among the accessions. Olika *et al.,* (2011) reported significant difference for 22 quantitative characters studied on 49 coffee accessions. Wide range of variability with regards to the growth characters have been reported on different coffee accessions (Deslegn Alemayehu, 2019: Baba Nitsa*et al.*, 2020)

Table 1: Analysis of variance (ANOVA) on growth characters at Ibadan in 2018 and 2019

Source	DF	PH	SG	NPB	NL	INL	LL	LW
Year	1	422.93**	176.75**	222.67**	231.76**	184.23**	208.62**	59.25**
Rep(Year)	4	390.80**	0.34**	38.76	91.47*	2.68	66.83	10.99**
Block(Year*Rep)	12	95.58**	0.20**	60.50**	47.86	3.76*	36.05*	5.95
Treat	38	80.77**	0.14**	63.25**	81.30**	5.46**	37.29**	11.13**
Year*Treat	38	59.21**	0.08	32.77	49.22**	3.94**	35.25**	6.04
Error	608	34.92	0.06	25.17	30.78	1.79	12.29	5.78
CV %		23.30	27.91	36.89	39.73	32.75	72.09	30.15
Total	701							

** Significant at 0.05 and 0.01 level of probability

Table 2: Analysis of variance (ANOVA) of plant characters at Owena in 2018 and 2019

Source	DF	PH	SG	NPB	NL	INL	LL	LW
Year	1	331.76**	34.86**	105.03**	694.56**	578.60**	284.37**	822.44**
Rep(Year)	4	445.06**	0.25**	339.84**	355.75**	5.45**	1.97	1.35
Block(Year*Rep)	12	689.82**	0.12**	60.33**	466.10**	4.68**	16.86*	5.26
Treat	38	698.96**	0.11**	25.32**	312.68**	3.54**	55.03**	13.98**
Year*Treat	38	176.47	0.04	19.71**	239.23**	2.54**	19.42**	2.58
Error	605	284.27	0.03	11.15	718.62	1.39	10.61	3.40
CV %		32.04	34.59	79.74	718.62	45.84	19.44	24.42
Total	698							

Field survey 2019 ** Significant at 0.05 and 0.01 level of probability

Conclusion and Recommendation

Based on the results it can be concluded that year and treatment had significant effects on the measured growth characters of coffee at seedling and vegetative stage. It therefore recommended that the measured growth characters should be used as criteria for selection of genotypes for improvement program.

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Experimental Title: Determinants of Coffee Production: The Case of Kogi State, Nigeria

Investigators: Lawal, J. O., Famuyiwa, B. S. and T.M. Orisasona

Introduction

Coffee is an important foreign exchange earner, contributing in varying degrees to the national income of the producing countries. It guarantees solid base for the promotion of economic development (Cambrony, 1992). One of the major factors that affected coffee farming was the disintegration of coffee commodity board in Nigeria which regulated coffee marketing as far back as 1986. The dissolution of the board restricted markets for coffee products and this resulted to profit loss which discouraged many farmers. Coffee like other agricultural products in Nigeria contributes a large percentage in income generation, employment and raw materials for the local industries. Like many of the Nigerian cash crops, the coffee sector had been neglected for years in favour of oil and this had discouraged so many of the farmers. This study is justified based on the fact that the knowledge of coffee productivity can motivate the farmers to produce more and remain in business of coffee.

Rationale

Coffee is a tropical plant, which comes in two main types: Robusta and Arabica in Nigeria. It is one of the most widely consumed beverages around the world with an estimated 3.5million cups consumed worldwide daily. As the world coffee output continues to increase, Nigeria's production continues to dwindle, and there had been fluctuations in global demand and prices in the last six year and irrespective of the rising demand for coffee globally, Nigerian farmers seem not to be tapping the potential as the produce has seen a significant dip in its production. Many farms have been abandoned and some coffee plantations replanted to other crops, but coffee demand continues to be on the rise. Despite the fact that states like Taraba, Plateau, Adamawa, Oyo, Osun, Ondo, Ogun, Lagos, Edo, Kwara, Kogi, Niger, Kaduna, Benue, Cross River and Akwa Ibom, are main coffee producers, it appears no farmer in Nigeria seems to be tapping the great potential. This study determined the factors that can boost production of coffee in Kogi state, Nigeria.

Objectives

1. To determine the socio-economic characteristics of coffee farmers and;
2. To determine the factors that can boost the production of coffee in the study area.

Materials and methods

Well-structured questionnaire was developed and administered to 80 coffee farmers in Kogi state; five villages were purposively selected from two different local government areas in the state using the multistage sampling technique. The first stage was the selection of two local government areas Kabba/bunu and Ijumu (LGAs) from the state and second stage, selection of coffee farming villages/communities from each of the LGAs and the third stage, the random selection of coffee farmers from the existing Agricultural development programme (ADP) list of coffee farmers. This selection was done proportionate to the size of the village population. The study employed the use of the descriptive analysis and multiple regression methods to achieve set objectives.

Results and discussion

The result showed that socio-economic characteristics and economic variables are determinants of production of coffee in the state; of all the coffee farmers interviewed, 67% of the farmers were male with 33% Kabba/bunu and Ijumufemale. The mean age of the coffee farmers was 60 ±5.96 years, mean household size of 8 ±2 persons; majority of the coffee farmers are smallholders with the average farm size of 1.5 ±0.8ha of farmland with over 30years of coffee farming experience. It was also recorded that more than sixty percent of the farmers have abandoned their coffee bushes and planted other crops while the remaining are just intercropping with coffee on their plots. All the coffee plots are old and moribund; the farmers are equally old with little or no motivation to remain in the coffee business. The result of the regression analysis shows that seven variables: age of farmer(x_1), age of coffee bush(x_2), availability of inputs(x_3), coffee farming experience(x_4), market access/channel(x_5), coffee price (x_6) and farm size (x_7) were significant at 1% level for the production of coffee in Kogi State, Nigeria.

Conclusions and perspectives

It was concluded that coffee production is viable in the area and that the production of coffee is dependent on age of farmer, age of plantation, availability of production inputs, farming experience, farm size, coffee price and the availability of accessible market. Based on findings, this study recommends that more women and youths be encouraged to take up coffee cultivation as business in the state, through more lands can be opened up for production and expansion. Also, based on the findings that poor marketing access and pricing contribute mainly to the abandonment of coffee farms which in turn has multiplier effects on the production of the crop; It is hence recommended that government should intervene in the crisis of the coffee sector by putting in place incentives for production in the state, price control system and create appropriate marketing channels which gives good access to market for the crop and encourage new entrants, help old stakeholders remain in business along the value chain.

Experimental Title: Assessment of farmers awarness and practices of wet coffee processing method in Kogi state

Investigators: Awodumila D J., Ipinmoroti R.R., Famuyiwa B.S., Abudl-karim I.F., Agbebaku EEO.

Introduction

Coffee farming originated from Africa (Ethiopia) before its spread to other countries of the world. (Williams, 2008). Coffee is a member of the family Rubiaceaea large family of over 5500 species widely distributed throughout the tropics Opeke (2005). The two most important species of cultivated coffees in Nigeria are Arabica coffee (highland coffee) and Robusta coffee (lowland coffee). In the international market, Arabica coffee is of the greatest economic importance but in Nigeria, Robusta coffee account for 94% while Arabica coffee accounts for only 4% of coffee export. The increasing use of Robusta coffee in the preparation of instant (soluble) coffee is making it to gain ground on Arabica coffee in the international market Williams,J A(1998). Over 80% of coffee from developing countries particularly Nigeria, is produced by small scale farmers who lack adequate technical education and are faced with low market price leading to poor management, poor productivity and abandon farms (Agbongiarhuoyi*et al 2006)*

Coffee is one of the most popular beverages in the world. Nearly 25million farmers in about 50 countries around the world depend on coffee for a significant part of their livelihood (Cague*et al 2009*). Coffee is ranked second in value only to oil as a source of foreign exchange in many of the major producing countries. Along its channel of production and marketing, various activities provide employment for hundreds of millions of people worldwide

The coffee cherry as it is harvested cannot be used. It has to be processed to obtain marketable green or clean coffee product. Essentially, two main post-harvest processes applied to coffee cherries are the dry process and the wet process, the dry process consists of drying the whole cherry then mechanically/physically removing the dried outer parts whereas wet method involves removing the beans from the cherry by squeezing them out (pulping) and the sticky mucilage on the beans is then broken down by fermentation, after which it can easily be washed off the beans with clean water before drying. It produces high quality coffee beans (Leloup, V *et al 2004*).

According to Raghu Nath Subedi (2010), coffee wet processing method produces clean parchment, good quality green bean, pleasant aroma, original/natural flavour, better taste, it is also less prone to fungal attack and it fetches higher price in international market. The disadvantages of dry processing method are; drying cherry takes longer time, there is high risk of secondary fermentation, it is prone to fungal attack, poor quality coffee, it is not suitable for export market and relatively cheaper in price. It is very important for farmers to be aware of the importance of coffee wet processing over dry processing and be encouraged to practice it. It is against this backdrop that this study was undertaken to analyze coffee farmers' awareness and practices of wet processing method

The specific objectives of the study are to:

1 describe the personal characteristics of coffee farmers in the study area

2 ascertain levels of awareness of wet processing method

3 describe levels of practice of wet processing method in the study area

4 identify constraints encountered by coffee farmers in the study area

The hypotheses of the study are stated in null form as given below:

Ho1 There is no significant relationship between respondents selected personal characteristics and level of practice of wet processing method

Ho2 There is no significant relationship between awareness and practices of wet processing method.

Materials and Methods

A multistage sampling procedure was used to select farmers for the study. The study was conducted in kogi State because it is the highest producer of coffee Robusta in Nigeria (CRIN). The second stage involves random selection of two (2) Local Government which are Kabba-Bunu and Ijumu as a result of their prominence in coffee production. Three (3) villages were purposively selected from each local government due to coffee production activities in large quantity making a total of six (6) villages. Fifteen (15) farmers were randomly selected in each village to make a total of sample size of ninety (90) respondents.

Data were collected with interview schedule. Level of awareness of wet processing methods were measured by asking farmers to indicate whether they were aware of the stated coffee wet processing methods/techniques with response option "yes" or otherwise "no". Furthermore, the percentages were shaped and categorized with low awareness or high awareness

The level of practice of wet processing was captured by using a 3 point Likert type rating scale namely Regularly=3, occasionally=2 and never=1.Thereafter, Grand mean was calculated, mean above grand mean represents high practices while mean scores that is less than or equal to grand mean implies low practices.

Descriptive statistics such as frequency counts, percentages and means were used to analyze the objectives while the hypotheses were tested with chi-square and Pearson product moment correlation (PPMC)

Results and Discussion

Personal characteristics of the respondents

Table 1 indicates that majority of the respondents (84.4%) were males while only 15.5% were females. This in line with a similar study carried out by Agbongiarhuoyi*et al 2011*) where majority of coffee farmers were found to be male and this suggests that male farmers are more involved in coffee production than female counterpart. It may also indicate that coffee farming practices require more strength. The table also revealed that most of the respondents (73.3%) were above 50 years of age with mean age of 59.6%. the age distribution implies that most of the respondents are no longer in their active age. It can be deduced from this finding that the percentage of youths in coffee production is low in the study areas. This might be because most youths have left for urban arears. A large proportion of the respondents were married (64.4%). This was so because marriage is highly cherished in the study area, apart from that, coffee production and processing is very tedious job that a single individual cannot cope with except with more hands. The mean household size for farmers is 9.2 persons. The implication of this is that farmers with large household size enjoy cheap labour for wet processing method. This is in consonance with Onuk, etal (2013), as they found household labour supporting farm power needs of farmers in Enugu State. Nigeria. More than half of the respondents (68.9%) had farm size of less than 3 hectares, 26.7% had farm size between 4-6 while only 4.4% had hectares of land of 7-9. The mean farm size was 3.06. The result of farm size disagrees with Agbongiarhuoyi et al (2011) who reported that 75.5% of coffee farmers cultivate one hectare and below.

Majority (71.1%) engaged primarily in farming as occupation, 13.3% are civil servant while 15. 6% of the respondents engaged in trading. This result is in agreement with the submission of (Oluwatayo*et al 2008*) that rural dwellers mostly engaged in farming as occupation.

Table 1: Distribution of respondents based on their personal characteristics

Variables	Frequency	Percentages	Mean
Gender			
Male	38	84.4	
Female	7	15.5	
Age			
30-39	8	8.9	
40-49	16	17.8	
50-59	12	13.3	
60-69	30	33.3	
70 & above	24	26.7	59.6
Educational Status			
No formal education	50	55.6	
Primary education	24	26.6	
Secondary education	8	8.9	
Tertiary education	8	8.9	
Marital Status			
Single	20	22.2	
Married	58	64.4	
Divorced	4	4.4	
Widowed	8	8.9	
Household Size			
1-5	20	22.2	
6-10	40	44.4	
11-15	18	20	
16 and above	12	13.3	9.2
Farm Size(HA)			
3 and below	62	68.9	
4-6	24	26.7	
7-9	4	4.4	
10 and above	Nil	Nil	3.06
Major Occupation			
Farming	64	71.1	
Civil Servant	12	13.3	
Trading	14	15.6	
Total	90	100	

Source; Field survey, 2020.

Awareness of coffee wet processing method.

From table 2 below ,91.1% of the respondents were aware of harvesting ripe coffee berry while 53.3% were aware of sorting out of harvested coffee berry. Whereas 53.3%, 66.7% and 62.1% were not aware of pulping, demulcilaging and washing of harvested coffee berry. Majority (93.3%) and (98.8%) were aware of drying and storage of harvested coffee berry. From these findings it shows that famers are more aware of the stages of coffee dry processing method than wet processing methods

Table 2: Percentage distribution of respondents based on levels of awareness of wet processing method

Level of awareness	Aware		Not aware	
	F	%	F	%
Harvesting of ripe berry	82	91.1	8	8.9
Sorting	48	53.3	42	46.7
Pulping	42	46.7	48	53.3
Demulcilaging	30	33.3	58	66.7
Washing	35	38.9	55	62.1
Drying	84	93.3	6	6.7
Sorting	50	55.6	40	44.4
Storage	89	98.8	01	1.1

Source; Field Survey ,2020.

Levels of awareness of wet processing method

From table3 below, 52.2 % of the respondents are aware of most of the stated coffee processing techniques while 47.8% were not aware of the stated coffee processing methods

Table 3: Categorisation of respondents' levels of awareness of coffee wet processing method

Categorization	Frequencies	Percentages
Low	43	47.8
High	47	52.2
Total	90	100

Source; Field Survey, 2020.

Practices of coffee wet processing method/technique

Table 4 represents the distribution of respondents according to the level of practice of each of the coffee processing methods. The result indicates that majority of the respondents (64.4%) regularly practice harvesting of ripe coffee berry with mean scores of 0.65. Also, majority (66.7 % ,71.1%, 91.1% and 68.9%) never practiced sorting, pulping, demucilaging and washing of coffee berry with mean scores of 0.48, 0.31, 0.11, and 0.45 respectively. More so, 64.4% and 66.7% of the respondents regularly practiced drying and storage of harvested/processed coffee berries with mean scores of 0.65 and 0.58 respectively. From the table, it was observed that harvesting of ripe berry, sorting, drying and storage all had high level of practices. The result indicates that the processing method carrying out by farmers in the study area is dry coffee processing which is in this order; Harvesting of ripe coffee berries, sorting of harvested coffee berries, drying of coffee berries and Storage of dried coffee berries. The core process of wet method which are pulping, demulcilaging and washing was not practiced, though there was high awareness of these processes but the practice was low. The result of this findings disagrees with the findings of Akinbile*, et al* (2014) that awareness of innovation gives high probability that it would be adopted

Table 4: Percentage distribution of respondents based on levels of practices of wet processing method

Level of Practice	Regularly		Occasionally		Never		Mean
	F	%	F	%	F	%	
Harvesting of ripe berry	29	64.4	14	31.1	2	4.4	0.65
Sorting	8	17.8	7	15.6	30	66.7	0.48
Pulping	3	6.6	10	22.2	32	71.1	0.31
Demulcilaging	1	2.2	3	6.7	41	91.1	0.11
Washing	2	4.4	12	26.6	31	68.9	0.45
Drying	29	64.4	14	31.1	2	4.4	0.65
Sorting	7	15.6	6	13.3	32	71.1	0.47
Storage	30	66.7	12	26.7	3	66.6	0.58

Grand mean =0.46

Source; Field survey, 2020.

Note: Any mean that is less than grand mean means low practices, while mean that is greater than or equal to grand mean means high practices

Distribution of respondents based on Sources of labour

The distribution showed on Table 5 bellow revealed that 28.9 percent of the respondents used family labour only, 53.3 percent used family and hired labour, while 6.7 percent and 11.1 percent used only hired labour and communal labour respectively. The result indicated that there are abundant sources of farm labour that will be of help for farm operation especially coffee processing.

Table 5: Percentage distribution of respondents based on Sources of labour

Source of Labour	Frequency	Percentages
Family members only	26	28.9
Family Members plus hired labour	48	53.3
Hired labour only	6	6.7
Communal labour	10	11.1

Source: Field Survey,2020

Constraints encountered in coffee processing

Table 6 shows the constraints faced by the farmers in order of severity. Low market price for processed coffee, lack of government support in form of loan and financial assistance, inadequate processing machine and inadequate labour were ranked 1st (mean=2.80), 2nd (mean=2.78), 3rd (mean=2.71), and 4th (mean=2.46) in order of their severity respectively. poor access to credit is a serious issue to farmers, this usually come as a result of high and stringent measures adopted in granting loan to farmers such as high interest rates, and high collateral demand etc. Since wet processing is labour and financial intensive, lack of access to fund may prevent the farmers from adopting wet processing method. Also, lack of technical expert, high cost of labour and poor drying due to high rainfall were ranked 5th (mean=2.30), 6th (mean=2.15), and 7th (mean=2.11) in order of their severity respectively.

Table 6: Percentage distribution of respondents based on constraints encountered in coffee processing

Constraints	Mean	Rank
Low market price for processed coffee	2.80	1st
Inadequate/lack of processing machine	2.71	3rd
Lack of technical expert	2.30	5th
Inadequate labour	2.46	4th
Poor storage facility	1.52	9th
High labour cost	2.15	6th
Poor drying due to high rainfall	2.11	7th
Lack of government support	2.78	2nd
Inadequate drying infrastructure	1.95	8th

Source: Field Survey,2020.

Test of hypotheses

Chi square test of relationship between respondents' personal characteristics and practices of coffee wet processing method

The result of test relationship between respondents selected personal characteristics and practices of coffee wet processing method are shown in table 7. It was discovered that no significant relationship existed between gender (x2 =1.243, p=0.277), marital status (x2=1.544, p=0.672), age (x2=0.384, p=0.693), and educational status (x=1.853, p=0.602) and practices of coffee wet processing method. This implies the variables above did not significantly determine practices of coffee wet processing method among respondents.

Table 7: Test of relationship between respondents' personal characteristics and practices of coffee wet processing method

Variables	X^2Value	Df	p-Value	Decision
Sex	1.243	1	0.277	Not significant
Marital status	1.544	3	0.672	Not significant
Age	0.384	1	0.693	Not significant
Educational status	1.853	3	0.602	Not significant

Source: Field survey, 2020

Significant at *0.05 level of probability

PPMC Test of relationship between awareness and practices of coffee wet processing method

Table 8 presents the result of test relationship between awareness and practices of coffee wet processing method. There was no significant relationship found between awareness of coffee wet processing method and practices of wet process method. This means that respondents having knowledge of coffee wet processing does not lead them to practice coffee wet processing method. This could be as a result of high cost of equipment for wet processing or the strenuous nature of the process. Famuyiwa et al (2013) claimed that knowledge does not equal to practice. This implies that apart from knowledge, some other variables have effect on the practice /adoption of a farming method.

Table 8: Test of relationship between awareness and practices of coffee wet processing method

Variables	r-value	P value	Decision
Awareness versus practices of coffee wet processing method	0.200	0.193	Not significant

Conclusion

The study concludes that most of the coffee farmers are no longer in their productive age. It was also discovered that the method of processing mostly practiced by coffee farmers was dry processing method which is very cheap and very easy to practice. There was high awareness of the stages involved in wet processing method but did not lead them to practice it The study had revealed array of challenges hindering farmers from practicing wet processing method, these constraints are listed in order of severity which are, low market price for processed coffee, lack of government support in terms of loan and financial grant, inadequate/lack of processing machine, inadequate labour, and lack of technical expert.

Recommendation

Efforts should be geared by government and relevant agencies toward encouraging coffee farmers to practice wet processing method because it produces good quality green coffee which attracts high premium in international market.

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Experimental Title: Efficiency of coffee marketing and farmers linkage in Nigeria

Investigators: Taiwo. O[1] Akinpelu A.O [1,] Ogunjobi T.E[2], Awodumila D.J [1] Ogunwolu Q .[1].Adesida F.A[1]

Introduction

Coffee is rated second in trade volume in the world after oil nevertheless; records have shown that the Productivity level and income in the Nigeria coffee farm household have been too low over the years.

Coffee growing and drinking started in Ethiopia in the 9th century. Today, it is an important commodity and a popular beverage in the world. Over 2.25 billion cups of coffee are consumed in the world every day (Ponte Stefano, 2002). Over 90% of coffee production takes place in developing countries, while consumption happens mainly in the industrialized economies. Worldwide, about 25 million small producers rely on coffee for a living.

In spite of coffee demand globally and known to be second to oil in world trade volume and despite over 110 varietal coffee plants available in the Mambila plateau, Nigeria coffee production has been on decline over the years as compared with her counterpart producing countries whose output has been on the increase (Lewin, B. D. Giovannucci, and P. Varangis. 2004). Statistics also shows that coffee contribution to Nigeria Agriculture has been on decline ICO (2015). The study carried out on West and Central Africa coffee production shows that while Cameroon and Côte d'Ivoire produce 48,240 tons from 175,000ha of land and 171,000 tons from 480,000ha respectively, Nigeria records 5,400tonnes from a 3,750ha. A critical factor in the rather low and declining coffee productivity in Nigeria is a serious lack of market demand for Nigeria coffee, which is a critical factor in the stimulation of coffee production in Nigeria. Furthermore, the coffee marketing in Nigeria has been found to be inefficient due to small buyers of coffee who influence coffee price at the detriment of the farmers, also lack of adequate financing, imperfect market information, low quality coffee/ quality differentiation among others are the determinant factors affecting the efficiency of coffee marketing in Nigeria(Ayoola J. B. 2012).

Nestlé Nigeria dominates coffee sales in Nigeria. The company's Nescafé is popular among coffee consumers in Nigeria because it was the first coffee brand in the country and has built up strong brand loyalty. These attributes gave the company a dominant 84% share of off-trade volume sales in 2011(Euromonitor international, 2012). As such there is the need to collaborate with the company and with government intervention through CRIN to form a good link between the processors and manufacturers and farmers so as to make the coffee market more efficient and thus making coffee production more desirable.

Nigeria is blessed with the natural and human resources to produce coffee. Low market demand for coffee is believed to have led to the abandonment of coffee plantation in Nigeria. It is the lack of understanding of the efficient market for coffee produced in Nigeria that necessitates this study.

Against the above background therefore, the study seeks to:

1. Ascertain the various factors that are affecting the efficiency of coffee marketing in Nigeria, with the bid to increasing coffee output and enhancing the livelihood of the farmers
2. Determine the socioeconomic characteristics of the coffee farmers in the study area
3. To make policy recommendations that will enhance coffee demand in Nigeria and put the country on top as one of the coffee producing nation, particularly that there exist a great potential in natural and human resources for achieving such fit.

Material and Methods

Kogi State was purposively chosen for the study. The study is targeted at coffee producers in the chosen State. In carrying out the study, primary data was used in collecting relevant data through questionnaire administration and focus group discussion. Two local governments (kabba and Ijumu) were purposively sampled in the state. Thirty coffee producers were randomly sampled in each of the local government to make a total of sixty respondents. The data collected were analyzed using both descriptive and quantitative method of analysis

Data Analysis

Descriptive Statistics (mean, standard deviation and simple frequency tables) was used in the analyses of the socio-economic variable and agronomic practices while partial correlation analysis was used to ascertain the factors that affects the market efficiency of coffee marketing in the study area.

Discussion

Table 1 shows the socioeconomics characteristics of the coffee farmers in the study area. Result analyzed shows that majorities (90.2%) of the respondents are male farmers and most of them (31.1%) only acquire adult education showing that most of the respondents do not have formal education therefore may not readily adopt new innovation on improving coffee production. Of the total respondents, 73.8% constituting the majority farms both cash and arable crops. This has to a very large extent help in improving the livelihood and food security of the farmers. The result further shows that most (61.3%) of the coffee farmers have between 21-30ha of coffee farms. However, most of the plots are not optimally utilized for coffee production mainly due to low coffee demand. Majority are primarily farmers with an average age of 69 years of age and with majority (54.1%) having farming experience of above 50 years. This shows that most of the farmers are aged and well above productive age hence low coffee productivity for coffee in the study area.

These findings corroborate with Ayoola J. B, 2012, that the majority of the coffee farmers (about 53 percent) were above the age of 50 years and about 72 percent had been involved in coffee production for at least 15 years and none of the farmers had any formal training in coffee production. This equally indicate the reason for the low outputs of which majority produce between 1-5bags of 80kg jute bags between the 2016-2018 cropping season.

Most (29.5%) of the farmers source their coffee seedlings from the agricultural development project (ADPs) hence the agency is much closer to the farmers as compared to other agencies such as IITA, CRIN etc.

Further analysis indicates that most (43.2%) of the farmers are faced with the problem of low demand for their coffee while (38.3%) attest to the fact that low/poor price of coffee was a major reason for low production. Farmers therefore were not motivated to produce coffee due to low demands for farmers coffee and which is as a result of poor quality of processed coffee (most of the farmers practiced dry coffee processing of which wet processing is highly desirable) this also adduced to the fact that majority could not sell their coffee produce.

Furthermore, the result on table 2 shows the descriptive statistic of the farmers. The table shows that the farmer receives between an average of sixty-four naira and ninety five naira on a kilogram of coffee between the 2016-2019 seasons. This is far low compared to the international coffee price and could therefore not compensate for farmers expenses in the coffee production and processing.

Table 3 shows the correlation analysis carried out to show that the amount coffee farmers receives has significant effect on the distance to market at 1% level of significance implying that the farmers really go to market due to far distance (3-5km) and perhaps old age.

(Average of 69 years) hence there are chances that the farmers receives low price for the coffee hence showing in efficiency in the marketing of coffee. Furthermore, the correlation between who buys coffee and the amount offered is significant at 10% while the perceived reasonable amount by farmers and the farmer's age is significant at 1% indicating a very strong variable affecting the efficiency of coffee marketing. Thus the marketing of coffee is not as efficient as expected due to the critical factors affecting the farmer's price for coffee, unorganized market, age of farmers etc.

Conclusion and Recommendation

The study carried out shows that the coffee farmers has no organized and efficient market for their coffee and this has affected the price /amount the farmer receives for coffee per kilogram and thus by extension low coffee production. It is therefore recommended that government /agencies should help in the organization of good market for the farmers, encourage youths to go into coffee since there is high demand globally as well as provide extension training for the farmers furthermore, price sensitization is highly recommended for the farmers through there cooperatives and extension agents.

Table 1: The Socio-Economic Characteristics of the Coffee Farmers.

Socio Economic Characteristics Variable	Numerical Values	Percentage
Gender		
Male	55	90.2
Female	6	9.8
Total	60	100
Educational level		
Primary education	16	27.8
Secondary education	14	23.0
Tertiary education	11	18.0
Adult education	19	31.1
Total	60	100
Primary occupation		
Farming	45	73.8
Artisan	8	14.7
Civil Servant	7	11.5
Total	60	100
Farm size		
1-10ha		8.2
11-20Ha	45	6.6
21-30ha	38	61.3
31-40ha	12	19.7
Above 40ha	2	3.3
Total	60	100
Age of farm		
1-5 years	12	19.7
5-10 years	17	27.9
10-15 years	18	29.5
15-20 years	3	4.9
20-25 years	11	18.0
Total	60	100
Farming experience		
1-10 years	5	8.2
11-20 years	4	6.6
21-30 years	5	8.2
31-40 years	8	13.1
41-50 years	6	9.8
Above 50 years	33	54.1
Total	60	100
Source of coffee materials planted		
CRIN	12	19.6
IITA	11	18.0
ADP	18	29.5
Fellow Farmers	10	16.4
Chemical Market Sellers	10	16.4
Total	60	100
Problems farmers are facing		
Low Coffee Products/Materials	6	9.8
Lack of Credit Facilities	13	21.3
Low Market Demand	27	43.2
Lack Of Modern Processing Equipment	9	14.8
Others	5	8.2
Total	60	98.4
What responsible for low coffee sales		
Government policy	16	26.6
Low Coffee Price	23	38.3
No Enough Buyers	16	26.6
Rejection Due To Poor Quality	5	8.3
Total	60	100
Average Quantity of coffee produced		
1-5 bags	35	57.4
5-10 bags	11	18.0
10-15 bags	13	21.3
15-20 bags	1	1.6
Total	60	98.4
System	1	1.6
Total	61	100.0

Table 2: Descriptive Statistics of farmers

	Mean	Std. Deviation
Price per kilo 2016	67.1667	90.44320
Price per kilo 2017	87.5000	136.11592
Price per kilo2018	94.6667	110.90486
Age	68.7000	14.13530

Table 3: variables affecting marketing efficiency of coffee farmers

		age	gender	buyers	Perceived reasonable price	Price/kilo 2018	Distance from market	Edu cational level	Size of farm
Age	Correlation	1.000	-.384	-.055	.393	-.094	.235	-.113	-.035
	Significance (1-tailed)	.	.001	.339	.001	.240	.036	.197	.395
	df	0	57	57	57	57	57	57	57
Gender	Correlation	-.384	1.000	-.042	-.322	-.037	-.207	-.330	-.258
	Significance (1-tailed)	.001	.	.376	.006	.389	.058	.005	.024
	df	57	0	57	57	57	57	57	57
Buyers	Correlation	-.055	-.042	1.000	.086	.188	-.188	.152	.002
	Significance (1-tailed)	.339	.376	.	.258	.077	.077	.125	.495
	df	57	57	0	57	57	57	57	57
Perceived reasonable price	Correlation	.393	-.322	.086	1.000	.159	.088	-.003	.051
	Significance (1-tailed)	.001	.006	.258	.	.114	.254	.491	.351
	df	57	57	57	0	57	57	57	57
Price/kilo 2018	Correlation	-.094	-.037	.188	.159	1.000	-.377	.066	-.207
	Significance (1-tailed)	.240	.389	.077	.114	.	.002	.309	.057
	df	57	57	57	57	0	57	57	57

Distance from market	Correlation	.235	-.207	-.188	.088	-.377	1.000	-.092	.157
	Significance (1-tailed)	.036	.058	.077	.254	.002	.	.245	.117
	df	57	57	57	57	57	0	57	57
Educational level	Correlation	-.113	-.330	.152	-.003	.066	-.092	1.000	.104
	Significance (1-tailed)	.197	.005	.125	.491	.309	.245	.	.217
	df	57	57	57	57	57	57	0	57
Size of farm	Correlation	-.035	-.258	.002	.051	-.207	.157	.104	1.000
	Significance (1-tailed)	.395	.024	.495	.351	.057	.117	.217	.
	df	57	57	57	57	57	57	57	0

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Experimental Title: Gender Differentials among Coffee Producing Households in North Central Nigeria
Investigators: Akinpelu, A.O., Oluyole, K.A , and Orisasona*,* T.M..

Introduction

Coffee is one of the most important Third World export commodities, and 70 percent of coffee producers are small-scale farmers (Milford, 2004). The coffee plant originated in Ethiopia. However, coffee-drinking habits had spread to Europe by the 17^{th} century. The coffee tree can be grown only in warm areas without frost or sudden temperature shifts, and it also needs plenty of rain. This explains why it is a common export commodity for countries in tropical areas, and an unsuitable one for the rest of the world. Commercially grown varieties are *Coffee Arabica* and *Coffee Robusta*. Meanwhile, *C. Arabica* has a mild taste, it is more fragile, and its best growing conditions are found in warm zones or in the highlands of tropical zones. Contrastingly, *C. Robusta* is more resistant and can be grown between sea level and 800 metres above sea level

The role of gender in agriculture cannot be overemphasized. The pervasiveness of gender stratification in the distribution of production resources, information and even access to appropriate technologies is an issue of great importance (Simonyan, *et al*., 2011). In virtually all societies, men and women differ in their undertakings, vis-à-vis right to use as well as control over resources needed in participating in decision making (Abidogun*et al.,* 2019). Men are generally presumed to be the chief actors in farming (Mohammed and Abdulquadri, 2012). Nevertheless, FAO (2008) reported that women make up over half of the agriculture labour force yet they are frequently subjected to discrimination, poverty and hunger. Similarly, Hjorts (2005) reported that compared to men, women especially those from small and marginal farming families perform over 60 percent of on-farm activities in sub-Saharan Africa and comprise a major driving force in the economic and social fabric of rural South Africa with major responsibilities in agricultural and non-agricultural business enterprises. However, the ability of women to obtain agricultural inputs is directly constrained by gender discrimination (Hughes, 2005).

In spite of several efforts made at realizing gender equality and women empowerment in Nigeria, gender gaps continue terribly undesirable and frightening. This has gone a long way to influence women participation in all agricultural production as they are not given equal opportunities like their male gender. Thus, this study intends to identify gender differentials among coffee producers in North central Nigeria. The dearth of information on actual gender responsibility and efficiency in coffee production is a big challenge to meaningful agricultural and coffee development planning in Nigeria. There is therefore the need to plan holistic agricultural programme in coffee production that will address the problems of gender differentials to enhance food sufficiency.

Objectives

The broad objective of the study is to identify gender differentials in technical efficiency among coffee producing households in North Central Nigeria. The specific objectives are to

1. profile the socio-economic characteristics of coffee farmers in the study area
2. identify areas of gender involvement in cofffee production in the study area
3. determine factors influencing gender involvement in coffee production

Methodology

The study employed multistage random sampling technique to select coffee farming households. The first stage was a purposive selection of Kogi State, Nigeria. The area is particularly known for high coffee production as more than 90 percent of the coffee produced in Nigeria is believed to come from the state. The second stage involved a purposive selection of three towns within Ijumu Local Government Area. These are Iyamoye, Kabba and Ilogun-bunu. These areas are known for the cultivation, production and marketing of this crop. Thirty farmers were randomly selected from each of the towns. A total sampling frame of ninety respondents was used for the study. Meanwhile, the study categorized gender into boys, girls, men women, man and woman boy and girl. Data were collected on some socio economic characteristics of the respondents such as age, gender, marital status, educational level, household size, farm size, farm age and farming experience, respectively. In addition, nursery establishment, farm clearing, transplanting, weeding, pruning, harvesting, sorting, drying, packaging and marketing were operations assessed by the study. Data was analyzed using descriptive statistics (frequency and percentages), and multiple regression analysis.

Results and Discussion

Table 1 below shows the summary statistics of socio-economic characteristics of coffee farmers in Kogi State, Nigeria. The table reveals that the mean age of the farmers is about 53 years. The implication of this is that coffee farmers in the study area are ageing and are at the peak of productive years and this perhaps may be responsible for the average farm size of about 4 hectares put into cultivation of the crop by farmers. Similarly, the table reveals that the maximum educational level of the farmers was tertiary education. However, a mean educational level of about 2 years shows that majority of the farmers had no formal education. The implication of this is that the farmers may perhaps not have enough and adequate access to information on improved production packages of the crop. This assertion corroborates the findings of Agbongiarhuoyi*et al* (2013). Furthermore, the table reveals an average household size of 8 persons. This implies that the farmers may perhaps utilize members of the household as labour for some operations relating to cultivation of the crop. This may reduce some transaction costs that may be incurred on the crop.

Furthermore, it was shown that the average age of the coffee farms was about 31 years. This implies that the farms are old and thus the farmers may be experiencing diminishing returns in productivity. Moreover, the table revealed an average farming experience of about 22 years. This is in tandem with Agbongiarhuoyi*et al* (2013) who reported that about 41.2 percent of coffee farmers in Kogi State had between 21-31 years farming experience.

Table 2 below shows the percentage distribution of gender according to operations among coffee farmers in Kogi State, Nigeria. The table reveals that nursery establishment, weeding and transplanting were activities carried out by men. They had 51.1 percent, 36.7 percent and 30.0 percent, respectively. This implies that these operations on coffee farms are majorly performed by men. This perhaps may be because these are operations in coffee farms that require more energy and commitment which can only be adequately achieved by men. Similarly, the table reveals that pruning (64.4%) and clearing (41.4%) were farm operations majorly carried out by boys (young adult males) in the study area. The implication of this is that these operations can be carried out with little supervision from older men. Moreover, harvesting, drying and marketing were coffee operations jointly carried out by about 85.6 percent, 84.4 percent and 46.7 percent, respectively of men and women in the study area. This may perhaps be because these harvest and post harvest operations in coffee production need more attention and patience due to the need to get neat and coffee quality that will meet the demand of the final consumers hence, the participation of adult of both genders.

Table 3 below shows the factors influencing gender involvement in coffee production in Kogi State, Nigeria. The table reveals that marital status though with positive coefficient was significant at 5% level of probability. The implication of this is that being married has a positive relationship with coffee production. This perhaps may explain the reason for the involvement of both gender in harvesting, drying and marketing probably because of the need for joint decisions in carrying out these operations. In addition, the table reveals that farm ownership was also significant at 5% level of probability with positive coefficient. This implies that farm ownership has a positive relationship to gender involvement in the production of coffee in the study area. This is because farm ownership may perhaps encourage coffee production as it is expected that farmers will be willing to invest on the land they own. Furthermore, the results show that age of coffee farm is negative and highly significant at 1% level of probability. This implies that age of coffee farm has an inverse relationship to gender involvement. This perhaps may be due to perceived reduction in productivity of the crop due to age thus leading to lack of interests among the farmers in the study area. Moreover, farm experience was positive and highly significant at 1%

level of probability. This is expected based on a priori expectation that the higher the farm experience the higher will be the interest of a farmer in the production of a particular crop. Hence, farm experience in coffee production may encourage gender involvement in coffee production as this will have exposed the farmers to a lot of opportunities in the production of the crop in the study

Table 1: Summary statistics of socio-economic characteristics of coffee farmers in Kogi State, Nigeria

Variables	Mean	Standard Deviation	Minimum	Maximum
Age	53.32	12.04	27	75
Educational Level	2.02	1.26	0	4
Household Size	7.80	3.37	3	15
Farm Size	3.78	1.78	1	8
Age of Farm	30.73	11.67	10	56
Farming Experience	22.31	8.77	10	46

Source: Field Survey, 2019 Number of Observation: 90

Table 2: Percentage Distribution of gender according to operations among coffee farmers in Kogi State, Nigeria

Operations	Boys	Men	Girls	Women	Men and Women	Boy and Girl	Total
Nursery Establishment	15.5	51.1	0.0	0.0	7.8	25.6	100.0
Clearing	41.1	22.2	0.0	0.0	36.7	0.0	100.0
Transplanting	0.0	30.0	25.6	10.0	5.5	28.9	100.0
Weeding	32.2	36.7	14.4	0.0	16.7	0.0	100.0
Pruning	64.4	32.2	0.0	0.0	0.0	3.3	100.0
Harvesting	0.0	0.0	14.4	0.0	85.6	0.0	100.0
Sorting	0.0	0.0	15.6	43.3	41.4	0.0	100.0
Drying	0.0	0.0	15.6	0.0	84.4	0.0	100.0
Packaging	14.4	12.2	14.4	26.7	16.7	15.6	100.0
Marketing	14.4	0.0	0.0	38.9	46.7	0.0	100.0

Source: Field Survey, 2021

Table 3: Factors influencing gender involvement in coffee production in Kogi State, Nigeria

Variable	Coefficient	Std. Error	t-Value
Age of Farmer	0.002	0.004	0.63
Marital Status	-0.154	0.074	-2.08**
Household Size	-0.009	0.015	-0.67
Farm Ownership	0.025	0.101	0.24**
Age of Coffee Farm	-0.001	0.004	-1.15***
Farm Experience	0.013	0.005	2.41***
R^2	0.6065		
Adjusted R^2	0.3489		
Number of Observation	90		

Source: Field Survey, 2019 ***,**,*, Significant at 1%, 5% and 10% level of Probability

Conclusion and Recommendations

The study assessed gender differentials among coffee producing households in Kogi State, Nigeria. The mean age of the farmers is an indication that coffee farmers in the study area are ageing. Hence, it is recommended that efforts should be made to stimulate the interests of young adults by providing incentives that would encourage their involvement in the production of coffee. Moreover, harvesting, drying and marketing were coffee operations jointly carried out by men and women in the study area. It is thus recommended that these operations should be made less laborious so as to encourage young adults to participate. This could be done by the provision of farm gate postharvest technologies that are affordable and accessible to the farmers. Similarly, the farmers could be trained on cost effective ways of carrying out these operations to improve efficiency in the production of coffee in the study area. Furthermore, the farmers should be provided with improved and early maturing coffee varieties to replace old and less productive coffee plants in their farms. This will increase the productivity of the crop on the farmers' farms.

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TEA PROGRAMME

Experimental Title: Good Agricultural Practices for Tea in Nigeria

Investigators: Yahaya, A. T, Ipinmoroti, R.R, Adedeji, A.R, Oluyole K.A, Famuyiwa, B.S, Olaniyi O. Adeosun, S; Mokwunye, I.D and Obatolu, B.O; Agbebaku, E.O, Oluyole K.A.

Introduction

Tea farming in Nigeria has lost its share potential owing to problems in Production, processing and marketing. The cultivation and processing of tea in Mambilla plateau is characterized by: crude cultivation methods, lack of technological know-how, poor agronomic practices, smallholder farmers, illiteracy of farmers, there are problems with poor quality tea leaves, low productivity, poor access to wider market, low pricing, and poor farmer income.

There are poor linkages among the stakeholders and the value chain is underdeveloped. There are tea packaging companies which import their raw materials from other tea suppliers around the world while tea leaves are wasting in Mambilla plateau. Private sector has insufficient quality tea leaves, leading to inability to meet local market demands and importation of tea leaves.

The project aims to improve the productivity and profitability of tea through upgrade of tea value chain in Taraba State, Nigeria. The study is to be implemented in phases; the first phase concentrate on problem with production while the second phase will address problem with processing along with M&E of GAP training on production and the last phase considers the problem with marketing.

Objective

The goal of the project is to improve the agricultural practices of tea farmers to enhance tea yield and competitiveness.

Methodology

Invitation was made to all tea stakeholders across the country. A stakeholder's meeting was carried out on how to move tea sector forward in Nigeria. A training on ethical practices in tea production- Good Agricultural Practices (GAP) in tea production was carried out. Papers were presented focusing on tea industry in Nigeria from different perspectives (farmers, processors, Government, private sector).

A stakeholder's workshop and training program which brings together all actors public and private (Raw Materials & development Councils, Federal Ministry of Trade and Investment, Federation of Agricultural Commodity Association of Nigeria, Association of Tea Packaging Companies of Nigeria, Mambilla Beverages Nigeria LTD, Kaldi Africa, Prosasidor Nigeria Limited, Maizamari Integrated Farms Nigeria LTD, Federal Ministry of Trade and Industry, The Nigeria Agribusiness Register, Export Promotion Council, National Coffee & Tea Association of Nigeria (NACOFTAN), Small Scale Tea Producers Association, Tea Growers Association of Nigeria, Tea Marketers Association of Nigeria, Women Group, and the youth Group, Taraba State Governor, Chairman Sarduana LGA, Royal Highness Mondua of Kamkam, of Mambilla Kingdom) in the industry to fuse ideas on moving tea industry forward in Nigeria organized by Cocoa Research Institute Nigeria (CRIN).The program commenced with registration of guests comprising farmers, processors, packagers, marketers, NGO's, ministries, community leaders, Royal Highness, Taraba State Government, Sarduana Local government, women group and youth group.

The meeting was opened by his Royal Highness Mondua of Kamkam, of MambillaKindom, this was followed by the Governors speech, the Chairman Sarduana LGA's speech, and the Executive Director CRIN speech. The principal investigator, Mrs Yahaya, Aderonke, began with an opening speech "Why are we here"? She explained the problems confronting the tea industry in Nigeria and highlighted potential benefits that can be derived with efforts at enhancing tea industry for the country and all stakeholders along the value chain.

At the plenary session, papers were presented on various assigned topics which address the broad topic of the workshop from different perspectives: Farmers, Processors, and packagers, Government, Research & Development and Marketers. The last day of the program featured the technical session on Good Agricultural Practices (GAP) with presentations by different scientists from discipline such as: Breeding, Agronomy, and Soil scientist, Pathologist, Entomologist, GIS experts, and Extension and Economist. This was followed by on farm demonstration and field trip, also, a training evaluation exercised was carried out with administration of questionnaire and the program concluded with presentation of certificates to participants. It is worthy of note that one hundred and eighty (180) farmers were invited to the training but a total of six hundred (600) attended and were trained and the meeting came to an end at4.00pm.

Plenary session

Paper 1. Tea, a commodity crop for Nigeria: potential, challenges and opportunities

Presenter: Secretary General, NACOFTAN (Hassan K. Usman)

In his presentation, highlighted the challenges and needs of tea industry in Nigeria as follows:

Challenges:
- Lack of formidable tea policy
- Absence of tea commission /board
- Poor coordination among stakeholder in tea chain
- Limited quality processing knowledge

Needs:
- Inadequate training of tea farmers
- Absence of training facilities
- Poor pricing for tea
- Inadequate farm inputs
- Expansion of tea farming into low land

Paper 2. Tea export: A big challenge and way out

Presenter: Mambilla Tea Processing Company

Below is the summary of key points:

- Nigeria must increase tea production in order to satisfy the demand of consumers
- To develop tea industry, government must increase duty on imported tea
- There is need to establish Tea council in Nigeria
- There is need to formulate farmers cooperative that would handle processing, packaging and marketing of tea products.

Paper 3. Upgrading tea value chain in Nigeria: potential, opportunities and challenges

Presenter: Alh. Abubakar Kollere& Engr. Almustapha Kamil (RMRDC)

He gave a brief introduction on tea types, health benefit, and consumption and highlighted the global overview of tea as follows:

- Demand for green tea is increasing worldwide
- Tea production continues to increase globally due to increase in demand as 2.5million cup of tea is consumed in the world.
- Gap between production and consumption is widening

He itemizes other uses of tea like: tea extract being used for the production of dye, power and organic detergent, tea seed oil used as good source of protein for human consumption. The by- products of seed oil (tea cake) is used as bio-fertilizers. He also highlighted some of the activities of Raw Materials Research and Development Councils as follows: it supplies tea farmers with equipment, inputs, fertilizers and farm tools. The council has also formulated strategic committee on development of tea value chain in Nigeria. He further itemized actions needed to increase tea production in Nigeria:

- Breeding of improved varieties that are disease resistant
- Proliferation of tea farms on the Mambilla
- Supply of inputs to out-growers
- Creating access for tea farmers to credit faculties
- Decreasing tariff on imported tea processing equipment
- Increasing tax on imported processed tea to encourage local production

He mentioned the strengths, weakness, opportunities and threat to tea production on Mambilla plateau.

Strength: Good weather and suitable soil

Weakness: Subsistence farming approach, low youth and women involvement in tea value chain

Opportunities: Support from CRIN and other research institute

Threats: Communal crisis, insecurity, farmers- cattle rearer clash, competition with other crops

Paper 4: Tea industry in Nigeria: Journey So Far

Presenter: MD, Mambilla BEVERAGES Nigeria Limited

He mentioned the types of processed tea by the company and the history and commencement of tea production and processing in Nigeria as follows:

- Tea production began in 1972 in Nigeria
- Tea beverage company was established in 1975
- Commercial production started in 1982
- Mambilla beverages was incorporated in 2012
- Hydro- electric power plant was installed in the tea estate in 2016

Challenges: - Inadequate quality staff
-Poor government policy on importation of equipment
- Inadequate credit facilities

Recommendations: -Training -Institution of government policy

- Enforcement of 40% local processing of tea
- Ban on importation of tea leaves
- Enforcement of adherence to quality standards
- Increasing price of tea (fresh & brewed tea)

Papers presentation by the different scientists is compiled in the training manual attached.

At the end of the program, a communiqué was written as follows:

White paper for Nigeria tea

- ✓ Establishment of Nigerian Tea board focus on international safety standard
- ✓ Establishment of Tea promotion Bureau within the Tea board to promote Nigeria's tea in export market.
- ✓ Establishment of Tea commission
- ✓ Establishment of National Tea policy
- ✓ Establishment of National Export Sector Strategy in Tea.

National tea policy for Nigeria

- ➢ Establishment of a co-ordination tea value chain
- ➢ Improving tea quality by reaching out to smallholders' farmers
- ➢ Encourage domestic value addition
- ➢ Address infrastructures and political constraint
- ➢ Establishment of labour practices to improve quality reduces poverty and ensures gender quality.
- ➢ Built reputation for quality and diversify end market
- ➢ Address tariff escalation
- ➢ Built national quality infrastructure and collaboration

Farmers

- ➢ Subsidy for tea farmers on fertilizers, new replanting and infilling
- ➢ Guarantee minimum price for tea leaf
- ➢ Subsidy and incentive for value added production
- ➢ GAP awareness
- ➢ Provision of advisory services
- ➢ Advisory Services

Processors

- ➢ Custom duty rebate scheme- repaid of tea export tax to exporters
- ➢ Export expansion grant scheme
- ➢ Productivity expansion grant
- ➢ Tax free incentive subject to previous years increase in the export
- ➢ Payment of interest on loans for capital investment in tea
- ➢ Value addition of tea to be encouraged
- ➢ Encourage promotional activities to enhance demand for value added tea products for Nigeria in major market
- ➢ Promotion of tea research
- ➢ Promotion of lion logo to enhance marketing of Nigeria value added tea overseas.
- ➢ Promotion of upgrading among small holders' farmers
- ➢ Improve productivity among small holders' farmers
- ➢ Subsidy for new replanting of old tea bushes with new once
- ➢ Promotion of certification in tea
- ➢ Taxes and others should be strategically used
- ➢ Enforcement of compliance with basic domestic food safety standard and adapted to domestic code of conduct- organic tea production, low chemical residue and high quality
- ➢ Nigeria meet export and import standard and certification to voluntary sustainability standards
- ➢ Ensuring all exports tea companies comply with ISO 3720, standard, HACCP, GLOBAL GAP, CODEX ALIMENTARIUS regulations and methyl bromide reduction.
- ➢ Ensure the development of treaties with selected importing countries for mutual recognition of domestic testing of compliance with importation standards
- ➢ Ensure processing companies/factories adopt standard of current buyers
- ➢ Adherence to public standard (sanitary, phytosanitary) and private standards of lead firms
- ➢ Compliance with EU & US standards

Conclusion and Recommendations

The workshop and stakeholders meeting looked at ways to upgrade tea sector in Nigeria from all stakeholders perspective. It goes forward to train the small holders' farmers on Good Agricultural Practices to enhance their business. The study recommends a further training on Good Processing Practices for the small holders' tea actors.

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Experimental Title: Enhancing establishment of Tea (C*amelia sinensis*) through integrated application of organic and urea fertilizers at Ibadan, Nigeria

Investigators: Akanbi, O. S. O and Olaniyi, O. O

Introduction

Tea (*Camelia sinensis)* is a crop of high economic value in many nations of the world including Africa and most especially in Taraba state, Nigeria where it is grown in commercial quantity, Tea produced in Taraba state is consumed locally and sometimes exported to other African countries.

Tea plant requires high nutrients supplementation for optimal leaf production most especially N, P, K and Mg, any lack of these nutrient elements will affect its production and quality respectively.

Tea adaptation and cultivation at Ibadan have been ongoing for more than Twenty (20) years with the sole aim of establishing adaptable commercial clones. This has been without a conclusive result hence the need for more research efforts along this line. A multi – discipline survey was conducted at Cocoa Research Institute of Nigeria, Ibadan in 2014 involving all major stakeholders along Tea value chain to identifying and finding a common solution to problems confronting Tea production in Nigeria. However, it was discovered that, Tea (*Camellia sinensis*) can grow well at Ikom, Uhonmora and Ibadan respectively. Based on the results of the survey, the present trial was conducted to examine the effect of some selected agricultural wastes used as fertilizers on the establishment of Tea in Ibadan. The study also sought to confirm the suitability of Ibadan ecology to Tea cultivation and the effects of the selected fertilizers on soil properties.

Materials and Methods

The trial was conducted on an existing young tea plot of about four years at Cocoa Research Institute of Nigeria (C.R.I.N), Onigambari, Kilometer 14, Ijebu – Ode Road, Adebayo, Idi Ayunre, Ibadan in Oluyole Local Government Area, Oyo state, Nigeria.Ibadan is situated between scope 7^0 $10^'$ N and longitude 03^0 $52^'$ E. It lies at a height of around 122 meters above the Sea level and is found in the rainforest zone of Nigeria. The plot was marked out and divided into three blocks.The fertilizer treatments were applied sole and in combination with Urea at different ratios (50:50 & 25:75). Altogether, there were five treatment combinations (CPHA (sole); CPHA+ Urea (50:50); CPHA+ Urea (25:75); Urea (sole) and control). The fertilizer treatments were split applied at 150kgNha^{-1} in a banded form on both sides of the plant and buried. The design used was a randomized complete block design (RCBD) in three replications. Agronomic data such as plant height (cm); stem girth (cm); number of leaves per plant; leaf area and survival count (establishment rate) were collected at monthly interval and tea harvest per plot.

Preceding the setting of the investigation, soil samples were collected from the plot which has been fallowed for four (4) years with the aid of soil auger at 0 – 20cm depth and were thoroughly mixed to form a composite sample. Post treatments soil samples were equally collected per treatment and processed for laboratory analytical procedures to determine the various soil chemical properties as described below:

Soil for routine laboratory investigation was air-dried, sieved to go through a 2mm sieve, and subjected to routine laboratory examination for both physical and chemical properties according to IITA (1982) analytical procedures. The particle size distribution was determined by the hydrometer method as outlined by Juo (1979). Soil samples were dispersed using 5% sodium hexametaphosphate (calgon) solution and the soil suspensions were stirred for 15 minutes with a multi- mix machine based on gravitational sedimentation as governed by Stooke's law. Hydrometer was used to measure the quantity of Sand, Silt and Clay and reported in percentages of total sample. The pH of the soil was determined using soil and distilled water suspension in ratio of 1:2.5: Soil: Water. After stirring for 30 minutes, the pH (H_2O) value was read using a glass electrode pH meter using Mclean, (1982) procedure. The samples were determined electronically on a direct reading of pH meter using electrode with a saturated potassium chloride calomel reference electrode. The pH was calibrated and standardized with buffer pH 4 and 7. Organic carbon (OC) was determined by wet dichromate oxidation method as described by Nelson and Sommers, (1982) and Organic matter was determined by multiplying organic carbon values by Van Bemmelen factor of 1.724 based on the assumption that soil organic matter was 58% carbon. Total nitrogen (N) was determined using a modified Kjedahl digestion procedure as described by Bremmer, J. M. (1996). Nitrogen in the soil was converted to ammonium sulphate by digesting the sample with concentrated sulphuric acid that was added. The ammonia liberated by distillation of the digest with the solution of hydroxide was collected by 5% boric acid mixed indicator solution and titrated with standard hydrochloric acid. Available Phosphorus (P) was determined by BrayP-2 method and read from spectrophotometer as described by Nelson and Sommer (1982). Exchangeable acidity was determined by soil extraction with 1N KCl and titration with 0.05N NaOH using phenolphthalein indicator as outlined by IITA (1979). The micro – nutrients – Cu, Zn and Mn were determined after extraction of the soil samples using Fonseca, (2010) extraction method.

All data generated will be subjected to analysis of variance and significant means separated by LSD.

Result and Discussion

The results of the particle size analysis of the soil (Table 1) indicated that the soil is sandy clay loam. The sand, silt, and clay were 680; 140; and 180g/kg respectively. The silt + clay content (320g/kg) is sufficient to retain soil moisture content for good growth for different tea clones; this will help the soil to hold enough moisture during the short duration of dryness (Egbe *et al*, 1989)

The result of the chemical analysis of the soil shows that the soil pH (H_20) is slightly acidic (6.4) and falls within the range of (4.5 - 6.5) considered ideal for tea cultivation in Nigeria (Egbe *et al* 1989). The soil pH of 6.4 may not pose any threat for sustainable tea production. This is because continuous tea production naturally causes reduction in soil pH value.The soil is generally low in essential nutrient element which is the common characteristics of most tropical soils and Nigerian soil in particular because of high rainfall and high rate of decomposition of the organic materials, excessive leaching of the major soil nutrients elements beyond the rooting area coupled with low activity clay of soils from these regions (Ogunwale*et al,* 2002). The soil total N (1.01g/kg) is very low and falls below the critical value of 3.35g/kg soil under tea cultivation in Kenya (Othieno, 1980). The soil available P, K, Ca and Mg contents of 4.12mg/kg, 0.12, 1.58 and 0.71mol/kg soil were equally found to be low. However, the low nutrient status suggests that there will be need for external nutrient supplementation for optimal and sustainable production of tea in Ibadan.

Table 1: Initial soil samples and Fertilizer materials analysis

S/N	Soil Chemical properties	Values	CPHA
1	pH(H_2O)	6.40	10.80
2	N	1.01	1.01
3	P	4.12	1.00
4	K	0.88	5.88
5	Ca	1.58	4.17
6	Mg	0.71	0.95
7	Cu	0.43	101.94
8	Mn	18.70	384.93
9	Zn	20.21	87.98
	Particle Size analysis		Textural Class
i)	%Sand	680	
ii)	%Silt	140	Sandy -clay laom
iii)	%Clay	180	

Table 2 presents the effects of integrated application of Organic (CPHA) and urea (inorganic fertilizers on the tea growth and establishment rate in Ibadan. Application of CPHA based organic fertilizers with or without urea fertilizer significantly ($p > 0.05$) enhanced tea growth in terms of leaf formation, increased height, stem girth and production of broader leaves. Integrated application of CPHA and urea fertilizer at a ratio of 75:25 significantly ($p > 0.05$) produced tea with higher plant height (cm); stem girth (cm); number of leaves and leaf area (cm^2) values respectively relative to the control (Table 2). Similar observation was observed with the percentage field establishment in terms of survival rate with CPHA+ Urea (75:25) recording the highest survival rate on the field relative to the control one year after treatment application. However, Control and sole CPHA recorded the lowest values. The treatment effects of CPHA + Urea (75:25) and CPHA+ Urea (50:50) on plant height, number of leaves and percentage establishment were not statistically different from each other but were statistically different compared to the control. The positive response of the soil and tea plant to the applied fertilizer treatment with respect to tea plant growth irrespective of fertilizer source was an indication that the soil is deficient in essential plant nutrients hence needs nutrient supplementation for better performance.

Table 2: Effects of integrated application of Organic (CPHA) and urea (inorganic fertilizers on the tea growth and establishment rate in Ibadan

Treatments	Plant Height(cm)	Stem Girth(cm)	Number of leaves	Leaf area (cm^2)	% Establishment
Control	19.45d	0.50c	5.00c	432.33e	41.2d
CPHA (Alone)	25.8c	0.55c	5.25c	500d	57.2c
CPHA+Urea (50:50)	56.20a	0.70b	6.80a	520c	71.50b
CPHA+Urea (75:25)	60.00a	0.88a	7.00a	625.01a	72.36b
Urea (Alone)	50.63b	0.71b	6.20b	600.4b	75.00a

Means with the same letter within the same column are not significantly different from each other

Application of sole CPHA or combined with urea fertilizer positively and significantly ($P>0.05$) influenced the post treat effects on the nutrient composition of the soil one year after application (Table 3). Relative to the control, CPHA applied sole or in combination with urea increased significantly the soil total nitrogen (N) contents of the plot under review with CPHA + Urea at ratio 50% CPHA and 50% Urea recording the highest value of 1,60g/kg soil. This was followed by 1.40g/kg soil recorded for CPHA+Urea (75:25). The least values of 0.5 and 1.0g/kg however, were noticed in the control and where sole Urea was applied respectively. The increases observed over the control was an indication that for better and optimal performance of the test crop the soil must be amended with suitable fertilizer materials that could supplied the required deficiencies in right quantity. Similar effects of applied treatments were observed on the amount of available phosphorus (P) and potassium (K) left in the soil one year after application. The integrated application of CPHA and Urea at 50% CPHA and 50% Urea recorded the highest values of soil available P (2.70mg/kg soil) and K (0.80cmol/kg soil) contents while the least value was noticed in the control plot. However, there was no significant different in the amount of K released into the soil by CPHA and +Urea (50:50). This may likely be attributed with a very slow rate of nutrient released by CPHA within the first year; the effect may be more noticed in the second year after treatment application. The soil organic carbon (OC) and Ca were equally enhanced by the sole application of CPHA or in combination with Urea. Sole application of CPHA produced highest value of 11.80g/kg soil, this was distantly followed by CPHA + Urea (50:50) which recorded 8.16g/kg soil. The control plots on the other hand, recorded the least OC value of 4.0g/kg soil (Table 3).

Table 3: Effects of integrated application of organic and urea fertilizers on tea soil in Ibadan

Treatments	*N(g/kg)*	*P(mg/kg)*	*K(cmol/kg)*	*Ca cmol/kg*	*Mg(cmol/kg)*	*OC (g/kg)*
Control	0.51	1.30	0.63	0.42	0.26	4.00
CPHA (Alone)	1.01	2.50	0.78	0.60	0.60	11.80
CPHA+Urea(50:50)	1.60	2.70	0.80	0.52	0.52	8.16
CPHA+Urea(75:25)	1.40	2.60	0.65	0.53	0.53	7.20
Urea (Alone)	1.00	1.18	0.60	0.10	0.10	6.50

Means with the same letter within the same column are not significantly different from each other

Conclusion and Recommendation

Based on the available results, it could therefore concluded that integrated application of CPHA and Urea fertilizer enhanced agronomic characteristics of tea, improves its establishment and positively influenced soil chemical properties (N,P,K,Ca, Mg and Organic carbon.

It is therefore recommended that, similar study using the same treatments be replicated at Owena and Uhonmora CRIN Substations to further study the performance of the said crop across locations.

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EXTENSION PROGRAMME

Experimental Title: Dissemination of selected CRIN technologies in major cities in Nigeria

Investigators: Uwagboe, E.O., Agbongiarhuoyi, A.E., Oduwole, O. O. Adebiyi, S., Famuyiwa, B. S., Abdulkarim, I. F, Williams, O. A., Agbebaku, E. E. O., Jayeola, C. O.

Introduction

CRIN has developed many technologies which are still on shelf and there is need to disseminate these technologies to end users. Technology transfer will improve the living condition and productivity levels of Nigeria people. The benefits of technology transfer include industrialization, job creation, increase in income, poverty reduction, enhance adoption and improved productivity.

Objective of the Study

The general objective of the study is to promote CRIN developed technologies to end users in Nigeria.

The specific objectives are to:

(1) To sensitive and create awareness on CRIN developed technologies,
(2) To train end users on CRIN developed technologies,
(3) Evaluation of participant's feedback on the disseminated technologies

Methodology

Multi-stage sampling procedure was used to select participants for the project. Benin city was purposively selected based on their volume of trade. In the city a centralized location was selected for the exhibition. Some traders in five markets in Benin City were invited for the exhibition. Government personnel, Farmers, Farmers association, Bakers, Processors, ADP Extension agents were invited. The following CRIN developed products were exhibited; Cocoa Bread, Cocoa powder, liquid soap, cashew kernel and chocolate. Flyers, posters and banners indicating the products were printed. A giggle for the exhibition was aired in Edo state broadcasting station radio for 2 weeks before the programme.

Results

One hundred participants attended the programme and sales of the products were made. Live radio programme (Waka-about) was held at Edo broadcasting station Benin City and Dr Oduwole, O. O. and Dr (Mrs) Jaiyeola, C. O. featured in the programme. There has been several telephone calls from the general public on their intention to purchase CRIN products/seedlings and cocoa pods and becoming distributors. The feedback result from the survey conducted on the perception of the participants was favourable.

Recommendations

1. Adequate fund should be released in the production of CRIN products
2. This exhibition should be conducted in other major towns or cities in the states where CRIN mandates are produced

Experimental Title: Dissemination of Cocoa Pod Husk (CPH) Technology as Poultry Feed to Substitute for Some Quantity of Maize in CRIN Adopted School

Investigators: Orimogunje, O.A, Adebiyi, S, Agbongiahuoyi, A.E, Oduwole, O.O, Uwagboe, E.O. Famuyiwa,B.S, Awodumila, D.J, Abdul-karim, I.F, Williams, O.A, Agbebaku, E.E.O, and Adebowale, B.A.

Introduction

Cocoa-pod husk (CPH) is a by-product of the cocoa harvesting industry, and it forms about 80% of the cocoa fruit. It is essentially a waste product except for the negligible amount used in the manufacture of local soap and feeding of livestock (Uwagboe et al, 2010). CPH is usually an under-utilized agro-waste from cocoa commercial farm, which could serve as good nutritional source for monogastric animals (Adeyeye et al, 2017). It is estimated that 0.8 to 1.0 million tons of CPH is generated annually in cocoa farms in Nigeria (Ojeniyi, 2006). CPH is an agro-based by-product which may be incorporated into layers diets to reduce the maize requirement. Very little of the potentials locked up in this by-product have been exploited (Egbe and Olubamiwa,1989) Studies conducted in Nigeria have shown that crushed CPH could be incorporated into livestock feeds.

The inclusion of CPH in layers mash will reduce quantity of maize by 20%, thereby reducing the cost of maize that is soaring. The increase in the price of conventional feed ingredients constitute the primary cause of the rise in animal feed production cost and the subsequently making animal protein cost very high (Adeyeye et al, 2017). The replacement of one or more major ingredients in conventional feed will reduce drastically the production cost of animal feeds thereby increasing assess to animal protein (Adeyeye et al, 2017). According to Agunbiade and Olubamiwa (2002) CPH contains protein, energy and fibre which has gained considerable interest as livestock ingredients in Nigeria owing to availability and lack of large scale commercial application.

Commercial poultry production, provides easily accessible and affordable meat and eggs. About 80% of the world population get most of their basic nutrients like proteins, fats and vitamins from meat and eggs (FAO, 2009). Presently, in Nigeria and other developing countries, despite the recent relatively rapid expansion in the livestock industry, protein consumption is 75% below the FAO requirement (Ibe, 2000). A high cost of animal production gives rise to a high cost of animal protein thereby reducing the affordability of animal protein. Therefore, reducing the cost of animal production by using by-products from crops will greatly increase the affordability of animal protein.

Maize being one of the major ingredients in feed making is faced with allot of challenges now during production, ranging from the disastrous effects of army worms, destruction of several maize farms by grazing cattle, farmers' and herders' clashes, effect of climate change which brings about crop failure and so on. These factors have increased rapidly the price of maize which is the major ingredient in poultry feed. Furthermore, there is need for maize to be substituted by CPH which is almost free. The outbreak of army worm in maize has really jerked up the prices of corn. Armyworm was observed at the onset of the cropping season in 2017. The new pest caused significant damage to maize crop whose demand for higher yield increases yearly due to rising population and urbanization, as well as the growing poultry, and fish sectors of the economy (Djimkoffi*et al*, 2020).

The adopted village and school concept was initiated by Agricultural Research Council of Nigeria (ARCN) in collaboration with Cocoa Research Institute of Nigeria (CRIN). The West African Agricultural Productivity Programme (WAAPP) embraced the idea and used it to reposition technologies development and dissemination in all research institutes in the country. Establishment of different intervention project like poultry, fishery, arable crop production and so on were implemented. The major purpose of these projects were to disseminate developed technologies in research institutes including CRIN to farmers in nearby communities and to encourage youth in agriculture. On this back drop, inclusion of CPH to replace 20% maize was carried out by CRIN with following specific objectives:

- Encourage the inclusion of CPH in poultry feed formulation by farmers.
- Encourage secondary school students to have interest in agriculture from their youthful age.
- Increase the income of farmers by reducing cost of poultry production.
- Encourage secondary school students and teachers to be job creators.

Methodology

The study was carried out in Mamu Comprehensive High

School, Ijebu North Local Government Area in Ogun state.The location of the school falls within 5km range as stipulated by ARCN. Mamu Comprehensive High School was purposively selected because of proximity and interest to participate in the project in order to enhance adoption. The junior and senior secondary school Agricultural students from the chosen school were the target audience. The Agricultural science teachers also participated in the project.

Eighty (80) point of lay birds (18 weeks) Bovan Brown breed were stocked in two different cages of 40 birds per cage. They were fed with conventional feed till 20 weeks to attain optimum laying capacities. After which the two categories of birds were fed differently with CPH fortified feed and the conventional feed. Data were taking daily on egg laid, feed consumption, and vaccination in both categories. The result gotten were explained using graph, tables and charts.

Processing of CPH: Disease free and fresh cocoa pod were harvested, they were broken by the use of club, cocoa beans and placenta were removed. The husks were chopped into smaller sizes to allow easy drying. The husk was sundried to a moisture content of about 10%. The husks were reduced to smaller pellets and were well grinded and stored on wooden pallets until it was being used.

Results and Discussion

Table 1 shows the feed formulation for both conventional

Table 1. Feed formulation table for the conventional feed and CPH fortified feed

S/No	Ingredient (conventional)	Percentage	Ingredient (CPH fortified)	Percentage
1	Maize	45	Maize	36
2	CPH	-	CPH	9
3	Soya meal	10	Soya meal	10
4	Wheat offal	12	Wheat offal	12
5	Limestone	8.6	Limestone	8.6
6	Bone meal	2.0	Bone meal	2.0
7	PKC (Palm kernel cake)	6.5	PKC	6.5
8	Groundnut cake	15	Groundnut cake	15
9	Premix	0.25	Premix	0.25
10	Toxin binder	0.15	Toxin binder	0.15
11	Salt	0.3	Salt	0.3
12	Super liv	0.05	Super liv	0.05
13	Lysine	0.15	Lysine	0.15

Source: field survey, 2021

Calculation based on price differences between conventional feed and CPH fortified feed

The results in table 2 shows a price reduction of 495 naira per 25kg of layers' mash after substituting 20% maize with CPH. So, instead of purchasing a 25kg layer mash bag for 4,900 naira, it will only be sold for 4,405 naira.

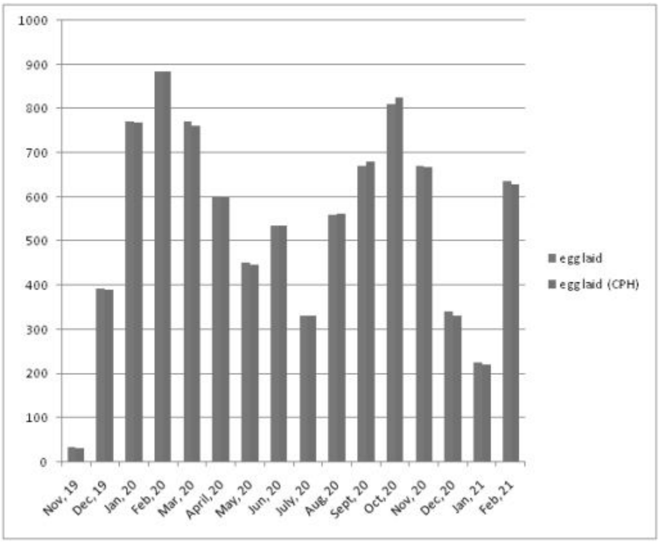
Table 2: Analysis of maize quantity in 25kg layers mash

Cost price layer mash per 25kg (₦)	Price of maize per kg(₦)	Percentage of maize in 25kg mash	Price of maize in 25kg mash	Price of maize in 25kg mash minus other ingredients
4,900	220	45/100 x 25= 11.25	220 x 11.25= 2,457	4,900- 2,457= 2,425
		CPH fortified feed (20% maize substitute with CPH)		
Cost price layer mash per 25kg (₦)	Price of maize per kg(₦)	Percentage of maize in 25kg mash (20% maize substitute with CPH)	Price of maize in 25kg mash minus 20% maize	Price of CPH fortified feed after substituting 20% maize with CPH
4,900	220	20/100 x 45 =9 9/100 x25= 2.25	2.25 x 220= 495	4,900- 495 =4,405

Table 3: Production record for both conventional and fortified feed with CPH

S/No	Month	No of bird fed with regular feed (control)	No of egg laid per month	No of bird fed with CPH fortified feed (fortified)	No of egg laid per month	Total no of bird	Total of egg laid
1	November, 2019	40	31	40	30	80	61
2	December, 2019	40	392	40	390	80	782
3	January, 2020	40	770	40	769	80	1,539
4	February, 2020	40	885	40	884	80	1,769
5	March, 2020	40	770	37	760	77	1,530
6	April, 2020	37	602	36	598	73	1,200
7	May, 2020	37	450	36	446	73	896
8	June, 2020	37	535	36	534	73	1,069
9	July, 2020	33	329	35	330	68	659
10	August, 2020	33	558	35	562	68	1,120
11	September, 2020	33	671	35	679	68	1,350
12	October, 2020	33	810	35	825	68	1,635
13	November, 2020	33	669	33	667	66	1,336
14	December, 2020	33	340	31	330	64	670
15	January, 2021	33	225	31	218	64	443
16	February, 2021	33	635	31	628	64	1,268

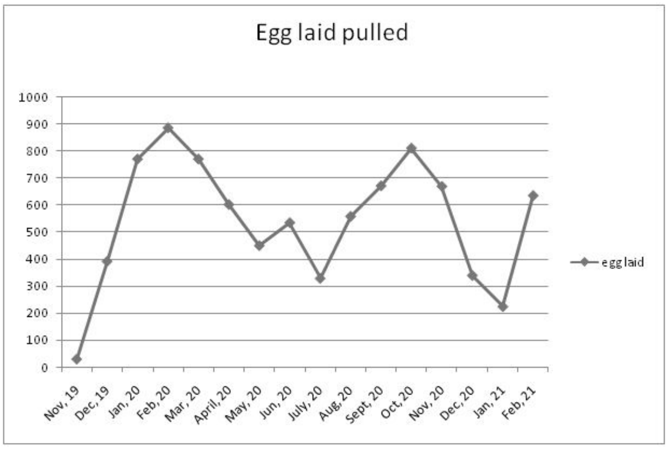
Source: field survey, 2021



Source: field survey, 2021

Figure 1: Bar chart showing the eggs laid by birds fed with convectional feeds and CPH fortified feed.

The figure 1 above show the result of the egg laid by birds fed with conventional feeds and CPH fortified feed. It means that there is very close difference between the two feeding ingredient. The result of Ashade et al. (2010) corroborate this finding that 100% maize substitution with CPH, had no significant effect on the survival, weight gain, and feed conversion ratio at reduced cost in the diet of *Oreochromisniloticus* .



The figure 2 above shows the egg laid by birds fed with the conventional feed and CPH fortified feed between November, 2019 and February, 2021.

Figure 1: Renovated poultry pen and student feeding the birds in Mamu school

Figure 2: Research scientists with Agric. students at the poultry

Figure 3: Eggs layed before collection with CRIN Team in the poultry

Constraints

- Transportation problems during Covid 19 pandemic national lockdown (March – October, 2020) it was very tasking and costly to get feed across to the school because of restriction in vehicular movement.
- Theft was experienced at different times, especially when students were on holidays.
- The cold attitude of the new school principal toward the project as at that time apart from the financial benefit he enjoys from sales of eggs.
- Diversion of money realized from sales of eggs to other school project, thereby depriving the poultry immediate needs. In fact, CRIN has to salvage the situation in some occasions by supplying feeds and drugs after the temporary hand over to ensure sustainability.
- Irregularities in record keeping during students' holiday.

Conclusion

- The poultry project served as a very good way of disseminating CRIN developed CPH technology to secondary school students in Mamu adopted school.
- CPH was effectively used to replace 20kg of maize and still achieve the same result as using the conventional feed.
- The students and teachers gained allot in the activities spanning from renovation of poultry pen, stocking, egg laying and record keeping, which gave them an insight of how they can invest on poultry production after graduating from school and to the teachers after retirement.
- It increases the students interest in agriculture because seeing is believing. The project was basically participatory which facilitated adoption among many students and some members of Mamu community.

Recommendations

- Monitoring and evaluation team should be empowered financially for the sustainability of the project.
- Back-up funds should be made available to bail out adopted school in case of emergency situation as experienced in Mamu in January, 2021.
- More adopted schools should be established to enjoy the good gesture from CRIN.
  - Security of the poultry pen should be taking more seriously by the school management.
  - Back-up plans should be on board to sell off and restock the pen when the birds are getting old and production has dropped.

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LIBRARY, INFORMATION AND DOCUMENTATION DEPARTMENT

(HOD: Fagbami, O.O.)

Dr Mrs Ogunjobi T.E.- Acting Head, Library Division

Objectives

The main objective of the Department is to acquire, process, organize, store and disseminate information with a view to stimulate and guide research on CRIN mandates crops.

Library Information and Documentation Department (LID) comprises of three (3) divisions which are: Library, Information Communication Technology (ICT) and Documentation divisions. These three (3) divisions supported the research activities of the institute by providing services.

The personnel: There were thirteen (13) staff working at LID department. These included; two (2) Librarians, two(2) Programme Analysis, three(3) Library Officers, one(1) Chief Printer, one(1) Data Processing Officer, one(1) Chief Typist, two(2) Clerical Officer and one(1) Agricultural Field Attendant

Library Division (Dr (Mrs). Ogunjobi T.E. – Acting Head, Library Division)

Achievements

In the year under review, the achievements of the division were: provision of information resources that aided the research work of researcher through print and electronic medium, provision of newspaper to library users etc.

Library Building Renovation

The library roof was replaced and the walls and all offices were repainted to provide an enabling environment for readers.

ICT division (Ibe Osita – Acting Head, ICT Division.)

The ICT Division composed of Internet/Website and Automation section. This division was saddled with the responsibilities of providing the Institute with Internet connection, web presence and the digitization of library collections.

Staff Strength: The division comprised of four staff – Programme Analysts (2), Data Processing officer (1) and Chief Printer (1).

Achievements

In the year under review, the achievements of the division cut across maintenance of the Institute website, provision of Internet (wired/wireless) for all staff and handling of official local/International correspondences on behalf of the Institute. Other achievement includes:

1. Migration of Institutes website domain from –ng.org to .gov.ng
2. Distribution of donated 86 pieces of Zinox E-pad computer systems by Nigeria Communication Commission (NCC) to scientists, management staff, divisions, sections and units
3. Extension of wireless Internet signals to SPN, LID, ERLS and administrative block
4. Activation of hot spot login accounts to institute's Internet for staff
5. Updating institute's website with staff profiles and activities
6. Online Liaison between the Institute and collaborators
7. Handling of official correspondences
8. Training of interns
9. Creation of Institution e-mail for staff

Documentation division – (Fagbami O.O. and BabafemiIbitope)

Work continued on processing of printed journal papers on Cocoa Research Institute Database on Nigeria (CRIDAN).

Yearly collation of all published papers of scientists was done.

Staff Identity card was produced by collating the data of staff request.

Compilations of bibliographies were assigned to Library staff and it's on-going. Processing of Annual report by the Secretariat staff continues. Requests were made from Scientist for the outstanding reports.

Research 4life database which contain AGORA, AINARI, OARE, GOALI was acquired, and the Username and password made available for scientists.

ENGINEERING (Head: Engineer Bakare T)

Preamble

During the year under review, 2016 till date, the Engineering /Works Division operated as hitherto into three (3) technical sections and fourteen (14) operational units. This help to effectively utilize the available manpower and to deliver maximally in all fronts of the official responsibility of the division tom support and service the Research mandated goal of the Institute.

Sections:

The three technical sections are arranged below:

(1) Civil Engineering
(2) Electrical Engineering
(3) Mechanical Engineering

Units

We have fourteen operational units, which are listed below

(1) Civil

* Carpentry
* Mansory and Bricklaying
* Roads

(2) Electrical
* Generation & Protection
* Networks & Installations
* Billing & Metering

(3) Mechanical
* Agricultural & Equipment
* Fabrication & Welding
* Plumbing & Water supply
* Generation, Refrigeration & Air-condition
* Machine shop
* Motor vehicles
* Special Duties (Maintenances, Planning & Monitoring)
* Transport

Personnel

Names of all Staff in Engineering Division

`S/N	NAME	DESIGNATION
1	Engr. Bakare Taiwo	Chief Maintenance Engineer/HEW
2	Engr. Ikpefan Patrick	Principal Maintenance Engr. l
3	Mr. Titiloye Isaac	Senior Maintenance Engr.
4	Mr. Olutola Ola	Chief Tech. Officer
5	Mr. Agwimah Emmanuel	Chief Tech. Officer
6	Mr. Ajiboye Gbenga	Asst. Chief Tech. Officer
7	Mr. YinusaSakiru Adedoyin	Principal Tech. Officer l
8	Mr. Awe Jacob	Principal Tech. Officer l
9	Mr. OgunsuyiBusuyi	Principal Tech. Officer l
10	Mr. Gold Ahmed	Principal Tech. Officer l
11	Mr. Oduntan Samson	Principal Tech. Officer l
12	Mr OyawaleMuniru	Higher Tech. Officer
13	Mr. OgunwumiOluseye	Higher Tech. Officer
14	Mr. Ajayeoba Babatunde	Higher Tech. Officer
15	Mr. OgbechieMicheal	Higher Tech. Officer
16	Mr. Mathews Dare	Senior Works Superintendent
17	Mr Akintoroye Ambrose	Senior Works Superintendent
18	Mr Ogbechie Christopher	Senior Works Superintendent
19	Mr. Adeyanju Stephen	Higher Works Superintendent
20	Mr. Balongun Roland	Higher Tech. Officer
21	Mr. Adedoyin Nkanlola	Higher Works Superintendent
22	Mrs. TogunOlubukola	Higher Tech. Officer
23	Mr. Oyeniran Sunday	Works Superintendent
24	Mr. OyebanjoToyosi	Works Superintendent
25	Mr. Ironua Samuel	Senior Foreman
26	Mr. Ibiyemi Adewale	Senior Foreman
27	Mr. Oke Babatunde	Works Superintendent
28	Mr. Ojo L. Idowu	Senior Foreman
29	Mr. AdeogunMorufu	Senior Foreman
30	Mr. Uwaifo l. Andrew	Senior Foreman
31	Mr. AdekanbiAderemi	Asst. Tech. Officer
32	Mr. Ismaila Salami	Senior Craftsman
33	Mr. Ojo Moses	Senior Craftsman
34	Mr. AdesidaAdewumi	Senior Craftsman
35	Mr. Adeboye Kehinde	Foreman
36	Mr. Oladimeji Taofeek	Craftsman
37	Mr. Boluwade Sunday	Senior Craftsman
38	Mr. FaniyiJimoh Abiola	Senior Craftsman
39	Osun Micheal	Senior Craftsman

40	Mr. Adio Dare	Asst. Technical Officer
41	Mr. AladeGboyega	Senior Craftsman
42	Mr AdedayoSalaudeen	Senior Craftsman
43	Mr Adekanbi Segun	Senior Craftsman
44	Mrs. Ajekigbe Femi	Secretarial Asst. l
45	Mr. Ajayi Olalekan	Agric. Field Attendant l
46	Mr. Gabriel Ibhazakor	Agric. Field Attendant ll
47	Mr Rotimi Ipinmoroti	Motor Driver Mech.
48	Mr. Oladipupo Kayode	Senior Work Superintendent
49	Mr. Ajiroba Taiwo	Senior Work Superintendent
50	Mr. Enodumwenben Anthony	Senior Work Superintendent
51	Mr. Kpeleye Friday	Work Superintendent
52	Mr. Odeku Olufemi	Work Superintendent
53	Mr. Tijani Fatai	Chief Motor Driver Mechanic l
54	Mr. Muraina Lukman	Chief Motor Driver Mechanic l
55	Mr OsungbadeAyoade	Higher Technical Officer
56	Mr. OgunkunleGbadebo	Senior Motor Driver Mechanic
57	Mr. Arumemi Christian	Senior Motor Driver Mechanic
58	Mr. ArowobusoyeAkinrinsola	Senior Motor Driver Mechanic
59	Mr. Oluwole Segun	Senior Motor Driver Mechanic
60	Mr. AdesuyiBusuyi	Senior Motor Driver Mechanic
61	Mr. Oyedele Bolaji	Senior Motor Driver Mechanic
62	Mr. Iyeh Moses	Senior Motor Driver Mechanic
63	Mr. Nome Peter	Motor Driver Mechanic
64	Mr. Rabiu Akeem	Motor Driver Mechanic
65	Mr. Ajewole	Motor Driver Mechanic
66	IsmailaTajudeen	Motor Driver Mechanic

Achievement of the Division

1. General maintenance of buildings, equipment, vehicles and road network within the Institute
2. Erection of fencing Poles and wires along the Institute outside Lawn
3. Supervision of all Contract works like road construction, the Laboratory complex, installation of solar/inverter system in the Institute and so on.
4. Re-roofing of the Event Centre.
5. Redd-roofing of the Engineering workshop.
6. General transport activities.

Functions and Responsibilities of Engineering Division

1. Initialize and develop a process plan to service the research mandate goal.
2. To design, construct, install and maintain any engineering related equipment to support the research mandate goal.
3. Daily Maintenance of vehicle fleets, building, machinery, and equipment's that drives the research mandate goals.
4. Prepare tender document to facilitate excursion of capital projects.
5. To advice the Executive Director and CRIN management on the tenets of the ethnics of the engineering profession.

Major challenges faced by the Division

- Lack of readily available working fund to solve immediate maintenance needs.
- Also, poor or rather no imprest reimbursement.
- Lack of an upgrade of equipment and tools in commensurate with available manpower.
- Insufficient training and re-training of staff to meet up with the global trends in maintenance techniques Minor challenge faced by the division:
- Lack of an engineering inventory store which will enable closeness to maintenance spare items thereby eradicating long down time delay.
- Also, the Engineering Division lack daily logistics like availability of vehicle to move materials finished work to the site, a direct projection of poor funding.

Scope for Future Recommendation

1. Provision of upgrade equipment /tools for the day to day running of the division
2. Training of staff to meet with the recent global technology
3. Provision of daily needed maintenance items in the inventory store to eradicate delays in the execution of maintenance plans.
4. The farm machineries could be used for hiring in-order to generate IGR
5. Construction of a 33KV transmission line or a dedicated line to solve the problem of light in the Institute which could also be a source of IGR.

INTERNAL AUDIT

The internal audit division was designed to monitor, control, appraise, evaluate and examine the financial and operating activities in the Institute. We have the mandate to provide a complete and continuous audit of the accounts and records of revenue and expenditure, assets, allocated and unallocated stores of the Institute as provided in section 1702 of the Financial Regulations. We are responsible to the Chief Accounting officer who is also the Executive Director of the Institute.

Staff Strength

Our staff are qualified professionals with expertise in the field of auditing and investigation, and financial reporting. As at 31st of December'2019, the division had sixteen (16) staff. This is as detailed below:

Accountants	7	Executive Officers	8
Secretary	1		

Note: - 1 of the Executive Officers (Mrs. Christopher Mimiola) is on a study leave absence as approved.

Responsibilities

In addition to exercising our core mandates of providing a complete and continuous audit of the accounts and records of revenue and expenditures, assets, allocated and unallocated stores of the Institute as spelt out in section 1701 sub section (i) and (ii) of the federal republic of Nigeria Financial regulation (as revised'2009), the division perform amongst others the following duties: -

- Maintenance of adequate checks against fraud and misappropriation of assets.
- Verification of assets and liabilities at regular intervals.
- Examination and constant scrutiny of all system of authorization of payment to ensure adequate control of expenditure
- Ensuring that various policies as put in place by the Management are strictly adhered to.
- Ensuring that information required by the Management for effective performance is reliable, complete and timely.
- Conducting periodic examination of internal checks to ensure accuracy and efficiency.
- Reviewing accounting system and related internal controls.
- Examination of financial and operational information for management, including detailed testing of transactions and balances.
- Reviewing the economy, efficiency and effectiveness (Value for Money Audit) of operations and functioning of both financial and non-financial controls.
- Conducting special investigations; and
- Any other related functions as may be assigned by the Chief Accounting Officer.

Achievements

The following are some of the heights we have attained during the year: -

- We have ensured transparency and accountability in the conduct of the Institute's businesses.
- Reviewed, monitored and ascertained accounting and internal control systems put in place by the management.
- We have been able to keep cost of items/materials requested within reasonable and acceptable limits without impairing the quality and quantity of its intended use.
- In many ways we have ensured compliance with extant rules and regulations vis-à-vis Financial Regulations. We have ensured that expenditures incurred are wholly, reasonably, exclusively and necessarily incurred in the interest of the institute.
- , public service rule, government official gazettes and circulars, and management policies.
- We have safeguarded the institute's property by confirming their existence, rights & obligations, completeness, valuation and allocation.

Challenges

Our major challenge is inadequate funding. Auditing is a continuous exercise that require gathering of sufficient, appropriate, relevant and reliable evidence on which our findings and recommendations are based. This cannot be achieved without proper and adequate funding. Though we realize that delay in the release of funds by the government warrant this at times. We encourage the management to priorities audit assignment in the institute.

Conclusion

Finally, our role as auditors is to join in the crusade of judiciously creating values for the Institute, protecting these values from being distorted or tarnished and managing the available resources to achieve the mandate of the Institute. This we are committed to as a machinery of government.

ANNUAL REPORT

OF THE

COCOA RESEARCH INSTITUTE OF NIGERIA, IBADAN

2020

TABLE OF CONTENTS

COCOA PROGRAMME

Experimental Title: Diagnostic assay, identification, and incidence of causal organism(s) of Cherelle Wilt Disease in three major cocoa producing States (Ondo, Osun and Abia) of Nigeria

Investigators: Adedeji, A. R., Otuonye, A. H., Mokwunye, I. U., Asogwa, E. U. and Akanbi, O. S. O.

Introduction

The cocoa tree, an understory tree crop that belongs to the *Malvaceae*, is of considerable economic importance to the producing countries chocolate and cocoa productbased companies of the western nations or Europe. The recent discovery of the health benefits of the polyphenols and flavonoids in processed cocoa products as a good antioxidant has led or resulted in increased demand for cocoa-based products around the world. With this development, meeting the local and international demand has become a herculean task for the producing countries of Western Africa that supply between 70-80% of processed raw bean which is an industrial raw material for finished cocoa products such as cocoa mass, used in making chocolate, biscuits, and confectioneries. Further, obtained from the commercial bean seed are melted cocoa-intended for various food industries for sweetening products, cocoa butter used in making sweets, perfume, pharmaceuticals and finished products that include, cocoa cake and various chocolate-based products, among others. Although these benefits, obtaining an optimum yield from cacao is faced with serious challenges. Chief among these factors that affect cocoa production is the plethora of cacao diseases, soil, and climatic conditions prevailing in the humid tropics that the perennial tree crop is grown, hinders genetic yield potential of the tree crop. Cacao pathogens reduce the potential crop by an estimated 810,000 tons annually (30% of world production) and individual farm losses can approach 100%, (Guiltinan, 2007).

The pathogenic organisms, soil microflora, and fauna and plant nutrients in the tropics are variable due to the variable weather conditions of the tropics that could be hot with low relative humidity and suddenly changes becoming cloudy with accompanying heavy rainfall that results to leaching down and washing off of soil nutrients, microflora and fauna. The rainfall also results in reduced temperature and high relative humidity of over 90%. This development affects the physiology of the cacao plant and encourages the infection and thriving of diseases of which cherelle wilt has suddenly become an important limiting factor to the cacao production in Nigeria.

Matured cacao plant of fruit-bearing age produces abundant flowers of which only 0.5-5% of cacao flowers set fruit that become young *Theobroma cacao* pods, known as cherelles. These young fruits are commonly lost to physiological thinning known as cherelle wilt, although some evidence is now available that indicates other possible causes that include abiotic such as sunscald and drought and biotic such as insect pest and pathogenic organisms. Between 20-90% of cherelles (young fruit) produced by a cacao plant can be lost to cherelle wilt. Cherelle wilt was considered a physiological thinning mechanism involving vessel occlusion in the cherelle peduncle (Melnick et al., 2013). Other possible causes have also been adduced to diseases causing organisms such as *Phytophthora* species, *Moniliophythoraroreri*, *Lasiodiplodia theobromae*, *Fusarium* species among others (Thorold, 1975; Opeke, 1992; Melnick et al. 2013). Symptoms manifest when wilting cherelles stop growing, turn yellow after a week, turn blackish-brown, and mummify remaining attached to the tree (Melnick et al. 2013). Peak wilt occurs 50 days after pollination followed by a second stage occurring around 70 days after pollination (Melnick et al. 2013).

Biotic factors, such as insect pest and disease-causing organisms, can also cause loss of cherelles. Cacao insects such as adult menbracid and adult treehoppers have been shown to cause 40% cherelle wilt (Bartolome, 1954). Other factors such as hormonal influence and deficiency of certain essential nutrient elements such as potassium, nitrogen, calcium, magnesium, copper, manganese, zinc and boron coincide with high cherelle wilting (Kasran et al., 1991).

This study, therefore, was initiated to study factors responsible for the different types of cherelle wilt in the cacao field in order to be able to proffer effective management measures to increase production and to update the results of previous research in the face of changing climate.

Materials and Methods

Pathology

As a result of the complaint of cacao farmers that reached the Institute in 2017, were the farmers reported continuous heavy losses to cherelle wilt since 2014 year with the year of report of incidence witnessing the highest, a team of scientists from the Institute was setup and assigned with the responsibility of ascertaining possible remote causes and management options available to proffer to the farmers.

In carrying out the task, the team survey the cocoa producing areas of Nigeria. In conducting the survey, stratified sampling method was used to divide the cocoa-producing states in the country into 3 cacao producing agro-ecological zones and from each zone, a state(s) with high cherelle wilt mortality according to previous reports and findings of preliminary study conducted was randomly selected. This resulted in the selection of Ondo state in the West, Abia state in the South- East, Cross River state in the South-South. Other states such as Oyo and Osun state from the West and Akwa Ibom from the South-South were later added due to further complain and pressure from these states. However, due to paucity of fund, the South-South states and Oyo were not covered.

In the states covered, three local government areas (LGAs) were selected starting with the local government with the highest production, the one following and the third one with marginal production. Within these LGAs, three cocoa farming communities per LGA and a cocoa farmer's farm per community were randomly selected and surveyed.

Furthermore, per farm visited, three cacao trees were selected. Soil samples were collected at different depths around the rhizosphere of the cacao stand and three spots farther from the stand but within the canopy. Leaves and diseased sample cherelle were also collected from the cacao plant and put in Ziploc plastic bags and labelled properly. Insect's pest was also sampled and collected. GPS reading of the farms and selected cacao plant stands were also taken. Other data obtained includes count of disease and healthy cherelle per tree selected (disease severity index), status of farm (clean, weedy or abandoned), terrain (sloppy or Flat), nearness to body of water (waterlogging during and after rainy season), types of vegetation around and within the farms (insight into nutrient status of the soil) and other insects pest and disease problems.

Questionnaires were further distributed to 20-25 farmers per community to obtained further information on type, period and method of pesticides, herbicides, and fertilizer application. How and where chemicals use by the farmers was acquired were other information obtained.

Analysis of diseased cherelle samples from the states surveyed

The diseased cherelle samples obtained were taken to the plant pathology laboratory at CRIN headquarters and pieces of lesion sections excised from the cherelle pods were then plated after normal laboratory routine on extract of Potato Dextrose agar (PDA) medium (per litre: 200g peeled and sliced *Solanum tuberosum*, 15g agar powder, 20g dextrose, 10% solution Streptomycin antibiotics) in 9cm diameter disposable plastic Petri-dishes at 3 pieces per dish for the 3 replicates dishes/per cherelle pod collected. Emerging hyphae were transferred by hyphal tip on to new PDA plates to obtain pure cultures.

Morphological data were taken of relevant colony cultural characteristics
(Pigmentation, colony appearance top, and bottom of plates and conidia or spore structure under x100 and x400 objectives of Olympus microscope mounted with scope 9.0 digital imagery camera to described them). The isolates after the morphological study were sent to CABI, UK for molecular analysis.

Pathogenicity test of the fungal isolates: Pathogenicity was conducted on the fungal isolates
obtained from the various states surveyed to see fungal isolates that will produce the same symptom(s) observed in the field.

Statistical analysis: Percentage colony count of the organisms was done following Otuonye *et al.,* (2014), while percentage disease severity index was calculated by dividing the total infected cherelle over the total number of pods (both healthy and disease) then multiply by 100

Entomology

Diagnostic survey of insect pests on cherelles were conducted in different locations. In each farm, ten trees with healthy cherelles and cherelle wilt were randomly sampled. The sampling period was for 3 hours on each farm and records spanned from morning to evening. The plants on each plot were searched visually and the insects on the plants were counted. A representative sample of each insect species were collected and taken to the insect museum, CRIN, Ibadan for proper identification. Materials used for collecting insect samples included sweep nets for flying insects, pair of forceps and hand picking for larvae and slow-moving insects. They were deposited into glass vials labelled with the following information. Damage symptoms were also noted. Meteorological parameters (temperature, humidity, and rainfall) were collected.

Soil

(a) Study Area

The study areas coverthree farms (Mokore in Orile – Owu LGA, Ita Apa in Atakunmosa LGA and Orisumbare in Obokun LGA of Osun state; Ondo East, Ago store in Akure South and Alade - Idanre in Idanre LGA of Ondo state and three cocoa producing local governments areas (Umuahia North, Ikwano and Bende) in Abia state respectively.

Soil and Leaf Samples collection

Cocoa Farms were demarcated into three plots. From each of the plot, three augering points were located where soils samples were collected at 0 – 15; 15 – 30 and 30 – 45cm, the samples collected were labelled accordingly. These procedures were repeated throughout the selected farms. Altogether, twenty- seven soil samples were collected per plot, these were later bulked into nine (9) samples per location, the same procedure was repeated across three farms per local government.

Leaf samples were collected from the fourth leaf round the cocoa tree where soil samples were collected, the number of leaf samples collected were the same as the number of soil samples respectively.

Pre soil and Laboratory Analysis

Soil samples collected were air dried, sieved using 2mm sieve and subjected to physical and chemical analysis. Mechanical analysis was done using hydrometer method as described by Bouyoucos (1951), pH was determined in water (1:2 Soil: Water ratio) using a pH meter with glass electrode as described by Jackson (1965).Total Nitrogen (N) using Micro Kjedahl procedure as described by AOAC, (1990). Organic carbon content was determined using the Walkley – Black method (Nelson and Somers, 1982), available Phosphorus determination was done by the Bray method described by Bray and Kurtz (1945). Exchangeable K, Ca, Mg and Na were determined by extraction with 1N ammonium acetate and the amount of K, Ca, Na in the filtrate were determined using a Perkin Elmer Atomic Absorption Spectrophotometer (AAS). Micro – nutrients – Cu, Fe, Zn and Mn were determined after extraction of the soil samples with 0.1 NH_4Cl and the filtrate read on AAS. Exchangeable acidity was determined by soil extraction with 1N KCl and titration with 0.05N NaOH using phenolphthalein indicator as outlined in IITA laboratory manual, (1979). The effective cation exchange capacity (ECEC) of the soil samples was determined by summation of exchangeable bases (Ca, Mg, K, Na) and the total exchangeable acidity. All the sampling points are geo-referenced. Leaf Samples were equally prepared for laboratory analysis following standard method as outlined in the IITA Laboratory manual of 1979.

Data Analysis

Data were analyzed with the SPSS Version 18. The parameter analyzed include Mean and SEM. Means were separated with Duncan Multiple Range Test (DMRT). The incidence of cherelle wilt was correlated with insect pests using multiple regression analyses.

Results

Pathology:

Table 1 shows percentage disease severity index obtained per state surveyed and frequency of occurrence of organisms as shown by the percentage colony count.

The percentage disease severity index indicates that Ondo state has 94.23% followed by Abia with 73.35%, Table 1. Frequency of isolation showed that *Lasiodiplodia* spp had the highest percentage occurrence of 64.4%, 56.0% and 49.6% in Ondo, Abia, and Osun state respectively, while *Fusarium* spp with 51.8, 50.3 and 46.3 respectively, followed, Table 1.

Pathogenicity test conducted of the fungal isolates implicated *Lasiodiplodia* spp and *Fusarium* spp.

Results of molecular identification from CABI, identified, *Lasiodiplodia* spp, *Fusarium* spp-(*Fusarium solani* species complex, *Fusarium decemcellulare*), *Aspergillus* section *nigiri*, *Colletotrichumgloeosporioides*, *Bionectriaceae*, *Trichoderma ovalisporum*. Based on the pathogenicity test and identification by CABI, it is obvious that *Fusarium solani* species complex, *Fusarium decemcellulare*, *Lasiodiplodia* spp. and *Bionectriaceaei* have been implicated elsewhere to be wilt pathogen of cocoa organs and several plant hosts.

Entomology

The insect pests observed on the wilted cherelles were sucking insect pests, termites, psyllid, and pod miner. A positive and significant correlation coefficient ($r= 0.743$) was observed between sucking insect pests and the incidence of cherelle wilt. The correlation between the cherelle wilt and termite ($r = 0.260$) and psyllids ($r= 0.146$) were positive but not significant. There was a negative and non-significant relationship with pod miner (Table 2). The regression model was significant ($R^2= 0.557$, $F (4,29) = 9.122$), implying that all the insect pests observed which constituted the predictor variable together contributed to the cherelle wilt condition. However, based on individual contribution towards the cherelle wilt condition, it was only the sucking insect pests that contributed significantly to the cherelle wilt compared to other insect pests encountered. The predictor variables also accounted for 55.7 % of the incidence of the cocoa cherelle wilt. A significant regression equation obtained for the sucking insect pests was $b= 0.742$, $t=5.510$, $p<0.01$.

Soils

Table 1 presents the results of soil samples collected from farmer's farm at Mokore in Orile – Owu Local government area, Osun state. The result indicated that the soils in these areas are loamy in nature, the soil pH in these areas are slightly acidic with the values ranging from 6.5 to 6.7 at the 0 – 15cm depths; 6.52 to 6.70 at 15 to 30cm depths and 6.2 to 6.75 at 30 to 45cm depths respectively. This observation agrees with earlier result of Akanbi, *et al.,* (2012). Generally, the acidic nature of the soil could be attributed to high rainfall of the two zones which may have leached out the basic cations from the soil surface in the study areas. However, the values fall within the range of 4.5 – 6.5 considered suitable for sustainable Cocoa production in Nigeria (Egbe *et al.,* 1989)**.** The soil Organic Carbon (OC)contents of the various sites selected at Mokore, Osun state were found to be inadequate compared to the critical level required for cocoa production. The organic matter ranged from 10.22 – 11.60gkg^{-1} soil; 10.77 – 11.77 and 10.22 – 1.70gkg^{-1} soil at 0 – 15, 15 - 30 and 30 – 45cm depths respectively. Similar trends were observed Atakumosa East and Orisunbare, Obokun Local Government area of Osun state with organic matter found at the top layer ranging from 10.02 – 11.06 at Atakumosa and from 10.80 – 12.70gkg^{-1} soil respectively. The OC at the deeper depths were equally found to be low, an indication that the sites require good agricultural practises that can enhanced the organic matter accumulation of the fields (Table 2 and 3). This on the other hand, might be the cause for the yellowing of both cocoa leaves and dropping of the young cherrelles in the plantations under study. The values of total N (0.08; 0.07 & 0.08mgkg^{-1}) at 0 – 15cm depths; (0.08; 0.07 & 0.06gkg^{-1}) recorded at the depths of between 15 and 30cm and OC values of (0.09; 0.07 & 0.08gkg^{-1}) found at 30 – 45cm depths (Tables 1, 2 and 3) fall below the critical value of 30gkg^{-1} soil recommended for optimum cocoa production in Nigeria. Apart from the Magnesium (Mg) contents which are adequate in all the sites visited in Osun state compared to the critical Mg value of 0.8cmolkg^{-1} soil, exchangeable cations (Ca^{2+} K^{+} and Na^{+}) and available P (Tables 1, 2 & 3) however, are grossly inadequate since they contained lower value with respects to the critical levels (50 and 0.30cmolkg^{-1} soil) calculated for sustainable cocoa production.

Tables 4, 5 and 6 present the results of analysis of soil samples collected from farmer's farm at Akure south, Ondo East and Idanre Local government area of Ondo state. The results indicated that the soils in these areas are loamy in nature with underlying clay content, good enough to support sustainable cocoa production.

The soil pH in these areas are generally slightly acidic with the average values ranging from 6.00 to 6.3.00; 6.00 to 6.40 and 5.90 to 6.45 at the 0 –15, 15 – 30 and 30 - 45cm depths in the three farm locations visited in Ondo - East Local government area of Ondo state respectively. This range is ideal for sustainable cocoa production and agrees with earlier observation result of Akanbi, *et al.,* (2012). Generally, the slightly acidic nature of the soil could be attributed to high rainfall of these zones which may have leached out the basic cations from the soil surface in the study areas. However, these values fall within the range of 4.5 – 6.5 considered suitable for sustainable Cocoa production in Nigeria (Egbe *et al.,* 1989). Similar observations were recorded at Idanre and Akure South Local government areas of the state. The pH ranged from 6.2 – 6.4; 6.20 – 6.60 and 6.50 – 7.00 across the three selected farms in the local government areas.

The OC on the other hand, ranged from 7.9 – 8.96; 7.90 9.68 and 9.50 – 10.50g/kg soil respectively while the pH values range from 6.30 – 6.50; 6.10 – 6.40 and 6.30 – 6.50 and OC are found to range from 8.70 – 9.75g/kg soil in the first farm, 8.70 – 8.75 and 9.68 – 9.84g/kg soil in second and third farms at Akure South local government area of the state.The organic carbon contents of the various sites selected in Ondo - East were equally found to be grossly inadequate compared to the critical level required for cocoa production. The organic matter ranged between 7.10 - 7.18; 8.75 – 9.68 and 7.72 – 9.07gkg^{-1} soil at 0 – 15, 15 - 30 and 30 – 45cm depths respectively. The OC across the depths were generally low, a condition which may influence the performance of the plantations to full capacity (Table 4). This trend was the same in all the farms visited in other two local government areas (Tables 5 and 6). The OC were far below the critical level of 30.00g/kg soil required for optimal growth performance of cocoa. The low OC contents might be the one of the reasons for the yellowing of cocoa leaves and dropping of the young cocoa pods (cherrelles) in the plantations under study.

The total N varied from 0.01 – 0.06%; 0.05 – 0.08%% and 0.04 – 0.07% at the three farmers' farms visited in Ondo East while the values of soil N varied from 0.07 – 0.09% at the first location; 0.06 – 0.08 at the second farmer's farm and 0.17 – 0.20% on the third farm (Table 4) selected in Idanre local government areas. Generally, N is deficient in all the farms selected in Idanre local government area, this might be because of ageing farms and continuous mining of nutrients through harvesting of cocoa pods year in year out without returning same back into plantations either through mineral or organic fertilizer. Although, there are heap layers of dry cocoa leaf litter falls found everywhere in the plantations which are still under process of decomposition. Nitrogen is responsible for the green colouration in plants, the lack of it leads to yellowness of leaves in flowering plants. Therefore, its short supply in these farms may perhaps be the reason for the yellowish nature of Cherelles and consequently premature abortion of the Cherelles.

Similarly, the Magnesium (Mg); Calcium (Ca) and Potassium (K) contents found in all the farmer's farm visited in Idanre, Akure East and Akure South (Tables 4, 5 and 6) Local government areas of Ondo state were low compared to the critical levels of 0.8; 50.0 and 0.30cmolkg^{-1} soil calculated for sustainable cocoa production in Nigeria (Egbe *et al.,* 1989). Summarily, the soils in these areas were generally low in native nutrients; this might be due to years of usage coupled with continued mining of nutrients through pod harvesting without necessarily applying fertilizer to replace the mined nutrient elements. This on the other hand might not be unconnected to the cherrelles wilt (Yellow Okro) experienced in these areas.

Micronutrient Contents

The micro-nutrients are those nutrients that are needed in a small quantity by the crop. At the selected farmer's farms in Idanre (Table 4), the micronutrients (Fe and Zn) contents of the site varied between 0.14 and 0.16g/kg soil Fe in the first farm visited, the value recorded at the second locations ranged between 0.14 and 0.17g/kg soil Fe while that of the third farm varied from 0.12 to 0 0.1glkg soil Fe respectively within the site. The values of Zn recorded from all the locations ranged from 0.17 - 0.19; 0.20 – 0.23 and 0.06 – 0.10g/kg soil Zn. The farms at Akure East (Table 5) recorded a similar result of 0.14 0.16; 0.16 – 0.18 and 0.15 – 0.20g/kg soil Fe, 0.19 – 0.21; 0.18 0.19 and 0.18 – 0.21g/kg soil Zn respectively. Similarly, the values recorded at Akure South (Table 6) ranged between 0.16 – 0.18; 0.16 – 0.17 and 0.16 – 0.19g//kg soil Fe, 0.09 – 0.20; 0.18 – 0.22 and 0.21 – 0.22g/kg soil Zn at 0 – 15cm; 15 – 30 cm and 30 – 45 cm respectively.

Abia State

The results from Abia State are presented on Tables 7, 8 and 9 below. The results of Soil samples collected at various farm locations at Umuahia, Bende and Ikwano Local Government areas revealed that the soils are slightly acidic with the pH values within the ideal recommended for cocoa cultivation in Nigeria.

The Soil N recorded in all the farm locations at Umuahia. Ikwano and Bende Local Government areas are moderately adequate for the good growth of cocoa, but the values are much lower in some locations. The total N varied from 0.01 – 0.09%; 0.10 – 0.12%% and 0.07 – 0.10% at Umuoha, the values decreased with depths (Table 7). At Ikwano, the values of soil N varied from 0.09 – 0.14%; 0.10 – 0.13 and 0.06 - 0.07% at 0 – 15, 15 – 30 and 30 – 45cm depths respectively (Table 8). Similar trend was recorded at farm locations at Bende Local Government areas (Table 9).

The organic carbons (OC) across the depths in all the farm locations were generally low and below the critical value of 30%. The organic carbon recorded across the farms at Umuahia Local Government areas ranged from 12. 60 – 12.64; 11.40 – 11.86 and 10.60 – 10.64gkg^{-1} soil at 0 – 15, 15 - 30 and 30 – 45cm depths (Table 7), at Ikwano Local Government Area, the organic carbon varied from 10.00 – 10.92; 12.00 – 12.40 and 8.05 – 8.16g/kg soil (Table 8). Also, the farmer's farms selected across Bende Local Government areas recorded OC values which ranged from 7.80g/kg soil; 8.50 – 9.12g/kg soil and 11.82 12.00g/kg soil (Table 9). These values fall below the required amount for optimum cocoa production.

The Magnesium (Mg) contents was low in Umuoha, adequate Ikwano and Bende Local Government areas (Tables 7,8 and 9); Calcium (Ca) contents were found to be limiting in all the farms visited in the three local government areas. Potassium (K) contents on the other hand were adequate in the entire farmer's farm visited in Umuoha, Ikwan and Bende Local Government areas (Tables 7, 8 and 9) of Abia State. The short supply of these major and essential nutrients elements on the other hand might be the main cause of yellow Okro (Cherrelles wilt) which cause dropping young cocoa pods Cherrelles experienced in these areas.

Observations

The following are the general observations in the course of our visit to the various locations selected in the three states for sample collections.

1. Many of the Cocoa plantations visited were old,
2. The plantations were planted without following recommended spacing; most of the cocoa plots were overpopulated with touching or inter-locking branches.
3. Poor shade regime of most of the farms visited were also noticed, this may enhance the build-up high humidity
4. There was no history of fertilizer usage in all the farm location visited across the states.

Conclusion/Recommendations

The high disease severity index from the states surveyed shows that cherelle wilt could be exacerbated by pathogenic organisms aided by some soil factor, management practices and prevailing climatic condition of the area involved. Sucking insect pests of cocoa include mirid, tea mosquito bug, shield bug among others. The study has demonstrated that these sucking insect pests are significant predictors of cherelle wilt. These sucking insect pests which feed extensively on cocoa pods might contribute to the wilting condition through the toxic effect of their saliva or by lowering resistance of pods to wilting. In order to address the wilt condition of young pods, an in-depth study on the role of these pests is to be conducted.

The low level of major soil nutrients required by the cocoa plant to perform optimally might trigger the physiological disorder in the plant thereby leading to the physical expression of cherelles wilt expressed by the cocoa plants across the study areas. This disorder may be expressed in the leaves and even on the young forming pods inform of yellowness of the leaves or the young cocoa pods which might result to premature abortion.
Based on the preliminary results of the soil analysis and the general observations of the farmer's farms in these locations, it is therefore recommended that fund be made available to run the Laboratory analysis of the leaf samples collected from the various farm locations for a more and better understanding of the scenario.

Also, training on good agricultural practices, most especially in soil nutrient management, Disease and Pest management be organized across study areas.

Challenges: Fund limitation and difficult terrain of areas surveyed

Status: On-going

Plans: Conclusion of survey of listed states and field trials of fungicides on fungal isolates in three cocoa agro ecological zones to proffer management options for the control of cherelle wilt disease. The final stage will be book publication and teaching farmers and stakeholder's best and cost-effective management options available

Table 1. Percentage Disease severity indexand frequency of isolation of fungal isolates

State Surveyed	% Disease severity index	% frequency of fungi isolated from infected cherelle pods															
		Lasi odiplodia spp	Aspergillus niger	Fusanum species	Rhizopus nigircans	Trichoderma spp	Colletotrichum	Botrytis spp	Aspergillus spp	Pythium spp	*Cto'vtdaria* spp	*Penicillitan* spp	Yeast	Streptomyces	*FusaritionOxysp oriton*	*Neurosopora* spp
Abia	72.35	26.10	2.90	10.14	-	-	-	-	-	5.80	-	4.35	31.88	10.14	-	2.90
Osun	68.16	29.41	22.05	14.70	2.10	7.11	9.01	-	2.34	14.70	-	1.47	7.35	-	1.47	-
Ondo	94.23	19.4	4.47	0.05	20.63	1.58	11.11	25.9	3.17	1.58	9.52	1.58	-	-	26.98	-

Table 2: Relationship between the Incidence of Cherelle wilt and Insect Pests of Cocoa

Insect Pests	Correlation coefficient (r)	Regression equation
Sucking insect pets	0.743*	Y= 0.271+ 0.742x
Termites	0.260	Y= 0.271- 0.013x
Psyllids	0.146	Y= 0.271- 0.013x
Pod miner	-0.045	Y= 0.271- 0.142x

*Correlation is significant at p< 0.05

Table 1: Results of soil samples collected from farmer's farm at Mokore in Orile –Owu Local government area, Osun state

	Farm 1			Farm 2			Farm 3		
Soil Properties	0 - 15cm	15 – 30cm	30 – 45cm	0 – 15cm	15 – 30cm	30 – 45cm	0 – 15cm	15 – 30cm	30 – 45cm
pH	6.70	6.60	6.75	6.70	6.60	6.20	6.50	6.52	6.72
Na $cmolkg^{-1}$	0.58	0.56	0.64	0.64	0.62	0.62	0.60	0.63	0.68
K cmolkg	0.12	0.26	0.08	0.17	0.05	0.27	0.21	0.16	0.09
Ca $cmolkg^{-1}$	0.27	0.25	0.38	0.37	0.31	0.30	0.33	0.32	0.35
mg $cmolkg^{-1}$	1.24	1.26	1.37	1.35	1.41	1.46	1.51	1.50	1.70
H^{+}	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.084	0.07
Av. P($mgkg^{-1}$)	8.70	8.74	9.40	9.46	8.96	8.94	8.86	8.88	9.12
OC(gkg^{-1})	10.7	10.77	11.24	11.32	11.5	11.7	11.6	11.72	10.22
TN($mgkg^{-1}$)	0.08	0.07	0.06	0.08	0.07	0.06	0.09	0.07	0.08
Fe ($mgkg^{-1}$)	1.64	1.62	1.58	1`.56	1.7	1.72	1.88	1.86	1.84
Zn ($mgkg^{-1}$)	1.82	1.8	1.72	1.7	1.94	1.96	1.97	1.94	1.96
CEC	2.91	2.87	3.40	3.39	3.29	3.35	3.36	3.36	4.14
% Base Saturation	97.43	93.39	97.85	97.79	97.57	97.61	97.47	97.5	98.21
% Silt	86.4	8.6.42	80.2	80.32	82.6	82.7	78.4	78.6	88.4
% sand	10.1	10.14	14.2	14.25	12.6	12.8	20.1	20.14	10.4
% clay	3.5	3.44	5.6	5.43	4.8	4.5	1.5	1.26	1.2

Table 2: Results of soil samples collected from farer's farm at Atakunmosa Local government East,Ita Apa in Osun state

	Farm 1			Farm 2			Farm 3		
Soil Properties	0 - 15cm	15 – 30cm	30 – 45cm	0 – 15cm	15 – 30cm	30 – 45cm	0 – 15cm	15 – 30cm	30 – 45cm
pH	6.1	6.3	6.26	6.3	6.2	6.1	6.4	6.12	6.02
Na $cmolkg^{-1}$	0.46	0.42	0.50	0.44	0.32	0.51	0.6	0.5	0.48
K $cmolkg^{-1}$	0.55	0.62	0.88	0.75	0.77	0.76	0.80	0.78	0.94
Ca $cmolkg^{-1}$	0.22	0.20	0.33	0.32	0.29	0.20	0.21	0.28	0.29
mg $cmolkg^{-1}$	1.00	0.76	1.00	1.11	1.03	0.96	0.81	0.9	0.8
H^{+}	0.06	0.05	0.07	0.06	0.07	0.07	0.07	0.08	0.07
Av. P($mgkg_{-1}$)	7.36	8.00	7.60	7.65	7.80	7.17	7.20	7.78	7.21
OC(gkg^{-1})	11.02	11.00	10.01	10.02	10.23	10.61	10.13	10.32	12.50
%TN	0.07	0.03	0.94	0.09	0.08	0.09	0.08	0.08	0.04
Fe ($mgkg^{-1}$)	0.44	0.92	1.01	0`.96	0.82	1.60	1.21	1.06	0.24
Zn ($mgkg^{-1}$)	1.11	0.90	1.00	1.11	1.21	1.00	1.17	1.31	1.01
% Silt	85.6	81.46	81.3	85.35	83.5	81.9	76.4	79.4	87.4
% sand	11.1	15.10	14.0	10.25	11.7	12.5	21.1	19.34	11.4
% clay	3.3	3.44	6.7	4.40	4.8	5.6	2.5	1.26	1.2

Table 3: Results of soil samples collected from farmer's farm at Orisunbare in Obokun Local government area, in Osun state

	Farm 1			Farm 2			arm 3		
Soil Properties	0 - 15cm	15 – 30cm	30 – 45cm	0 15cm	15 – 30cm	30 – 45cm	0 15cm	15 – 0cm	30 – 45cm
pH	6.01	5.90	6.45	6.23	6.56	6.26	6.45	6.62	6.52
Na $cmolkg^{-1}$	0.50	0.51	0.54	0.60	0.52	0.72	0.70	0.66	0.61
K $cmolkg^{-1}$	0.68	0.65	0.80	0.75	0.83	0.91	0.74	0.86	0.69
Ca $cmolkg^{-1}$	0.12	0.21	0.34	0.33	0.31	0.3	0.32	0.29	0.30
mg $cmolkg^{-1}$	0.64	0.96	0.87	1.00	0.92	0.60	0.81	0.90	1.10
H^+	0.08	0.06	0.05	0.08	0.06	0.05	0.07	0.06	0.08
Av. P($mgkg^{-1}$	7.6	7.84	8.80	8.56	8.46	8.07	8.74	7.68	8.12
OC(gkg^{-1})	12.7	11.57	14.14	10.80	14.53	10.87	12.63	13.72	20.85
TN(gkg^{-1})	0.08	0.76	0.08	0.10	0.05	0.07	0.80	.06	0.04
Fe ($mgkg^{-1}$)	0.64	0.52	0.51	0`.57	0.78	0.92	1.53	1.25	1.04
Zn ($mgkg^{-1}$)	0.62	0.90	0.61	0.97	0.86	0.97	0.99	0.90	1.05
% Silt	83.4	80.32	82.4	83.42	83.6	81.4	75.4	80.6	86.5
% sand	12.1	16.24	12.2	11.15	10.4	13.8	22.1	18.15	12.3
% clay	4.5	3.44	5.4	5.43	7.0	4.8	2.5	1.25	1.2

Table 4: Results of soil samples collected from farmer's farm at Ondo East Local Government Area of Ondo State.

	Farm 1			Farm 2			Farm 3		
Soil Properties	0 - 15cm	15 – 30cm	30 – 45cm	0 – 15cm	15 – 30cm	30 – 45cm	0 – 15cm	15 – 30cm	30 – 45cm
pH	6.30	6.20	6.00	6.40	6.10	6.00	6.01	5.90	6.45
Na $cmolkg^{-1}$	0.37	0.36	0.30	0.38	0.37	0.35	0.29	0.27	0.26
K $cmolkg^{-1}$	0.41	0.50	0.49	0.56	0.50	0.49	0.51	0.45	0.41
Ca $cmolkg^{-1}$	0.28	0.27	0.25	0.28	0.27	0.23	0.30	0.28	0.29
Mg cmolkg	0.18	0.18	0.09	0.21	0.20	0.18	0.06	0.04	0.01
H^+	0.09	0.10	0.07	0.09	0.08	0.07	0.07	0.05	0.06
Av. P(mgkg)	6.64	6.62	6.00	6.94	6.91	5.90	7.07	6.74	6.08
OC(gkg)	7.80	7.81	7.10	9.68	8.75	8.50	9.07	8.03	7.72
TN (%)	0.06	0.03	0.01	0.08	0.07	0.05	0.07	0.05	0.04
Fe ($mgkg^{-1}$)	0.14	0.16	0.15	0.16	0.17	0.14	0.12	1.10	1.00
Zn ($mgkg^{-1}$)	0.18	0.19	0.17	0.23	0.20	0.20	0.11	0.09	0.06
CEC	1.42	1.40	1.38	1.52	1.50	1.49	.46	1.40	1.60
% Base Saturation	93.29	92.91	90.68	94.08	94.00	93.06	96.05	94.20	93.60
% Silt	62.20	70.20	64.20	75.20	65.20	61.80	81.9	75.4	89.40
% sand	36.20	28.20	25.20	13.20	33.20	36.20	12.5	11.1	19.34
% clay	1.60	1.60	10.60	2.60	1.60	2.00	5.6	2.5	1.26

Table 5: Results of soil samples collected from farmer's farm at Idanre Local Government Area of Ondo State.

	Farm 1			Farm 2			Farm 3		
Soil Properties	0 - 15cm	15 – 30cm	30 – 45cm	0 15cm	15 – 30cm	30 – 45cm	0 15cm	15 – 30cm	30 – 45cm
pH (H_2O)	6.45	6.40	6.20	6.60	6.50	6.20	7.00	6.90	6.50
Na cmolkg^{-1}	0.41	0.40	0.40	0.46	0.45	0.42	0.52	0.50	0.47
K cmolkg^{-1}	0.60	0.58	0.54	0.62	0.60	0.59	0.71	0.65	0.60
Ca cmolkg^{-1}	0.32	0.31	0.30	0.32	0.31	0.30	0.45	0.41	0.40
Mg cmolkg^{-1}	0.19	0.18	0.16	0.26	0 24	0.22	0.46	0.40	0.50
H^+	0.09	0.85	0.80	0.08	0.75	0.70	0.06	0.05	0.04
Av. P(mgkg^{-1})	7.86	7.82	7.50	8.00	7.82	7.80	7.50	7.20	7.00
OC(%)	8.96	8.94	7.90	9.68	9.67	.80	10.50	10.50	9.60
TN%)	0.09	0.08	0.07	0.08	0.07	0.06	0.06	0.05	0.04
Fe (mgkg^{-1})	0.16	0.16	0.14	0.18	0.16	0.17	0.20	0.18	0.15
Zn (mgkg)	0.21	0.20	0.19	0.19	0.18	0.17	0.21	0.20	0.18
CEC	1.60	1.58	1.54	1.75	1.65	1.60	1.80	1.70	1.65
% Base Saturation	94.38	94.30	93.80	95.24	94.80	93.46	97.24	96.50	94.70
% Silt	60.00	61.80	70.20	77.20	76.20	80.90	80.20	72.20	85.90
% sand	31.00	28.20	25.00	21.40	21.10	20.10	18.40	25.40	10.10
% clay	9.00	10.00	4.80	1.40	2.70	9.00	1.40	2.40	4.00

Table 6: Results of soil samples collected from farmer's farm at Akure South Local Government Area of Ondo State

	Farm 1			Farm 2			Farm 3		
Soil Properties	0 - 15cm	15 – 30cm	30 – 45cm	0 – 15cm	15 – 30cm	30 – 45cm	0 – 15cm	15 – 30cm	30 – 45cm
pH	6.50	6.40	6.30	6.20	6.10	6.40	6.50	6.40	6.30
Na cmolkg^{-1}	0.45	0.44	0.39	0.38	0.37	0.35	0.48	0.46	0.44
K cmolkg^{-1}	0.63	0.61	0.60	0.52	0.50	0.51	0.61	0.60	0.60
Ca cmolkg^{-1}	0.32	0.31	0.30	0.27	0.25	0.23	0.33	0.32	0.30
Mg cmolkg^{-1}	0.21	0.20	0.19	0.17	0.16	0.15	0.24	0.23	0.21
H^+	0.08	0.08	0.08	0.10	0.10	0.08	0.10	0.08	0.09
Av. P(mgkg^{-1})	6.96	6.94	6.75	6.78	6.75	6.72	7.90	7.48	7.30
OC (%)	9.75	9.72	8.70	8.75	8.72	8.70	9.84	9.80	9.68
TN (%)	0.09	0.08	0.07	0.07	0.06	0.06	0.10	0.09	0.07
Fe (mgkg^{-1})	0.18	0.18	0.16	0.17	0.16	0.16	0.19	0.17	0.16
Zn (mgkg^{-1})	0.20	0.09	0.17	0.19	0.18	0.22	0.22	0.22	0.21
CEC	1.68	1.44	1.39	1.44	1.39	1.30	1.74	1.72	1.70
% Base Saturation	96.93	94.93	92.82	93.06	92.10	92.00	96.10	95.46	93.60
% Silt	62.20	69 40	70.80	63.20	62.80	61.00	69.40	69.20	69.00
% sand	27.20	29.40	29.20	21.60	27.20	27.69	26.60	27.20	20.20
% clay	1.60	11.20	10.00	15.20	10.00	11.31	15.00	13.60	10.80

Table 7: Results of soil samples collected from farmer's farm at Umuoha North Local Government Area of Abia State

	Farm 1			Farm 2			Farm 3		
Soil Properties	0 - 15cm	15 – 30cm	30 – 45cm	0 15cm	15 – 30	30 – 45cm	0 15cm	15 – 30cm	30 – 45cm
pH	6.60	6.20	6.00	6.50	6.10	6.00	6.65	6.60	6.45
Na $cmolkg^{-1}$	0.51	0.50	0.48	0.49	0.48	0.46	0.47	0.46	0.42
K $cmolkg^{-1}$	0.73	0.72	0.64	0.68	0.63	0.60	0.64	0.62	0.60
Ca $cmolkg^{-1}$	0.35	0.34	0.32	0.32	0.30	0.29	0.35	0.34	0.32
Mg $cmolkg^{-1}$	1.22	1.20	1.15	0.24	0.22	0.20	0.26	0.22	0.24
H^+	0.08	0.08	0.07	0.85	0.83	0.80	0.08	0.07	0.65
Av. P($mgkg^{-1}$)	8.46	8.44	8.40	8.94	8.74	8.68	7.52	7.50	7.50
OC (%)	12.64	12.62	12.60	11.86	11.40	10.90	10.64	10.62	10.60
TN (%)	0.14	0.12	0 09	0.12	0.11	0.10	0.10	0.08	0.07
Fe ($mgkg^{-1}$)	0.25	0.20	0.20	0.19	0.16	0.13	0.16	0.15	0.13
Zn ($mgkg^{-1}$)	2.89	2.80	2.50	0.26	0.24	0.22	0.22	0.20	0.19
CEC	1.80	1.78	1.70	1.80	1.79	1.68	1.79	1.75	1.70
% Base Saturation	95.53	95.48	93.90	95.26	95.24	95.00	97.00	95.50	93.56
% Silt	73.20	71.20	68.80	69.00	68.20	68.00	76.40	71.40	68.80
% sand	25.20	27.40	29.00	20.00	20.20	21 40	20.00	21.00	20.10
% clay	1.60	1.40	2.20	11.00	11.60	1.60	3.60	7.60	11.10

Table 8: Resultsof soil samples collected from farmer's farm at Ikwano Local Government Area of Abia State**.**

	Farm 1			Farm 2			Farm 3		
Soil Properties	0 - 15cm	15 – 30cm	30 – 45cm	0 – 15cm	15 – 30cm	30 – 45cm	0 – 15cm	15 – 30cm	30 – 45cm
pH	6.62	6.60	6.00	6.60	6.20	6.00	6.50	6.20	6.00
Na $cmolkg^{-1}$	0.48	0.46	0.42	0.52	0.50	0.49	0.54	0.50	0.48
K $cmolkg^{-1}$	0.68	0.66	0.60	0.64	0.62	0.60	0.71	0.70	0.68
Ca $cmolkg^{-1}$	0.33	0.32	0.30	0.34	0.30	0.29	0.38	0.36	0.32
Mg $cmolkg^{-1}$	1.14	1.11	1.10	1.12	1.10	1.10	1.10	1.01	1.00
H^+	0.78	0.70	0.67	0.08	0.07	0.06	0.14	0.13	0.11
Av. P($mgkg^{-1}$)	7.88	7.86	7.40	8.60	8.40	8.20	6.55	6.37	6.25
OC(gkg^{-1})	10.92	10.90	10.80	12.40	12.20	12.00	8.16	8.12	8.05
TN($mgkg^{-1}$)	0.12	0.10	0.09	0.13	0.12	0.10	0.07	0.07	0.06
Fe ($mgkg^{-1}$)	0.18	0.15	0.13	0.21	0.20	0.18	0.24	0.22	0.21
Zn ($mgkg^{-1}$)	0.24	0.22	0.20	0.23	0.20	0.19	0.28	0.25	0.22
CEC	2.70	2.69	2.52	2.74	2.68	2.65	2.87	2.77	2.68
% Base Saturation	98.04	97.02	93.52	97.08	95.00	93.03	95.67	95.26	92.70
% Silt	68.21	68.10	63.24	71.20	68.60	67.70	73.20	72.60	71.20
% sand	31.20	21.50	33.56	28.20	28.20	30.00	26.40	27.10	28.20
% clay	1.60	1.40	3.20	0.60	3.20	2.30	0.40	0.30	0.60

Table 9: Results of soil samples collected from farmer's farm at Bende Local Government Area of Abia State.

	Farm 1			Farm 2			Farm 3		
Soil Properties	- 15cm	15 – 30cm	30 – 45cm	0 15cm	15 – 30cm	30 – 45cm	0 15cm	15 – 30	30 – 45cm
pH	6.20	5.8	5.9	5.70	5.60	5.20	6.75	6.70	6.20
Na $cmolkg^{-1}$	0.51	0.50	0.49	0.56	0.52	0.51	0.47	0.49	0.51
K $cmolkg^{-1}$	0.35	0.33	0.32	0.38	0.34	0.30	0.61	0.61	0.59
Ca $cmolkg^{-1}$	0.38	0.28	0.33	0.31	0.25	0.21	0.38	0.35	0.32
Mg $cmolkg^{-1}$	1.11	1.10	1.05	1.14	1.12	1.09	0.40	0.50	0.24
H^+	14	0.13	0.12	0.14	0.08	0.08	0.07	0.06	0.08
Av. P($mg\,kg^{-1}$)	6.52	6.50	6.50	6.40	8.00	7.60	9.10	9.00	8.89
OC (%)	.26	8.16	7.80	11.30	8.50	9.12	12.00	11.82	11.96
TN (%)	0.10	0.08	0.07	0.10	0.09	0.08	0.09	0.07	0.05
Fe ($mgkg^{-1}$)	0.20	0.18	0.14	0.16	0.09	0.20	0.19	0.18	0.17
Zn ($mgkg^{-1}$)	0.27	0.25	0.22	0.24	0.23	0.20	0.20	0.21	0.23
CEC	2.98	2.85	2.81	2.65	2.61	2.58	1.80	1.74	1.50
% Base Saturation	97.20	98.08	96.03	95.60	93.80	92.80	96.00	94.85	95.10
% Silt	73.10	68.40	70.00	76.20	71.10	70.00	67.35	68.30	64.80
% sand	26.60	20.30	27.60	10.60	26.50	29.20	30.00	31.40	35.10

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Experimental Title: Growth and Establishment of Cocoa Seedlings under intercrop with plantain at different transplanting positions

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Introduction

Cocoa (*Theobroma cacao* L.) is a tropical woody species which belongs to the family Malvaceace (Alverson *et al*., 1999). Under natural condition, the tree can attain a height of 20 -25 m (Lachenaud *et al*., 1997), whereas under cultivation, plant height varies from 3 to 5 m. The geographical origin of cacao is South America (Oluwalade, 2018). It is considered as one of the most important perennial crops with an estimated world output of 4.2 million tonnes in 2018 (ICCO, 2007), while FAO (2011) reported an estimated annual yield of 3.2 million tonnes in 2009. It is cultivated in the Humid tropics of the world (Yanelis *et al.,* 2012) with more than 70% production coming from Africa as source of income for producing countries (Simo *et al*., 2018). Cocoa production is dominated by small-scale farmers who live and work in the cocoa belt providing them employment and income (Minimol *et al*., 2015; Ngoh *et al.,* 2015) Cocoa is the most prominent export crop in Nigeria in terms of its production and export capacities.

Traditionally, cacao farmers in Nigeria established their farms with plantains or other food crops, either sown directly at stake or seedlings are transplanted from the nursery into the field (La Anyane, 1963; Benneh, 1987; Opeke, 2005). Conventionally, cacao seedlings are planted or transplanted in between the plantain suckers (Owusu-Benpah, 1988). The temporary shade provided by plantain provides direct shade to the cacao seedlings for 2 to 3 years after transplanting. Moreover, despite the provision of shade by plantain for transplanted young cacao seedlings, it is a known fact that the highest percentage of these seedlings die between the first and second dry seasons as a result of soil moisture deficit during the peak of dry seasons (Babadele, 2018). It is also established that plantains that are planted to provide shade during the dry period do shed most of their leaves as a result of limited soil moisture in order to survive (Babadele, 2018). In Nigeria, cocoa production is limited to the rainforest and savanna transition zones. Presently, the level of cocoa production stands at 350,000 tonnes per annum (ICCO, 2015), in spite of the fact that Nigeria is endowed with vast land areas suitable for its cultivation. Adoption of good management practices can bring about increased bean production of up to 100-300% (Famuagun, 2016). According to Famuagun and Agele (2010), the major reason attributed to low productivity despite the huge effort of the government were limited access to modern production technology, limited access to input and credit facilities, low percentage of survival (less than 35%) of transplanted seedlings at the end of the second dry season due to soil moisture stress and poor field management. There are also concerns that the projected global temperature rises and subsequent increase in potential evapo-transpiration and demand for plant water may lead to further drought stress during the dry season and deterioration of cocoa climate condition (Laderach *et al*, 2013; Schroch *et al.,* 2016). To solve the above-mentioned problems, more robust farm management strategies are therefore needed.

Effective management of cacao seedlings on the field using agronomic practices like dry season irrigation and optimum shading regime to enhance root development could improve plantation establishment and cacao productivity. However, research efforts that would ensure cocoa sustainable production at the early stage of establishment are seen as steps in the right direction which remains sacrosanct for the survival of young cocoa in the field and the improvement of farmers' income (Agbongiarhuoyi *et al.,* 2016). Moreover, it is a known fact that cacao cultivation in Nigeria is predominantly in the hand of peasant farmers who cannot afford irrigation facilities. Due to climate change, rainfall and humidity have been on a decline progressively since mid-1970s (Omotosho *et al.*, 2000), while global warming has been on steady increase. Given the increasing global demand for cocoa and quest for obtaining sustainable production systems, it is imperative to understand the effects of some agronomic practices on the responses of cacao seedlings to dry season environmental conditions especially the hydrothermal stresses (Daymond and Hardley,2004). Improved insights would be valuable towards the attainment of optimum seedlings establishment and vigor on the field (Famuagun and Agele, 2019). Much of success of intercrops in cacao establishment depends on understanding the role each component plays in the system: cacao/plantain farming system has been recommended (Manu and Tettel, 1988) but the transplanting arrangement in the face of global warming and climate change is a gap in research.

Objective of the study: To evaluate effect of different planting positions of cacao and plantain on survival and morphological growth of cacao on the field.

Materials And Methods

Study area

Field experiment was carried out at the experimental farm of Cocoa Research Institute of Nigeria (CRIN), Uhonmora Station in Edo State between 2018 and 2020 covering two consecutive rainy seasons and two dry seasons. The location, a derived savanna zone of Nigeria, lies on latitude 6'5N and longitude 5'50'E. The rain fall is between 1000 – 1500 mm per annum. The maximum temperature ranges between 26 to 35 ^{0}C with an average of about 30 ^{0}C while minimum temperature ranges from 15 to 25^{0}C with an average of 20 ^{0}C. Relative humidity is high during the raining season, ranges from 50 to 85 % with an average of 75%. There are seasonal variations in the values of relative humidity, which varies from 65 to 89% during the rainy season and 46 – 70 % during the dry season. The rainy season which runs from April to October is characterized by heavy rains, low ambient temperature and high humidity; while the dry season runs from November to March and is characterized by little or no rain, high ambient temperature and very low humidity.

Acquisition and preparation of experimental materials

Seedlings of hybrid CRIN TC genotype were collected from CRIN, Uhonmora nursery, while plantain suckers were collected from experimental plots in the station. Experimental plot of 50 by 30 m was mapped out and the experiment was laid out in rows of 3 x 3 m.

Treatments and experimental design

The field experiment comprised four treatments (four different transplanting positions of cacao seedlings and plantain suckers):Plantain suckers on top of cacao seedlings at transplanting (PTCT), Cacao seedlings on top of plantain suckers at transplanting (CTPT), and Cacao seedlings transplanted 30 cm (between 2 plantain stands) apart from plantain suckers at transplanting (CT30cmP) and Cacao seedlings transplanted 150 cm (between 2 plantain stands) apart from plantain suckers at transplanting (CT150cmP) as control. The experiment was laid in Randomized Complete Block Design (RCBD) with three replications. Layout of the experimental site (Measurement, pegging, and holing) was carried out. One hundred and forty-four (144) plantain suckers were planted at 3 x 3m spacing as shade crop. The same number of five months old cacao seedlings (Hybrid) of average height of 50 cm (raised in the nursery) was transplanted on treatment basis. The experiment was monitored for 22 months after transplanting (MAT).

Data collection

Data collected included growth parameters of cacao seedlings (Plant height, Number of leaves, Stem diameter, Leaf area, Number of branches) and their Survival counts. The growth parameters were taken on monthly basis for 22 months commencing from 3 months after transplanting (3MAT). Plant height (cm)was measured using a meter rule from the ground surface to the tip of the main stem. Stem diameter (cm) was measured with Vernier Caliper 30 cm above the ground level. Number of leaves, Number of branches and Survival count were determined by visual count. Leaf area was also measured. The growth parameters were taken monthly for 22 months commencing from 3 MAT. Survival counts were carried out at 10 and 22 MAT

Data collected were subjected to statistical analysis using analysis of variance (ANOVA) as well as descriptive statistics, and significant means were separated by Duncan Multiple Range Test (DMRT) ($P<0.05$)

Results and Discussion

Effects of transplanting positions of cacao seedlings on survival count are represented in Figure 1. Cacao seedlings on top of plantain suckers at transplanting (CTPT) and Plantain suckers on top of cacao seedlings at transplanting (PTCT) significantly (P<0.05) enhanced the survival count of cacao seedlings relative to other treatments at 10 and 22 MAT, while cacao seedlings on top of plantain at transplanting gave the highest survival count in both 10 and 22 MAT (Figure 1). The highest seedlings survival count recorded in 10 and 22 MAT under Cacao seedlings on top of plantain suckers at transplanting (CTPT) could be as a result of commensalism relationship between the transplanted cacao seedlings on top of the plantain suckers in which both shared the same environment and the cacao benefitted from the water and cooler weather around the biosphere especially during the dry season, yet the plantain was not adversely affected. The relationship is called table fellowship. This result also confirmed that the survival of transplanted cacao seedlings did not depend on the spacing adopted but the arrangement of cacao with the plantain. This result was corroborated by Ayegboyin *et al*. (2020), Famuagun and Agele (2019) who reported that the reduction in stand mortality under moderate and dense shaded plots was traced to improved microclimate conditions occasioned by shade plants that aided reduced air and soil temperature, reduced moisture loss through evaporation and increased activities of microbial organism under shaded microclimate. It was also observed that the same CTPT treatment had the lowest percentage mortality rate of 18% after the end of the first dry season; this was closely followed by PTCT (19%) (Figure 1).

Effect of transplanting position of cacao seedlings on growth parameters of cacao seedlings is presented in tables 1 -5. The CTPT also gave the highest plant height, number of leaves, stem diameter, number of branches and leaf area at 4 MAT, at 15 MAT, at 13, 14, 15 MAT, at 15 MAT and 15 MAT, respectively. When compared with the conventional transplanting of cacao seedlings in between the plantains (CT150cmP), CTPT increased the plant height, number of leaves, stem diameter, number of branches and leaf area at 4 MAT, at15 MAT, at 3, 13, 14, 15 MAT, at 3, 15 MAT and at 13, 14,15 MAT respectively by 1%, 10%, 61%, 2%, 3%, 8%,46%, 11%, 5%, 3% and 13% respectively; while CT150cmP treatment significantly enhanced cacao seedlings, number of leaves, number of branches and leaf area at 4 MAT, 4 and 13 MAT, 3, 4,5 MAT, respectively, when compared with the other treatments. This finding could be due to the fact that the cacao seedlings which could have been suppressed by plantain shade were not directly positioned under the plantain suckers but in between which is 150cm apart. This discovery is in agreement with the reports of Famaye *et al*. (2003) that, due to the competition that exists among them, closely spaced cacao seedlings produced smaller morphological parameters than well-spaced ones. Shipat (2001) as well as Famuagun and Agele (2016) also established that the leaves and circumference of plants are among the main factors that determine the vigour needed for the growth of cacao seedlings after transplanting.

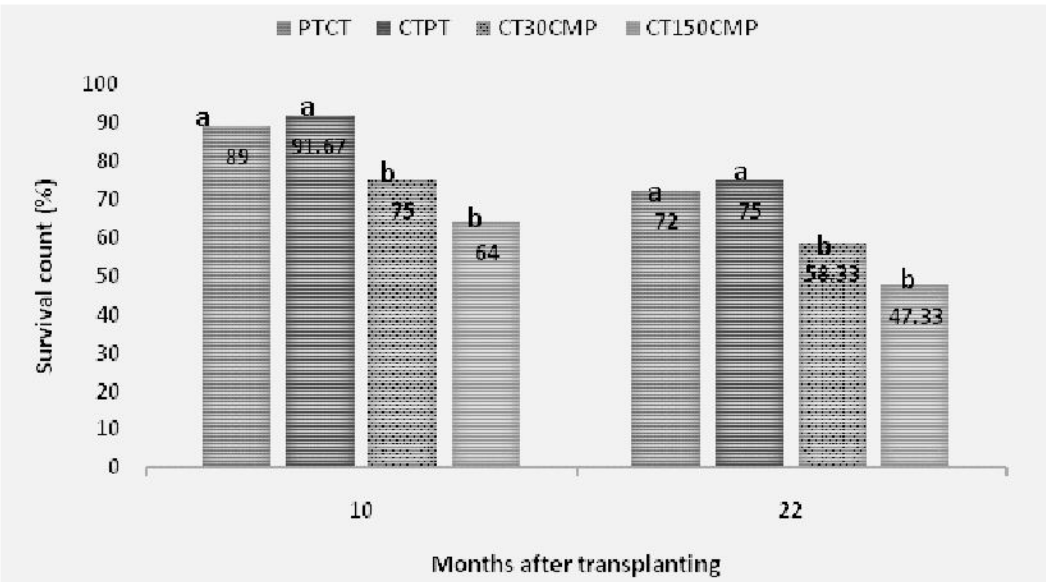

Figure 1: Effect of transplanting positions on survival count (%) of cocoa seedlings
Means followed by the same letters in each composite bars are not significantly different by DMRT (P<0.05)
PTCT: Plantain on top of cacao seedlings at transplanting; CTPT: Cacao on top of plantain at transplanting; CT30cmP: Cacao transplanted 30 cm apart from plantain; CT150cmP; Cacao transplanted 150 cm apart from plantain

Table 1: Effect of transplanting positions on plant height (cm) of cocoa seedlings

Treatments	3 MAT	4 MAT	5 MAT	12 MAT	13 MAT	14 MAT	15 MAT
PTCT	74.33b	98.33c	124.00c	175.67a	179.67a	182.67a	187.00a
CTPT	94.33ab	147.00a	157.67ab	159.33a	173.00a	178.67a	195.33a
CT30cmP	92.00ab	134.00b	146.33b	162.33a	169.67a	182.00a	191.33a
CT150cmP	112.67a	145.67a	164.67a	177.00a	179.67a	186.67a	200.67a
Mean	93.33	131.25	148.17	168.58	175.50	182.50	193.58

Means followed by the same letters along each column are not significantly different by DMRT (P<0.05)
PTCT: Plantain on top of cacao seedlings at transplanting; CTPT: Cacao on top of plantain at transplanting; CT30cmP: Cacao transplanted 30 cm apart from plantain; CT150cmP; Cacao transplanted 150 cm apart from plantain

Table 2: Effect of transplanting positions on number of leaves of cocoa seedlings

Treatments	3 MAT	4 MAT	5 MAT	12 MAT	13 MAT	14 MAT	15 MAT
PTCT	23.00a	45.67b	64.33ab	92.33a	111.00a	114.33a	132.33a
CTPT	9.00c	48.00b	83.33a	91.33a	110.67a	112.67a	137.67a
CT30cmP	13.33b	31.00c	55.67b	90.00a	109.00a	109.00a	121.33a
CT150cmP	11.33bc	87.33a	87.33a	92.33a	127.00a	116.00a	123.67a
Mean	14.17	53.00	72.67	92.00	114.42	113.00	128.75

Means followed by the same letters along each column are not significantly different by DMRT (P<0.05)
PTCT: Plantain on top of cacao seedlings at transplanting; CTPT: Cacao on top of plantain at transplanting; CT30cmP: Cacao transplanted 30 cm apart from plantain; CT150cmP; Cacao transplanted 150 cm apart from plantain

Table 3: Effect of transplanting positions on stem diameter(cm) of cocoa seedlings

Treatments	3 MAT	4 MAT	5 MAT	12 MAT	13 MAT	14 MAT	15 MAT
PTCT	0.63a	1.57ab	1.83b	3.27a	3.33a	3.70a	3.67b
CTPT	0.43ab	1.60ab	2.23ab	3.03a	3.73a	3.83a	4.07a
CT30cmP	0.73a	1.20b	2.30ab	3.20a	3.47a	3.43a	3.77ab
CT150cmP	0.17b	1.83a	2.67a	3.37a	3.67a	3.73a	3.73b
Mean	0.49	1.55	2.26	3.22	3.55	3.81	3.68

Means followed by the same letters along each column are not significantly different by DMRT (P<0.05)
PTCT: Plantain on top of cacao seedlings at transplanting; CTPT: Cacao on top of plantain at transplanting; CT30cmP: Cacao transplanted 30 cm apart from plantain; CT150cmP; Cacao transplanted 150 cm apart from plantain

Table 4: Effect of transplanting positionson number of branches of cocoa seedlings

Treatments	3 MAT	4 MAT	5 MAT	12 MAT	13 MAT	14 MAT	15 MAT
PTCT	0.47a	2.00b	5.67ab	3.50b	4.17b	5.67ab	5.33a
CTPT	0.37a	3.33b	5.00bc	3.60ab	4.20b	5.00bc	6.00a
CT30cmP	0.57a	1.33b	4.00c	4.37a	4.17b	4.00c	4.33b
CT150cmP	0.20b	6.67a	6.67a	4.00ab	6.67a	6.67a	5.33a
Mean	0.40	3.33	5.33	3.89	4.80	5.33	5.25

Means followed by the same letters along each column are not significantly different by DMRT (P<0.05)
PTCT: Plantain on top of cacao seedlings at transplanting; CTPT: Cacao on top of plantain at transplanting; CT30cmP: Cacao transplanted 30 cm apart from plantain; CT150cmP; Cacao transplanted 150 cm apart from plantain

Table 5: Effect of transplanting positions on leaf area (cm^2) of cocoa seedlings

Treatments	3 MAT	4 MAT	5 MAT	12 MAT	13 MAT	14 MAT	15 MAT
PTCT	70.33bc	84.00b	95.33b	308.33a	306.33a	308.67a	327.00b
CTPT	76.33c	74.33c	86.67b	164.67b	292.33a	302.67a	362.67a
CT30cmP	77.33b	82.00b	93.00b	153.33b	165.00b	206.33b	232.00a
CT150cmP	101.33a	110.33a	119.67a	241.33a	279.00a	292.67a	316.67b

PTCT: Plantain on top of cacao seedlings at transplanting; CTPT: Cacao on top of plantain at transplanting; CT30cmP: Cacao transplanted 30 cm apart from plantain; CT150cmP; Cacao transplanted 150 cm apart from plantain.

Conclusion and Recommendations

Much of success of intercrops in cacao establishment depends on understanding the role each component plays in the system, cacao/plantain farming system has been recommended, but the transplanting arrangement in the face of global warming and climate change is a gap in research which this work has filled. Furthermore, the long dry season and the wind – storms early March to April in the study area usually devastate the plantains so that effective shade is not actually provided for the cacao in the later part of the dry season when the shade is needed most. This study hereby concludes that Cacao transplanting on top of plantain (CTPT) enhanced the best performance of cacao seedlings when compared to other treatments because cacao seedlings would have benefited from the soil moisture available at the base of plantain for survival and morphological growth.

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Experimental Title: On-Station and on-Farm Evaluation of four New Cocoa Varieties for Nigeria

Investigators: Muyiwa, A.A., Adeigbe, O.O., Adenuga, O.O., Olaniyi, O.O; Adepoju F.; Mapayi, A.E., Olasupo; Anagbogu C. and Keji Dada

Collaborators: Oyedokun, A.V (Entomologist), Adedeji, A. A., Otuonye, H. (Pathologists), Ibiremo, O.S., Ogunlade. M.O. (Soil Fertility Scientists), Nduka, B. A. (Crop Physiologist), Aikpokpodion, P. (Soil Chemist), Ogunwolu, (Food Nutritionist) Adejobi, K.B. (Agronomist), Okeniyi, M. (Nematologist), Lawal, J.O. (Agricultural Economist), Famuyiwa, S. B (Agricultural Extensionist).

Introduction: In 2011, twelve cocoa hybrids which had consistently outperformed the popular F3 Amazon cocoa variety in yield and earliness were presented to the National Committee on Naming, Registration and Release of Crop Varieties for evaluation and for release. However due to some reasons, only eight of these hybrids were accepted for release by the Committee. As such, this proposal is put forward to further evaluate the remaining 4 varieties in order to collate recent/up to date, necessary data and information needed for putting them forward for release by the National Committee on Naming Registration and Release of Crop Varieties. This is necessary considering the fact that these four hybrids are equally good as the other eight previously accepted (Dr. Peter Aikpokpodion, pers. Comm.).

Pods of the four hybrids were generated by crossing of the parental trees at the institutes' headquarters. The 4 hybrids were evaluated along with 3 check varieties including F3 amazon, WACRI and farmer's variety at the CRIN headquarters and on nine farmer's fields in seven states in the cocoa agro-ecologies of Nigeria including Ideal climate, Ideal soil and Marginal climate. These include Cross river (2 locations) Abia (1 location), Akwa-ibom (1 location), Ogun (1 location), Edo (1 location), Osun (1 location), and Ondo (2 location).

The project activities carried out is as listed below:

1. Hybrid pod generation
2. Nursery activity
3. Farm site selection, farmers' consent visit, and soil sample collection and analysis
4. Supply of farmers with planting materials
5. Field trial at CRIN HQ.
6. On-farm trial in nine locations (Cross rivers-2 locations, Abia-1 location, Akwa-ibom-1 location, Ogun-1 location, Edo-1 location, Osun-1 location, and Ondo-2 locations).
7. Data collection
8. Data analysis, interpretation, collation and presentation to National Variety release committee for evaluation and subsequent release.

Activities 1-6 carried out as at the date of this report and described below.

Progress Report: The project commenced in February/March 2019 immediately after fund release, with pollination process, which produced pods of the four hybrids. Selection of farm sites, visit to obtain farmers' consents, and soil sample collection and analysis were made in March 2019.

The farmers selected after visitation and inspection of the suitability of their farms were:

1. Mr Etok (08060940588) at Oborokara, Uyo, Akwa-Ibom state
2. Mr Ibe Williams (08059587576) at Bendegeh-Ekim, Cross River State
3. Mr Kirian Banjo (08101382173) at Boki East of Cross River State replaced by Mr. Richard Etim, Effraya, Cross-River state (07034376770, 07051126991) **
4. Mr Francis Ohilebo (08038905024) at Uhonmora (Edo state),
5. Kabiyesi (08067538218) at Ikoromaja in Oshun state
6. Gabriel Abiodun (08033076186) at Idanre, Apomu area, Ondo state
7. Mr Ade Fagite (08038129701) at Wasimi village in Ondo state
8. Chief Manure (08077017838) at Mamu in Ogun state
9. Chief Chijioke Nwosu (08068156361) at Bendel replaced by Dr. Onukwo Joseph at Kwomu orie village, Bende, in Abia state**

Note: 2 farmers had to be replaced because of their lack of cooperation to ensure the success of the project. Chief Chijioke Nwosu (08068156361) of Bende, in Abia state did not comply to secure the allotted farmland for us and was replaced by Dr. Onukwo Joseph of Kwomu orie village, Bende. Mr Kirian Banjo (08101382173) of Boki East, Cross River State failed to raise the nursery and also cut off communications and was replaced by Mr. Richard Etim, of Effraya, Cross-River state (07034376770, 07051126991).

Pods generated were distributed to farmers in June/July 2019 and seedlings raised in nursery beds.

Seedling of the four new cocoa varieties were raised in the CRIN HQs., nursery to support the pods given to farmers for nursery in June/July 2019. These seedlings were taken to the farmers for planting from Tuesday 23rd June to Tuesday 30th June 2020 upon the ease of Covid-19 pandemic lockdown by the Federal Government. Clones were also raised from TC material and included with the materials given to farmers for clonal evaluation.

Upon visit to the farmers' plots, their nursery seedlings performance was inspected, and more hybrid seedling were given to augment for losses and new clonal generated seedlings were given to be included in the trial. Farmers (e.g at Wasimi) with enough seedling raised from the pods were not given additional seedlings. Plantain was observed to be already established on the plots. Field plan of planting the cocoa seedlings was made and demonstrated on their farm. The seedlings were established on 4 blocks, with minimum of 6 tree replications per block.

Table 1. List of seedlings distributed to farmers

	T12 llxN38	T53 5xN38	T65/7 x Tl01/15	T86/2 x T57/22	F3	WACRI	TCI	TC2	TC3	TC5	TC7	Tc8
Ikoromaja	15	26	-	10	-	14	40	15	20	8	14	13
Idanre	30	30	-	30	30	30	40	15	20	8	14	13
Wasimi	—	-	10	-	-	10	40	15	20	-	14	13
Uhonmora	24	20	10	12	12	20	40	15	20	8	14	13
Ibeku	30	25	-	16	18	30	40	15	20	8	14	13
Akwa Ibom	40	30	10	20	22	30	40	15	20	8	14	13
Cross River 1	33	25	10	19	21	25	40	15	20	8	14	13
Cross River 2	30	30	-	30	30	30	40	20	24	16	14	13
Mamu	30	30	10	20	22	30	40	15	20	8	14	13



Experimental Title: On-Station Trial of New Cocoa Cultivar Development

Investigators: Muyiwa, A.A., Adeigbe, O.O., Adenuga, O.O., Olaniyi, O.O; Adepoju F.; Mapayi, A.E., Olasupo; Anagbogu C. and Keji Dada (Plant Breeders)

Collaborators: Oyedokun, A.V (Entomologist), Adedeji, A. A., Otuonye, H. (Pathologists), Ibiremo, O.S., Ogunlade. M.O. (Soil Fertility Scientists), Nduka, B. A. (Crop Physiologist), Aikpokpodion, P. (Soil Chemist), Ogunwolu, (Food Nutritionist) Adejobi, K.B. (Agronomist), Okeniyi, M. (Nematologist), Lawal, J.O. (Agricultural Economist), Famuyiwa, S. B (Agricultural Extensionist).

Introduction: Cocoa breeding is a continuous process of creating more variation to meet present demands of farmers for sustainable production. Continuity of the breeding process to advance new genotypes or varieties is majorly due to the usual challenges of the declining genetic potential of available genotypes (over the years). The dynamics of biotic (pest, diseases etc.) and abiotic (soil, climate etc.) factors leading to the generation of new variants and strains of pests, pathogens and degradation of soil fertility among others have over the years kept crop breeding an active discipline of problem solving in agriculture. Further breeding leads to improvement of economic or other traits of interest, advances the genetic potential of the species, improves livelihood of users (farmers) through reduction of inputs, increase in yield and quality etc. Moreover, higher cocoa productivity promotes and stabilizes the cocoa business for every player in the cocoa value chain. The ever-increasing demand for cocoa by the world growing population and market, coupled with changes in the environment, makes breeding for higher cocoa yield and quality a usual and primary objective of most breeding programmes. The objectives are:

1. To raise new varieties of cocoa with higher yield
2. To raise new varieties of cocoa with advanced tolerance/resistance to major pests and diseases of cocoa
3. To raise new genotypes of cocoa with better adaptability to various ecologies of Nigeria and low uptake potential for heavy metals
4. To raise new genotypes of cocoa with higher quality

Methodology: Selection were from the existing hybrid progenies and some parents for some economic traits (yield, resistance to Phytophtora pod rot, resistance to Mirids, and improvement of quality). Pods of progenies were generated by hand pollination in a backcross breeding programme. A total of ten progenies were generated. Seedlings raised from the pods for eventual on-station and off-station multi-locational evaluation with at least three checks (F3 Amazon and CRIN Tc-2 and CRIN Tc-3) on the field. On-station sites are CRIN head quarter at Ibadan and four sub-stations (Ajassor, Ibeku, Owena, Uhuomora). The off-stations sites will be at least ten specific locations across the notable cocoa ecologies of Nigeria in the farmer's plot. States of choice for the trial will include Oyo, Ondo, Ekiti, Osun, Edo, Cross River, Delta and Abia states.

The plant breeder will generate agro morphological data for at least five years on the genotypes in the different locations (on and off farm), moreover, the diversity of the progenies will be studied at the genomic level using the single nucleotide polymorphism (SNP). The response of the genotypes to soil nutrition will be studied; the pathologist and the entomologists will screen the progenies for resistance to Phytophtora pod rot and Mirid respectively and the quality profile of the genotypes will be assessed by the food nutritionist.

Progress Report: 3 sub-stations trials (CRIN HQ., Ajassor and Owena) have been attempted. Pods of progenies of the selected parents were generated by hand pollination in a backcross breeding programme in 2018/2019. Seedlings of the hybrid progenies were raised from the pods in the nursery along with three checks (F3 Amazon and CRIN Tc-2 and CRIN Tc-3). The seedlings were planted on the field after clearing and plantain establishment at the zone 8 of CRIN HQ, and at Ajassor and Owena sub-station in 2020.

However, some challenges were faced in the process of generating the hybrids; Six crosses were successful out of ten and some of the successful crosses did not develop to maturity probably due to old age of the mother tree. Therefore, the need to resupply in the next season.

Materials planted in On-stationtrials at Ibadan HQ, Ajassor and Owena on June/July 2020.

Material	Ibadan HQ (Zone 8)	Owena	Ajassor
NV1	30	30	30
NV2	30	30	30
NV3	8	9	9
NV5	30	30	30
NV8	12	_	_
NV10	30	30	30

Status: The Covid-19 pandemic stay at home order of staff under grade level 12 which started from March 2020 spreading to 2021, was a major setback for the plots.

Experimental Title: Fertilizer Application Enhances Establishment of Cacao Seedlings in Plant-Parasitic Nematodes Infected Soil

Investigators: Orisajo, S.B and Adejobi, B.K.

Introduction

Cocoa (*Theobroma cacao*) is grown in the humid tropics of the world (Yanelis et al., 2012) with more than 70% production coming from Africa as a source of income for producing countries (Simo et al., 2018). The crop production is dominated by small-scale farmers who live and work in the cocoa belt providing them employment and income (Minimol et al., 2015; Ngoh Dooh et al., 2015). However, cocoa production has witnessed a downward trend because of ageing trees and small farms that do not provide an attractive income to current and future cocoa farmers, low farm gate prices making it difficult to afford costly inputs such as mineral fertilizers, climate change (Läderach et al., 2013; Schroth et al., 2016) pests and diseases and falling soil fertility. The production increases by new plantings and rehabilitation of moribund farms, but a build-up of plant-parasitic nematodes causing dieback with chlorotic symptoms, sudden death and retardation of cacao seedlings' growth in nurseries and young plantations and deteriorating soil fertility has caused many farmers to lose heart and abandon the crop (Orisajo et al., 2012; Orisajo, 2018).The need to pay attention to soil fertilization is now almost as important as the control of pests and diseases in cocoa. Tropical soils are inherently low in soil organic matter and fertility status; hence external fertilizer supply is a key factor in raising crop production.

Fertilization is an indispensable agricultural practicein which organic and inorganic fertilizers are used primarily to improve plant nutrition and hence crop productivity (Tian et al., 2015; *Francioli* et al., 2016). Inorganic fertilizers perform a decisive role in improving crop productivity but are wildly applied. The production andapplication of these fertilizers cause serious environmental damage like greenhouse gas emissions, eutrophication (Copetti et al., 2016), pollution (De Notaris et al., 2018), leaching and contamination of groundwater thereby posing risk to human health (Huang et al., 2018; Jalali & Latifi, 2018). The continuous application of NPK leads to increase in the soil compactness, decrease in thesoil pH (Adamtey et al., 2016), soil fertility, soil porosity, and organic carbon level (Chaudhary *et al.,* 2017) as well as soil beneficial microorganism populations (Wei *et al.,* 2017). Continuous excessive applications of inorganic fertilizercan also lead to nutrient accumulation in soil, and eventual P and N lossfrom soil to aquatic ecosystems (Qiao et al., 2012; Yanet al., 2013). Excessive N and P applications will also deteriorate the soilquality and reduce the soil's production levels (Zhang et al., 2015). With rising costs of chemical fertilizer and the aforementioned growing concernsover the environmental impact of excessive fertilizer application, there has been an increasing scrutiny on how nutrients aremanaged on farms (Chen et al., 2014).

Organic fertilizers (manures)are gaining attention as the alternative to inorganic fertilizers. Organic manureproduced from biomass and animal conventionallyplays an important role in recycling of nutrients (Hasler et al., 2015).When added to soils, organic manure enhances soil fertility by increasing nutrient availability(Cavagnaro, 2014), soil organic carbons(Xie et al.,2014),available N and P, micronutrients, soilaggregation, andwater holding capacity, as well as leading to a highsoil buffering capacity against external disturbances (Yuet al., 2012;Liang et al., 2012;Chaudhary et al., 2012;Sogn et al., 2018). Though, the benefits associated with organicamendments majorly depend upon the type and application rate of organic fertilizers (Jones & Healey, 2010).

The application of organic material, though a traditional practice to improve soil fertility and structure, is also known as a control method for soil-borne diseases, including plant parasitic nematodes (Hassan et al., 2010; Houx et al., 2014).In recent years, a variety of organic materials, such as animal and greenmanures, compost, and proteinous wastes, are used for this purpose(Summers, 2011; Stirling et al.,2011;Renco & Kovacik, 2012; Olabiyi & Oladeji, 2014; Abolusoro et al., 2015;Rudolph & DeVetter, 2015; Tiyagi et al., 2015; Briar et al., 2016; Forge et al., 2016;Atandi et al., 2017; Shiferaw et al., 2017). Incorporation of organic amendments has been shown to be detrimental to plant parasitic nematodes (Wang *et al.,* 2004) due to release of NH4, formaldehyde, phenol, volatile fatty acids and toxic compounds (Oka, 2010; McSorley, 2011; Briar et al., 2016). It was generally postulated that the adverse influence oforganic amendment on plant-parasitic nematode is referred to increasing host resistance to nematode infection and enhancement of growth performance (Country & Millon, 2008).

This work examined the effects of organic and organo-mineral fertilizers on plant-parasitic nematodes, cacao seedlings growth and establishment on the field. This will possibly ameliorate the current frustration faced by small-scale farmers on poor establishment of cacao seedlings and thereby increasing the crop production and income.

Materials and Methods

Study Area

Field experiments were carried out at the Cocoa Research Institute of Nigeria (CRIN) experimental farms in Ibadan, Oyo State and Owena, a CRIN Substation in Ondo State, Nigeria. Ibadan lies between the latitude 7^0 30' N and longitude 3^0 54' E at an altitude of 1222 m above sea level. It is located in the tropical rain forest ecosystem with mean solar radiation of 18mj/m^2/day and an annual average rainfall of 2000 mm with a bimodal pattern. Owena lies between the latitude $7^0$15' N and longitude $5^0$12' E at an altitude of 367 m above sea level. It is located in the tropical rain forest ecosystem with mean solar radiation of 30mj/m^2/day and an annual average rainfall of 1500 mm with a bimodal pattern.

The experiment was conducted over three years on the False horn plantain (*Musa* spp. L., AAB – group cv. Agbagba) as shade crop planted with cacao (*Theobroma cacao* cv. F3 Amazon) in Ibadan and Owena. The experiment was set as a randomized complete block design involving four fertilizer types [Goat Dung (GD), Organic (OF), Organo-Mineral Fertilizer (OMF) and NPK 15:15:15] which were separately applied at 200, 400, 600kg/ha and unfertilized served as control. Each treatment had 3 replications. Healthy sword suckers of plantain of approximately uniform size (50-60cm tall, 30-40cm pseudostem girth) pared to remove lesions were planted at a spacing of 3x3m. Cocoa seedlings of 5 months old were planted four weeks later at the same spacing.

Soil Samples Collection and Analysis

Soil samples were collected randomly from each of the experimental sites at both locations (Ibadan and Owena) with the aid of soil auger at 30cm depth. For the pre-cropping analysis, the samples were bulked together and mixed thoroughly, air dried at room temperature and analysed for various elements. Particle analysis was determined using the hydrometer method (Kettler et al, 2001). Organic carbon determination wasby the potassium dichromate oxidation method (Zhang et al., 2001). The total nitrogen (N) was determined byKjeldahl method; available P by ammonium-vanadomolybdate colorimetric method; e*xchan*geable K and Na by flame photometer; and e*xchangeable Mg, Ca and Mn were determined using atomic absorption spectrophotometer* (Ryan et al., 2001). Soil pH was read on pH meter (1:1 water). Soil was assayed to confirm the presence and the initial population density of the nematodes (Coyne et al., 2007). Two grammes (2g) each of the organic fertilizers used were also analyzed for nutrient composition.

Fertilizer Application and Data Collection

The fertilizers were applied to treatment plots one month after transplanting using ring method of application at 5cm away from the base of cacao. Monthly Data collection on growth parameters (plant height, stem girth, number of leafs, and leaf area and number of branches) commenced 3 months after transplanting. Leaf samples (4th leaf) were collected from 4 tagged cocoa seedlings at 12 months after transplanting and were analysed in the laboratory for chemical composition. The experiments were monitored for 36 months (144 weeks after planting). Survival count was carried out 12 months after transplanting. At 15 months after transplanting, soil samples were collected from treatment plots and were processed and analysed for physical properties (sand silt, loam, clay, soil moisture content and soil bulk density), chemical properties (soil organic matter, soil pH, N, P, K, Mg, Ca, and Na), and plant-parasitic nematodes population densitiesusing aforementioned standard procedures.

Data Analysis

Nematode population densities were $\log_{10}(x + 1)$ transformed and percentage data were square-root-transformed prior to analysis to stabilize variances (Gomez & Gomez, 1984), while the other data collected were not transformed. Only the predominant nematode species were included in the data analysis. Analyses of variance (ANOVA) were carried out to test for main effects and interactions. Pre-planned comparisons between treatment combinations were tested with linear contrasts. All analyses were performed using GENSTAT.

Results and Discussion

Nutrient Composition of the Organic Materials

The nutrient composition of the organic materials applied to the soil is presented in Table 1. The C: N ratio of the organic fertilizers used are8.2, 9.4, 9.8 for Goat dung, Organo-mineral fertilizer and Organic fertilizer, respectively. Changes in the C:N ratio of aggregates may reflect the degree of organic materials decomposition within aggregate fractions (Baldock et al., 1992). Higher C:N ratios of aggregates suggest that soil organic C is relatively fresh or little altered, whereas, soil organic C is more decomposed and relative aged when the C:N ratio of aggregates is low (Chen et al., 2010).Difference in soil organic matter quality within aggregate fractions will result in difference in the types of nutritional substrates available, which may directly affect the natural of microbial communities(Bending et al., 2002).In general, amending the soil with organic materials having low C: N ratio (less than 20) resulted inrapid mineralization of N in the form of NH4+ or NO3 – for absorption and uptake by plant roots (Powers & McSorley, 2000).The fertilizers used in these experiments have low C: N and this appeared to have positive effects on the survival of the cacao seedlings.

Table 1. The nutrient composition of the organic materials

Properties	Goat dung (GD)	Organo-mineral fertilizer (OF)	Organic fertilizer (OF)
pH (water)	8.17	7.00	7.30
Organic carbon (%)	40.1	40.5	36.4
Organic matter (%)	69.1	69.8	62.8
Total nitrogen (%)	4.9	4.3	3.7
Available P (cmol/kg)	113.24	138.06	7.08
K^{-}(cmol/kg)	0.41	0.19	5.56
Mg^{--}(cmol/kg)	1.20	1.00	6.00
Ca^{--}(cmol/kg)	2.60	2.00	13.10
Na^{--}(cmol/kg)	0.38	0.18	2.30
C:N	8.2	9.4	9.8

3.2 Survival and Growth of Cacao Seedlings as Affected by Fertilizer Application

Fertilizers applied significantly ($p < 0.05$) enhanced the survival of cocoa seedlings 12 months after transplanting on the field. The percentage survival of cacao seedlings under organic fertilizers at Ibadan and Owena increased significantly compared to NPK and control even at the lowest rate of 200kg/ha used in the experiment (Table 2). However, application of 600 and 400kg/ha of NPK enhanced the survival of the cacao seedlings than the control. In the same vein, growth of cacao seedlings was consistently improved by the fertilizer application compared with the control at both locations (Table 3). Application of Goat dung, Organo-mineral fertilizer and Organic fertilizer at 200, 400 and 600kg/ha led to a significant increase in the height of cacao compared with NPK and control (Table 3). Similar pattern was observed for other growth parameters measured. In contrast, there was a significant reduction in plant height, stem girth, number of leaves, leaf area and number of branches of cacao in unfertilized plots. The increase in growth parameters could be attributed to the enhanced nitrogen and phosphorus uptake by the plant using organic amendments (Pandit et al., 2018). Organic manures have been shown to supply required plant nutrients, improve soil structure and promote plant growth (Agbede et al., 2014, 2017). The addition of organic manure in soil may encourage the immobilization of bio-available nitrogen and phosphorus, which may otherwise be lost through leaching or emissions in the environment (Sun et al., 2018). The inclusion of organic manure may also generate higher transpiration rates leading to higher water retention in the soil. Hence, more availability of water soluble nutrients may cause the crop yield improvement (Doan et al.,2015).

Application of inorganic fertilizer, NPK, even at the lowest 200kg/ha also improved cacao growth significantly compared with the control (Table 3). This agrees with the earlier study that the use of appropriate levels of NPK fertilizers have good effects on plant growth factors (Irshad *et al.,*2006). NPK application enhanced the availability of macro nutrients, nitrogen, phosphate, and potassium in the soil. These nutrients, therefore, were readily absorbed by the crops. In crop metabolism, these nutrients are utilized in carbohydrate synthesis, cellulose, proteins, hormones, and enzymes. All these processes triggered the growth of plant organs such as plant height, stem diameter, number of leaves, leaf area and number of branches as reported in this present study. This result was in line with the previous studies conducted by Mandal *et al.,* (2009) and Bandyopadhyay *et al.,* (2010). In their studies, applications of NPK also triggered the growth of vegetative crops.

3.3 Relationships between Plant-Parasitic Nematodes and Cacao Growth

Relationships between the predominant plant-parasitic nematode population densities recovered and vegetative growth of young cacao revealed various statistically significant interactions (Table 4). *Meloidogyne incognita*, *Pratylenchuscoffeae* and *Radopholussimilis* population densities were negatively correlated with the survival percentage of the cacao seedlings ($r = -0.69$, $p < 0.01$; $r = -0.58$, $p < 0.05$ and $r = -0.46$, $p < 0.05$, respectively). Furthermore, *M. incognita* was negatively correlated with the plant height ($r = 0.91$, $p < 0.01$), leaf area ($r = -0.61$, $p < 0.01$) and number of branches ($r = -0.51$, $p < 0.05$). This confirmed the previous reports that root-knot nematodes, *M. incognita*, damage on cacao seedlings led to stunted growth of the plants (Afolami & Caveness, 1983; Afolami & Ojo, 1984). Similarly, *H. multicinctus*, *P. coffeae* and *R. similis* population densities were negatively correlated with plant height ($r = -0.46$, $p < 0.05$; $r = -0.51$, $p < 0.05$; $r = -0.43$, $p < 0.05$, respectively), while they have no significant correlation with leaf area and number of branches (Table 4). However, plant height was positively correlated with survival percentage ($r = 0.89$, $p < 0.01$), leaf area ($r = 0.71$, $p < 0.01$) and number of branches ($r = 0.53$, $p < 0.05$).

Table 2. Survival of cacao seedlings as affected by fertilizer application at Ibadan and Owena (12 months after transplanting)

Treatments		Ibadan experiments	Owena experiments
Fertilizers	Rates (kg/ha)		
Goat dung	600	94.44a	94.44b
	4000	94.44a	94.44ab
	2000	94.44a	88.33abc
Orgao-mineral fertilizer	6000	90.44a	83.33abc
	4000	88.88a	83.33abc
	200	77.77ab	83.33abc
Organic fertilizer	600	94.44a	100.00a
	400	90.44a	90.44a
	200	83.33ab	83.33abc
NPK 15: 15: 15	600	66.66b	72.22bc
	400	77.77ab	72.21bc
	200	72.21ab	66.88cd
Control		66.66b	49.89d

Treatment means within each column followed by the same letters are not significantly different from each other using Turkey's HSD at 5% level

Table 4. Linear correlation matrix (half) of mean values for plant-parasitic nematode population densities / 100g soil, percentage survival, plant height, leaf area and branches of young cacao

	Hm	Pc	Rs	Survival	Plant height	Leaf Area	Branches
				(%)	(cm)	(cm')	(no)
M incognita (J2)	0.96^{--}	0.41^{-}	0.67^{--}	-0.69^{--}	-0.91^{--}	-0.61^{--}	-0.51^{-}
H multicintus	0.46^{-}	0.72^{--}	0.24	-0.46^{-}	-0.12	-0.24	
P coffeaea-	0.84^{--}	-0.58^{-}	-0.51^{-}	-0.15	-0.18		
R similis-	-0.46^{-}	-0.43^{-}	-0.15	-0.17			
Survival (%)				-	0.89^{--}	0.63^{--}	0.51^{-}
Plant height (cm)					-	1.71^{--}	0.53^{-}
Leaf Area (cm)						-	0.28

Mi*: Meloidogyne incognita;* Hm: *Helicotylenchus multicinctus;* Pc: *Pratylenchus coffeae;* Rs: *Radopholus similis*
Correlation coefficient significant at $^{*}p< 0.05$, $^{**}p <0.01$.

Effects of Organic Fertilizers on Population Densities of Plant-Parasitic Nematodes
The incorporation of Goat dung, Organo-mineral fertilizer and Organic fertilizer at 200, 400 and 600kg/ha led to a significant reduction in the population densities of these plant-parasitic nematodes compared with NPK fertilizer and control (Table 5). This is in agreement with earlier studies that soil amendments with different types of organic manures are effective in reducing the population densities of many soil-borne plant pathogens including plant-parasitic nematodes (Hassan et al., 2010; Shiferaw et al., 2017). Organic manure has been reported to be rich in several compounds especially nitrogen and phenolics (Hassan et al., 2010; Renco & Kovacik, 2012). Nitrogen in the organic manure after conversion into ammonia (Thoden et al., 2011) has been reported to kill several plant parasitic nematodes (Lazarovits et al., 2001).Phenols and nematostatic chemicals released from organic matters into amended soil significantly decreased the nematodes population (Oka 2010; Briaret al., 2016). Several workers using organic soil amendments have reported satisfactory results on the plant growth and yield in avariety of crops with marked reduction in the population of plant-parasitic nematodes (Orisajo et al., 2008; Pakeerathan et al., 2009; Iqbal et al., 2012; Chaudhary &Kaul, 2013; Abolusoro et al., 2015; Adepoju et al., 2017). All the treated plants showed significant and satisfactory results when compared to untreated control. The findings in this study are similar with the aforementioned earlier reports. In the same vein, application of NPK at 200, 400 and 600kg/ha 600 also had a significant lower population densities of *M.incognita*, *H.multicinctus*, *P.coffeae* and *R.similis***.** These findings are consistent with earlier studies that the use of appropriate levels of NPK fertilizers have good effects on plant growth factors with resultant reductions in plant-parasitic nematode populations (Irshad *et al.,*2006; Ameen et al., 2013; Osman et al.,2015; Kolawole et al., 2018).

Conclusion
Improving the agronomic conditions for plant growth is an important factor for increasing the plant tolerance to plant-parasitic nematodes (Charegani *etal.*, 2010). Results from this study have shown that the addition of fertilizers to the soil will improve the survival and growth of cacao seedlings. With rising costs of chemical fertilizer and the growing concerns over the environmental impact of excessive fertilizer application, Goat dung, Organo-mineral fertilizer and Organic fertilizer at 200kg/ha are recommended for soil application. These have shown to enhance the field establishment of cacao seedlings in soils infected with plant-parasitic nematodes.

Table 5. Effects of fertilizer types and rates on population dynamics of nematodes in Ibadan and Owena

Treatments	Ibadan				Owena			
	Meloidogyne incognita *(000)*	*Helicorylenchus muticinetus* (000)	*Prarylenchus coffeae* (000)	*Radopholus similis* (000)	*Meloidogyne incognita* *(000)*	*Helicorylenchus muticinetus* (000)	*Prarylenchus coffeae* (000)	*Radopholus similis* (000)
GD600	o.28e	0.01c	0.36c	0.01c	0.33e	0.01c	0.37c	0.01c
GD400	0.28e	0.02c	0.37c	0.01c	0.33e	0.01c	0.37c	0.01c
GD200	0.27a	0.02c	0.35c	0.02c	0.33e	0.01c	0.38c	0.01c
OMF 600	0.35d	0.0lc	0.33c	0.02c	0.44d	0.01c	0.37c	0.01c
OMF 400	0.34d	0.02c	0.33c	0.02c	0.44d	0.01c	0.38c	0.01c
OMF 200	0.34d	0.0lc	0.36c	0.02c	0.43d	0.01c	0.38c	0.01c
OF 600	0.16f	0.0lc	0.33c	0.03c	0.l9f	0.01c	0.40c	0.01c
OF 400	0.16f	0.0lc	0.35e	0.02c	0.19f	0.01c	0.40c	0.01c
OF 200	0.17zf	0.0lc	0.37c	0.02c	0.l9f	0.01c	0.41c	0.02c
NPK600	1.67c	0.22b	2.02b	0.14b	1.81c	0.21b	3.01b	0.14b
NPK400	1.63b	0.23b	1.97b	0.14b	1.77b	0.21b	3.01b	0.14b
NPK200	1.61b	0.23b	2.01b	0.14b	l.76b	0.22b	3.02b	0.15b
Control	7.63a	2.12a	8 36a	3 53a	7.01a	1.25a	7.84a	3 41a

Treatment means within each column followed by the same letters are not significantly different from each other using Turkey's HSD at 5% level

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Experimental Title: National Survey of Cocoa growing Agro-Ecologies to update Epidemiological Data on *Phytophthora Megakarya* in Nigeria

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Introduction

Worldwide, about 3.5 million tons of cocoa is produced annually (WCF, 2010a). Notwithstanding, cocoa demand has been increasing by an average of 3% a year for the past 100 years. Industry representatives estimated that the cocoa sector will need to achieve annual production of at least 4.5 million tonnes of cocoa by 2020 to satisfy demand (WCF, 2010b). Cocoa production is one of Africa's greatest industries and 70% of cocoa produced is contributed by Africa (WCF, 2010a). In Nigeria today, the amount of cocoa produced is not commensurate to the large area of land used for cocoa cultivation. This is due to several factors, most importantly pest and disease outbreaks (PAN, 2001). Black pod disease of cocoa caused by *Phytophthora megakarya* is the most devastating disease of cocoa in West Africa, frequently causing total loss of pods (Opuku *et al*., 2000). Copper and metalaxyl-based fungicides are the most common methods of disease control used by farmers for the disease control, but do not prevent regular outbreaks of black bod disease every cropping season. Unfortunately, indiscriminate use of fungicides by growers may cause the emergence of resistant pathogens and deleterious effects on non-targets and the environment. To circumvent this situation, breeding for resistant cultivars has been a top priority. However, to breed durable resistance to *P. megakarya*, there must be a good understanding of its population biology (McDonald and Linde, 2002). It is surprising that the population structure of a pathogen of such magnitude has been so little studied and available data on its population is very old. There is a need to investigate the population structure and genetic variation of *P. megakarya* using molecular tools. Specifically, the studies will simultaneously examine population structure and genetic variation in virulence-related genes. Obtaining these data is a prerequisite to further understand the epidemiology of the disease and for selecting disease resistance sources for cocoa breeding.

Objective

To examine the population structure and genetic variation of *P. megakarya* in Nigeria, including the phylogenetic relationships among populations or clonal lineages.

Materials and Methods

Diseased cocoa pod samples were collected from Akure South, Idanre and Ondo West Local Government Areas of Ondo State, and Atakumosa East and Irewole Local Government Areas of Osun State as well as from Ikom, Boki East and West, Etung and Obubra Local Government Areas of Cross River State. The infected pods were surface-sterilized and inoculated under aseptic condition into freshly prepared potato dextrose agar and carrot agar plates. Associated *P. megakarya* isolates were sub-cultured and characterized morphologically. The isolates were thereafter taken to the laboratory for molecular characterization and phylogenetic analysis.

Results and Discussion

About 145 different strains of *P. megakarya* were isolated and characterized from across the five cocoa growing Local Government Areas in Ondo, Osun and Cross River States (Table 1).

Table 1: Number of isolates recovered

	State/Local Government					
	Ondo			Osun		Cross River
	Akure South	Idanre	Ondo West	Atakumosa East	Irewole	Boki E/W (8), Etung (7), Ikom (3), Obubra (7)
No. of *P. megakarya* isolates	23	21	24	27	25	25

Sequences of some of the strains characterized are as shown below:

Nucleotide sequences of fungi isolates from Cocoa samples

>PHYTOPH 1
GATTGgCTTCGGCTGAACAGAAGCTTATTGGGC
GTTTTTCCTgCTATGGCGGTATGAAGTAGTGAAC
CGTAGTTATGtGGGCTTGGCTTTTGAATGTGCTC
GCTGTGCGAAGTAGAGTGGCGACTTTGGTTGTC
GAGGGTCGATCCATTtGGGAAATTGTGTGTACTT
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> PHYTOPH 3
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>PHYTOPH 4
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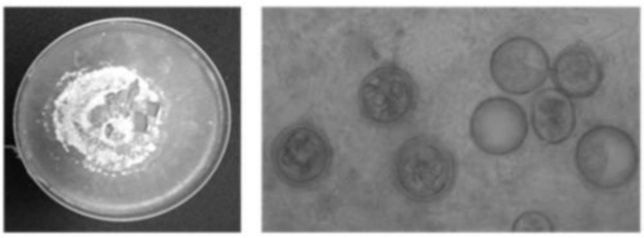

Sample Name: Be2. 3
Organism Name: *Phytophthora megekaya*

Morphological Characteristics
Dense rosette or homothallic felt-like colony and stoloniferous mycelia growth on PDA at Maximum

Microscopic Characteristics.
Phytophthora megakaya produced the following; semi-palpillate sponrangnum with sometime short pedicels, with some caducous ovoid, semi-palpillate sporangium with long pedicel, Oogonium with aplerotic oospore and amphigynous antheridium.

Summary: About 120 different strains of *P. megakarya* were isolated and characterized from across the cocoa growing Local Government Areas of Ondo, Osun and Cross River States. The research work is still on-going as more States are still to be covered.

Challenges faced
Unavailability of cooled incubation facility for the *Phytophthora* strains especially during off-season.

Status: Ongoing

Experimental Title: On-farm demonstration of CRIN Liquid soap in Abia State.
Investigators: Yahaya L.E, Adedeji A.R and Agbonghiaroyi, A.

Introduction
Nigeria is endowed with huge natural resources which include cocoa. Cocoa is planted across the cocoa ecological zone. There is need to diversify the Nigerian economy because of overdependence on crude oil which finite in nature. The cocoa production generates high volume of pod husk which has been source of host to pathogens in most farms. This has been harnessed in soap production as one of CRIN perfected technologies. Farmers need income to supplement whatever they can get from cocoa farming and thus sustain them as the engage in cocoa business. Soap production using pod husks from cocoa prove to be one of such sources of income. This project trained farmers on this perfected technology of CRIN.
The Eastern cocoa producing regions of Nigeria have been marginalized in terms of funding and resource distribution. Umuahia north and Bende are two out of the major cocoa producing areas in the East and report has it that they have not been enjoying the training programme CRIN has been extending to other cocoa producing areas in other regions of the country. It is for this reason the work is focusing on this part of the country.

Materials and Methods: Farmers were trained on soap production using cocoa pod husk. This was done using the participatory approach method. The saponification process as modified by Yahaya *et al*, 2004 for soap production was employed while involving the farmers in the production process. Farmers were made to participate in the training so that they can have mastery over the process of production and were able to take up the skill at the end of the training.

Results and Discussion: Over sixty farmers and stakeholders participated and were favorably disposed to the training programme as they were all excited and enthused about the training. They aslo looked forward to having similar training from CRIN.

Conclusion and Recommendations: It is therefore recommended that such training be replicated in other cocoa producing states so that they can all benefit from the potentials available to them in terms of cocoa value addition.

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Chaco, M.C; Okieimen, F.E and Edema, M.O (1993). Laboratory course in Organic Chemistry. Basic University Chemistry series
Kirk-Othmer (1967). Encyclopedia of Chemical technology, 2nd Ed vol. 1 McCutheon , J.W (1974). In "Detergent and Emulsifier.

CASHEW PROGRAMME

Theme: Enhancing productivity and associated production technologies of cashew in Nigeria
General objective: To promote access to improved cashew genotypes, enhance the capacity of the stakeholders in the value chain
Cashew Research Projects
Projects undertaken by the Programme in cashew are in the following areas:

- Crop Improvement
- Crop Protection
- Crop production
- Economics and Extension
- End Use Research

Crop Improvement projects
Title 1: Cashew germplasm enhancement and maintenance
Objective: to prune outgrown interlocking branches and put standard tags and sign posts proper identification of the genotypes
Achievements: Signposts and tags are being fabricated, pruning is on-going
Title 2: Selection for peelable cashew varieties in Nigeria
Objective: to determine the factor responsible for the difficulty in removing testa from the kernel.
Thirteen (13) out of 42 accessions were selected for ease of peelability trait from 3 States (Kogi, Enugu and Oyo).
High success rate (>60%) was obtained from grafting technique use to produce clones.
Two clonal plots were established each at Ibadan and Ochaja.

Plate 1: Newly grafted cashew seedlings at the nursery Ibadan.

Crop Production projects

Title 3: Effect of site-specific application of N and K fertilizers on the growth and yield of cashew at Ochaja, Kogi State Nigeria

The objectives of the study were to evaluate the effect of application of N and K fertilizers based on soil test value on the yield of cashew and to assess its effect on soil properties.

The nut yield of cashew was significantly (P < .05) improved as a result of nitrogen and potassium fertilizers (Figure 1).

Application of fertilizer based on the result of soil test and the need of the site in question will give an optimum result in terms fertilizer use efficiency and improve crop yield relative to blanket application of fertilizer without recourse to native nutrients of the soil.

Table 1: Initial soil physical and chemical properties of the cashew plot

Block	Soil Depth (cm)	Sand g/kg soil	Silt g/kg soil	Clay g/kg soil	pH	O.C g/kg	Total N g/kg	Ava. P Mg/kg	Exch K^+ Cmol/kg	Exch Ca^{2+} Cmol/kg	Exch Mg^{2+} Cmol/kg	CEC Cmol/kg	Base saturation %
A	0-20	885.20	22.80	92.00	6.7	0.78	0.07	5.03	0.012	2.26	0.35	2.78	95.83
A	20-40	895.20	12.80	92.00	6.8	0.66	0.02	5.20	0.011	1.73	0.29	2.18	95.05
B	0-20	895.20	12.80	92.00	6.6	0.97	0.05	5.35	0.012	1.26	0.27	1.70	92.81
B	20-40	875.20	32.80	92.00	6.7	0.86	0.02	5.55	0.012	1.34	0.25	1.15	91.62
Mean x		887.70	20.30	92.00	6.7	0.82	0.04	5.28	0.012	1.65	0.29	1.95	93.83

Table 2: Influence of Nitrogen and Potassium fertilizers on some soil chemical properties at Ochaja cashew plot.

Treatment	pH (H_2O)		Total N (g/kg)		Available P mg/kg		Exchangeable K cmol/kg	
Soil depth	0-20cm	20-40cm	0-20cm	20-40cm	0-20cm	20-40cm	0-20cm	20-40cm
N $_0K_0$–T1Control)	5.13	4.94	0.07	0.03	11.17	10.35	0.16	0.10
N_1K_0-T2	5.77	4.77	0.05	0.03	10.22	9.74	0.14	0.11
N_0K_1-T3	5.27	5.17	0.07	0.03	7.39	8.98	0.14	0.09
N_1K_1-T4	5.54	5.37	0.05	0.04	9.37	10.32	0.13	0.10
LSD (P<0.05)	0.19	0.20	0.01	0.02	0.72	0.60	0.01	0.01

Legend: N_0K_0–T1Control), N $_1K_0$-T2, N_0K_1-T3, N_1 $_1$K -T4

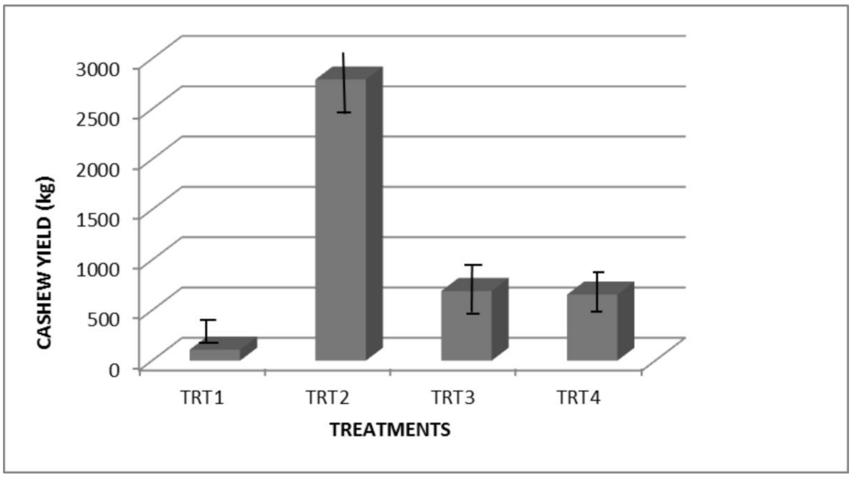

Figure 1: Effects of Nitrogen and Phosphorus based fertilizer on raw cashew yield (kg)

Experimental Title: Enhancing field establishment of cashew through integrated use of biochar and other agronomic practices

Investigators: Ibiremo, O.S., Ogunlade, M.O., Iloyanonmon C.I, Agbongiarhuoyi, A.E., Adeyemi, E.A, Akanbi, O.S.O and Agulana F.

Introduction

Cashew a perennial crop is adaptable to several ecologies as a result it is classified as a hardy crop. However, recent experience has revealed that several seedlings are loss within the first two years due to climatic problem. This has made hitherto hardy crop vulnerable and susceptible to climate change. The effect of climate change on the establishment and survival of seedlings in the field has become a matter of concern. The acute shortage of rainfall and other vagaries of weather are causing a lot of harm to crops in the field. The use of biochar (carbon-rich product) as a means of mitigating the effect of climate change on soil fertility management is a promising alternative that will promote adsorption of nutrients (native or applied), absorption of carbon dioxide, adsorption of soil water among others. Biochar technology is one of the recently developed technologies to mitigate climate issues. It has capacity to absorbs nutrients and water to be released at a later stage and has the capacity to stay in the soil for several decades. Other means of ensuring water conservation is through mulching (residues on the farm). The use of mulch is to utilize plant residues that many be considered useless for positive use. Intercropping enhances optimal utilization of land space. The planting of other crops with cashew during the dry season enables the environment to be moderated in such a way the heat within the farm is shared among the crops. This enables the survival of the individual crop within the cropping system. Cassava has the ability to adapt to extreme weather situation particularly during the dry season. In addition, the use of crop residues as mulching materials enables the environment to be preserved in terms of moisture within the crop environment. Use of crop residues at the base of crops preserve the soil moisture and allow the micro-climate to be cooler than the surrounding environment. The use of biochar made from cashew leaf litter in conjunction with inorganic fertilizer will help to slowly release the applied nutrients to the crop and prevent nutrient loss through leaching. The use of crop reduces as mulching materials also helps to reduce water loss particular during the dry season. When biochar is used in combination with inorganic fertilizers and plant reduces as mulching materials help in the establishment of seedlings.

Hence the objectives of this study are:

1. To assess the effect of Biochar Integrated with NPK fertilizer on survival of young Cashew.
2. To evaluate the positive effects of applying plant residues as mulching materials and intercropping with cassava on the survival of cashew at the end of the first dry season.
3. To determine the effect of these treatments on the soil physical and chemical properties.

Materials and methods

The experiment was established at Ibadan CRIN Headquarters in 2020 and to be replicated at Ochaja Substation. The land was cleared manually, and a few trees found there were felled and cut-cross and taken out of the plot. The layout was done, and the entire farm was 72 by 36m. Holing was done at 6x6m before planting. Jumbo seedlings of eight weeks were planted. The six treatments were:

T1- cashew + Birchar + NPK + Cassava, T2-Cashew + Birchar + NPK, T3-cashew + Mulch + cassava, T4-cashew + Mulch, T5-cashew + Guava and T6-cashew. The treatments were arranged in randomized complete block design (RCBD) with three replications. As a result of the COVID-19 pandemic coupled with late release of fund, the planting was done very late, and the rainfall stopped abruptly. Watering was done to ameliorate the effect of dry season on the seedlings. However, some of the seedlings dried up before watering commenced. Effort is being made to gang-up in year 2021 as soon as rainfall establishes. Prior to establishment of the trial, initial soil sampling was done at both CRIN headquarters Ibadan and Ochaja Substation. The initial physical and chemical characteristics were determined using standard laboratory procedures as outlined by IITA 1982, analytical manual.

Results and discussion

Prior to the establishment of the trial soil samples were collected at Ochaja substation and zone 3/ 4 CRIN Ibadan routine analysis was done. The result is presented in Table 1. The sand function of the soil at Ochaja substation at 0-20cm (topsoil) and 20-40cm (sub soil) were 942 and 932g/kg soil respectively. The sand content of the soil at CRIN Ibadan had a mean value of 877g/kg soil both at top and subsoil. The silt content at both top and sub soils was 29g/kg at Ochaja Substation while the silt at CRIN Headquarters Ibadan was relatively higher with an average value of 69g/kg soil. However, the clay in the soil of Ochaja substation was 37% lower than the clay at CRIN Ibadan soil at both depths. This implies that the at Ibadan could hold water better than the soil at Ochaja Substation. The soils at boths location could be classified as sandy loam which is idea for cashew cultivation. The pH of the soil at Ochaja at 0-20cm was 5.6 while that of 20-40cm was 5.20. Similarly, the pH of the soil in CRIN Ibadan at 0-20cm was 7.02 and the subsoil was 6.98. The pH range in the two locations are ideal for cashew cultivation. The organic carbon in Ochaja substation at 0-20cm and 20-40cm were 6g and 3g/kg soil respectively.

The organic carbon in CRIN Ibadan was much higher at 0-20cm with mean value of 11g/kg soil. However, the level of organic carbon at 20-40 (sub soil) was deficiently lower which indicates that organic carbon decreases with depth. Similarly, the total N in Ochaja Substation was 0.5g/kg at 0-20cm while that total N in Ibadan headquarter was 0.6g/kg across the two depths. The available P at Ochaja substation and Ibadan CRIN Headquarters was relatively high as it ranged from 14 to 23mg/kg at 0—20cm while at 20-40cm, it ranged from 11 to 14mg/kg soil.

The exchangeable bases at the soil matrix in Ochaja substation were generally low compared to the soil at CRIN Ibadan headquarters. In Ochaja substation, the mean exchangeable Ca across the two soil depths was 2.04cmol/kg soil while in CRIN Ibadan, the mean exchangeable Ca was 4.37cmol/kg soil. Similarly, the exchangeable Mg and K in Ochaja Substation were 0.87 and 0.07 cmol/kg respectively.

The exchangeable Mg and K in CRIN Ibadan were 2.13 and 0.18cmol/kg soil respectively. The exchangeable acidity (Al + H) ranged from 0.10 to 0.12cmol/kg soil in Ochaja substation while that of CRIN Ibadan ranged from 0.06 to 0.07cmol/kg. this implies the acidity in Ochaja substation was much higher than the exchangeable acidity in CRIN Ibadan soil. Hence, in the management of the fertility of the soil, the use of acid-forming fertilizers should be discouraged. The soils of Ochaja substation has a relatively high base saturation with a mean value of 95% while the base saturation in CRIN Ibadan was higher with an average value of 99%. The implication of this is that the soil matrix well saturated with basic cations. Although the Ibadan experiment was established very late in the year under review (2020), but a little achievement was made. However, many seedlings were lost due to high intensity of dryness during the dry season that followed the establishment. It was observed only few seedlings (35%) survived the dry season. The missing stands has been replaced and the Ochaja counterpart has just been established. The next stage is monitoring and data taking. The cassava in Ibadan experiment has been harvested and the second year planting is underway.

Plate 1: Climate mitigation trial using biochar and other agronomic practices
Plate 2: Climate mitigation trial using biochar and other agronomic practices

Table 1: Initial soil physical and chemical characteristics of Ochaja Substation and Ibadan, CRIN headquarter

Location	Soil depth (cm)	Particle size (g/kg) Sand	Silt	Clay	pH	O.C (g/kg)	Total N (g/kg)	Avail. P (mg/kg)	Exch. Bases (cmol/kg) Ca	Mg	K	Na	Exch. Acidity (cmol/kg)	ECEC (cmol/kg)	Base Sat. (%)
Ochaja	0-20	942	29	29	5.64	6.4	0.60	14.57	2.72	1.00	0.09	0.46	0.10	4.38	97.62
Ochaja	20-40	932	29	39	5.20	3.10	0.40	14.53	1.37	0.74	0.05	0.27	0.12	2.55	95.25
Ibadan	0-20	882	64	54	7.02	10.57	0.70	23.36	5.71	2.63	0.25	0.36	0.06	9.02	99.26
Ibadan	20-40	872	74	54	6.98	2.70	0.50	11.52	3.04	1.64	0.12	0.29	0.07	5.14	98.64

Experimental Title: Influence of appropriate fertilizer application on yield of cashew in Ochaja

Objectives: To evaluate the influence of the various fertilizer types on yield of cashew and to assess the influence of fertilizer types on soil physical and chemical properties.

Achievement: Soils of the plantation was deficient in Nitrogen and potassium. There is need for appropriate fertilizer application to enhance cashew nut yield.

Table 1: Initial physical and chemical properties of soils of cashew plantations in Ochaja

Parameters	Soil depth (cm) 0 -20	20 – 40
pH	5.37	5.07
Organic carbon (g/kg)	6.90	4.13
N (g/kg)	0.30	0.27
P (cmol/kg)	6.54	6.23
K (cmol/kg)	0.07	0.06
Ca (cmol/kg)	9.53	8.13
Mg (cmol/kg)	0.59	0.50
Na (cmol/kg)	0.36	0.39
Ex base (cmol/kg)	0.55	9.08
Ex. Acidity (cmol/kg)	0.10	0.11
ECEC (cmol/kg)	10.65	9.19
Base saturation (%)	99.06	98.80
Zn (mg/kg)	4.11	4.39
Cu (mg/kg)	3.04	0.37
Mn (mg/kg)	27.60	9.45
Fe (mg/kg)	16.60	16.76
Sand (g/kg)	847.6	828.6
Silt (g/kg)	120.6	130.6
Clay (g/kg)	31.8	40.8
Textural class	Loamy sand	Loamy sand

Table 2: Initial leaf nutrient content of cashew plantations in Ochaja

Parameters	Value
Organic Carbon	51.6
N (g/kg)	11.4
P (g/kg)	0.53
K (g/kg)	14.5
Ca (g/kg)	74.54
Mg (g/kg)	6.10
Zn (mg/kg)	115.87
Mn (mg/kg)	380.23
Fe (mg/kg)	236.11
Cu (mg/kg)	18.37

Experimental Title: Biochar generation from cashew litter and its influence on yield of cashew in Ibadan and Kogi

Objectives: To produce of cashew litter biochar and analyse for its chemical properties.

Achievement: Leaf litter generated ranged between 5.5-14.3 tons/ha.

Table 1: Weight of leaf litter (kg/ha) under different kola plantations.

Cashew plantation	Mean weighttons/ha	Rangetons/ha
A (20year)	13.6b	12.9-14.3
B (29 years)	7.0a	5.5-8.5
SE		

with mean leaf litter production of 13.6 tons/ha and 7.0 tons/ha for plantations A and B respectively. The 29-year-old cashew plantation had 94 % lower leaf litter than the 20-year-old cashew plantation.

Experimental Title: Development, utilization and evaluation of cashew apple-wheat composite flour for confectionery production

Objectives: to utilize cashew apple powder in the formulation of composite flour for bread and other confectionery production.

Achievement: cashew apple powder has been produced and analysed

Experimental Title: Plantation diversification through bee keeping under cashew orchard at Ibadan and Ochaja

Objective: To utilize cashew plantations for honey production as additional income for farmers

Achievements: 75 % colonization was recorded in the entire hives baited.

92 liters of pure and highly graded honey were harvested.

Plate 3: Honey from cashew plantation at Ibadan and Ochaja

Experimental Title: Behavioral Bioassay of Stem Girdler to Host Plant Volatiles
Investigator: Mokwunye, I.U

Introduction
Cashew is an important economic crop in Nigeria. It is cultivated in almost all agro-ecological zones in Nigeria. The major products of cashew traded on the international market are kernels and CNSL while the pseudo-apples are locally consumed. Besides, the cashew tree is also used to control erosion and serves as wind break. Damage by insect pests has contributed to decline in productivity of the crop. Despite the huge losses attributed to stem girdler infestation, farmers hardly apply pesticides due to several limiting factors. This should be encouraged by exploring other safer alternatives such as the utilization of semiochemicals. It is known that most insects use volatile cues to identify and locate appropriate requirements such as host, oviposition sites, mates etc. An improved understanding of pest olfaction could lead to the development of a novel protection of cashew, based on semiochemical. The objective of this study was to determine the semiochemical interactions between cashew and *A. trifasciata*, which can be exploited for monitoring the pest population, mass trapping and to alter the behaviour of *A. trifasciata*.

Materials and methods
Behavioral bioassays
Insect behavioural assays were carried out using a glass Y-tube olfactometer following the description by Ginzel and Hanks (2005). This was to determine the responses of sexually matured male and female stem girlder to cut cashew stems and young leaves volatiles. Static air was allowed through the two glass chambers measuring 14 cm ID x 55 cm high, one glass chamber contained five 5 cm long cashew stem or leaf as the odour source and the other served as a blank control. Individual test females and males were gently released into base of the main tube of the olfactometer and observed for 15 min. The time spent in each zone was recorded using a stop watch. Each trial was replicated with 30 female and 30 male respondents. Data on the mean time spent in, and number of entries (visits) into, odour and control arms of the olfactometer were the parameters chosen for assessment of the differences between odour source and control.

Extraction of Volatiles from Cashew Plant Parts
The plant materials, cashew stems and leaves were air-dried for 5 days under laboratory conditions. Thereafter solvent-assisted extraction method according to Cañas-Hoyos *et al.* (2017) with slight modification was applied. The extract was stored in the freezer for subsequent analysis.

Gas Chromatography-Mass spectrometry (GC-MS)
Coupled gas chromatography-mass spectrometric (GC-MS) analysis of the cashew plant part extracts were carried out at the Central Laboratory, University of Lagos, Lagos, Nigeria. The plant part extracts were analysed using an Agilent HP 7890 Gas chromatograply coupled to an HP 5975 mass spectrometer (EI, 70 eV, Agilent, Palo Alto, California, USA) equipped with an HP-5MS column (30 mm x 0.320 mm ID x 0.25 um, Agilent, Palo Alto, California, USA) in the spitless mode. The oven temperature was programmed at 80 °C for 2 min and then increased by 12 °C min^{-1} to 240 °C, and held at this temperature for 6 min. The interface temperature between GC injector and MS was 250 °C. The carrier gas was helium. GC-MS identifications were made by comparison of retention time and spectra with mass spectral databases (NIST, 2005), and confirmed by peak enhancement on GC using authentic compounds. Quantification of the components were based on external calibration curve prepared from standard solution of the parameter.

Statistical analysis
Data on the mean time spent in either arm of the olfactometer was analysed using t-test while the data on the number of entries (visits) into odour and control arms of the olfactometer was analysed using χ^2 test.

Results and Discussion
In the Y-tube olfactometer bioassays, both male (male: t = 2.228, d.f = 11, p = 0.040) and female (t = 2.341, d.f =11, p = 0.040), A. trifasciata spent significantly greater proportion of time in the arm with intact cashew stems compared to the control (Figure 1). For most cerambycid species, plant volatiles are attractive to both sexes, thus playing a role in mate location. The result of this study has provided support for this assertion. *There was no significant difference between proportion of time spent by either male (t = 1.477, d.f =11, p = 0.178) or female (t = 1.697. d.f =11, p = 0.165) A. trifasciata in the olfactometer arm containing the intact cashew leaves and control arm (Figure 2). The number of times male and female A. trifasciata entered the odour zones (cashew stems and leaves) were not significantly different from the control (Figures 3 and 4).*

The GC-MS analysis of the cashew stem bark extract detected fourteen (14) compounds that represented 94.76% of the extract (Figure 5). The most abundant copounds were 5-hydroxymethyl furfural (60.87%), Alanyl-β-alanine (10.63%), n-Hexadecanoic acid (5.25%) and 2,3-dihydro-3,5-dihydroxy-6-methyl 4H-pyran-4-one (4.70%). Trace amount of carbohydrates such as D- mannoheptulose (0.78%), D-allose (0.51%), 4-O-methylmannose (0.10%) and amino acids namely cycloserine (0.59%, L-asparagine (0.55%) were identified in the cashew stem bark extract. Documented evidence shows that fatty acids such as Hexadecanoic acid (palmitic acid), cis, cis-9,12-Octadecadienoic acid (linoleic acid), Octadecenoic acid and Octadecanoic acid (stearic acid) are useful as whitefly attractants (Hamilton, 2010).

A total of twenty four (24) compounds were identified in the cashew leaf extract and they belonged to classes such as hydrocarbons, fatty acids, esters and terpenes. Terpenes were predominantly present. Earlier studies have established that hydrocarbons such as sesquiterpenes, monoterpenes, alkanes and fatty acids function as olfactory cues for host finding among insect species (Harborne, 2003; Schoonhoven et al., 2005). The major compounds present were 3β, 17β-dihydroxyestr-4-ene (10.89%), Hexadecanoic acid, ethyl ester (7.49%), I-Methylbicyclo[3.2.1] octane (7.28%) and 3α, 17β-dihydroxysterene (7.06%). The least abundant compounds were Methyl (Z)-5,11,14,17-eicosatetranoate (0.31%), Aromandendrene (1.42%) and 2,2,6-trimethyl-1-(2-methyl-cyclobut-2-enyl)-hepta-4,6-dien-3-one (1.60%) (Figure 6).

Conclusion and Recommendation

In conclusion, both sexes were independently attracted to cashew stems, they did not show significant attraction to cashew leaves. Thus, signifying that the cashew stem volatiles play a role in host location and maybe mate location as well. Synthetic version of the identified compounds can be developed and utilized for field monitoring pest population or/and mass trapping of the stem girdler, particularly since they are low–density pest.

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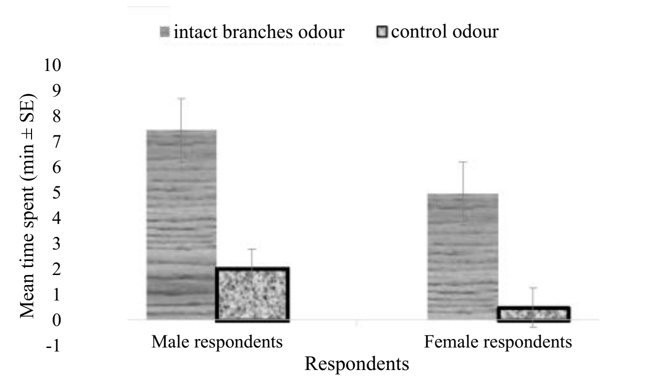

Figure 1: Responses of male and female *Analeptes trifasciata* within an olfactometer as expressed as mean time spent (minutes) in intact stem odour arm and control arm

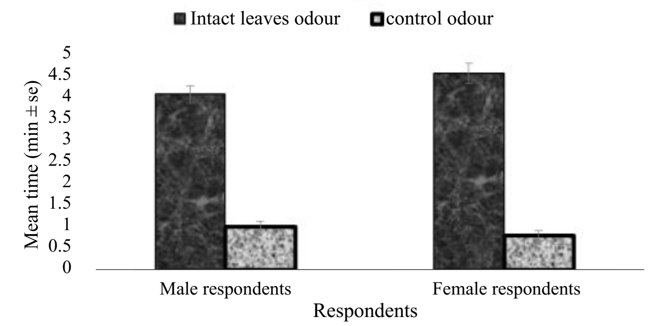

Figure 2: Responses of male and female *Analeptes trifasciata* within an olfactometer on mean time spent in intact leaves odour arm and control arm

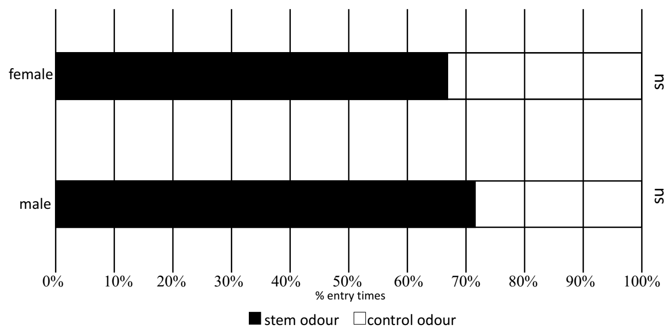

Figure 3: Responses of male and female Analeptes trifasciata within an olfactomete to cashew stems as expressed as mean number of entries into cashew stem and control odour arms

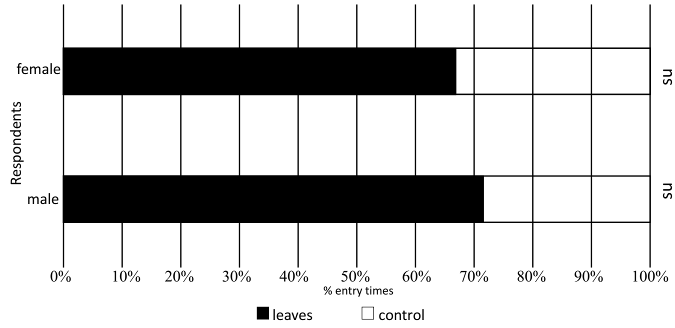

Figure 4: Responses of male and female Analeptes trifasciata within an olfactometer to cashew leaves as expressed as mean number of entries into cashew leaves and control odour arms

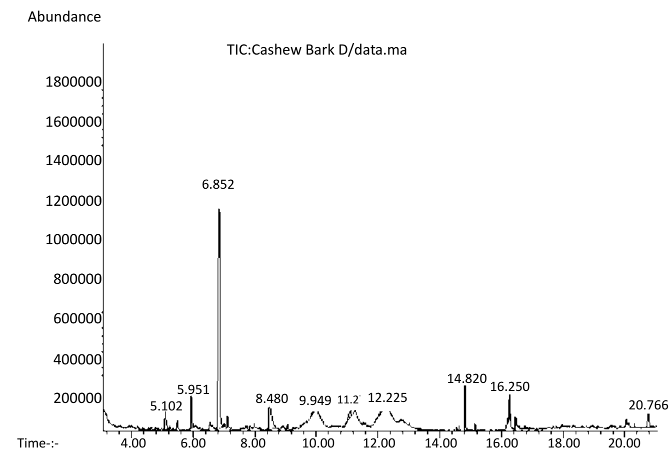

Figure 5: Chromatogram of intact cashew stems extract

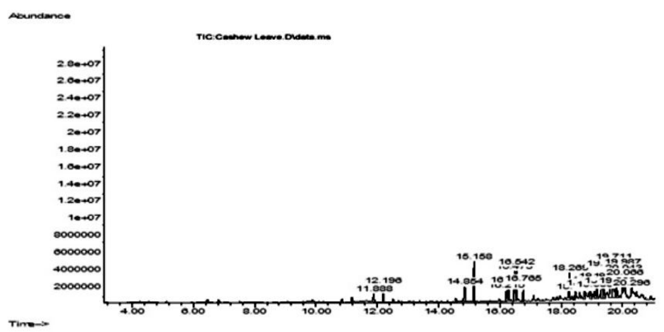

Figure 6: Chromatogram of intact cashew leaf extract

COFFEE PROGRAMME

Experimental Title: Mycotoxins production in variedly processed *Robusta* and *Arabica* coffee in storage
Investigators: Adeniyi, D. O., Mofolasayo, A. S. and Adeji, A. O.

Introduction

Interaction between environmental stress factors such as water activity and temperature, may have an influence on expression of the biosynthetic regulatory genes, growth and mycotoxin production by mycotoxigenic species of fungi. The risk of spoilage is a function of factors including: the variety of crop, time and method of harvest and storage, storage temperature, moisture content and drying method prior to storage. Storage is a critical stage where infection and mycotoxin accumulation occur. The potential sources for contamination of products are mostly environmentally based and include air, dust, soil, water, insects, rodents, birds, animals, microbes, humans, storage, shipping containers, handling and processing equipment. Infection of agricultural produce in the field by fungi could have resulted in production of mycotoxins during cultivation, harvesting, storage, transport and processing, most contamination is of a microbiological nature.

The adverse economic effects attributed to mycotoxin contamination and losses are widely felt in all sectors of food production and particularly in agricultural commodities. Mycotoxin contamination of agricultural commodities has considerable economic implications. Two important groups of fungi: field fungi and storage fungi. The previous invades the seeds while the latter still in the field and require high moisture conditions of 20 – 21%. (CAST, 2003). The growth of toxigenic fungi can adversely affect produce quality and produce mycotoxins. The fungal genera, *Fusarium* and *Alternaria* are considered most important because of their toxigenic ability to produce mycotoxins, they are classified as field fungi, while *Aspergillus* and *Penicillium* species are often considered storage fungi (Roige *et al*., 2009).

Fumonisin, aflatoxin, ochratoxin, zearalenone and trichothecenes such as deoxynivalenol, T-2 toxin and nivalenol are appreciate as most important mycotoxins. The important mycotoxins produced by *Aspergillus* species include aflatoxin B1, B2, G1 and G2, ochratoxin A, sterigmatocystin and cyclopiazonic acid. Aflatoxins are produced mainly by *A. flavus, A. parasiticus* and *A. nominus*. Zearalenone is a phenolic resorcyclic acid lactone mycotoxin produced by several *Fusarium* species, particularly *Fusarium graminearum*. The proliferation of these fungi is stimulated with higher moisture content, higher temperature during storage, long storage period, intensive infection by fungi before storage and by higher activity of insects and mites. Therefore, it is important to identify the species of fungi in coffee beans with special emphasis on mycotoxigenic species, which pose a potential risk to human and animal health. The occurrence and the formation of ochratoxin in processed coffee beans have been studied by many authors, it was present before storage, indicating the possibility that harvesting and post – harvest handling of coffee berries could be critical steps leading to contamination. There is currently little information available on the presence of ochratoxin – producing moulds in coffee beans that undergo wet and mechanical processes and the impact of these processes on the production or presence of ochratoxin among other mycotoxins.

Materials and Methods

Different types of coffee beans were sourced from stores in Cocoa Research Institute of Nigeria (CRIN). The coffee beans were of dry processed *Arabica* highland coffee, wet processed *Robusta* lowland coffee, husked dry processed *Robusta* lowland coffee and dry processed dehusked *Robusta* lowland coffee. The pH of the coffee beans of varied sources was determined using a pH meter following standard procedures. Effect of post-harvest handlings and storage were assayed on the associated mycotoxins in the categorized coffee beans.

Results and Discussion

The pH values of coffee beans varied with sources; the acidity of the beans was highest in husked dry processed *Robusta* lowland coffee with 4.5 while the dry processed *Arabica* highland coffee was near neutral with pH of 6.0. All categories of coffee beans used in this study had acidic medium condition.

Table 1: pH of stored coffee beans

Code	Coffee bean source	pH
AHD	dry processed *Arabica* highland coffee	6.0
RLW	wet processed *Robusta* lowland coffee	5.6
RLDH	husked dry processed *Robusta* lowland coffee	4.5
RLDD	dry processed dehusked *Robusta* lowland coffee	5.5

The dry processed *Arabica* highland coffee recorded five mycotoxins comprising of aflatoxins and ochratoxin-A. four other mycotoxins were detected whose identity were unknown. The concentration of ochratoxin-A was highest (8.6881ppb) followed by 8.2028ppb recorded for aflatoxin B2, while the least concentration of 3.1186ppb was recorded in aflatoxin G2 (table 2).

Table 2: Mycotoxins associated with dry processed *Arabica* highland coffee

Peak ID	Ret Time	Height	Area	Conc ppb
Aflatoxin B2	1.248	497921.000	5266799.000	8.2028
Aflatoxin B1	1.473	390751.188	4735150.500	6.9522
Aflatoxin G1	1.682	206823.641	3716628.750	4.7246
Aflatoxin G2	2.432	98751.609	2636212.500	3.1186
Unidentified	4.540	125.113	297.460	0.0018
Ochratoxin A	1.315	10153.037	205958.609	8.6881
Unidentified	1.773	9817.846	137223.656	4.4465
Unidentified	1.923	9410.674	206092.469	6.7081
Unidentified	2.498	5066.014	121860.164	4.1573

Aflatoxins B2, B1, Ochratoxins -A were detected in the wet processed *Robusta* lowland coffee with 10.9478ppb of aflatoxin B2 as the highest but aflatoxin B 1 recorded the least concentration (3.0522ppb) while three other mycotoxins were not identified (table 3).

Table 3: Mycotoxins associated with wet processed *Robusta* lowland coffee

Peak ID	Ret Time	Height	Area	Conc ppb
Aflatoxin B2	1.298	748490.813	12600794.000	10.9478
Aflatoxin B1	1.765	186730.234	3774966.750	3.0522
Unidentified	0.115	51.658	295.867	0.0354
Ochratoxin A	1.307	10434.562	207410.438	4.7972
Unidentified	1.715	10529.284	420708.406	8.2983
Unidentified	2.557	6887.426	208012.031	2.8691

The dry processed dehusked *Robusta* lowland coffee also recorded eight mycotoxins but identity of three were not known. The identified toxins were Aflatoxins B2, B1, G1, G2 and Ochratoxins-A. Concentration of aflatoxin B1 (9.7053ppb) was highest but 0.0122ppb was the least recorded in aflatoxin G2 (table 4).

Table 4: Mycotoxins associated with dry processed dehusked *Robusta* lowland coffee

Peak ID	Ret Time	Height	Area	Conc ppb
Aflatoxin B2	1.315	218185.672	1444442.000	5.5544
Aflatoxin B1	1.490	324264.031	6658855.000	9.7053
Aflatoxin G1	2.340	58988.348	1181982.250	2.7281
Aflatoxin G2	2.973	705.000	1135.800	0.0122
Ochratoxin A	1.348	13182.044	247627.719	7.7454
Unidentified	1.815	11515.943	167668.438	2.1719
Unidentified	1.973	10747.178	214948.813	3.4241
Unidentified	2.548	5319.500	125975.227	1.6585

The concentration of mycotoxins varied with coffee bean types used in this study. The detected concentrations of aflatoxin B2 was most in wet processed *Robusta* lowland coffee, aflatoxin B1 highest in dry processed dehusked *Robusta* lowland coffee and ochratoxin-A was highest in dry processed *Arabica* highland coffee. Aflatoxin G2 recorded the least concentrations in dry processed *Arabica* highland coffee and dry processed dehusked *Robusta* lowland coffee while aflatoxin B1 was smallest in wet processed *Robusta* lowland coffee.

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$$\Pi = \sum Y_i^{\,p} P_i^{\,p} - \left(\sum a_{ij} P_j^{\,p} + \sum a_{ij} P_k^{\,p}\right) \quad \text{............(1)}$$

Where:

Π = Private Profit;

$Y_i^p P_i^p$ = Value of output produced at private prices;

$\Sigma a_{ij} P_j^p$ = Cost of tradable inputs used at private prices;

$\Sigma a_{ij} P_k^p$ = Cost of domestic factors used at private prices.

If Private Profit < 0, which is negative private profit, this shows that the product is not competitive given current technologies, prices of inputs and outputs, and policy and that operators are earning subnormal rate of return when private profit = 0, operators are earning normal profit while when private profit > 0, that is positive private profit. The positive private profit implies that the product is competitive given current technologies, prices of inputs and outputs, and policy and the producers are earning positive returns and this should lead to expansion of the system.

4.5.1.2. Private Cost Ratio (PCR) - This shows the private efficiency of the farmers or the marketers and is an indication of how much one can afford to pay domestic factors (including a normal returns to capital) and still remain competitive.

$$PCR = \frac{\sum a_{ij} P_k^{\,p}}{Y_i^{\,p} P_i^{\,p} - \sum a_{ij} P_j^{\,p}} \quad \text{...............(2)}$$

Where:

$\Sigma a_{ij} P_k^p$ = Cost of domestic factors at private prices;

$Y_i^p P_i^p$ = Revenue at private prices;

$\Sigma a_{ij} P_j^p$ = Cost of tradable inputs at private prices.

PCR < 1 indicates that the product is highly competitive given current technologies, inputs and output prices and policy and that entrepreneurs are earning excess profits. It shows that the entrepreneur can pay for all the domestic factors including bank loan and its interest with the operation still remaining competitive. The PCR > 1 implies entrepreneurs are making losses, that is after paying for the domestic factors, the operation is no more competitive PCR = 1 indicates the breakeven point.

Results and Discussion

The result of the socio-economic characteristics of the farmers is shown in Table 1. The table shows that only 7.41% of the total respondents are of age 50 years and below indicating that the proportion of youths among the respondents is low. Meanwhile, 77.77% of the total respondents were above 60 years of age. Hence, 77.77% of the farmers were above the productive age of 60 years. The lowness in the proportion of the youths is a bad pointer to coffee production efficiency as younger farmers are more active on farm work than the aged ones. Table 1 also shows that 100% of the respondents were males. This is quite obvious in that farm work is a tedious work and is only men that could cope effectively with it. Apart from this, most of the farms were inherited and some traditional cultures permit only the male children to inherit farms. As regards the educational level of the respondents, the result of the analysis shows that 70.37% of the respondents were having formal education. This would improve the efficiency of the farmers in as much that literate farmers would find it easier to adopt new technologies on coffee than the illiterate ones. The analysis on farm size shows that 81.48% of the respondents had farm size of 5 hectares which shows that most of the farmers are small scale farmers. Table 1 also shows that 66% of the farmers had the age of their farms greater than 30 years showing that most of the farms are old and hence the farm's productivity would reduce, therefore such farms needs to be rehabilitated. As regards farming experience, 96.7% of the farmers were having more than ninety years of experience on coffee farming. This is a good pointer to an increased productivity. Table 1 also revealed that majority (85.19%) of the farmers had inherited farms while just 14.81% established their farms themselves.

Table 1. Socio-economic variables of coffee farmers

Variables	Frequency	Percentages
Age of farmers (years)		
≤ 50	6	7.41
51-60	12	14.82
61-70	21	25.92
> 70	42	51.85
Total	81	100.00
Sex		
Male	81	100.00
Female	0	0
Total	81	100.00
Educational level		
No formal education	24	29.63
Primary education	18	22.22
Secondary education	15	18.52
Tertiary education	24	29.63
Total	81	100.00
Size of farm (Ha)		
≤ 5	63	81.48
5.1-10	18	18.52
> 10	0	0.00
Total	81	100.00
Age of farm ((years)		
≤ 10	6	7.41
11-20	6	7.41
21-30	3	3.70
31-40	21	25.93
> 40	45	55.55
Total	81	100.00
Farming experience (years)		
≤ 10	1	3.70
11-20	0	0
21-30	9	11.11
31-40	15	18.51
41-50	18	22.22
> 50	38	44.46
Total	81	100.00
Type of ownership		
Self-owned	12	14.81
Inheritance	69	85.19
Total	81	100.00

Source: Field survey, 2019.

The result of the competitiveness analysis as shown on table 2 showed that coffee production is highly competitive in the two coffee farm ownership types considered. This is because the Private Profitability (PP) and the Private Cost Ratio (PCR) result is positive and is less than one respectively in all the farm ownership types. Considering the values of PP, coffee production in the two ownership types is highly competitive since the values are very high in the two ownership types. However, coffee production is more competitive in self owned type of ownership because the value of Private Profitability is the higher between the two ownership types (N241,192.86). This is followed by inheritance type of ownership with PP value of N104,850.00. The values of Private Cost Ratio showed that coffee production in the two ownership types is highly competitive, meanwhile, the lower the PCR the higher the competitiveness. Therefore, coffee production in self ownership is more competitive since it is having the lower PCR (0.089). This is followed by inheritance type of ownership with PCR of 0.166. Looking at the values of both the PP and PCR together, it clearly showed that coffee production is more competitive in self ownership than inheritance type of ownership given current technologies, prices of inputs and outputs, and the prevalent government policies.

Table 2. Competitiveness of Coffee Production Systems

Coffee Production Systems	Private Profitability (PP)	Private Cost Ratio (PCR)
Self-Owned	241,192.86	0.089
Inheritance	104,850.00	0.166

Source: Field survey, 2019.

Conclusion

Majority of the respondents are formally educated, and this is a pointer towards high productivity and increased competitiveness in coffee production. Also, most coffee farmers in the study area were small scale producers, this is because majority of the farmers were having farm size of five hectares and below. Coffee production in the study area is highly competitive. However, coffee production in self ownership management system is the most competitive of the two types of farm ownership. In as much that coffee production in the study area is highly competitive, it is hereby recommended that government should give farmers incentives to expand their coffee farms as majority of the farmers are small scale farmers (having less than 5 hectares of land). The incentives may include provision of soft loans as well as subsidized inputs.

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Experimental Title: Establishment of Coffee Seedlings in Ibeku Substation

Investigators: Okeniyi, M .O. and Adedeji, A. R

Introduction:

The Togolese coffee in the station has since been neglected and abandoned and all effort to rehabilitate it does not yield result hence the resolve to establish a new coffee plot.

The new plot of land had already been mapped out and plantain planted. It is hoped that it will be funded for the project to actualize.

Materials and Methods:

The project is located at Ibeku substation. The size is 0.5 hectare which will later be expanded to 1 hectare.

Result and Discusion

The land has been cleared with plantain already established at a planting distance of 3 by 3.

The coffee seedlings required for the establishment will be sourced from the head quarters.

Status: On-going

Experimental Title: Determinants of Farmers' Adoption of Standard Practices in Coffee Production in Kogi State, Nigeria

Investigators: Abdul-karim, I. F. and Orisasona, T. M.

Introduction

Agriculture was the leading sector in the 1950s, 1960s and 1970s, it then accounted for 63 percent of the Gross Domestic Product (GDP, 1960-1964), and 54 percent in 1965-1969 (Williams, 2008). Cash crops such as coffee, cocoa, cashew, oil palm, gum Arabic, and rubber were major sources of employment and livelihood to farmers and the agricultural sector contributed to the nation's foreign exchange. In recent times, the Nigerian economy, in terms of revenue and foreign exchange, is undoubtedly dominated by the oil sector but agriculture holds the key to sustained development of the country with respect to provision of employment opportunities, as a source of income for rural families, food for the population and for the provision of raw materials for industry. Nigeria has a highly diversified agro-ecological condition which makes possible the production of a wide range of agricultural produce. There are standard practices of coffee recommended by research institutes in order to meet up with international standard practices. According to Cocoa Research Institute of Nigeria (CRIN, 2004), Good Agricultural practices (GAPs) need to be adopted by the farmers in coffee production and need to be followed strictly, this will help the farmer in their production as well as livelihood. There are two broad problems that have been identified in African agriculture which explain why yields are low. The first is lack of appropriate technology and the second is lack of adoption (Dether & Effenberger, 2013). In Nigeria for instance, the vast majority of producers, who are smallholder farmers, often rely on the traditional farming practices with consequential results of low output and income (Darwah & Verter, 2014). The institute had at various times developed relevant technologies and had also recommended improved practices especially in the area of Good Agricultural Practices (GAP) as well as processing of coffee. Meanwhile, coffee undergoes both primary and secondary processing before it is exported. Thus, it is pertinent to determine farmers' adoption of standard practices on routine GAPs/ field practices that would improve the productivity and sustainability of existing coffee farms and plantation in Nigeria, hence this might ameliorating the coffee farmers' suffering.

Research Questions

Hence, this study sought to provide answers to the following questions:

- What are the standard practices of coffee production available to farmers in the study area?

- What are the sources of information on coffee export standard practices in the study area?
- What is the respondents' knowledge level on coffee export standard practices?

Objectives of the study

The general objective of the study is to investigate the determinants of farmers' adoption of standard practices in coffee production in Kogi State, Nigeria. While the specific objectives were to:

- Identify standard practices of coffee production available to farmers in the study area.
- Examine the sources of information on the coffee export standard practices available in the study area.
- Determine farmers' knowledge level on coffee export standard practices in the study area.

Materials and Methods

The study was carried out in Yagba South East LGA of Kogi State of Nigeria. Kogi state is purposively selected for this study because the state is the highest producer of coffee in Nigeria (Akinpelu and Oluyole, 2020; Idrisu *et al.* 2012).

A multistage random sampling technique was employed in the data collection. Yagba Southeast was purposively selected for the study because of their high production of Coffee among the LGAs in the State. Thereafter ten communities (Aginmi-Oke, Aiyegunde-Oke, Alu, Ejuku, Ife-Olukotun, Igbo-Ero, Igbagun, Oranre, Takete-Isao and Odo-Amu) were randomly selected from twenty-two communities producing coffee in the LG Area of the study area. From each community ten respondents were randomly selected based on the lists of coffee farmers received from the Agricultural Development Programmee in the State for the study area making a total sum of one hundred participants or respondents for the study.

Results and Discussion

No results and discussion yet because the projects is ongoing. The administration of questionnaire and analysis of data for the result will be carried out in due course when the next fund is release.

Recommendation

The study is essential for coffee farmers because it will broaden their experience more on post-harvest handling of coffee produce, educate them on current way of harvesting and processing of coffee for internationally accepted produce.

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Experimental Title: Capacity Building on Export Standard Practices (ESP) among Coffee Based Farmers on Coffee Production in Kogi State

Investigators: Abdul-karim, I. F., Ipinmoroti, R. R., Famuyiwa, B. S., Orisasona, T. M.

Introduction

Agricultural exports remain the second largest foreign exchange earner despite the oil boom (a non–renewable resource) of 1970 which occasioned the neglect of this vital sector of the economy. This is quite significant if one takes into consideration that a single commodity in the sector, i.e. coffee, has continuously accounted for about 60% of Nigeria's non – oil export earnings.

Nearly 25 million farmers in about 50 countries around the world depend on coffee for a significant part of their livelihood (Cague et al., 2009). Coffee is ranked second in value only to oil as a source of foreign exchange in many of the major producing countries. Coffee is one of the most important cash crops in Nigeria; contributing to70% of employment attributed to agriculture in Nigeria. Coffee provides employment and cash income for a large a number of people in the coffee growing areas. This crop is cultivated in 13 states of federation: Oyo, Ogun, Osun, Ondo, Ekiti, Jos, Abia, Edo, cross river, Taraba, Akwa-ibom and Benue states. There has been a decline in coffee production in recent years due to some problems arising from several factors related to the quantity and quality of the product these factors include poor information on appropriate husbandry practices, good management practices, quality of the product, processing marketing problem.

Coffee residue is used as manure, mulches and animal feed and its oil is used in the soap industry. World coffee exports have been increasing up to 97.58 million bags in 2008/2009 compared to 96.08 million bags in the previous year, representing about a 1.6% increase (ICO, 2009). Similarly, the market price for coffee recorded the highest increase of 237% in 2008/2009 and 148.2% in 2006/2007. This indicates that the market for coffee is significant enough to justify an expansion in production in Nigeria and other countries. There has been a decline in coffee production in recent years due to some problems arising from several factors related to the quantity and quality of the product these factors include poor information on appropriate husbandry practices, good management practices, quality of the product, processing, marketing problem and poor pricing of the product. Previous studies have established that low profit from coffee is a major reason for declining participation in coffee production by farmers in Nigeria (Sanusi et al, 2004).

According to Raghu (2010), coffee wet processing method produces clean parchment, good quality green bean, pleasant aroma, original/natural flavour, better taste, it is also less prone to fungal attack, and it fetches higher price in international market. Research has shown that Nigeria farmers' lack adequate processing methods on coffee production which have affected the product and caused reduction in production, processing, marketing, price and quality and quantity of the product, therefore with this project, the capacity building for coffee farmers' in the area on wet processing of coffee in the study area will be used to address the problem of poor quality, poor pricing and market problem of the product which at the end provide adequate solution to the problem.

Objectives of the study are to:

- examine the socio-economic characteristic of the farmer,
- investigate the processing methods used by the coffee farmers in the study area,
- identify the constraints faced by the farmers during processing and after with adequate solution.

Materials and Method

The study was carried out in Yagba South-East LGA of Kogi State of Nigeria. Kogi state is purposively selected for this study because the state is the highest producer of coffee in Nigeria (Akinpelu and Oluyole, 2020; Idrisu *et al.* 2012).

A multistage random sampling technique will be employed in the data collection. Yagba South-East was purposively selected for the study because of their high production of Coffee among the LGAs in the State. Thereafter ten communities (Aginmi-Oke, Aiyegunde-Oke, Alu, Ejuku, Ife-Olukotun, Igbo-Ero, Igbagun, Oranre, Takete-Isao and Odo-Amu) were randomly selected from twenty two communities producing coffee in the LG Area of the study area. From each community ten respondents were randomly selected based on the lists of coffee farmers received from the Agricultural Development Programmee in the State for the study area making a total sum of one hundred participants or respondents for the study.

Results and Discussion

No results and discussion yet because the projects is ongoing. The administration of questionnaire and analysis of data for the result will be carried out in due courses when the next fund is release.

Recommendation

The study is essential for coffee farmers because it will broaden their experience more on post-harvest handling of coffee produce, educate them on current way of harvesting and processing of coffee for internationally accepted produce.

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Achievements

In the year under review, the division has been able to achieve the following feats:

- Proper monitoring and evaluation of the internal control mechanisms put in place by the management of the Institute.
- Ensure compliance with government rules and regulations, and other official gazettes and circulars.
- Increase in the level of compliance with the different control measures (preventive, detective, corrective, directive and compensating) put in place.
- Cost reduction and controls have improved drastically, as we have been able to manage these by ensuring the best quality of items or material is bought for the institutes use.
- The rate of retirement of advances by staff have improved compared with the previous years as the rule of no retirement of previous advances before getting another was strictly enforced.
- No extra budgetary spending: expenditures were wholly, reasonably, exclusively and necessarily incurred.
- On a regular basis, physical inspection of the Institutes assets were carried out for update on existence, current value, completeness, rights & obligations and allocation of these assets.

Experimental Title: Perceived Constraints affecting Coffee Production in Nigeria, A Case Study of Edo State
Investigators: Awodumila D.J and Famuyiwa B. S

Introduction

The origin of coffee farming has been traced to Ethiopia in Africa before its spread to other countries of the world (Williams, 2008, Ngussie and Dererse, 2007). Coffee belongs to the botanical family Rubiaceae, which has some 500 genera and over 6,000 species (Davis 2001). Most are tropical trees and shrubs that grow in the lower storey of forests. Other members of the family include gardenias and plants that yield quinine and other useful substances, but Coffee is by far the most important member of the family economically (Payel G et al 2014) Brazil is by far the largest grower and exporter of green coffee beans in the world followed by Vietnam, Colombia, Indonesia, Ethiopia and India – producing nearly 2.5 million tonnes of green coffee beans per year (Franca et al 2009). Although Coffee is grown and exported by more than 50 developing countries, it's mainly consumed in the industrialized countries namely United States of America, Finland, Sweden, Belgium and Japan among others (Agbongiarhuoyi et al., 2006; and Daviron and Ponte, 2005). The two most important species of cultivated coffees in Nigeria are Arabica coffee (highland coffee) and Robusta coffee (lowland coffee). In the international market, Arabica coffee is of the greatest economic importance but in Nigeria, Robusta coffee account for 94% while Arabica coffee accounts for only 4% of coffee export. The increasing use of Robusta coffee in the preparation of instant (soluble) coffee is making it to gain ground on Arabica coffee in the international market (Williams, 1998). In the world market, Coffee plays a vital role in the balance of trade between developed and developing countries; being an important foreign exchange earner, contributing in varying degrees to the national income of the producing countries (Cambrony, 1992 as cited by Ayoola et al 2012.). Despite the importance of coffee products to nations economy, its production is faced with so many challenges Several factors and challenges have been attributed to the country's dwindling production level, majority of which have forced farmers to abandon coffee for other crops to make ends meet. Major factors contributing to the abandonment of coffee farms, include poor pricing and marketing channel, lack of training on good coffee farming practices and value chain for coffee, lack of government support in terms of funding, provision of inputs and land acquisition. According to Gbenga Akinfenwa (2019), explained that most of the coffee plots are old and farmers have suspended major cultural practices on their farms. Other noticeable factors constraining coffee production are Transport problem, Land tenure system, Prolonged draught, Climate change, Soil erosion, Pests and diseases, Farmers/herders clash and Lack of technical know-how on wet processing method. All the aforementioned production constrains are being considered with the aim of determining ways of bringing coffee farming back to its lost glory Specifically, the objectives were to describe the socio-economic characteristics of coffee farmers; ascertained some coffee production technologies engaged in by farmers, identify some constraining factors affecting coffee production, and determine coffee farmers' perception towards constraining factors affecting coffee production. The hypothesis of the study was stated in null form; there is no significant relationship between socioeconomic characteristics of the respondents and the constraints to cashew production.

Methodology

The research work was carried in Edo State. Multi stage sampling procedure was used in selecting respondents for the study. Three Local Governments Areas noted for coffee production were selected. These are Owan East, Owan West and Uhunmwonde. One community per LGA where coffee is produce were selected. Lastly, thirty respondents were selected in each community to make a total number of ninety respondents. A structured interview schedule was used for field data collection from coffee farmers in the study areas. Descriptive statistics and chi-square were used in data analysis. The variables were measured at 0.05 Level of probability.

Result and Discussion

The socioeconomic characteristics of the respondents

The result of socioeconomic characteristics shown in Table 1 revealed that 67.7 percent of the respondents are between 31to 50 years of age with mean age of 41 years. This indicates that the respondents are still in their productive age. The result of age distribution of farmers contradicted the findings of Ayoola et al (2012) that the majority of sampled coffee farmers was above 50 years old The result also revealed that 61.1 percent of the respondents were male while 38.9 percent are female. The male dominance in coffee production may be as a result of having access to land through inheritance which their female counterpart did not. Also, greater percentage (88.9%) of the respondents are married, this may be because coffee production needs more hands during maintenance and processing. Sixty percent of the respondents had primary school certificate and above. It indicates that most of coffee farmers in the study areas are literate. The table also indicates that majority (91.1%) used both family and hired labour in their farm. This could be as result of tedious nature of coffee work that required more hands

Table1: Distribution of the respondents based on Socioeconomic characteristics n=90

Variables	Frequency	Percentage	Mean
Age			
Less than or equal to 30	11	12.2	
31- 40	27	30.0	41.6 yrs
41-50	33	36.7	
51-60	12	13.7	
61 and above	7	7.8	
Sex			
Male	55	61.1	
Female	35	38.9	
Marital status			
Single	5	5.6	
Married	80	88.9	
Divorced	4	4.4	
Widowed	1	1.1	
Religion			
Christianity	63	70.0	
Islam	24	26.7	
Traditional	3	3.3	
Level of Education			
No formal education	36	40.0	
Primary	30	33.3	
Secondary	20	22.2	
Tertiary	4	4.4	
Primary Occupation			
Farming	78	86.7	
Business	2	2.2	
Civil Servant	10	11.1	
Family size			
1-5	66	73.3	
6-10	19	21.1	
10 and above	5	5.6	
Source of labour			
Family	3	3.3	
Hired	5	5.6	
Both	82	91.1	

Source: Field survey, 2022

Distribution of the respondents based on coffee production technologies utilization

The distribution of respondents based on coffee production technologies utilization is shown in Table2. The result revealed that 18.9% of the respondents never prune their coffee plantation while 36. 7% and 44.4% occasionally and regularly prune their coffee plantation with mean score of 0.75. coffee farmers need to be encouraged to regularly prune their plantation to enhance high productivity. Also, 13.3% of the respondents never gap up the death stands while 70% and 16.7% occasionally and regularly gapping up dead coffee stands in their plantation. Furthermore, 63.3% of the respondents never practiced coffee rehabilitation. This technique is very important in order to increase the economic life span of unproductive coffee plantation and coffee farmers must be trained on rehabilitation technique. The table also revealed that 64.4%, 73.3% and 70% of the respondents occasionally practiced control of pest and diseases, timely harvesting of coffee berries and use of improved coffee seedlings respectively while only 7.8% of the respondents never practiced recommended planting spacing

Table 2: Distribution of the respondents based on coffee production technologies utilization

Coffee production Tech.	Never	Occasionally	Regularly	Mean
Regular pruning	18.9	36.7	44.4	0.75
Gapping up	13.3	70	16.7	1.02
Coffee Rehabilitation	63.3	23.3	12.4	1.11
Control of pest and diseases	13.3	64.4	22.2	1.07
Timely Harvesting	6.7	73.3	20.0	1.13
Use of improved coffee seedlings	12.2	70	17.8	1.06
Recommended planting spacing	7.8	68.8	23.3	1.14

Source: Field survey, 2022.

Distribution of respondents based on constraining factors affecting coffee production

The various production constraints encountered by coffee farmers and their rank order of severity was presented in table 3. Constraints like land tenure system farmers-herder clashes and Lack of technical know-how on wet processing method ranked 1st and 2nd. respectively. The issue of farmers-herder clashes is a serious problem in coffee farming in fact, some farmers are almost given up as a result of incessant attacks by herdsmen. Also, coffee wet processing method is the best method to get good quality coffee products but unfortunately, farmers lack needed training and equipment to carry it out. Price fluctuation and inadequate credit facilities ranked 3rd in order of severity in constraints faced by coffee farmers. Coffee farming is a capital-intensive project, farmers need to purchase agrochemicals, pay wages to labourer and purchase some farm implements. It is difficult to get loan from the bank to finance coffee farming Akinbode SO (2013) explained that the requirement from commercial banks make it difficult for farmers to access credit to finance farming work Also, pests and diseases, inadequate information, and climate change with mean 1.55 ranked 4th while soil erosion and unavailability of labour with mean score 1.48 ranked least.

Table3: Distribution of respondents based on constraining factors affecting coffee production

Constraints	Not a constraint	Minor constraints	Major constraints	Mean	
Inadequate credit facilities	24.4	31.1	61.1	1.19	3rd
Unavailability of labour	5.6	41.1	53.3	1.48	8th
Transport problem	3.3	41.1	55.5	1.51	6th
Land tenure system	4.4	41.1	54.4	1.49	7th
Prolonged draught	5.6	38.9	55.5	1.49	7th
Soil erosion	6.7	37.8	55.5	1.48	8th
Climate change	6.7	31.1	62.2	1.55	4th
Unstable government policies	6.7	34.4	58.9	1.53	5th
Land tenure system	5.6	31.1	63.3	1.58	1st
Price fluctuation	4.4	34.1	61.1	1.56	3rd
Pests and diseases	5.6	34.1	60.0	1.55	4th
Inadequate information	5.6	33.3	61.1	1.55	4th
Farmers/herders clash	8.9	31.1	60.0	1.57	2nd
Lack of technical know-how on wet processing method	10.0	30.9	59.1	1.57	2nd

Source: Field survey, 2022.

Respondents' perception to coffee production constraints

The table revealed that greater percent (93.3%, and 85.6%) of the respondents agreed that credit facilities is not readily available and unstable government policies affect coffee production while 70% of the respondents strongly disagreed that farm labour is cheap and affordable. The table also revealed that 60%, 51.1%, 52.2% and 56.7% of the respondents agreed that pilfering is common practice in coffee farm, information about GAP is not readily available, farmers-herders' clashes is a problem and pest and diseases respectively are serious constraints affecting coffee production while 54.4% and57.4% of the respondents strongly disagreed that climate change is not a serious problem and it is cheap to transport coffee

Table 4: Coffee farmers' perception about constraining factors affecting coffee production

Statements	SA	A	U	D	SD
Credit facilities are not readily available	5.5	93.3	1.2	/	/
Unstable government policies	4.4	85.6	6.7	3.3	/
Farm labour is cheap and affordable	8.9	/	1.1	20.0	70
Pilfering is common practice in coffee farm	22.2	60	18	26.7	3.3
Information about GAP is not readily available	18.9	51.1	25.6	1.1	3.3
Farmers/herders clashes	44.4	52.2	/	3.3	/
Pests and diseases is a problem in coffee production	17.8	56.7	20.0	2.2	3.3
Middlemen make more gain	16.7	57.8	20.0	2.2	3.3
Climate change is not a serious problem	21.1	1.1	3.3	20.0	54.4
It is cheap to transport coffee	13.3	24.4	1.1	3.3	57.4

Source: Field survey, 2022.

Test of hypotheses

The result of chi-square showing relationship between respondents selected socioeconomic characteristics and constraints to coffee production. The table revealed a significant relationship between level of education (X=42. 252; $p<0.000$), Sources of labour (X=20.422; $p<0.000$), Sources of capital (X=15.262; $p<0.000$) and constraints to coffee production. The implication of significant relationship between education and constraints is that the more educated a farmer is the less constraints he/she may likely face because of the high level of exposure. Also, the significant relationship between sources of labour , sources of capital and constraints implies that labour and capital are key factors in coffee production. A farmer that has good sources of finance is likely to overcome some of the constraints to coffee production. It may likely assist farmer to hire labour instead of depending on family labour only.

Table5: Chi- square analysis between respondents' socioeconomic characteristics and constraining factors affecting coffee production.

Variable	X	DF	p-valve	Decision
Marital status	30.293	3	0.532	NS
Level of Education	42.252	3	0.000	S
Sources of labour	20.422	2	0.000	S
Source of capital	15.262	2	0.000	S

Source: Field survey, 2022.

Conclusion and Recommendation

The study concludes that coffee farmers are still in their productive stage. Farmers frequently utilized most coffee production technologies. The study had revealed array of constraints facing coffee farmers which might affect coffee production in commercial purposes these include; lack of access to credit, price fluctuation, farmers-herders' clashes, sharp practices of middlemen, price fluctuation etc. As a result of the importance of coffee production and its products to Nigerian populace, government should intervene in the present crisis rocking the coffee sector by creating appropriate marketing channel and put in place price control system. Farmers need to be encouraged by making available to them credit facilities as most of them depend on personal savings and money gotten from family and friends to finance their farming operation. Inputs should be subsidized by government and made available to farmers in large quantity. Lastly, farmers need training on some coffee production technologies like coffee rehabilitation technique

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Experimental Title: Efficacy of fertilizers and improved agronomic practices on the rehabilitation of old coffee plots in Kusuku

Investigators: Ipinmoroti R.R.; Oloyede, A.A. and Daniel M.A

Introduction

Coffee is a major commodity crop of economic importance in the international market. It is cultivated for the berries which are of value for good health of man Nigeria has fared prominently in the cultivation of coffee in the past but Nigeria contribution to the world market presently have been dwindling over the past few decades due to oil boom that had led to farms to be abandoned by the poor resource farmers. The old age of the farms, soil fertility problems and detrimental climate change are additions to the hindrances to optimal coffee production in Nigeria.

The present shifts of Nigeria government from petrol depended economy to broad based multi-facet resources economy and more importantly, looking at the possibility of improving the economy through cultivation of agricultural commodity crops of which coffee is germane, calls for interest in investment in new establishments and rehabilitation of old coffee plots in Nigeria.. Presently, lots of research findings have evolved on Coffee Research by Cocoa Research Institute of Nigeria in this regard. However for rehabilitation of old coffee plots, the use of coppicing method to generate new chuppons and planting of improved coffee seedlings under old stands are common. This is usually done along with proper soil management through soil test reports as well as coffee leaf sample analysis. The use of coppicing, soil test and coffee leaf analysis and evaluation were engaged in this study at Kusuku, Taraba state.

Materials and methods

The study was a field experiment at Kusuku with two field locations A and B Location A was an on-station site at the old and moribund coffee plantation in Kusuku CRIN Sub-station, while location B was on-farm sites in Kusuku, Mambilla plateau. The experimental plots were mapped out to contain 40 stands of coffee plants that were identified and subsequently coppiced at 30cm to the ground level. The cut surface of each coppiced coffee plant was painted with red coloured paint. Before coppicing, candidate leaf samples were collected for laboratory analysis. There were 3 fertilizer types which includes NPK (15:15:15), poultry manure and NPK (15:15:15) + poultry manure at 50:50 mixture ratio (Organo-mineral), and the control (No fertilizer) for a total of 4 treatments. Each treatment was applied to 10 coppiced coffee plants randomly and tagged accordingly. The coppiced coffee stands were left for generation of chuppons for which only the two that were close to the ground level were retained. Growth parameters in terms of girth, height, number of leaves, branches will be collected on the retained chuppons at 3 months interval. This will continue for 36 months and fruits yield collected per treatment. Soil samples at 0-30cm were collected randomly on the plots at 10 different points using soil core sampler. The soils collected per plot were mixed to form composite sample that represents each plot.

Collected soil samples were air dried in the laboratory, sieved through 2mm sieve and analysed using standard laboratory methods (AOAC, 1990) for the textural soil separates, pH, organic C, total N, available P, exchangeable cations which includes the K, Ca, Mg, Na and the exchangeable acidity ($Al^{+3} + H^{+}$). The ECEC and base saturation levels were calculated. The micro-nutrient contents were determined and they include Mn, Fe, Cu and Zn. Similarly, the coffee leaf samples were oven dried at 70 ^{o}C to constant weight and milled with stainless harmer mill and analysed for the N, P, K, C, Ca, Mg and Na contents in percentage, as well as the Mn, Fe, Cu and Zn contents in mg/kg.

Results and discussion

Soil textural properties

The soil separate analysis showed that the soils contained 63.8-68.8% sand, 25.8-29.4% silt and 4.8-6.8% clay (Table 1). The soil separated distribution indicates that the soils were generally sandy loam in texture. The silt + clay contents ranged from 33.2-36.2%, which was higher than the critical level of 32% reported ideal for coffee soils and other tree crops (Egbe, et al., 1989).This entails that the soils would be able to hold sufficient water for the coffee plants usage, reduce seepage loss and guide against surface run-off that can lead to soil structural damage.

Tables 1: Soil physical properties

Properties	On-Station Plot	On-Farm Plot	kola/coffee plot
Sand (%)	63.8	68.8	65.8
Silt (%)	29.4	26.4	29.4
Clay (%)	6.8.	5.8	4.8
Texture	Sandy loam	Sandy loam	Sandy loam

Soil pH, Organic and nutrient contents

The soil pH, organic C, macronutrients and ECEC contents are shown in Table 2. The soil pH range of 4.44-4 – 5.40 indicates that the soils were acidic. However, the on-station plot was more acidic compared with the on-farm and coffee/kola intercropped plots. The soil pH for both the on-farm and coffee/kola intercropped plots were within the soil pH range ideal for coffee cultivation, while it was below the range for the on-station plot. The soil organic C for the on-farm and coffee/kola plots was 3.48 and 3.21% respectively, while it was 2.27% for the on-station plot. While the on-farm and coffee/kola plots had soil Organic C levels above the critical level of 3.0%., the on-station plot was below the critical level. The very low soil organic C of the on-station plot must have resulted to the very low pH level of the soil. The soil organic C must be improved upon through the use of organic fertilizers or judicious management of farm wastes and mulching materials on the plot. This act will help to correct the acidic nature of the soils on the on-station plot.

Table 2: Soil macro nutrient contents across the coffee plots

Properties	On-Station Plot	On-Farm Plot	Coffee/kola plot
Ph	4.44	5.10	5.90
N (%)	0.145	0.186	0.213
Org. C (%)	2.27	3.48	3.21
P (mg.kg)	27.09	20.84	18.97
K (cmol/kg)	0.32	0.58	0.41
Ca (cmol/kg)	1.861	6.060	7.480
Mg (cmol/kg)	0.603	0.845	1.151
Na (cmol/kg)	0.360	0.520	0.480
Al^{+3}+H^{+} (cmol/kg)	0.127	0.135	0.132
ECEC (cmol/kg)	3.171	8.135	9.620
BS (%)	95.99	98.34	98.63

The soil total N ranged from 0.145 – 0.213%, the value was higher for the coffee/kola intercropped plot and least for the on-station plot. However, the values were higher than the critical level of 0.09% for soils suitable for coffee (Table 3). To maintain continuous sustainable coffee production on th plots, there is need for rational application of nitrogen supplying fertilizers. The soil available P ranged from 18.97 – 27.09 mg/kg soil. The values were least for the coffee/kola plot. This might be as a result of the additional demand and competition for same by the kola plants in the intercrop. However, the soil available P across the plots were higher than the soil critical level of 6.0 mg/kg soil for coffee.

The soil exchangeable cations indicated that K was0.32 – 0.58 cmol/kg soil. It was least for the on-station coffee plot and highest for the on-farm coffee plot. The values were lower than the soil critical level of 4.0 cmol/kg soil. The soil Ca content ranged from 1.86 – 7.48 cmol/kg soil. The value was least (1.86 cmol/kg) for the on-station plot and highest (7.48 cmol/kg) for the coffee/kola plot. However, the Ca contents across the plots were lower when compared to the critical level of 8.9 cmol/kg soil. The soil Mg content ranged from 0/503 – 1.151 cmol/kg soil. The values followed similar trend as described for the soil Ca content. The values were lower compared to the soil critical level of 8.0 cmol/kg soil. The soil Na content was 0.36 – 0.52 cmol/kg soil. The values were low and could not pose any threat to coffee plants and the soil structure.

Table 3: Coffee soil and foliar nutrient critical levels

Sample	N	P	K	Ca	Mg
Soil	%	mg	← cmol →		
	0.09	6.0	4.0	8.9	8.0
	←	%	→		
Foliar	1.10	0.07	1.40	0.37	0.13

On the overall, the lower levels of the exchangeable cations compared to their critical levels for coffee soils indicated the need for the application of appropriate fertilizers that will supply adequate amount of the nutrients to the soils for optimal coffee growth and berry yield on a sustainable level. This was in ttrend with reports by Ipinmoroti and Ogeh (2014). The use of organic fertilizers or manures will be more appropriate so that the advantage of improving the soil organic matter content could be achieved.

The soil contents for Mg and K showed that the Mg/K ratios were 1.45,1.57 and 2.48 for the on-station, on-farm and the coffee/kola intercropped plot respectively. It indicated that the coffee plots had nutrient imbalance problem, this is because, the soil Mg/K ratio should be 2/0. Fertilizer application efforts should be geared towards correcting this in the soil nutrient management activities.

The soil exchangeable acidity (Al^{+3}+H^{+}) contents showed a range of 0.127 – 0.135 cmol/kg soil. The level of soil exchangeable acidity was however very low compared to the exchangeable cations. This was reflected in the soil base saturation levels of 96.00 – 98.63% calculated for the soils. The soil effective cation exchange capacity (ECEC) ranged from 3.17 – 9.62 cmol/kg soil. The value was least (3.17 cmol/kg) for the on-station plot and highest (9.62 cmol/kg) for the coffee/kola intercropped plot.

Micro-nutrients

The soil micro-nutrient contents (Table 4) showed that the soil Mn ranged from 14.45 – 48.05 mg/kg soil, while Fe content was 25.2 – 42.8 mg/kg soil, it was 3.295 – 5.15 mg/kg soil for Cu and 16.81 – 61.73 mg/kg soil for soil Zn content. Generally, the soil micro-nutrient levels were sufficient for coffee plants production on the field. The sufficient amount of these nutrients in the soil forecloses the problem of micron-nutrient deficiency in the proper nutrition of the coffee plants on the various field plots. However, the use of fertilizer materials that could supply some quantity of the various micro-nutrients in the soil will be an added advantage in helping to replenish the soils of nutrients removed by crops through harvests of the berries.

Table 4: Plots soil micronutrient contents

Properties	On - Station P lot	On - Farm Plot	kola/coffee plot
Mn	14.45	48.05	42.95
Fe	25.2	42.85	41.05
Cu	3.495	3.295	5.150
Zn	16.81	61.73	32.85

Coffee foliar nutrient contents

The leaf N content ranged from 0.85 – 1.09% (Table 5) with the least value for the om-station plot and highest for the on-farm plot. The values were however lower compared with the critical level of 1.10%. it was observed that despite the high soil content for N, it does not reflect in the leaf content. This might be as a result of fixation in the soil. The leaf P content ranged from 0.04 – 0.11%. The on-farm and coffee/kola intercropped plots were higher in P contents than the critical while it was lower than critical for the on-station plot. This is a sign of P fixation in the soils of the on-station plot. This might be due to the very low organic C contents of the soil with resultant low organic matter and high acidic nature, with high tendency for P fixation.

The coffee leaf Ca contents (Table 5) showed that Ca contents ranged from 0.61 - 0.74% with the on-station having the highest value of 0.74%, which was followed by the on-farm plot (0.64%) and it was least (0.61%) for the coffee/kola intercropped plot. The coffee leaf Ca contents were higher than the critical value of 0.37% and were considered adequate for the coffee plants. On the other hand, the coffee leaf Mg content ranged from 0.10 – 0.12% which was lower than the critical value of 0.13% and hence, considered not adequate for the coffee plants across the plots. Similar trend to this was obtained for the leaf K content which ranged from 019 – 0.52% which were lower than the critical level of 1.40%

The coffee leaf micro-nutrient contents showed that Mn, Fe, Cu and Zn ranged from 202 – 271mg, 905 – 952mg, 30.8 – 40.40mg and 197.3 – 293.2mg respectively. These values were considered to be very high when compared to the soil contents for the elements. It showed that crop removal was higher than their supply to the soil and this could not maintain sustainable optimal coffee berry production on the plots.

Table 5: Coffee foliar nutrient contents across the plots

Properties	On-station Plot	On-farm plot	Coffee/kola Intercrop plot
N (%)	0.89	1.09	1.07
P (%)	0.04	0.09	0.11
K (%)	0.19	0.41	0.52
Ca (%)	0.74	0.64	0.61
Mg (%)	0.11	0.12	0.10
Na (%)	0.33	0.31	0.29
Org. C (%)	17.83	22.57	20.41
C/N ratio	20.03	20.71	19.07
Mn (mg)	202	264	271
Fe (mg)	905	952	944
Cu (mg)	30.8	24.2	40.4
Zn (mg)	293.2	20.71	248.1

Fertilizer and poultry manure

The N:P:K (15:15:15) contains 15% each of N, P and K (Table 6) while the poultry manure contains Ca, Mg, Fe, Cu Mn and Zn in addition to the N, P and K. the C/N ratio was 8.72 which indicates it can easily be decomposed and mineralised to release nutrients to the soil for planted coffee usage. The organic C content makes the manure a veritable material that could help to build up the soil organic matte and improve on the soil buffer capacity.

Table 6: NPK (15:15:15) and poultry manure nutrient contents

Properties	Poultry manure	NPK 15:15:15
N (%)	1.63	15
P (%)	0.34	15
K (%)	0.51	15
Ca (%)	3.59	-
Mg (%)	0.24	-
Na (%)	0.18	-
Org. C (%)	14.21	-
C/N ratio	8.72	-
Mn (mg)	441	-
Fe (mg)	2160	-
Cu (mg)	51.8	-
Zn (mg)	177	-

Recommendations

The study revealed the need for soil and plant nutrient content auditing in order to know the plantations' true condition and the appropriate ways to correct or ameliorate the situation. The coffee plots were very low in the soil organic C, Mg, K and micro-nutrients. The short supply of N and P in the plant leaves requires that steps need be taken to reduce nutrient fixation in the soils. This could be achieved through appropriate organic fertilizer utilization to supply the nutrients and also helps to build up the soil buffer capacity

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Experimental Title: Information Need and Seeking Behaviour of Coffee Farmers in Edo State, Nigeria
Investigators: Ogunjobi T.E and Famuyiwa B.S

Introduction

Information is conceived as an important resource that contributes immensely towards the development of any nation. Ideally, information brings about knowledge, and a knowledgeable community is also an informed community. This signifies that a community cannot develop without knowledge and a community can only become knowledgeable if they recognize and use information as their tool for development (Kamba, 2009). Access to the right information by farmers can help them to acquire knowledge and confidence to participate fully in farming activities. People need information to develop their potential through training to succeed in life, to enrich their cultural experience, and to take control of their daily lives.

Information has been identified as an important factor in improving agricultural production of any nation. It also serves as an essential tool for decision making. Human beings need information to be able to make decision on any meaningful thing. Thus, for any development to take place, relevant, efficient, and effective information need to be sought. This therefore means that the agricultural sector needs timely and up-to-date information (Ronke, 2005).

Information needs generally refers to the kind of information a particular person is looking for at a specific point in time. Information need comes up when an individual identifies a problem or information gap and develop a desire to solve the problem or bridge the information gap. Such information identified may lead to information seeking and the formulation of request for information (Igwerson and Jarvelin, 2005). Hence, information need simply means requirement for information. It can also be seen as a demand and want. Haruna and Mabawonku (2001) as cited in Yusuf (2012) asserted that information needs are diverse and consistently changing and not agreeable to generalization. Thus, it varies among groups, individual and society. Similarly, Wilson asserted that information need is influenced by a number of factors such as the range of information sources available, the use, background, motivation, professional orientation, etc. surrounding the users and consequences of information. Devadson and Lingam (1996) had stated that, information needs represent gaps in the current knowledge of the user. In day to day work; lack of self-sufficiency constitutes an information need. Information needs are thus a factor that may drive users to seek information to fill the gaps in their information and knowledge. Cocoa farmers require different types of information for day-to-day farming activities. Moreover, the level of information needs may differ between people, or a group of people, depending on a range of factors, such as age, level of education, socio-economic tatus, range of information sources available, level of awareness, and ease of use of information (Kaniki, 2003). The need for information arises when an individual is confronted with a problem or a situation that requires a solution which is not immediately available or the mechanism put in place towards the resolution is not suitable (Mooko and Aina, 2006). Information need is the gap between what an individual knows and what that person is expected to know (Ozioko as cited in Okpala, 2010). The way and manner people look for information varies from each other in terms of culture, religion, age, gender, occupation, location, status, education, experience and exposure. Likewise, the level of need for the same information may differ in people from the same socio-economic and political background, or in terms of availability and awareness of information and ease of use of that information (Aina, 2004). Adequate information has the potentials of broadening the minds of people, transforms lives, and allows for greater sense of independence.

Objectives of the study

The main objective of this study is to investigate the information needs and seeking behaviour of Coffee farmers in Nigeria. The specific objectives are to:

1. Identify various types of crops grown by coffee farmers in Edo State, Nigeria.
2. Find out types of Information need by coffee farmers in Edo State, Nigeria
3. Establish sources of seeking information by coffee farmers in Edo State, Nigeria
4. Ascertain the degree of preference of various sources of information sought by coffee farmers in Edo State, Nigeria.
5. Determines the degree of preference of Information sought by coffee farmers in Edo State, Nigeria.
6. Identify the challenges facing coffee farmers in accessing agricultural information in Edo State, Nigeria.

Methodology

Three local governments were purposively selected and covered in Edo State Nigeria. The three local government were Owan east, Owan west and Uhomonra Local government. One hundred copies of questionnaire were distributed (Owan east 35 copies, Owan west 35 copies and Uhomonra 30 copies). Ninety were retuned making 90% return rate. Analysis was done using frequency and percentages.

Results and Discussion

Table 1: Demographic Variable

Age	Frequency	Percentage
20-30	11	12.2
31-40	27	30.7
41-50	33	36.7
51-60	10	13.3
Above 60	7	7.8
Marital Status		
Single	5	5.6
Married	80	88.9
Divorced	4	4.4
Widowed	1	1.1
Educational Background		
No formal Education	36	40.0
Primary School Cert	30	33.3
Secondary	20	22.2
Tertiary	4	4.4
Religion		
Christianity	63	70.0
Muslim	24	26.7
Traditional	3	3.3
Primary Occupation		
Farming	78	86.7
Business	2	2.2
Civil Servant	10	11.1
Source of Income		
Friends	6	6.7
Personal Savings	74	82.2
Cooperative	10	11.1

Source: Fieldwork 2020

Table 1 revealed that ages 41-50 and 31-40 were prominent in coffee farming activities, majority of them were married (80), many of them did not have formal education (36) while those that have were primary school holders (30). Majority of them were Christians (63), their primary occupation was farming (78) and their sources of income were majorly from their personal savings (74) and cooperatives societies (10)

Section B:

Table 2: Types of crops grown by coffee farmers.

Crops	Strongly Agreed	Agreed	Disagree	Strongly disagree
Maize	50	26	7	8
Cassava	19	59	4	8
Potatoes	20	54	8	8
Coffee	16	60	7	7
Rice	12	63	9	6
Beans	8	61	15	6
Oranges	10	62	11	7
Coconuts	8	63	12	7

Source: field work 2020

Table 2 revealed that some other crops were planted by coffee farmers. The crops were maize (50) strongly agreed while rice (63), coconut (63), oranges (62), beans (61) cassava (59) and potatoes (54) were agreed to.

Table 3: Types of Information need by coffee farmers

Types of information need	Strongly agreed	Agreed	Disagree	Strongly Disagree
information on new varieties of seeds and seedling	80	6	2	2
quantities of chemical to use	10	77	3	-
information on market situation	12	71	6	-
information from research institutions and farmers	15	69	3	3
best planting techniques	21	61	6	2
methods of disease prevention and control	17	63	9	1
best processing methods	19	60	7	4
Information on record keeping	24	52	10	4
Improve seed variety	22	57	7	4
Information on use of fertilizer	17	60	10	3
Information on agro-chemicals	19	59	10	2
Information on credit needs	19	64	5	2
information on Pest and disease prevention and control	15	68	6	1
method of planting and improving new coffee hybrids	12	70	7	1

Source: field work 2020

Types of information need by coffee farmers (table 3) included information on new varieties of seeds and seedling, quantities of chemical to use (77), information on market situation (71) method of planting and improving new coffee hybrids (70) information from research institutions and farmers (69) pest and diseases (68), credit needs (64), methods of disease prevention and control (63) and best planting techniques (61).

Table 4: Sources of seeking information by coffee farmers

Sources	Strongly Agreed	Agreed	Disagree	Strongly disagree
Family members	65	14	2	9
Radio	23	59	2	6
Television	21	59	5	5
Extension Agents	23	60	6	1
Neighbours	27	54	8	1
Friends	19	59	9	3
Books	23	55	8	4
Village leaders	21	61	5	3
Farmers group	16	63	7	4
Social media	13	65	7	5

Source field work 2020

Table 5: State your degree of preference of the following sources of information

Sources	Highly preferred	Preferred	Moderately preferred	Not preferred
Family members	59	10	15	6
Radio	29	45	14	2
Television	28	44	15	3
Extension Agents	32	42	13	3
Neighbours	19	48	10	13
Friends	17	47	11	15
Books	17	43	14	16
Village leaders	24	34	10	22
Farmers group	22	38	8	22
Social media	22	36	9	23

Source: field work 2020

The above table 5 revealed the degree of preference of sources of information to coffee farmers in Nigeria. The most sources of information were family members (59), extension agents (32), radio (29), television (28), village leaders (24), farmers group (22) and social media (22).

The sources of seeking information by coffee farmers in Nigeria(table4) included family members (65), neighbours (27), radio (23), extension agents (23), books (23), village leaders (21) and television (21). Others like friends (19), farmers group (16) and social media (13) were less sought.

Table 6: Degree of preference of Information sought by coffee farmers

Degree of Preference of information on:	Highly preferred	Preferred	Moderately preferred	Not preferred
new varieties of seeds and seedling	67	8	8	7
quantities of chemical to use	29	46	12	3
market situation	29	48	13	-
research institutions and farmers	36	40	12	2
best planting techniques	39	40	10	1
methods of disease prevention and control	32	44	13	1
best processing methods	32	47	10	1
record keeping	26	53	11	-
Improve seed variety	35	44	11	-
use of fertilizer	37	42	10	1
agro-chemicals	32	49	9	-
credit needs	32	47	10	1
pest and disease prevention and control	28	52	10	-
method of planting and improving new coffee hybrids	32	49	9	-

Source: field work 2020

From the table 6 above, the degree of preference of information sought by coffee farmers revealed that new varieties of seeds and seedling was highly preffered (67), followed by best planting techniques (39), use of fertilizer (37), research institutions and farmers (36) and improved seed varieties (35) while market situation (13), methods of disease prevention and control (13) and quantities of chemical to use (12) were moderately preffered.

Table 7: Challenges facing coffee farmers in accessing agricultural information in Nigeria

Challenges	Strongly agreed	Agreed	Disagree	Strongly disagree
Information not easily accessible	68	17	-	5
Lack of up-to-date information	40	46	2	2
Language barrier	31	54	4	1
Lack of awareness of information centre	35	49	5	1
Challenge of electricity to listen to television and radio	32	54	3	1
Inadequate finance to purchase data	31	57	2	

Source: field work 2020

Information not easily accessible, lack of up-to-date information (40), lack of awareness of information centre (35), challenge of electricity to listen to television and radio (32) were the major challenges facing coffee farmers in seeking information needs in Nigeria as it was found in table7 above.

Recommendations

The following are therefore recommended:

Government should provide agricultural loans to coffee farmers in Edo State, Nigeria. This will aid their farming activities and improve their productivity

Provision of electricity to farmers in rural areas is very germane and should be looked into by Edo state government. This will help coffee farmers to have access to information that will improve coffee farming activities in Edo State, Nigeria.

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KOLA PROGRAMME

Background

The Theme of Kola Research Programme is to Improve Kola Productivity and Promote Safe Consumption of the Produce in Nigeria. To achieve this theme, Kola Research Programme has set out the objectives to: a) improve the genetic potentials, agronomic and husbandry practices of Kola, b) identify effective control methods of pests and diseases of Kola, c) develop safe methods of Kola storage for human consumption and d) investigate effective utilization of Kola and its by-products. Against this background, in spite of the COVID-19 pandemic, the programme was able to achieve some of her set objectives highlighted below:

Clonal propagation and development of high yielding Kola varieties

Introduction: The programme saw the urgent need for CRIN to assemble new kola germplasm and properly characterize its germplasm for optimum utilization. This is very important because the existing germplasm has a very narrow genetic base and is largely uncharacterized. Also, the existing germplasm consists of old and unfruitful trees. These two key factors make the existing germplasm unsuitable to solve the problems identified in kola production, which are self and cross incompatibilities and inefficient pollination, regarded as responsible for low yield. The gestation of the crop also needs to be reduced. Proffering solutions to these problems will encourage further farmer interest in the crop. The Institute at present does not have any improved or identified variety for distribution to farmers. Therefore, the use of vegetative propagation urgently needed to be improved upon and perfected by the Institute in her attempts to solve the aforementioned problems. This study therefore aims to identify good performing kola genotypes from farmer's plots and propagate them through cutting and grafting.

Methodology

Collection of Scions: A pre-survey of kola farms with identified good accessions was carried out in selected locations in Okuku (Osun State) and Bamikemo (Ondo) States of Nigeria. These included two farms each in both States. Stem cuttings were collected from four accessions from each farm. This implies eight accessions from each of Okuku and Bamikemo. A total of fourteen accessions were used in the study. Stem cuttings were collected from the apical regions of the trees selected as mother trees which have diverse genetic origin. They are noted to fruit early and with good tree architecture and are also resistant to diseases. Collected scions were semi-hardwood flushes (greenish brown in colour) harvested from the mother tree. The scions were between 10cm - 20cm long and possessed enough buds including an active apical bud which should develop into a new shoot. The scions were harvested very early in the morning before sunrise, and the leaves around on the scions were trimmed to reduce leaf area and thus minimize moisture loss due to transpiration. The scions were wrapped in moist cotton wool to prevent scion dehydration and transported in an empty box from the farmers' plots to the site of the experiment at CRIN headquarters.

Setting of cuttings: Dressing of the cuttings involved the removal of their leaves except two or three leaves close to the apical bud are left. The detached end of the cutting was not dressed. The cuttings were planted directly into propagation structures (wooden boxes) filled with rooting medium. The rooting medium used was a mixture of river sand and rice husk in a ratio of 1:1. The entire cuttings together with the medium were covered with transparent polythene sheet after sowing. The entire medium and cuttings are then kept under shade. Cuttings are then watered every 2-3 days and inspected for rooting and leave development. A hundred cuttings of each accession

Grafting: The detached end of the scion is shaped like a wedge using a knife and grafted unto root stocks that were six months old. Grafted plants were covered with small transparent polythene sheets to create a humid environment around the leaves and helps reduce transpiration. The plants were arranged under shade and success checked periodically for about two months. Grafting tapes and transparent polythene covering on successful grafts were removed immediately. After six months, successful grafts were transplanted to the field.

Results: Though 29.2% of the grafted materials remained green after two weeks after of grafting, only 2% of the original population were successfully established into the germplasm plot. Sprouting among the *Cola* accessions was observed to have been inconsistent with the expectation of 3-4 weeks after grafting, as more than half the initial 29.2% that were green after two weeks remained green even beyond six weeks, and some sprouts were eventually recorded beyond eight weeks after grafting. A similar result was reported in 2018. These inconsistencies may be attributed to the timing of the grafting which lied between March and August. Humidity was high during this period, and could have accounted for the low success rate. Appropriate timing for ideal grafting activities (as observed with cacao) lies between October through Early December, and February through Early April.

Callus formation and eventually, root development occurred in some of the accessions used in the setting of cuttings. Three months after setting of cuttings, 36.84% of the original population of the cuttings set remained green after 12 weeks of setting (Figure 2a). Ten percent (10%) of these green produced new sprouts (Figure 2b), which are already developing through the juvenile stage at 12 weeks after setting (Figure 2c and 2d).

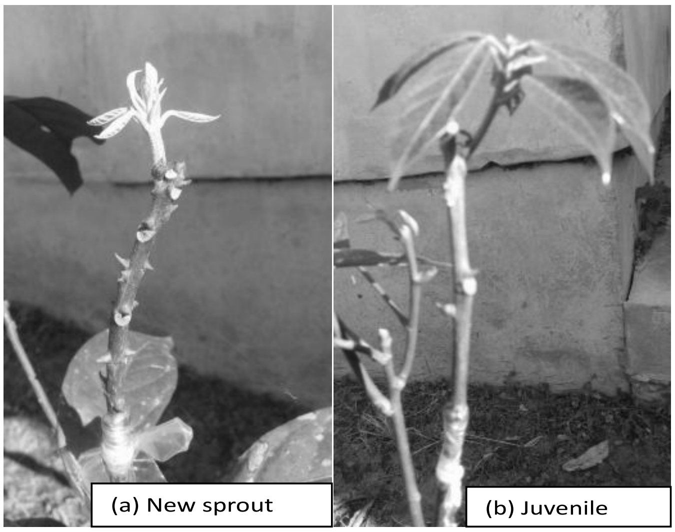

Figure 1: Successful grafting in Cola accessions

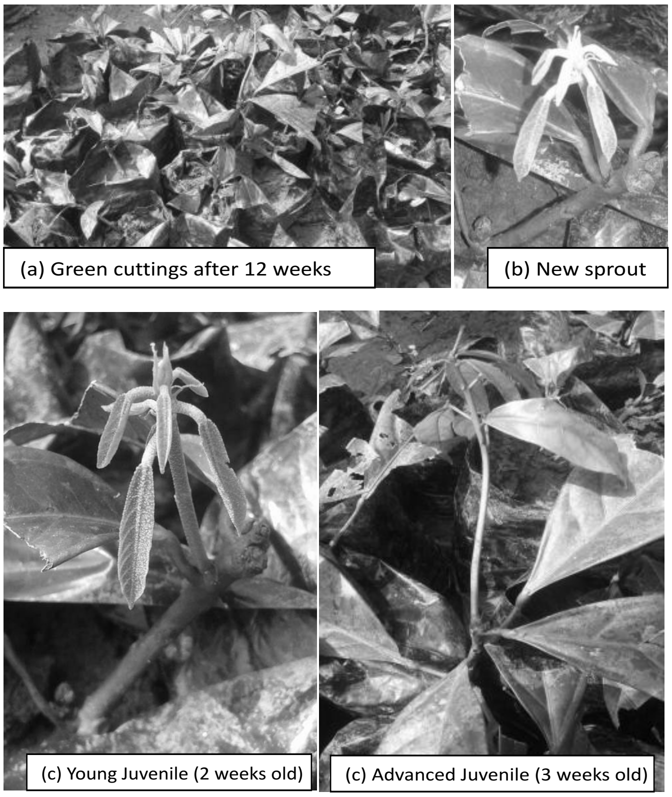

Figure 2: Sprouting, Leaf formation and development of juveniles in Cola cuttings

Achievement

Many cuttings and grafted materials from this experiment were successfully established in a new Cola germplasm plot at CRIN Headquarters, Ibadan. The success obtained in the setting of the kola cuttings is significantly different from all the previous results obtained from cuttings of the various *Cola* spp set. This result indicates that with further efforts, CRIN will be able to successfully establish clones of better performing kola genotypes in its germplasm collection, thereby paving way for the development of improved kola varieties for distribution to farmers.

Evaluation of antimicrobial potentials of selected botanicals against kola nut storage rot pathogen (*Lasiodiplodia theobromae*)

Introduction

Cola species (Family: Sterculiaceae) are native to the tropical rainforests of Africa, West Indies, and Brazil. The kola tree reaches heights of between 40-60 feet. Out of the twenty-five species known to exist, *Cola nitida* and *C. acuminata* are the two most commonly cultivated and suitable for human consumption. Nuts of these two *Cola* spp. are commercial export commodities for the production of kola-chocolate, liquors, laxatives and caffeine for pharmaceutical purposes. Maturity of kola fruits usually takes place 4-5 months after pollination, with characteristic change in colour from deep green to a paler tint (at a time the fruit should be harvested), as the follicles will start to dehisce thereafter. Exposed seeds are more prone to insect attack and subsequently predispose the nuts to fungal infection. Numerous toxic metabolites are produced in mould-infected stored kola nuts as can be found in other mould-contaminated foods. When such nuts are consumed, they pose a huge health risk to the consumers. Due to the warm, humid rainforest zone in which cultivation, processing and storage of the kola nuts take place, there is high risk of mould infection. Most traders as a result, labour assiduously to maintain the freshness of the nuts, prevent fungi growth and insect attack that predisposes Cola to rot infection in storage. This requires removal of infested nuts at intervals during the storage period, but this does not control fungi which spread rapidly in the nuts. Most traders and consumers do not discard fairly mouldy nuts during storage, leading to infection of more hitherto healthy nuts and a huge loss in the long run**.** Diseases associated with stored kola nuts include dry rot, grey mould and black rot. Storage rot caused by *Lasiodiplodia theobromae* is a serious post-harvest disease of kola nut. This fungus, with some other storage moulds, causes discolouration, shrinking, rottening and physiological alterations in kolanut. These subsequently cause defects which seriously depreciate the commercial value of the nuts. In a bid to control the incidence of storage-induced kola nut rot/spoilage, most of the individuals trading in the commodity have resorted to the use of synthetic chemicals, which though very effective, is costlier and constitute some high level health hazards to both the handlers and consumers of the commodity. There is therefore, the need to shop for much safer, ecologically friendly and cheaper alternatives for the management of kola nut storage disease.

Methodology

The effectiveness of leaf extracts of *Azadirachta indica, Piper guineense, Eucalyptus camaldulensis*, *Lantana camara* and *Citrus sinensis* peel against mycelia (vegetative) growth and pycnidia production of kola nut rot pathogen, *L. theobromae*, was determined using poisoned food technique. Ten (10), 20, 30 and 40% concentrations of each of the five extracts were prepared from their stock solutions and pour-plated with freshly sterilized but cooled (45oC) potato dextrose agar (PDA). Synthetic fungicide (mancozeb 80WP) solution was prepared at the manufacturer's recommended rate of 0.5g/100ml and separately pour-plated with PDA to serve as standard check/positive control. The freshly prepared PDA was also poured into another set of sterile Petri dishes containing neither extracts nor chemicals to serve as untreated/negative control.

The poisoned as well as control plates were inoculated with agar discs (8mm diameter) of the kola rot pathogen cut with the aid of a sterile cork borer. All the plates were incubated at 28-32oC and the mycelia growth diameter of the inoculated fungus in each of the plates was measured every 24hours using transparent ruler until the negative control plates were completely covered. Percentage inhibitions of the pathogen's mycelia growth were calculated using the formula:

Percentage inhibition (%) =

Where: Dc = Mycelia growth diameter in control

Dt = Mycelia growth diameter in treatment

Each of the treatments was replicated thrice in a completely randomized design. At the tenth day of incubation, pycnidia structures produced on each of the treated plates and their controls were counted and recorded. Data obtained were subjected to analysis of variance using Statistical Analysis Software (SAS) 9.1 package.

Results

Percentage mycelia growth inhibitions produced by extracts of *A. indica, P. guineense, L. camara*, Eucalyptus and Citrus peels within 24 hours of incubation ranged between 26.09-33.05%, 33.05-51.31%, 45.22-60.87%, 55.65-64.35%, and 52.18-67.83% respectively (Table 1). At 24 hours after incubation, the four extract concentrations of Eucalyptus as well as 20-40% concentrations of Citrus extract and 10% Lantana gave significantly highest mycelia inhibitions ($P \leq 0.05$) against *L. theobromae* and better than the standard check (mancozeb). These were closely followed by 20% Lantana, Mancozeb, 10% Citrus and 40% *P. guineense* which produced 53.74, 53.48, 52.18, and 51.31% mycelia growth inhibitions, respectively, while the four extract concentrations of Azadirachta and 10% *P. guineense* gave the least inhibitions (Table 1). The situation was more or less the same at 48 hours after incubation, but with the standard check (Mancozeb) producing the highest inhibition at this instance. The chemical also gave the significantly highest mycelia inhibition, 53.69% ($P \leq 0.05$) at 72 hours of incubation, followed by 20-40% Citrus extracts, 30 and 40% Eucalyptus, 10 and 30% Lantana and 40% *P. guineense*. The four extract concentrations of Azadirachta as well as 10-30% *P. guineense*, 20% Lantana, 10 and 20% Eucalypus and 10% Citrus produced significantly lowest inhibition values ($P \leq 0.05$) (Table 1).

Virtually all the extract concentrations with the exemption of 10 and 20% Azadirachta, 10-40% P. guineense, 30% Lantana and 30 and 40% Eucalyptus, showed noticeable reductions in the mycelia growth inhibitions at 48 hours after incubation when compared with their respective values, 24 hours earlier. A similar trend was noticed in the positive control plates (Table 1).

Average number of pycnidia induced by Azadirachta, *P. guineense*, Lantana, Eucalyptus and Citrus ranged between 10-24, 3-28, 9-34, 8-51, and 8-48, respectively, while an average of 36 pycnidia were observed in the negative control plates (Table 1). The number of pycnidia produced by the pathogen decreased as the concentration of each of the extracts increased. Eucalyptus at 10% concentration induced the highest average number of pynidia (51), followed by 20% concentration of the extract (48), and 10% Citrus (48). The positive control plates showed no pycnidia growth, while *P. guineense* at 40% concentration closely followed with an average number of 3 pycnidia (Table 1).

Highest overall inhibitions (58%) were produced by mancozeb, and closely followed by Citrus (49.17%), Eucalyptus (49.13%) and Lantana (42%), while Azadirachta (26.6%) gave the least inhibition against the pathogen (Figure 3).

Table1: Inhibitory effects of plant extracts on mycelia growth and sporulation of*L. theobromae*

Extract Conc. (%)	Mycelia growth inhibition (%) at:			Average no. of pycnidia
	24HAI	48HAI	72HAI	
NL				
10	29.59fg	34.93f-h	23.93c	24.00
20	26.09g	26.83h	21.57c	21.00
30	33.05e-g	28.60gh	22.94c	17.00
40	26.96g	23.54h	21.18c	10.00
IY				
10	33.05e-g	38.98fg	24.71c	28.00
20	40.87d-f	47.34c-f	26.28c	23.00
30	37.39e-g	44.81d-f	23.34c	20.00
40	51.31b-d	58.23a-c	29.23b-c	3.00

LT				
10	45.22c-e	40.00e-g	24.71c	34.00
20	46.09c-e	41.52ef	25.69c	31.00
30	53.74b-d	46.83c-f	30.80bc	21.00
40	60.87ab	56.96a-d	31.59bc	9.00
EU				
10	55.65a-c	44.81d-f	24.32c	51.00
20	64.35ab	52.40b-e	23.34c	48.00
30	62.61ab	64.05ab	38.07b	36.00
40	64.35ab	64.05ab	31.59bc	8.00
OR				
10	52.18b-d	43.29ef	23.93c	48.00
20	57.39a-c	51.90b-e	30.41bc	24.00
30	62.61ab	61.77ab	38.66b	16.00
40	67.83a	60.00ab	40.04b	8.00
MCB	53.48b-d	66.83a	53.69a	0.00
CTR	-	-	-	36.00

Means with same letters in the same column are not significantly different at P≤0.05 using Fisher's LSD

Key: NL- *Azadirachta indica* IY- *Piper guineense* LT - *Lantana camara*
EU- *Eucalyptus camaldulensis* OR- *Citrus sinensis* (peel) MCB- Mancozeb
HAI- Hours after incubation

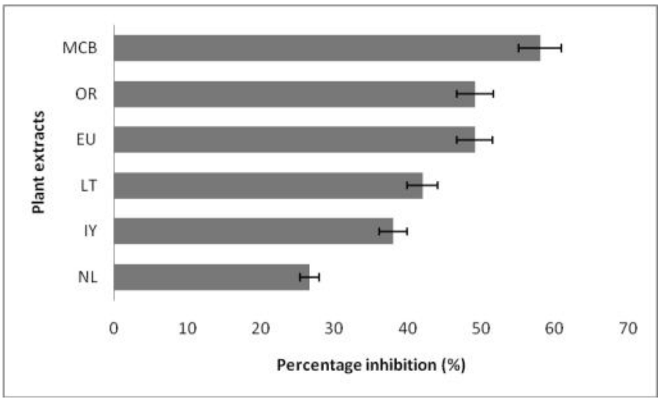

Figure 3: Overall effects of plant extracts on the mycelia growth of kola rot fungus, *L. theobromae*
Key NL- *Azadirachta indica* IY- *Piper guineense* LT- *Lantana camara* EU- *Eucalyptus camaldulensis* OR- *Citrus sinensis* (peel) MCB- Mancozeb

Findings from this research showed a decrease in the number of pycnidia produced by the kola pathogen as extract concentrations of all the botanicals used in this study increased, indicating an increase in extract inhibitory effects on the pathogen's sporulation. The inhibitory effects of the plant extracts used in this study against the kola nut storage pathogen, *L. theobromae* was due to the presence of some phytochemicals, which are secondary metabolites synthesized by plants and often sequestered in tissues to protect them against microbial attacks.

Achievement

The use of extracts of *P. guineense* (aqueous) and *L. camara* (ethanolic) at 20-40% and 10-20% concentrations, respectively, having shown some potential against the kola pathogen, is therefore recommended for an effective control of kola storage rot disease.

Partnership with Bissy Inc. USA for the production of Kola Powder

The Institute partnered with Bissy Inc. USA geared towards promoting production, processing and healthy consumption of kola nuts locally and internationally. We were able to source kola nuts free of diseases and chemical residue from farms that are observing Good Agricultural Practices (GAP). These were delivered to the AACE Processing Factory, Sango, Otta, Ogun State.

Achievement

Kola energy powder, with three (3) times natural caffeine more than Coffee, was produced from the processed kola nuts. The powder is rich with antioxidants, boosts metabolism and improves performance, more effective than coffee and tea.

Figure 4. Kola nut Energy Powder

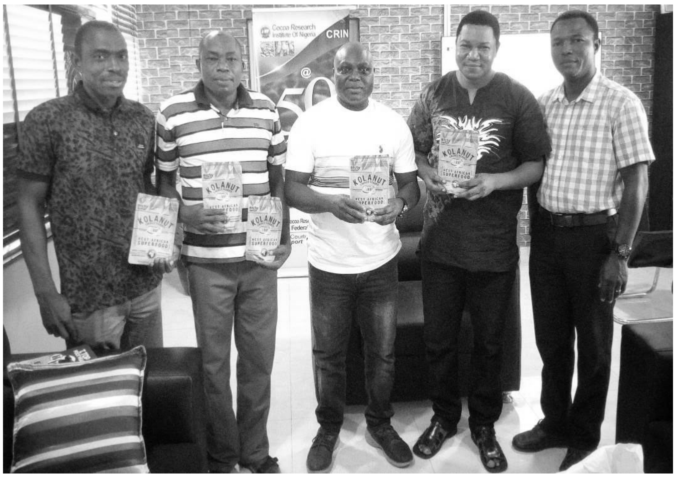

Figure 5. Presentation of Kolanut Energy Powder by CRIN Scientists to the ED, Dr. Patrick Adebola (middle)

Experimental Title: Evaluation of antimicrobial potentials of selected botanicals against kola nut storage rot pathogen (*Lasiodiplodia theobromae)* in Nigeria
Investigators: Ogundeji, B. A., Orisajo, S. B., Olorunmota, R. T., Oyedokun, A. V. and Agbeniyi, S. O.

Introduction
Cola species (Family: *Sterculiaceae*) are native to the tropical rainforests of Africa, West Indies, and Brazil. The kola tree reaches heights of between 40-60 feet. Out of the twenty-five species known to exist, *Cola nitida* and *C. acuminata* are the two most commonly cultivated and suitable for human consumption (Opeke, 1992). Nuts of these two *Cola* spp. are commercial export commodities for the production of kola-chocolate, liquors and laxatives. The presence of alkaloids such as caffeine, kolanin and theobromine make kolanuts useful for pharmaceutical purposes (Atanda *et al*., 2011). The caffeine containing nut is used also as a flavouring ingredient in beverages and that is the origin of the term *cola* (Greenwood, 2016). Maturity of kola fruits usually takes place 4-5 months after pollination, with characteristic change in colour from deep green to a paler tint (at a time the fruit should be harvested), as the follicles will start to dehisce thereafter. Exposed seeds are more prone to insect attack and subsequently predispose the nuts to fungal infection. Numerous toxic metabolites are produced in mould-infected stored kola nuts as can be found in other mould-contaminated foods. When such nuts are consumed, they pose a huge health risk to the consumers (Opeke, 1992; Ndubuaku, 2015; Jimenez, 1991). Due to the warm, humid rainforest zone in which cultivation, processing and storage of the kola nuts take place, there is high risk of mould infection. Most traders as a result, labour assiduously to maintain the freshness of the nuts, prevent fungi growth and insect attack that predisposes *Cola* to rot infection in storage. This requires removal of infested nuts at intervals during the storage period, but this does not control fungi which spread rapidly in the nuts. Most traders and consumers do not discard fairly mouldy nuts during storage, leading to infection of more hitherto healthy nuts and a huge loss in the long-run (Atanda *et al*., 2011).

Diseases associated with stored kolanuts include dry rot, grey mould and black rot. Storage rot caused by *Lasiodiplodia theobromae* is a serious post-harvest disease of kolanut (Agbeniyi 1998). This fungus, with some other storage moulds, causes discolouration, shrinking, rottening and physiological alterations in kolanut. These subsequently cause defects which seriously depreciate the commercial value of the nuts (Agbeniyi, 2014). In a bid to control the incidence of storage-induced kolanut rot/spoilage, most of the individuals trading in the commodity have resorted to the use of synthetic chemicals, which though very effective, is costlier and constitute some high level health hazards to both the handlers and consumers of the commodity (Mokwunye and Oluyole, 2017). There is therefore, the need to shop for much safer, ecologically friendly and cheaper alternatives for the management of kola nut storage disease.

Materials and Methods
The effectiveness of leaf extracts of *Azadirachta indica*, *Piper guineense*, *Eucalyptus camaldulensis*), *Lantana camara* and *Citrus sinensis* peel against mycelia (vegetative) growth and pycnidia production of kolanut

rot pathogen, *L. theobromae,* was determined using poisoned food technique. Ten (10), 20, 30 and 40% concentrations of each of the five extracts were prepared from their stock solutions and pour-plated with freshly sterilized but cooled (45°C) potato dextrose agar (PDA). Synthetic fungicide (mancozeb 80WP) solution was prepared at the manufacturer's recommended rate of 0.5g/100ml and separately pour-plated with PDA to serve as standard check/positive control. The freshly prepared PDA was also poured into another set of sterile Petri dishes containing neither extracts nor chemicals to serve as untreated/negative control.

The poisoned as well as control plates were inoculated with agar discs (8mm diameter) of the kola rot pathogen cut with the aid of a sterile cork borer. All the plates were incubated at 28-32°C and the mycelia growth diameter of the inoculated fungus in each of the plates was measured every 24hours using transparent ruler until the negative control plates were completely covered. Percentage inhibitions of the pathogen's mycelia growth were calculated using the formula:

$$\text{Percentage inhibition (\%)} = \frac{Dc - Dt}{Dt} \text{x}100$$

Where: D_c = Mycelia growth diameter in control

D_t = Mycelia growth diameter in treatment

Each of the treatments was replicated thrice in a completely randomized design. At the tenth day of incubation, pycnidia structures produced on each of the treated plates and their controls were counted and recorded. Data obtained were subjected to analysis of variance using Statistical Analysis Software (SAS) 9.1 package.

Results and Discussion

Percentage mycelia growth inhibitions produced by extracts of *A. indica, P. guineense, L. camara, Eucalyptus* and *Citrus* peels within 24 hours of incubation ranged between 26.09-33.05%, 33.05-51.31%, 45.22-60.87%, 55.65-64.35%, and 52.18-67.83% respectively (Table 1). At 24 hours after incubation, the four extract concentrations of *Eucalyptus* as well as 20-40% concentrations of *Citrus* extract and 10% *Lantana* gave significantly highest mycelia inhibitions ($P \leq 0.05$) against *L. theobromae*and better than the standard check (mancozeb).These were closely followed by 20% *Lantana,* Mancozeb, 10% *Citrus* and 40% *P. guineense* which produced 53.74, 53.48, 52.18, and 51.31% mycelia growth inhibitions, respectively, while the four extract concentrations of *Azadirachta* and 10% *P. guineense* gave the least inhibitions (Table 1). The situation was more or less the same at 48 hours after incubation, but with the standard check (Mancozeb) producing the highest inhibition at this instance. The chemical also gave the significantly highest mycelia inhibition, 53.69% ($P \leq 0.05$) at 72 hours of incubation, followed by 20-40% *Citrus* extracts, 30 and 40% *Eucalyptus*, 10 and 30% *Lantana* and 40% *P. guineense.* The four extract concentrations of *Azadirachta* as well as 10-30% *P. guineense,* 20% *Lantana*, 10 and 20% *Eucalypus* and 10% *Citrus* produced significantly lowest inhibition values ($P \leq 0.05$) (Table 1).

Virtually all the extract concentrations with the exemption of 10 and 20% *Azadirachta*, 10-40% *P. guineense,* 30% *Lantana* and 30 and 40% *Eucalyptus* showed noticeable reductions in the mycelia growth inhibitions at 48 hours after incubation when compared with their respective values, 24 hours earlier. A similar trend was noticed in the positive control plates (Table 1).

Average number of pycnidia induced by *Azadirachta, P. guineense, Lantana, Eucalyptus* and *Citrus* ranged between 10-24, 3-28, 9-34, 8-51, and 8-48, respectively, while an average of 36 pycnidia were observed in the negative control plates (Table 1). The number of pycnidia produced by the pathogen decreased as the concentration of each of the extracts increased. *Eucalyptus* at 10%concentrationinduced the highest average number of pynidia (51), followed by 20% concentration of the extract (48), and 10% *Citrus* (48). The positive control plates showed no pycnidia growth, while *P. guineense* at 40% concentration closely followed with an average number of 3 pycnidia (Table 1).

Highest overall inhibitions (58%) were produced by mancozeb, and closely followed by *Citrus* (49.17%), *Eucalyptus* (49.13%) and *Lantana* (42%), while *Azadirachta* (26.6%) gave the least inhibition against the pathogen (Figure 1).

Table1: Inhibitory effects of plant extracts on mycelia growth and sporulation of*L. theobromae*

Extract Conc. (%)	Mycelia growth inhibition (%) at: 24HAI	48HAI	72HAI	Average no. of pycnidia
NL				
10	29.59fg	34.93f-h	23.93c	24.00
20	26.09g	26.83h	21.57c	21.00
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40	26.96g	23.54h	21.18c	10.00
IY				
10	33.05e-g	38.98fg	24.71c	28.00
20	40.87d-f	47.34c-f	26.28c	23.00
30	37.39e-g	44.81d-f	23.34c	20.00
40	51.31b-d	58.23a-c	29.23b-c	3.00
LT				
10	45.22c-e	40.00e-g	24.71c	34.00
20	46.09c-e	41.52ef	25.69c	31.00
30	53.74b-d	46.83c-f	30.80bc	21.00
40	60.87ab	56.96a-d	31.59bc	9.00
EU				
10	55.65a-c	44.81d-f	24.32c	51.00
20	64.35ab	52.40b-e	23.34c	48.00
30	62.61ab	64.05ab	38.07b	36.00
40	64.35ab	64.05ab	31.59bc	8.00
OR				
10	52.18b-d	43.29ef	23.93c	48.00
20	57.39a-c	51.90b-e	30.41bc	24.00
30	62.61ab	61.77ab	38.66b	16.00
40	67.83a	60.00ab	40.04b	8.00
MCB	53.48b-d	66.83a	53.69a	0.00
CTR	-	-	-	36.00

Means with same letters in the same column are not significantly different at P≤0.05 using Fisher's LSD

Key: NL- *Azadirachta indica* IY- *Piper guineense* LT - *Lantana camara*
EU- *Eucalyptus camaldulensis* OR- *Citrus sinensis* (peel) MCB- Mancozeb
HAI- Hours after incubation

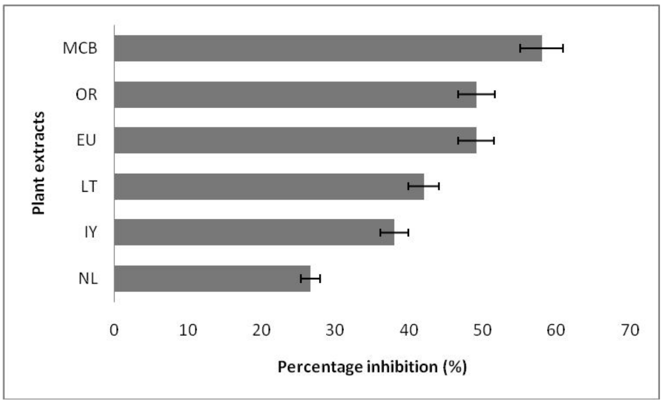

Figure 1: Overall effects of plant extracts on the mycelia growth of kola rot fungus, *L. theobromae*
Key: NL- *Azadirachta indica,* IY- *Piper guineense,* LT- *Lantana camara,*EU- *Eucalyptus camaldulensis* OR- *Citrus sinensis* (peel), MCB- Mancozeb

The inhibitory effects of the plant extracts used in this study against the kolanut storage pathogen, *L. theobromae* was due to the presence of some phytochemicals, which are secondary metabolites synthesized by plants and often sequestered in tissues to protect them against microbial attacks (Nweke, 2015). Findings from this research showed a decrease in the number of pycnidia produced by the kola pathogen as extract concentrations of all the botanicals used in this study increased, indicating an increase in extract inhibitory effects on the pathogen's sporulation. All the extracts used in this study (with the exception *A. indica* and *P. guineense*) also clearly produced increasing inhibitory effects against the pathogen's mycelia growth with increasing concentrations all through the incubation periods. These findings clearly agree with the discovery of Nweke (2015) who reported that the inhibitory effect of the extract of *C. aurantifolia* on the mycelia growth and spore germination of some plant pathogens increased with increasing concentration of the extracts. The findings of Ogundeji *et al.* (2018) which indicated that the percentage inhibition exhibited by freshly prepared aqueous extract of *P. guineense* against *P. megakarya* consistently increased with extract concentration also partly agrees with the results of this study. Mycelia inhibitions produced by the *P. guineense*in this study however does not agree with the findings of the authors.

Noticeable reductions in the effectiveness of the extracts at 48 to 72 hours after incubation agrees with the findings of Babalola *et al.* (2017) which opined that the antimicrobial potencies of some plant extracts including *P. guineense* decreased as incubation period increased. This discovery also seems to agree with the findings of Ogundeji *et al.* (2018) which indicated a reduction in the effectiveness of some selected botanicals against cocoa black pod disease pathogen, *Phytophthora megakarya* with storage time. The increase noticed in the pathogen's mycelia inhibition between 24-48 hours of incubation however disagrees with these facts.

The very low average percentages of inhibition produced by *Azadirachta* extracts against the kola rot pathogen disagrees with the findings of Adeniyi and Joseph (2014) which explained that the botanical, among a few others, could be used to effectively control strains of *L. theobromae* affecting cashew. Findings from this study also partly disagree with Sahi *et al.* (2012), who in an *in vitro* evaluation discovered that *Eucalyptus camaldulensis* and *A. indica* were effective against mycelia growth of *L. theobromae* strain causing quick decline of mango. These disparities may be an indication to a stronger aggressive nature on the part of the strain of *L. theobromae* affecting kola, when compared to others isolated from both cashew and mango. The differences may most likely be brought about by inherent and/or acquired genetic variations among the different strains. Further research however need to be carried-out to substantiate this possibility.

Differences in the number of pycnidia induced by the various extracts used in this study would most likely be due to differences in the type and/or concentrations of anti-sporulation ingredients naturally present within each of the plant extracts. Also, the production of lesser number of pycnidia as the concentrations of each of the extracts increased is an indication of the proportional presence of compounds capable of inhibiting sporulation in the botanicals.

Conclusion

Lantana, *Eucalyptus* and *Citrus* peel extracts used in this study, having shown reasonable efficacy, particularly within the first 48 hours of incubation, competed favourably with the positive control in the inhibition of kola rot pathogen, *L. theobromae.* Higher concentration (40%) of *P. guineense,* having shown some promise in inhibiting the pathogen's pycnidia production, could also be used in the suppression of the pathogen's sporulation. The use of extracts of *P. guineense* (aqueous) and *L. camara* (ethanolic) at 20-40% and 10-20% concentrations respectively, having shown some potential against the kola pathogen, is therefore recommended for an effective control of kola storage rot disease.

Experimental Title: Development of Bio-Pesticides for the Preservation of Stored Kola Nuts

Investigators: Agbeniyi, S.O., Adedeji, A.R., Orisajo, S.B., Asogwa, E.U., Otuonye, A.H., Mokwunye, I.U., Kolawole, O.O., Ogundeji, B.A. and Olorunmota, R.T.

Introduction

Nigeria accounts for about 70% of the total world production of kola nuts. About 90% of the kola nuts produced in Nigeria is consumed within the country while 10% is exported. A major challenge associated with kola nuts storage is the attack by weevil and moulds. In order to address this issue, kola nuts farmers and traders use various types of chemical pesticides including banned ones. These pesticides in their characteristic nature have the ability to permeate plant cells and remain as residues. Several authors have reported the presence of pesticide residues in various foods, vegetables, soils, sediments and diverse environment. Besides, since kola nuts most often undergo primary processing before consumption, it is important to develop safe pesticides with minimal or no human and environmental health consequences. There are several documented evidences of the effectiveness of plant- based materials for the management of crop pests. These include powders, essential oils and aqueous extracts of *Curcuma longa, Acorus calamus, Hyptis spicigera*, *Cassia nigricans* and *Mentha spicala* which have been shown to be effective against bruchids, curulionids and the tenebrionid *Tribolium castaneum* (Mishra *et al*., 1984; Lambert *et al*., 1985; Stoll, 1988). Seeds of *Azadirachta indica*, *Dennettia tripala* and the fruits of *Piper guineese* have pesticidal and behaviour modifying properties against various pests of stored products (Osisiogu and Agbakwuru, 1978; Ivbijaro and Agbaje 1986; Lale, 1992). This project attempts to explore and develop safe alternatives, such as bio-pesticides, for the control of storage pests and diseases of kola that can be easily administered and adopted by farmers.

Materials and Methods

Experimental laboratory: The laboratory bioassay tests are being carried out at the Entomology and Pathology Research Laboratories, CRIN headquarters, Ibadan.

Sources of kola nuts and other materials: All the fresh and infested kola nuts (pods/unskinned nuts) for this experiment were purchased from local vendors and farmers in Ogun and Osun States, Nigeria. All the other experimental materials (baskets, poly bags, Whatman filter papers, petri dishes, camel hair brush, trays, plastic bowsl etc.) were bought from reputable scientific suppliers in Ibadan, Nigeria.

Processing of kola nuts: The general method of skinning, curing and storage of experimental kola nuts according to Ndubuaku (2014) was carried out. The pods were collected into a clean platform, where they were cut diagonally with knife to extract the unskinned nuts. The unskinned kola nuts were soaked in water for 18 to 24 hours. Thereafter the testa coats were washed off easily. The skinned and washed nuts were then placed in wicker baskets for excess water to drain off. They were then aerated by spreading thinly on a table in the laboratory for 2 to 3 hours. The kola nuts were subsequently placed in unlined wicker baskets, covered lightly with banana leaves for few days to cure. Considerable “sweating” which reduced the moisture content of the nuts occurred during the curing process. This is done to increase the shelf life of the kola nuts after pods are broken and nuts skinned. The nuts were stirred periodically to avoid excessive heat buildup during curing process, which lasted for approximately 3 weeks. After curing, the kola nuts were stored in wicker baskets lined with fresh and desiccated plantain leaves. In a situation where overheating was observed, the nuts were aerated and left uncovered for 24 hours. However, if on the other hand, there was a tendency for drying, the thickness of the leaf lining was increased to check loss of moisture. The cured nuts were stored in baskets lined with fresh or dry leaves and placed in the laboratory and this serves as the stock culture of the weevils.

Similarly, samples of these kola nuts are being cultured *in-vitro* and associated pathogens isolated for identification and subsequent work. There was focus group discussion with kola nut farmers and traders to sensitize them on the dangers of using unapproved pesticides indiscriminately and to encourage participation in this research project.

Aqueous extract formulations: The plant parts of all the collected plant samples (leaves, seeds and bulbs) were chopped into bits and air dried for two weeks before being pulverized with a high-speed mill into fine powder. A range of serial dilutions was made with water to obtain solutions of three doses of 1,000g/L (100% w/v), 500g/L (50% w/v) and 250g/L (25% w/v) by soaking the samples in 1 litre of water. The solutions were left for 24 hours and then filtered to obtain the aqueous extracts in accordance with methods used by Ndubuaku, (2014).

Bioassay screening of the candidate plant materials in the laboratory: The efficacy of the aqueous extracts of the five (5) test plant samples were carried out at a concentration 100% w/v of the extract. The plant used were *Tectonia grandis, Musa paradisiaca, Carica papaya, Chromolaena odorata, Nicotiana tabacum, Jatropha spp* and *Vernonia amygdalina*. Twenty (20) cured kolanuts were randomly sorted out into three transparent plastic bowls of 1 litre volume each, containing 100% w/v of the extracts. The kolanuts were soaked in these various concentrations for 12 hours. A reference standard insecticide (Cypermethrin 10 EC) was used for comparison (Positive control), while distilled water was used as the control treatment (Negative control). The negative control treatment (0% w/v) kolanuts were soaked in distilled water for the same period of time, while the reference standard treated nuts were soaked in Cypermethrin for ten (10) minutes. Each of the treatments was replicated four times in a completely randomized design (CRD). The nuts were removed after the soaking period and placed in small flat baskets for excess water to drain off. The nuts in the baskets were aerated in the laboratory for a period of 72 hours to reduce the moisture content to a minimal level. The kolanuts treated with the various aqueous plant extracts were each placed in black light gauge polythene bag of dimension 42.5cm x 21.0cm and tied up. All the treatments were stored at the Entomology laboratory for subsequent record taking.

Post storage assessments: The various treatment levels in separate polythene bags were sieved every fortnight to determine the progress of adult *Balanogastris kolae* and *Sophrorhinus* spp emergence by direct counting of newly emerged adult weevil. Data obtained will be subjected to the analysis of variance and significant means were separated at 5% level using the Tukey's Honestly Significance Difference (HSD) Test.
Status: On-going.

Experimental Title: Development of Bio-pesticides for the Preservation of stored kola nuts (Entomology aspect)
Investigators: Mokwunye, I. U., Asogwa, E.U. and Olorunmota, R. T.
External Collaborators: Prof. O.O. Oyesiku and Dr. (Mrs.) E.O. Adesanya

Introduction

Nigeria accounts for about 70% of the total world production of kola nuts. About 90% of the kola nuts produced in Nigeria is consumed within the country while 10% is exported. A major challenge associated with kola nuts storage is the attack by weevil and moulds. In order to address this issue, kola nuts farmers and traders use various types of chemical pesticides including banned ones. These pesticides in their characteristic nature have the ability to permeate plant cells and remain as residues. Several authors have reported the presence of pesticide residues in various foods, vegetables, soils, sediments and diverse environment. Besides, since kola nuts most often undergo primary processing before consumption, it is important to develop safe pesticides with minimal or no human and environmental health consequences. This project attempts to explore safe alternative such as biopesticides. There are several documented evidence of the effectiveness of plant- based materials for the management of crop pests. These include powders, essential oils and aqueous extracts of *Curcuma longa, Acoruscalamus, Hyptisspicigera*, *Cassia nigricans* and *Menthaspicala* which have been shown to be effective against bruchids, curulionids and the tenebrionid*Triboliumcastaneum* (Mishra *et al.*, 1984; Stoll, 1988). Seeds and fruits of *Azadirachtaindica* and *Dennettiatripetala* and*Piper guineese* have pesticidal and behaviour modifying properties against various pests of stored products including kola (Asogwa*et al*., 2015; Ndubuaku, 2014; Lale, 1992; Ugwu and Mokwunye, 2019). This main objective of the project was to develop biopesticides as safe alternative for control of storage pests of kola that can be easily administered and adopted by farmers.

Materials and methods

Collection and Preparation of Plant extracts

The plant materials were obtained from the CRIN forest and environs. The plant materials were *Nicotianatabacum, Tectonagrandis, Jatrophacurcas, Musa paradisiaca, Carica papaya, Chromolaenaodorata* and Pepper. 200g of each plant material was measured and rinsed in 10% Sodium hypocloride solution. These were air-dried for 30 minutes in the laboratory. Then the dry sample of individual plant material was pulverised by pounding in a mortar. Thereafter, the powdery sample was soaked in 100 ml of water for 24 hours. The solutions were left for 24 hours and then filtered to obtain the aqueous extracts. The aqueous extracts were sterilized in the water bath. A range of serial dilutions was made with water to obtain solutions of three doses of 1,000g/L (100% w/v), 750g/L (75% w/v), 500g/L (50% w/v), 250g/L (25% w/v) and 100g/L (10% w/v) by soaking the samples in 1 litre of water. These extracts were used subsequently for the laboratory residual contact bioassays and storage trials.

Sources of kolanuts and other materials

Unskinned kola nuts for these experiments were purchased from local farmers and traders at Ogunmakin and Mamu markets, both inOgun State, Nigeria.

Residual toxicity of the candidate plant materials in the laboratory

The plants used were *Tectonagrandis, Musa paradisiaca, Carica papaya, Chromolaenaodorata,* *Nicotianatabacum* and *Jatrophacurcas*. The residual contact toxicity of the candidate plant materials was conducted in the laboratory using aqueous extracts of the seven (7) test plant samples at a concentration of 100% w/v. This was done by introducing 1ml of each plant aqueous extract into the filter paper placed in a petridish with perforated lids. Then five weevils were placed in the petridish. Distilled water was used as the control treatment (Negative control). Each of the treatment was replicated four (4) times. The weevil mortality was confirmed by gently probing each with a Camel's hairbrush and those that did not show any sign of movement were recorded as dead. Mortality count was taken at 20 minutes intervals for 300 minutes and continued daily for 3 days. The percentage (%) mortalities were recorded to determine the relative toxicity of the aqueous plant materials applied. This was compared with percentage mortality in untreated petridishes.

Kola nut storage trials with the candidate plant materials

Forty (40) cured kolanuts were randomly sorted out into three transparent plastic bowls of 1 litre volume each, containing the various concentrations (25% w/v, 50% w/v and 100% w/v) of the extracts. The kolanuts were soaked in these various concentrations for 18 hours. A reference standard insecticide (Cypermethrin 10 EC) was used for comparison (Positive control), while distilled water was used as the control treatment (Negative control). The negative control treatment (0% w/v) kolanuts were soaked in distilled water for the same period of time, while the reference standard treated nuts were soaked in Cypermethrin for ten (10) minutes. Each of the treatments was replicated four times in a completely randomized design (CRD). The nuts were removed after the soaking period and placed in small flat baskets for excess water to drain off. The nuts in the baskets were aerated in the laboratory for 6 days to reduce the moisture content to a minimal level. The kolanuts treated with the various concentrations of the aqueous extracts were each placed in black light gauge polythene bag of dimension 42.5cm x 21.0cm and tied up. All the treatments were stored at the Entomology laboratory for three (3) months.

Post storage assessments

The various treatment levels in separate polythene bags were sieved every week to determine the progress of adult *Balanogastriskolae* and *Sophrorhinus*spp emergence by direct counting of newly emerged adult -weevil until 98 days post treatment period (DPTP).

Extraction of bioactive components of the plant samples

The extraction and isolation of bioactive components of the plant samples were conducted at the Biology Laboratory, OlabisiOnabanjo University, Ago-Iwoye, Ogun State. Plant samples used included *Tetrapleuratetraptera, Jatrophacurcas, Lantana camara, Vernoniaamygdalina, Nicotianatabacum, Eucalyptus camaldulensis*and*Cymbogoncitratus*. The leaves of collected plant samples were chopped into bits and air dried in the laboratory for two weeks. Solvent-Assisted Extraction (SAE) according to Cañas-Hoyos*etal*., (2017) with slight modification was adopted. The dry samples were pulverized with an electric blender into coarse powder which were weighed and then macerated in three different solvents – Hexane, DCM and methanol representing non-polar, medium polar and high polar environment for 120 hr. The solution was concentrated in a rotary evaporator to remove the solvent and obtain the - concentrates. The concentrates have been stored for subsequent use.

Statistics

Data obtained were subjected to the analysis of variance and significant means were separated at 5% level using the DMRT.

Results and Discussion

There was no significant difference between the mortality caused by aqueous extracts of the plant samplesand control from 20 min to 280 mins after exposure. Though, *N.tabacum* was quick-acting as mortality of 15%, was observed at 40 minutes after exposure, this was not significantly different from others (Table 1). While *M. paradisiaca* extract recorded the earliest mortality at 100 min of exposure. Aqueous extracts of *Jatrophacurcas* and *Caricapapaya* did not record any mortality until 24 hr after exposure. At 300 minutes, only*N.tabacum*extract caused significant mortality (30%) which was different from the other treatments except *T. grandis*. At 24 hr, 48 hr and 72 hr, mortalities recorded for *N.tabacum* were 65%, 70% and 70%, respectively, these were significantly higher thanother treatments (Table 1). In previous studies, *N. tabacum*has alsobeen reported to possess insecticidal property.

The storage trial lasted for fourteen weeks when the weevils stopped emerging. Weevil emergence was observed in all the treatments at varying levels. There was no distinctive difference in terms of number of weevil that emerged amongst the different plant materials. The aqueous extracts of the tested plant materials neither suppressed development and emergence of the kola nut weevil in treated stored nuts nor sufficiently cause mortality of weevils. However, plant materials can be exploited for their pesticidal activity in either of the three major formulation types: aqueous, oil and powder. In addition, the efficacy of the formulation can also depend on the plant part used, for instance, Ugwu and Mokwunye (2019) reported that ethanol extract of seeds of *Jatropha*spp recorded up to 100 % mortality within 24 hr.

Consequently, we approached the Olabisi Onabanjo University (OOU) for collaboration in order to access its facilities such as equipment and Laboratory use, which was gladly granted. The bioactive components for each plant sample have been obtained and stored for subsequent use.

Conclusion and Recommendations

Out of all the plant samples tested*, N. tabacum* showed good prospects for use for kola nut protection against weevil in storage. However, the drawback with its use is that the concentration that can affect mortality is 100% which is not feasible for economic reasons.

The collaboration with the Research team from OOU should be nurtured and strengthened. In addition, the following activities are proposed for the full delivery of the project objectives.

- Determination of pesticidal properties of the bioactive components
- Formulation of most active extracts in pellets
- Determination of the pesticidal property of the pellets
- GCMS identification of the pesticidal compounds

Challenges

- Sourcing for weevil was very challenging largely because it was off season at the time of fund release and this delayed the work very much.
- Lack of conducive laboratory facilities for the maintenance of stock culture for continuous and regular supply of weevil.
- The lockdown of the institute as a result of the covid-19 pandemic and on-going strike action constitute major constraints.

Experimental Title: Mortality of adult *Balanogastris kolae* treated with aqueous of selected plant materials in the laboratory

Treatments	% Mortality/Time of exposure (minutes and hours)
	20 40 60 80 100 120 140 160 180 200 220 240 260 280300 24hr 48hr 72hr
Nicotianatabacum	0a15a15a15a15a15a 15a 15a15a15a15a25a25a25a 30b 65b 70b 70cd
Tectoniagrandis	0a0a0a 0a0a0a 15a 1515a 20a20a20a20a25a 25ab 30a30a65c
Jatrophacurcas	0a0a0a0a0a0a0a0a0a0a0a0a0a0a 15a 30a 50bc
Musa paradisiaca	0a 0a 0a 0a 5a 5a5a5a5a5a5a5a5a5a 10a 25a 35ab
Caricapapaya	0a0a0a0a0a0a0a0a0a0a0a0a0a0a15a 20a 35ab
Chromolaenaodorata	0a0a0a0a0a0a0a0a0a0a0a0a0a0a10a 15a 20a
Control	0a 0a0a0a0a0a0a0a0a0a0a0a0a0a0a0a0a

Means followed by different letters within the column are significantly different using DMRT at p<0.05

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Experimental Title: Soil Fertility Evaluation Of Some Kola Plantation In Kwara And Kogi States, Nigeria

Investigators: Ibiremo O.S. , Ogunlade M. O., Iloyanomon C. I., Taiwo N. and Fagbami O. S.

Introduction

Kola is an important economic cash crop with about forty kolanut species but two must cultivated species in Nigeria are *C. nitida* and *C. acuminate*(Ndagi et al., 2012). Apart from their industrial uses (wine, liquor, drug etc); the nut when chewed serves as energizer and stimulant (Adejoke et al., 2020). Kola production level over the years has been reported to decline due to old age and decline in soil nutrient. Soil nutrient of most kola plantations gradually decline below required level with continuous pod harvesting without maintenance program (Asogwa et al., 2012). Nutrient availability potential of soil depends on the quantity of nutrient the farmer could provide because plant nutrition is an important component of in kola production. Soil nutrient maintenance of most kola farm is constrained by the limited use of inorganic fertilizer due to high cos(Ndagi et al., 2012) and limited understanding of benefit of organic amendments to soil. To ensure proper growth and profitable yield, nutrient management is one important part that must be focused on by farmer. Many experiments have been conducted which show decline in soil and leaf nutrient level of kola plantation below requirement after many years of pods removal (Asogwa et al., 2012). There is need for further information on soil type and fertility status of various kola plantations across Nigeria. Research on soil nutrient level of these plantations is highly essential to recommend appropriate soil fertility management that will enhance kola yield on sustainable basis. Kwara and Kogi are among the states where kolanut is produced in Nigeria (Ndagi et al., 2012). This study was conducted by collecting soil samples from two farms per Local Government Area in each state to determine the soil fertility and leaf nutrient content to measure the capacity of the soil to support profitable production. It was observed that the farms visited were inherited and a decline in yield was generally reported by most of the farmers. This could be linked to old age and soil nutrient depletion as it has been reported. This investigation sought to confirm this claim by the farmers as well as to establish the need for replacement of soil nutrients removed through fertilizer application for sustainable kola production. Increasing the supply of nutrients has been reported to play major role in increasing yield of crop plant while observation showed that fertilizer is seldom used in kola plantation in Nigeria despite continuous nutrient removal from soil yearly. Therefore, evaluation and knowledge of the soil nutrient status of the kola plantations is necessary. The knowledge of nutrient status of soil and leaf is very much essential for the judicious application of fertilizer and soil amendment for higher crop production. Hence, the objectives of the studies are:

(I) To evaluate the physico- chemical properties of the soil,
(II) To determine nutrient status of the leaf
(III) To recommend adequate

||Materials and Methods

The study was carried out in two Local Government Areas of Kwara State (Oyun and Irepodun) and Kogi State (Ijumu and Yagba East). Soil and leaf samples were collected from plantation for analysis. Two farms were selected for study per local government area. A distance of 25 m by 25 m quadrat was given between point of sampling and leaves were randomly picked from closer kola tree to the point of sampling. Soil samples were randomly taken with soil auger from soil depths of 0-20cm and 20-40cm considered as topsoil and subsoil, respectively. Eight (8) samples from each depth were bulked together to form a composite sample. Composite samples were taken to the laboratory for physico-chemical analyses. Soil particles were air-dried, mixed up together, sieved with a 2.0mm sieve and analyzed using routine laboratory techniques. Soil samples were analyzed for particle sizes and compositions using the hydrometer method (Bouyoucos 1926). Soil pH was determined colorimetrically in water solution ratio of 1:1 according to (*Udo et al.,* 2009). The soil organic carbon content was derived through wet digestion dichromate acid-oxidation method (walkley and Black,1934) as modified by Nelson and sommers (1982).Total N was determined using Kjeldahl digestion method and available P by Bray P1 method. This involved the addition of 15ml of 0.03 NHFand 25ml of 0.5 N HCl to 460ml of water solution. Exchangeable cations (Ca , Mg , K and Na) were extracted by leaching 5g soil with 50ml of 1N NH4OAc buffered at pH 7.0. Exchangeable K and Na in the extracts were read on the flame photometer while Ca and Mg were read on Atomic Absorption Spectrophotometer (AAS). Exchangeable acidity was extracted with I N KCl and determined by titration with 0.05 N NaOH using phenolphthalein indicators. Soil effective cation exchange capacity (ECEC) was determined by summation method while percent base saturation was analysed. Extractable Zn was determined using 0.04M EDTA and concentration measured after extraction withthe aid of Atomic Absorption Spectrophotometer (FAO 2007). Leaf samples were bulked together to form a composite sample, air-dried and pulverized for chemical analysis.Plant samples were ashed with Murphy furnace at 500 °C for 5 hours, cooled, dissolved with 5 mL of 0.4 N HCl and leached to 100 mL with distilled water. The filtrates were used to determine Na+ and K+ by flame photometry, Ca2+ and Mg2+and Zn contents by AAS, P by colorimetry and N by theKjeldahl distillation method (Udoetal 2009).

Table 1: Soil pH, textural class and organic carbon content of the plantation soil at Kwara and Kogi States

Soil Sample	Organic C (g/kg)	pH(water) (1:1)	Particle size (g/kg) Sand	Clay	Silt	Textural class
Irepodun 1						
0-20	17.0	6.05	83.80	4.80	11.40	loamy sand
20-40	14.4	5.95	81.80	4.80	13.40	loamy sand
Irepodun 2						
0-20	9.0	5.75	87.80	4.80	7.40	sandy soil
20-40	7.3	5.75	91.80	4.80	3.40	sandy soil
Oyun 1						
0-20	13.2	5.80	86.60	6.00	7.40	sandy soil
20-40	6.1	5.55	82.60	14.00	3.40	loamy sand
Oyun 2						
0-20	20.2	6.30	88.60	6.00	5.40	sandy soil
20-40	9.7	6.00	80.60	12.00	7.40	loamy sand

Ijumu1						
0-20	28.4	5.90	87.80	4.80	7.40	sandy
soil						
20-40	23.0	5.85	85.80	4.80	9.40	loamy
sand						
Ijumu 2						
0-20	24.6	5.90	91.80	4.80	3.40	sandy
soil						
20-40	12.2	5.25	75.80	4.80	19.40	loamy
sand						
Yagba East 1						
0-20	24.1	6.45	83.80	4.80	11.40	loamy
sand						
20-40	8.3	6.50	77.80	8.80	13.40	sandy
loam						
Yagba East 2						
0-20	19.7	6.50	81.80	6.80	11.40	loamy
sand						
20-40	8.2	6.20	83.80	6.80	9.40	loamy
sand						

Table 2: Major Nutrient Content of Soils in Kwara and Kogi States

Soil		Exchangeable cation (cmol/kg)				Total N	Avail.P	Al+H
	ECEC		Base	Zn				
		Ca	Mg	Na	Kg/kg	(mg/kg)		
Sat								
Irepodun 1								
0-20	6.06	4.58	0.839	0.16	0.40	1.0	2.35	0.08
			98.68	16.70				
20-40	5.62	3.90	1.110	0.21	0.34	1.1	4.85	0.06
			98.93	15.50				
Irepodun 2								
0-20	4.48	3.23	0.780	0.20	0.18	0.7	2.25	0.09
			92.99	8.92				
20-40	3.39	2.60	0.512	0.12	0.09	0.9	1.23	0.0
			97.94	9.11				
Oyun 1								
0-20	8.30	6.38	1.517	0.18	0.16	0.8	9.51	0.06
			99.28	16.15				
20-40	5.73	4.21	1.050	0.18	0.18	0.7	13.49	0.11

			98.08	6.02				
Oyun 2								
0-20	9.04	6.66	1.330	0.28	0.70	1.3	8.94	0.07
			99.23	20.72				
20-40	3.39	2.60	0.512	0.12	0.09	1.1	1.23	0.07
			97.94	9.11				
Ijumu 1								
0-20	9.27	6.82	1.41	0.39	0.57	1.7	11.86	0.08
			99.14	29.18				
20-40	7.78	5.78	1.09	0.36	0.48	1.9	11.50	0.07
			99.10	27.27				
Ijumu 2								
0-20	8.61	6.54	1.16	0.34	0.51	1.5	11.70	0.06
			99.30	30.00				
20-40	3.66	2.12	0.81	0.28	0.35	1.6	3.63	0.10
			97.27	16.64				
Yagba East 1								
0-20	9.25	6.12	1.92	0.46	0.70	2.1	8.64	0.05
			99.46	31.39				
20-40	7.40	5.17	1.51	0.26	0.38	1.1	5.01	0.08
			98.92	19.70				
Yagba East 2								
0-20	8.29	5.91	1.59	0.27	0.43	1.3	5.11	0.09
			98.91	22.92				
20-40	5.68	3.71	1.22	0.25	0.45	1.2	2.20	0.05
			99.12					

Table 3: Leaf nutrient content for kola plantation in Kwara and Kogi States

Leaf Sample	Total N %	Avail.P mg/kg	K %	Ca %	Mg %	Organic C %	Zn mg/kg
Irepodun 1	1.057	857.18	1.284	1.204	0.141	14.07	72.13
Irepodun 2	0.562	789.95	1.086	0.944	0.109	15.31	57.74
Oyun 1	0.826	700.31	0.869	0.598	0.125	13.59	67.33
Oyun 2	0.1453	868.39	1.126	0.886	0.131	12.14	59.35
Ijumu1	1.09	638.08	1.07	1.03	0.11	14.48	68.76
Ijumu2	0.80	862.79	1.15	0.62	0.12	12.41	65.41
Yagba East	11.01	778.75	1.34	0.60	0.12	12.55	74..75
Yagba East	20.60	599.47	0.93	0.72	0.12	14.76	59.21

Table 4: Critical nutrient level required for kola production

	Total N %	Avail.P mg/kg	K %	Ca %	Mg %	Organic C %	Zn mg/kg
Soil sample	0.1	3.7ppm	0.12	0.8	0.08	1.05	
Leaf sample	1.09	0.08	1.2	0.47	0.34	-	

Results and Discussion

The pH of the soils in for Irepodun and Oyun local government areas(Kwara state) ranged between 5.75-6.05 and 5.55–6.30 respectively (Table 1). Kwara state could be said to be slightly acidic with ranges of 5.55 to 6.30. Kogi state was also slightly acidic and ranges from 5.25 to 6.50 , Ijumu LGA in particular was more acidic and the pH values fall below 6.0–6.5 reported to be normal for tree crops like cocoa, coffee, cashew and kola (Opeke, 1987, Wood and Lass 1985). Any activities that will further acidify the soil should be avoided in both states. These plantations will require a soil fertility improvement program that include application of liming materials to increase the pH to optimum values (6.0 –6.5) required to enhance availability and uptake of nutrients and to improve microbial activities.

The result showed that soil texture of Kwara and Kogi States were either loamy sand or sandy soils. Soil organic carbon contents in both states were lower than the critical value of 30.00g/kg considered optimum and ideal for tree crop plantation (Egbe et al., 1989). This result indicates that there has been a great loss of organic content from the soil reflecting the sandy texture of the plantations. Also, the organic carbon in the topsoil (0-20cm depth) at both Kwara and Kogi States were higher than the organic carbon content in the subsoil (20 -40cm depth). This may be attributed to the accumulation and decomposition of large amounts of leaf litter falls over the years. This result is in agreement with the findings of Iloyanomon and Ogunlade (2011).

Nitrogen (N) contents were adequate except for Irepodun II and Oyun I in Kwara state, which were below the critical level 1.0 g/kg for the cultivation of kola. Therefore, application of N on the plantation is needed for sustainable and profitable yield. Available Phosphorus for the plots in Kogi state were above the critical required value of 3.7mg/kg except at the sub soil in Ijumu2 and yagba east 2. Exchangeable Potassium for Kwara and Kogi States were above the critical value of 0.12cmol/kg recommended for kola cultivation (Egbe et al., 1989) The Magnesium, Mg contents of the soils in Kwara state were found to be adequate for kola cultivation except for Irepodun II which was totally deficient while top soil of Irepodun I (0.839cmol/kg) and sub soil of Oyun II were below the critical level of 9.00cmol/kg recommended for kola cultivation (Egbe et al., 1989). Also, Ca content were generally higher than the critical levels of 3.00cmol/kg established for kola (Egbe et al., 1989) in Kogi and Kwara states except for Irepodun II and Oyun 2 (Kwara state) sub soil which were lower (2.60 cmol/kg).

The kola leaf N contents were below critical levels of 1.09% recommended for kola (Egbe et al., 1989). P content of Irepodun II and Oyun I in Kwara state were lower than the critical value of 8000mg/kg (Egbe et al., 1989) while Irepodun I and Oyun II were above this value. Leaf K contents of kola plant were below 1.2% recommended for kola (Egbe et al., 1989) in all locations except for Irepodun I which is 1.284% and adequate compared to the critical value. The plant Mg contents were lower than the critical value of 0.34% in al the locations. The Ca contents were higher than the critical value of 0.47% recommended for kola in all locations. Organic carbon contents of the leaves ranged from 12.14 - 15.31%. Zinc leaves contents were above 2.5% recommended for tree crop cultivation (McKenzie, 2001).

Conclusion

The low organic matter content and slight acidity of the soil could affect major nutrients availability and may result to nutrient imbalance. The low N content of some of the plantation soil is not surprising as sandy soil especially under high rainfall are prone to N deficiency which must have affected N leaves content, this makes N fertilizer application necessary because N is needed for vegetative growth and profitable yields (Snoeck et al., 2016). Available P and exchangeable cation (Mg and Ca) were found adequate for most of the plantations. Variation in soil nutrient content of top soil and sub soil of some of the plantation shows that fertilizer management system that is specifically directed to address the need of the soil is required. Despite the low level of leaf nutrient (such as N, P, K and Mg) none of these plantation shows deficiency symptoms.

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Experimental Title: Evaluation of Kola Nut Supply Chain in Nigeria

Investigators: Yahaya, A.T, Adebiyi, S; Oluyole, K.A and Obatolu, B

Introduction: Globalization, urbanization and agro-industrialization puts increasing demands on the organization of agro- food chains and network. Food and agribusiness supply chain and networks which was once characterized by autonomy and independence of actors are now swiftly moving towards globally interconnected systems with large varieties of complex relationships which affect the ways food is produced, processed and delivered at the market (Ruerd Ruben, 2006; Readon and Barrett 2000) and also the revenue accruable from this agricultural produce. The market exerts a dual pressure on agro- food chains, forcing towards continuous innovation and agency coordination. Agricultural produce is being offered at a fairly competitive price, prices and quality issues are more important than ever, consumers can choose from an increasing number of products offered by competing chain.

Kola nut one of the major cash crops in Nigeria, has contributed largely to the GDP of the country, to maximize the full potential of the economic returns; there is need for the value chain to be properly developed; hence, an evaluation of the value chain in Nigeria become necessary.

Objectives

i. map out Kola value chain in order to give the functional analysis of the actors in each of the stages of the chain in the study areas
ii. analyze the competitiveness and the effects of policies on competitiveness at each stage of Kola value chain
iii. determine the comparative advantage of the nodes of Kola value chain in Southwestern Nigeria
iv. estimate the effects of price distortions on consumers' and producers' welfare in the study areas

Methodology

The study was carried out in two Kola producing states namely (Ondo, Ekiti) of Southwestern state of Nigeria. Multistage sampling techniques were be used to select three (3) local governments from each from the state namely Akoko North East, Owo, and Odigbo andEkiti West, Ado andEmure/Ise/Orun. Second stage involved selection of one hundred and fifty (150) respondents from each state in the proportion of fifty (50) from each LGA. Information was elicited through the use of structured questionnaire and focus group discussion. Returned questionnaire was sorted and analyzed.

Results and Discussion

Table 1 show the socio-economic characteristics of the respondent in Ondo and Ekiti states respectively. It shows that majority of the respondent are in their active years 46% and 52% respectively. The table also shows that majority of them are females 73.33% and 100% respectively. Majority 50% of the marketers in Ondo had basic education with only 26.67% Ekiti state. This informed their efficiency in trade.

Table1: Social Economic Characteristic of the respondents

Variable	Ondo		Ekiti	
Age	Freq.	percent	Freq.	Percent
≤ 40	12	8	2214.67	
40-50	42	28	2013.33	
51-60	69	46	7852 >60	27183020
Total	150	100.00	150	100.00
Gender				
Male	40	26.66	5 0	
Female	110	73.33150	100	
Total	150	100.00	150	100.00
Educational Status				
No Education	138.67	2	1.33	
Primary Education	7550	20	13.33	
Secondary Education	6241.33125	83.33		
Total	150	100.00	150100.00	

Source: Field Survey2020

Table 2 show the supply chain of kola-nut in Ondo and Ekiti respectively. The table shows that most 54.86% and 64% kola traders buy kola for trade from middlemen/women. This help in facilitating volume needed to trade in. The table also shows that all 150% of the traders deals in both wet and dry kola-nuts. Majority of the traders in Ondo sell their products to cities like Maiduguri, Zamfara Kebbi, Zaria, Sokoto, Kano and trade as far as Saudi- Arabia Dubai, Central Africa. Ondo kola nut marketers cover a wider scope in their business activities. While marketers in Ekiti trade within the northern states such asKebbi, Zaria, Sokoto, Kano, Maiduguri, Zamfara Also, majorityof the marketers used funds family and friends in their business. This is shows the easy at which such funds can be access. However, 28.67% marketers in Ondo used externalfunds, not minding the stressinvolved in accessing such fund as well as the high interest rate charged. This could be as a result of their scope of operation in kola trade. They need huge capital base to operate at such a wider range in their business dealings.

Table 2: Marketing and Sales

Variables	Ondo Freq.	percent	Ekiti Freq.	Percent
Who are your suppliers?				
Farmers	4026.67		138.67	
Processor	2818.674127.33			
Retailers	8254.669664			
Total	150	100	150	100
Where do you sell to?				
Gombe	10	6.675		8.67
Sokoto	151070		20	
Kano	20	13.33 41		18
Zaria	15102	12		
Maiduguri	18 1232		13.33	
Yola	12 8-		-	
Saudi-Arabia	106.67-	-		
Sudan	10	6.67 -		-
Cameroon	10 6.67--			
Central Africa	10 6.67 -			
Niger Republic	106.67 -			
Chana	10 6.67-			
Total	150100150	100		
Which type of kola nut do you sell?				
Dried		-	-	-
Wet		-	-	-
Processed	-	-	-	-
Unprocessed	-	-	-	-
Both	150	100	150	100

Source: Field Survey 2020

Table 3: Soures of Finance

Variables	Ondo Freq.	Ondo Percent	Ekiti Freq.	Ekiti Percent
Loan	4328.671510			
Family	6040		100	66.67
Friend	4731.33		3523.33	
Total	150	100	150	100

Source: Field Survey 2020

Conclusion and Recommendations

Marketers in the study areas are in their active working year. They are mostly women and are lettered. The marketers used mostly family funds and deals in both processed and fresh nuts. They sourced their produces mostly form middlemen/women and they have a very wide scope in their business activities. It is recommended that government annex Kola business in Nigeria to enhance the trade.

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Experimental Title: Introduction, Clonal propagation, and development of high yielding Kola varieties
Investigators: Adenuga, O. O. and Adebiyi, S

Introduction

There is an urgent need for CRIN to assemble new kola germplasm and properly characterise its germplasm for optimum utilization. This is very important because the existing germplasm has a very narrow genetic base and is largely uncharacterised. Also, the existing germplasm consists of old and unfruitful trees. These two key factors make the existing germplasm unsuitable to solve the problems identified in kola production, which are self and cross incompatibilities and inefficient pollination, regarded as responsible for low yield. The gestation of the crop also needs to be reduced. Profering solutions to these problems will encourage further farmer interest in the crop. The Institute at present does not have any improved or identified variety for distribution to farmers. Therefore the use of vegetative propagation urgently need be improved upon and perfected by the Institute in its attempts to solve the aforementioned problems. This study therefore aims to leverage upon and improve on the meagre acchievement of the previous year in which a small percentage of success was recorded in cloning techniques in the propagation of the species. Furthermore, activities are being initiated to commence the molecular characterization of the existing kola germplasm in CRIN for a more precise improvement procedure of the crop. Existing kola germplasm has a very narrow genetic base and is largely composed of old, unfruitful and uncharacterized trees.

Objectives

The eperiment was initiated to collect superior kola accessions from farmers' plots at contrasting locations in Osun State in Nigeria, establish at least 150 clones of such accessions and determine the success of clonal establishment of these accessions in CRIN's kola germplasm plot.

Materials and Methods

Collection of Scions: A pre-survey of kola farms with identified good accessions was carried out in selected locations in Okuku, Saga and Iyemogun (Osun State) State. These included two farms in each Location. Stem cuttings were collected from two accessions from each farm. This implies four accessions from each farm per location. A total of twelve accessions were used in the study. Stem cuttings were collected from the apical regions of the trees selected as mother trees which have diverse genetic origin. They are noted to fruit early and with good tree architecture and are also resistant to diseases. Collected scions were semi-hardwood flushes (greenish brown in colour) harvested from the mother tree. The scions were between 10cm - 20cm long and possessed enough buds including an active apical bud which should develop into a new shoot. The scions were harvested very early in the morning before sunrise, and the leaves around on the scions were trimmed to reduce leaf area and thus minimize moisture loss due to transpiration. The scions were wrapped in moist cotton wool to prevent scion dehydration and transported in an empty box from the farmers' plots to the site of the experiment at CRIN headquarters.

Setting of cuttings: Dressing of the cuttings involved the removal of their leaves except two or three leaves close to the apical bud are left. The detached end of the cutting was not dressed. The cuttings were planted directly into propagation structures (wooden boxes) filled with rooting medium. The rooting medium used was a mixture of river sand and rice husk in a ratio of 1:1. The entire cuttings together with the medium were covered with transparent polythene sheet after sowing. The entire medium and cuttings are then kept under shade. Cuttings are then watered every 2-3 days and inspected for rooting and leave development. A hundred cuttings of each accession

Grafting: The detached end of the scion is shaped like a wedge using a knife and grafted unto root stocks that were six months old. Grafted plants were covered with small transparent polythene sheets to create a humid environment around the leaves and helps reduce transpiration. The plants were arranged under shade and success checked periodically for about two months. Grafting tapes and transparent polythene covering on successful grafts were removed immediately. After six months, successful grafts were transplanted to the field.

Results

Though 35% of the grafted materials remained green after two weeks of grafting, only 6% of the original population were successfully establishes into the germplasm plot. This inconsistency may be attributed to the timing of the grafting which June. Humidity was high during this period and could have accounted for the low success rate. Appropriate timing for ideal grafting activities (as observed with cacao) lies between October through Early December, and February through Early April.

Callus formation and eventually, root development did not occur occurred all of the accessions used in the setting of cuttings. All eventually dried up.

Further ongoing field activities include periodic field maintenance (weeding, dry season irrigation and shade management).

Conclusion and Recommendation

Some grafted materials from this experiment were successfully established in a new *Cola* germplasm plot at CRIN Headquarters, Ibadan. A better level of success was obtained in the setting of the kola cuttings in the previous year. This result indicates that with further efforts need be employed, and aided by improved availability of research materials, to enable CRIN to successfully establish clones of better performing kola genotypes in its germplasm collection, thereby paving way for the development of improved kola varieties for distribution to farmers.

Timely release of research fund and adequate funding of research activities are hereby solicited for.

Challenge

The primary challenge in the execution of this research project was the late provision of fund, which made the execution very late, and resulted in the low response of the accessions to vegetative propagation techniques. Appropriate timing for ideal grafting activities lies between October through Early December, and February through Early April, whereas it was carried out in June in this instance.

Status

On-going

TEA PROGRAMME

Training on Good processing practices for tea: In Nigeria, Tea has not really commanded much premium due to poor processing methods among the farmers. This has led to poor earnings amongst tea stakeholders and the nation at large. To improve good earnings for tea via good price for the commodity, a training programme was organized on good processing practices for tea. Participants cut across tea farmers, local processors of tea and tea marketers in Taraba state.

Plate 1. Cross section of participants during the training

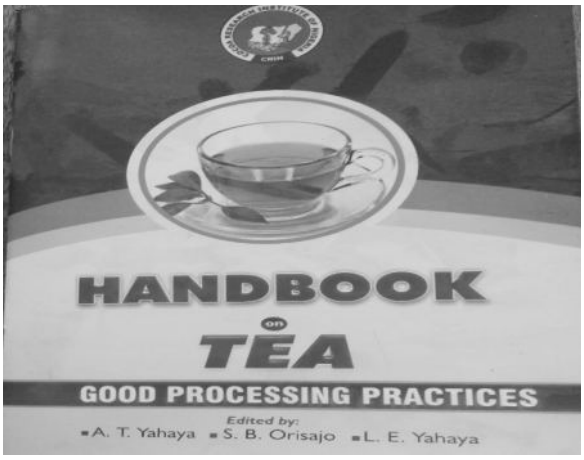

Plate 2. Copy of Training manual used during programme

Plate 3. Women participants during the training section

Plate 4. The PI of the project during her opening remark

Authentication and validation of Tea seed oil as edible oil and for other industrial applications.

Oil has been successfully expressed from Tea seed, a byproduct of tea. Chemical characterization and toxicity studies revealed its richness in polyunsaturated fatty acid and free of toxin, thus making it health friendly oil. Effort is underway to harness it in other areas of applications.

Plate 5. Tea seed oil

Development of Green Tea

The different types of Tea in the market involves different processing method in their production. Green Tea have been developed locally and characterized to ensure quality requirement is met. In order to go into large scale production, some equipments are required, one of which have been procured (Tea fixing machine). With funds available, the programme intend procuring the remaining (Tea dryer, roller and tea bag machine). We also intend improving the packaging of this product.

Plate 6. Pack of Green Tea

Experimental Title: Good Processing Practices on Tea in Nigeria

Investigators: Yahaya, A.T, Aroyeun, S.O; Yahaya, L.E; Jayeola, C.O, Oluyole, K.A; Igbinnadolor, R, and Agbebaku, E.O,

Introduction

Food chains are greatly affected by consumers concerns regarding food quality and safety and the sustainability of food production and handling methods. Societal concerns regarding chemical residues and environmental impact must be met in a competitive, increasingly global environment. Increasing consumer's demands regarding the quality, traceably and environmental friendliness of products and processes call for fundamentally new ways of developing, producing and marketing products (Hawkes and Ruel, 2011). This brings about the development of grades, standards and agreements regarding good production and management's practices as well as adequate monitoring systems to ensure quality compliance.

Tea industry in Nigeria has lost its share potential owing to problem in processing among others. The post harvest handling and processing of tea in Mambilla plateau is characterized by crude and unhygienic methods, lack of technological know-how, poor post harvest and unsafe processing practices. There are problems with poor quality tea leaves, poor processing methods, and resulting into lack of access to wider market, low pricing, and poor farmer income. There are poor linkages among the stakeholders and the value chain is underdeveloped. Private sector has insufficient quality tea leaves; there are tea packaging companies which import their raw materials from other tea suppliers around the world.

Attempt at improving the post harvest and processing practices comes with opportunities to increase nutrition sensitivity and food safety, improve rural income, reduce poverty, increase livelihood, and improve management of natural resources in a sustainable manner, and increase rural employment.

Objectives

Improve the ethical standards of tea small scale processors

Improve post-harvest handling and processing methods of the small-scale processors

Upgrade tea value chains through quality post-harvest handling and processing

Enhance the competitiveness of Nigeria Tea subsector.

Beneficiaries: Small scale processor and Farmers

Material and Methods

The project involved a training programm on post-harvest handling and standard processing methods for green and black tea on Mambilla, Taraba, state. It was a training of trainer's (TOT) methodology that is participatory in approach. Random sampling was used in selection of processors and farmers which include men, women and youths from the 6 tea producing wards in Sarduana local government areas. Three hundred (300) processors and farmers were trained in a batch of thirty (30) each to have ten (10) batches. Also, a post training assessment was carried out through administration of questionnaire.

Results and Discussion

All the 300 participants expressed their gratitude for the training as they all learned better methods of processing tea. They equally promised to adjust their former method of processing tea. And a feedback assessment was carried out with collection of samples processed from the trainees for analysis a year after the training. The report showed that more than 65% actually adopted the new skill acquired as the analysis of their samples conformed to standard. This has also improved tea pricing, enhance demand and access to wider market and boost income accruable from tea business and prevent exploitation.

Conclusion and Recommendations

The ethical standard for handling and processing green and Black tea was demonstrated to the stakeholders. Small scale processors and farmers were trained on how to upgrade tea business through proper and safe post-harvest handling and processing. A year field evaluation of the trainers shows a good adoption rate among the trainees. These small holders' trainees' livelihoods can be improved with their access to wider market for increase pricing for the products and also, to prevent exploitation. This study thereby recommends the link of these small holders to higher marketing opportunities.

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Experimental Title: Dynamics of Phosphorus Fixation in Selected Tea Cropped soils on the Mambilla Plateau in Taraba State, Nigeria

Investigator: Aikpokpodion, Paul E.

Introduction

Tea (*Camellia sinensis*) is the most widely consumed beverage in the world and ranked second to water as the most consumed drink worldwide (Ho et al, 2009). Tea has a significant role as a health drink. It is cultivated in fifty countries with major producers being India, China, Kenya, Sri Lankar, Vietnam, Turkey, Indonesia, and Iran (FAO, 2014). Nigeria is one of the countries in Africa that produce tea. Tea cultivation in Nigeria is mainly done on the Mambilla Plateau in Sardauna Local government area of Taraba State in the Northern part of the country. Report of Food and Agriculture organization (FAO) showed that the world production of tea stands at 5.56 million tons with plantation hectarage of 3.80 million (FAO, 2014).

Production of tea is steadily on the increase globally. Although tea's nativity is traceable to the humid tropics and subtropics, it has been found to have a very wide adaptability and thus can be cultivated in a wide range of climatic conditions and soils. It is also grown across a range of altitude from sea levels up to about 2,200 meters above sea level. Tea cultivation requires a minimum rainfall of 1,200mm per year but thrives optimally with annual rainfall of 2,500 – 3,000Mm. Tea has a productive life span of over 100 years with peak production periods between 30 and 50 years (Hajiboland, 2017)

Being an evergreen bush, it has the capacity to attain a height of 15meters in the wild if not maintained. For economic purposes, tea bush is maintained at a height of 0.6 – 1.0 meter to facilitate harvesting of leaves for tea beverage production (de Costa et al., 2007).

Tea is grown in soils that differ from one country to another with the most important feature being soil pH (Hajiboland, 2017). The pH requirement for the growth of tea is in the range of 4.5 to 5.6. Optimum soil conditions recommended for tea cultivation include well drained, deep, and well-aerated soil with more than 2% organic carbon (de Silva, 2007). Soil depth of less than 50cm, graveliness of more than 50% and rockiness of 20% affect the growth of tea adversely (Hajiboland, 2017) while tea plants grown on shallow and compacted soils are likely to suffer from drought and water logging. Under favorable climatic condition with adequate management, harvested leaf yield of tea can generally reach 4–5-ton ha^{-1}year^{-1}. There have been instances when yields of 6.5-ton ha^{-}year^{-} were reported (Hajiboland, 2017). However, tea yield at lower elevations is higher than that obtained from tea stands at higher elevations in the absence of soil constraints with proper management (Carr and Stephens, 1992; TFFK, 2002).

Currently in Nigeria, tea cultivation for commercial purpose is only on the Mambilla Plateau in Sardauna local government area of Taraba State. This is due to the favorable climatic and soil conditions for tea cultivation on the plateau. The climate of the plateau is semi temperate in nature. Outdoor temperature taken by 7.00 am hardly exceeds 19^{o}C. It can be as low as 13^{o}C during winter. At noon, temperature ranges between 14 and 30^{o}C depending on the period of the year (Aikpokpodion, 2020). Mambilla Plateau has elevation of 1500-2000m above sea level, covers an area of over 9,389 square kilometers and has an annual rainfall of 2000-3000mm.The soil pH of the Plateau where commercial tea cultivation takes place ranges between 4.45 and 5.50.

Tea plant was introduced on the Mambilla Plateau at the Nigerian Beverages Production Company in Kakara Village in the year 1972 (Hainsworth 1981; Omolaja and Esan, 2005)

At the time of introduction, four commercial clones (35, 68, 143 and 318) were brought into the country. In 1982, the Mambilla Substation of Cocoa Research Institute of Nigeria, located at Kusuku Village obtained the four clones from the Nigerian Beverages Production Company for research purpose (CRIN , 1982).

In recent time, the yield of tea crop on the Mambilla Plateau has been on a decline. This might in part be a consequence of the extremely harsh weather occasioned by global climate change. In addition, the decline in tea production on the Mambilla Plateau is the low level of some macro nutrients in the soil. A recent nutrient auditing of various tea plantations on the Mambilla plateau revealed that, phosphorus was the most limiting macronutrient needed for optimal production in all the investigated tea farms. Apart from the fact that, tea farmers on the plateau don't apply fertilizer to replenish the soil, the considerable level of Al, Fe and Mn in the acidic soils could enhance intense fixation of phosphorus in the soil.

Harvesting of tea leaves removes nutrients from the soil. The rate of nutrients removal depends on the duration of plucking rounds and their intensity. Continuous plucking of tea leaves leads to mining of macronutrients N, P and K thus, making it necessary to replenish the nutrients in soil (Tabu et al. 2015). The influence of applied fertilizer on tea yield arises from its effects on the shoot extension rate and the rate of regeneration (Mokaya, 2016). Phosphorus is an essential macro-nutrient, and it plays crucial role in the cellular structure and energy metabolism in higher plants (Hawkesford et al., 2012). Phosphorus plays major role in the formation of new wood and roots in tea. Its deficiency in tea manifests itself as absence of brightness in matures leaves and dieback of young and old woody stems (TRFK, 2002). Under moderate soil pH of about 5.5 to 7.0, phosphorus availability to plants is high but decreases at pH below 5.5 or above 7.0 (Hamid, 2006). In very acidic soils, phosphorus is adsorbed onto hydroxides of Al and Fe. Consequently, it becomes unavailable for plant uptake. On the Mambilla plateau, most of the tea farms have pH below 5. A recent study carried out by the author showed that 97% of the tea farms investigated on the plateau had pH ranging from 4.70 to 5.44 while 3% of the soils had pH ranging from 5.44 to 5.61. None of the tea farms however, had pH above 5.61.

A recent study carried out by the author also showed that all the sampled tea farms on the Mambilla plateau had available P lower than 15mg/kg which is the critical level of P required for tea cultivation. The low available P content of the soils is in part due to the inherent acidic nature of the soils which promotes P fixation in soil and makes it unavailable for tea plant uptake. To overcome phosphorus deficiency in tea soils on the plateau and enhance tea yield, application of phosphorus fertilizer becomes imminent. Information obtained from the farmers indicates that, none of the small-scale tea farmers applies fertilizer in replenishing the soil. Rather, they solely depend on the inherent nutrients in the soils for tea sustainability. On the other hand, the Mambila Beverage Company Kakara, the producer of Highland tea applies N:P:K 15:15:15 fertilizer occasionally on its tea plantations. The fertilizer application however, shows little or no difference on tea yield probably as a result of nutrients fixation in soil.

For adequate phosphorus fertilizer application to be obtained in acidic soils with high potential for P fixation, it is necessary to understand the chemistry and fate of applied phosphorus in such soils. In addition, recommendation, and application of phosphorus fertilizer on acidic soils on the basis of soil test without the consideration of P fixation capacity of the soils will be misleading and may not produce the desired result with respect to tea yield.

Owing to lack of adequate information on phosphorus fertilizer factor, phosphorus recovery and P fixation in tea grown soils on the Mambilla plateau, the study was carried out to examine the fate of applied P fertilizer with respect to its fixation and availability for tea uptake.

Materials and Methods

Phosphorus fixation study was conducted in soil samples obtained from selected tea farms on the Mambilla plateau to evaluate phosphorus fractional recovery, fertilizer factor and P fixation.

Physicochemical properties

The incubation study was conducted in the Soil laboratory of the Mambilla Substation of CRIN located at Kusuku in Sardauna local government area of Taraba State, Nigeria. Soil samples were collected from selected tea plantations at Nguroje and Kusuku with soil auger at the depth of 0-30cm in May 2019. The samples were air-dried in the laboratory and thereafter sieved with 2mm sieve. The physicochemical properties of the soil samples were carried out with wet chemistry. The samples were leached with 1N ammonium acetate. Each leachate was analyzed for exchangeable cations (Ca^{2+}, Mg^{2+}, K^+ and Na^+) determination (Schollenberger and Simeon 1945). Soil particle size was measured by the Boyocous hydrometer method. Soil pH was determined with glass electrodes in 1:2.5 soil-water suspensions. The organic carbon was quantified according to Walkley and Black (1934) protocol. Total Nitrogen was determined by the Macro Kjedahl method (Bremner 1996). Available Phosphorus was determined using Bray and Kurtz (1945) method.

Fractional recovery

Liquid phosphorus fertilizer was prepared in the analytical laboratory of Mambilla Substation in accordance with a modification of Hunter, (1975) method. To obtain 700ml mg PL^{-1}, 1.54g of KH_3PO_4 was prepared in 500ml of distilled water as stock solution.

Five (5) sorption treatment solutions (A-E) were prepared by diluting 10, 20, 40, 80 and 100ml of the stock solution to 100ml as shown in Table 1. A 6.0g of each soil sample was weighed into 80ml plastic cups in tray racks and 3ml of each of the five sorption solutions was added to the soil samples to arrive at 35, 70, 140, 280 and 560mg P kg^{-1}soil accordingly. Distilled water was thereafter added to the soil samples to keep the soil moisture at field capacity. The experimental set up was made in triplicate.

The treated soil and the control samples were incubated for a period of 3, 15, 30, 45 and 60 days under moist condition by adding distilled water when necessary. At the end of each incubation period, the treated samples and the counterpart control samples were air-dried and 3g of each subsample extracted with 18ml of Mehlich 3 solution for phosphorus determination. Colorimeter was thereafter used to quantify the recovered phosphorus after soil incubation. Fractional recovery, fertilizer factor and P fixation were calculated from the data obtained from P extraction.

The linear regression that expresses the relationship between fractional recovery and rates of P addition was calculated for the soils at the different incubation periods as

Y= a + bx................................. (1)

Where:

Y = P extracted in mgkg-1 after incubation

X = rate of P addition to soil

A = P extracted at zero addition

b = Fractional recovery

Phosphorus fixing capacity (PFC) was obtained from the relationship:

PFC = (1-FR)100

Where: FR = Fractional recovery

Table 1: Physicochemical properties of investigated soil samples

Parameters	Nguroje soil	Kusuku soil	Critical level
Total N (%)	0.42	0.29	0.34 %
Exc. Ca ($cmolkg^{-1}$)	0.69	2.07	2.3 $cmolkg^{-1}$
Exc. Mg ($cmolkg^{-1}$)	0.84	1.75	
Exc. K ($cmolkg^{-1}$)	0.28	0.51	3.6 $cmolkg^{-1}$
Exc. Na ($cmolkg^{-1}$)	0.68	0.37	
Exc. acidity ($cmolkg^{-1}$)	0.15	0.10	
Available P (mg kg^{-1})	8.16	8.18	15 $mgkg^{-1}$
Org C (%)	7.61	5.05	3.0 %
Fe ($mgkg^{-1}$)	14.65	17.55	
Mn ($mgkg^{-1}$)	6.45	13.05	
pH	4.77	5.01	4.5 – 5.6
Org Matter	13.10	8.70	
Cu ($mgkg^{-1}$)	0.15	1.35	
Zn ($mgkg^{-1}$)	3.16	29.68	
Clay (gkg^{-1})	160	340	
Silt (gkg^{-1})	72	132	
Sand (gkg^{-1})	768	528	

Table 2: Concentration of P in treatments' solution

	Vol of stock diluted to 100ml	Conc. of P in sorption solution	Weight of soil sample (g)	Vol. of sorption solution added to soil (ml)	Rate of P added to soil (mg/kg)
A	10	70	6	3	35
B	20	140	6	3	70
C	40	280	6	3	140
D	80	560	6	3	280
E	100	1120	6	3	560

Table 3: Fractional recovery of P in investigated soil samples

mg P/kg soil	Nguroje	Kusuku	Nguroje	Kusuku	Nguroje	Kusuku	Nguroje	Kusuku	Nguroje	Kusuku
	3 days		15days		30days		45days		60days	
35	0.0380	0.0191	0.0014	0.0037	0.0251	0.0006	0.0017	0.0015	0.0013	0.0004
70	0.0286	0.0140	0.0014	0.0030	0.0063	0.0034	0.0019	0.0014	0.0016	0.0007
140	0.0238	0.0047	0.0026	0.0019	0.0035	0.0073	0.0034	0.0021	0.0024	0.0010
280	0.0202	0.0060	0.0052	0.0013	0.0046	0.0096	0.0040	0.0036	0.0038	0.0028
560	0.0048	0.0024	0.0026	0.0060	0.0032	0.0054	0.0023	0.0020	0.0031	0.0018

Table 4: Phosphorus fixation in investigated soil samples

mg P/kg soil	Nguroje	Kusuku	Nguroje	Kusuku	Nguroje	Kusuku	Nguroje	Kusuku	Nguroje	Kusuku
	3 days		15days		30days		45days		60days	
					% of P fixed in soil					
35	96.20	98.09	99.86	99.63	97.45	99.94	99.83	99.85	99.87	99.96
70	97.14	98.60	99.86	99.70	99.37	99.66	99.81	99.86	99.84	99.93
140	97.62	99.52	99.74	99.81	99.65	99.27	99.66	99.79	99.76	99.90
280	97.98	99.40	99.48	99.87	99.54	99.04	99.93	99.64	99.59	99.72
560	99.53	99.76	99.74	99.94	99.68	99.46	99.88	99.80	99.62	99.82

Results and Discussion

Physical and chemical properties of the soils showed that both soils are acidic in nature (Table 1) with soil sample from Nguroje slightly more acidic (pH 4.97) than soil sample from Kusuku tea plantation (pH 5.01). The pH values obtained for both soils however fall within the pH range (4.5 – 5.6) required for tea cultivation. The values obtained for calcium in Nguroje soil (0.69 cmolkg^{-1}) and Kusuku (2.07 cmolkg^{-1}) were below the critical value (2.3 cmolkg^{-1}) (Table 1) required for adequate tea cultivation (Ipinmoroti *et al.*, 2011). The grossly low calcium content of Nguroje tea soil is expected when the soil acidity is put into consideration. The valus of 0.84 and 1.75cmolkg^{-1} (Table) obtained for Mg in Nguroje and Kusuku soils respectively were below the critical level of Mg required for tea cultivation (Othieno, 1981; Ipinmoroti *et al.*, 2011). Similarly, Obatolu, (1999) reported Mg deficiency in tea soils on the Mambilla plateau. The values obtained for K in Nguroje (0.28 cmolkg^{-1}) and Kusuku (0.51 cmolkg^{-1}) soils were grossly lower than the critical level of K (3.6 cmolkg^{-1}) required for tea cultivation.

Total N in Kusuku soil (0.29%) was lower than the critical level of N (0.34%) required for tea cultivation (Table). On the other hand, Nguroje tea soil had adequate total nitrogen in it. The higher total N value in Nguroje soil compared with Kusuku soil may not be unconnected with the level of soil organic matter in the former. Organic matter decomposition produces humus which is a valuable reservoir of nitrogen. Nguroje soil had organic matter of 13.10% while Kusuku soil had 8.70%. this suggests that Nguroje soil had higher proportion of humus which in turn enhances the capacity of the soil to retain nitrogen. Aside the fact that humus contains 10% N, the higher organic matter in Nguroje soil could also contribute to the adsorption of nitrogen in the soil. Though Kusuku tea soil was higher in clay, its contribution to the retainment of nitrogen in soil in an environment where annual rainfall is up to 3000 mm might be negligible considering the chemistry of nitrate. As nitrate is negatively charged, it is not attracted to clay particles (negatively charged surfaces) and consequently prone to leaching during precipitation. Humus has an anion exchange capacity and therefore can hold some nitrate which reduces leaching.

Available phosphorus in Nguroje soil (8.16 mgkg^{-1}) and Kusuku soil (8.18mgkg^{-1}) were grossly lower than the critical level of phosphorus (15 mgkg^{-1}) required for tea cultivation. The low available P content of the studied soils is an indication that tea plantations on the Mambilla plateau are deficient of phosphorus. The deficiency might be due to a few factors which include but not limited to weathering, high P fixation, non application of fertilizer to replace nutrient mined by tea plant annually.

Fractional recovery

Fractional recovery of P in Nguroje soil treated with 35mg Pkg^{-1} soil decreased from 0.038 at 3 days after incubation to 0.0013 at 60 days after incubation. Result showed a progressive reduction in phosphorus recovery as incubation period increased. It implies that, as the incubation period increased, phosphorus fixation also increased. Similarly, the fractional recovery of P in Kusuku soil treated with $35mgPkg^{-1}$ soil also decreased from 0.0191 at 3 days after incubation to 0.0006 after 30 days of incubation. Result showed an increase in P recovery in Kusuku soil at 45 days after incubation. It suggests a desorption of certain fraction of initially fixed P in the soil matrix.

The observed progressive reduction in P fractional recovery with incubation time is in consonance with the report of Ogunlade *et al*., (2011) and Mallikarjuna *et al.,* (2003). The decline in phosphorus recovery was indicative of fixation of a proportion of applied phosphorus in soil solution. A progressive decrease in P fractional recovery from 0.0286 to 0.0016 during 3 and 60 days after incubation respectively was also observed in Nguroje soil treated with 70 mg P kg^{-1} soil. The scenario was however different in Kusuku soil in which progressive decline in P recovery was only sustained in the first 15 days after incubation. Phosphorus fractional recovery declined from 0.014 at 3 days after incubation to 0.0030 at 15 days after incubation. Desorption of adsorbed P was observed at 30 days after incubation which resulted to increase in P fractional recovery (Table 3). The redistribution of P in terms of desorption that took place at 30 days of P treatment indicates that, a proportion of phosphorus that was adsorbed between 3 and 15 days of treatment was released back into soil solution for tea uptake. This suggests that phosphorus chemistry in soil is dynamic and not static. As the concentration of P in solution increased beyond 70 $mgkg^{-1}$, a progressive decline in P recovery with time reached a climax at 15 days after incubation in both Nguroje and Kusuku soils. The decline in P adsorption in both soils at solution P concentration of 70 $mgPkg^{-1}$ soil suggests saturation of sorption sites on the soil surfaces. Phosphorus fractional recovery was lower in Kusuku soil compared with Nguroje soil. This implies higher phosphorus fixation in Kusuku soil.

Fixation of nutrients in soil is hardly ascribed to a single mechanism or a single soil constituent due to the complex and multi-components nature of soil matrix. However, the higher P fixation in Kusuku soil compared with Nguroje soil may not be unconnected with the higher clay content of Kusuku soil compared with Nguroje soil. Table 1 show that Kusuku soil had 340g of clay per kg soil while Nguroje soil had 160mg clay per kg soil. In addition to higher clay content of Kusuku soil than Nguroje, Kusuku soil was also higher if Fe ($17mgkg^{-1}$) than Nguroje soil ($14.65mgkg^{-1}$). Phosphate ions are chemically unstable in soil solution and readily react with oxides and hydroxides of Al and Fe found on clay surfaces for acidic soils (Bolland *et al.,* 2003). Correlation of soil physicochemical properties of the investigated soils with fractional recovery showed that P fixation increased significantly with clay, Fe, Zn and Mn. In a similar study conducted by Ogunlade *et al*., (2011), it was reported that P fixation increased with clay, organic carbon, Fe and Mn in selected cocoa soils in Nigeria. Thomazi *et al*., (1990) reported that Fe oxides and clay were the main factors contributing to P fixation in soils. Owusu-Bennoah and Acquaye (1989) report showed that phosphate sorption was highly correlated with clay and free Fe_2O_3.

Hydrous oxides of Fe and Al have the ability to fix phosphate through adsorption on their surfaces. They occur in soils as discrete particles or films on other soil particles. They occur in the form of amorphous and crystalline hydroxyl compounds in soil. However, when aluminum and iron oxides in soil are less crystalline, the phosphate fixing capacity of the soil increases due to greater surface area available for adsorption. On the other hand, crystalline hydrous oxides fix more phosphate in soil than layer silicates. Clay fraction of soil is the main site of phosphorus fixation. The nature of clay minerals is also a factor that determines the capacity and intensity of phosphorus fixation in any soil. Phosphorus is retained in soil to a greater extent by clays of the 1:1 type (Kaolinite) than the 2:1 type clay (montmorillonite, illite, vermiculite) (Idris and Ahmed, 2012). According to Dean (1949), Fe and Al appear to be the most likely soil constituents that fix P by chemical precipitation in acid soils. When Fe and Al combine in equivalent. In most soils of the world where tea is cultivated, aluminum is a key soil constituent that contributes to soil acidity. Tea is a good accumulator of aluminum as an essential micronutrient required for optimum yield. Aluminum promotes the growth of tea bushes (Ghanati *et al*., 2005; Hajiboland et al., 2013). Aluminum is only available to plants under a low pH of 5.5 and below (Hajiboland, 2017). In acid soils Al becomes increasingly available, leading to toxicity for most plants except tea and other accumulator specie (Hajibolland, 2017). When Fe and Al are combined in equivalent quantities, fixation occurs between pH 2 and 3. In the presence of excess Fe, there is a tendency to extend the range of P fixation to pH 4. On the other hand, phosphorus fixation increases when Al and P are combined in equivalent quantities at pH 4. But in the presence of excess Al in soil solution, the range of P fixation extend from 4 to 7. The Fe and Al silicates and sesquioxides are the primary sources of Fe^{2+} and Al^{3+}

leading to the formation of chemically precipitated Fe and Al phosphate in acid soils.

Clay factor

Phosphorus fixing capacity of the clay minerals is mainly due to the replacement of OH ions from the clay minerals surface and reaction with soluble Al originating from the exchange sites and from the lattice dissociation of clay minerals to form insoluble P compounds.

The sesquioxides present in the free and hydrated state are considered the main causes of P fixation in acid soils. Certain reports have validated the influence of sesquioxides on P fixation. Raychaudhuri and Mukerjee, (1941) reported an increase in P fixation with increase in HCL extracted sesquioxides in red soils. Ghani (1943) reported a considerable reduction in P fixing power of an acidic soil through de-activation of Fe and Al by means of 8-hydroxyquinoline. In addition, an account of Ghani and Islam, (1946) showed that 90% of fixed phosphate in soil was recovered as Fe and Al phosphate.

Other chemical constituents of the soil that might have enhanced higher P fixation in Kusuku soil compared with Nguroje soil is the Ca and Mg contents of the soil. Result showed that calcium content of Kusuku soil was thrice the value of Ca in Nguroje soil while the value of Mg in Kusuku soil was twice that of Nguroje soil. The nature of the exchangeable Cations present on the colloidal complex of the soils plays an important role in P fixation. Patel and Viswanath, (1946) reported an increase in P fixation capacity with the increase in exchangeable ca, exchangeable bases and total cation exchange capacity. The exchangeable Ca ions act as bridge between phosphate ions and clay surfaces. According to Kanwar and Grewal, (1990), about 30% of P fixation in acidic soils of Himachal Pradesh was due to exchangeable Ca and Mg.

Fixation of phosphorus in Nguroje soil increased from 96.20 at 3 days after incubation to 99.87% at 60 days after incubation while Kusuku soil increased in P fixation from 98.09 % at 3 days after incubation to 99.96% at 60 days of incubation for samples treated with 35mg P/kg soil. Similar observation was made in all the soil samples treated with 70, 140, 280 and 560 mg P/kg soil.

The rate at which P fixation proceeds in soils is an important factor to be considered when assessing P availability to the growing plants. The observed increase in P fixation with reaction time is in agreement with the report of Ghani and Islam (1946) in which P fixation increased from 45% and 85% at 6 hours after incubation to 70 and 95% respectively 6 weeks after incubation in soils of Dacca (pH 5.2) and Berhampur (pH 4.6). Evaluation of phosphorus fixation with reaction time shows a rapid adsorption 96.20 and 98.09% in Nguroje and Kusuku soils respectively at three days after incubation. According to the report of Gupta, (1965) most of the applied soluble P was fixed up in 24 hours but gradually increased up to 30 to 45 days in soils depending upon the type of soil and thereafter remains constant.

In acidic soils of Baruijpur in West Bengal, Basu and Mukerjee (1972) reported a gradual adsorption of phosphorus up to 5 days before reaching a steady state at 18 days after incubation. In alluvial soils of Madhaya Pradesh, P fixation increased with time up to 60 days before reaching a steady state (Dravid and Apte, 1975). The first stage where P fixation is rapid is attributed mainly to exchangeable Al and Ca ions while the second stage of slow P fixation is attributed to the non-exchangeable Al presumably dissociated from the non exchangeable sites (Kanwar and Grewal, 1990)

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ECONOMICS AND EXTENSION DEPARTMENT

Project: Databank
Experimental Title: Report of Cashew Data Bank for Oyo State, Nigeria
Investigators: Oduwole, O.O., Lawal, J.O., Obatolu, B.O., Taiwo, O and A.T. Yahaya

Introduction

The dearth of data on Cashew as it relates to production and the farming households has affected planning and policy decisions at different levels. Many quarters have proved that CRIN should be the base for the collection of data on all its mandate crops. Data bank system involves a lot of information collection, generation, and modeling to meet the need of various users of information such as farmers, industrialists, and other stakeholders. It requires careful data collection and management for the needs of the various users of information.

Justification

There is no existing reliable data platform for CRIN mandate crops, and the available ones are not adequate and not reliable and timely, hence, there is a need to complement it to make it more robust. Various agencies and private sectors have different information on cashew and the available ones are limited to just production and price. However, there is need for information on socio-cultural variables, biological variables, soil, and spatial information (GIS).

Objectives

1. Collection and management of baseline information on cashew.
2. To provide the network with other local and international bodies.

Methodology: This will involve desk research, field survey and interactions with various stakeholders and scientists. Data bank is a continuous and dynamic process involving modeling techniques for the management of information. It involves a lot of rules for the coding system. Personal interviews and the use of questionnaires to collect data and the data set requirement will include the following:
- Socio-economic and physiological data, Weather data, Soil nutrients and water balances, - Phenolic and growth data (variety, acceptability, cultural), Agronomic data
- Disease and pest data- level of infection and damage, Pesticides, and their products
- Risk or uncertainty data; production, processing, and consumption patterns

Results and Discussion: This report is subdivided into the following major heading:

I. Socio- economic characteristics of the cashew farmers
II. Planting history of the cashew farmers
III. Cashew agricultural practices and rehabilitation methods
IV. Major constraints faced by farmers
V. Awareness of cashew production factors
VI. Proffered solutions by the farmers

Socio-Economic Characteristics of the Cashew Farmers

The socioeconomics of the cashew farmers are germane as this contributes positively or negatively to the production of the cashew in the study area. Such demographic characteristics like age, gender, educational levels, membership of associations, mode of land acquisition, sizes of farm among others were considered and analyzed.
The result shows that majority (87%) of the cashew farmers in Oyo state are male indicating that cashew plots are mainly owned by the male. Most of them (81%) are primarily farmers with few engaging in artisanship or business. They are relatively educated 30% had secondary education, 38.37% has no formal education and 25% had primary leaving certificates. This relatively shows that the farmers have the capacity to adopt new innovations /technologies on cashew production if such is extended to them.

Table 1: Distribution of Cashew farmers by Gender, Primary Occupation& Educational Status

Variables	Frequency	Percentages	Cumulative
Gender			
Female	10	12.82	12. 82
Male	68	87.18	100
Primary occupation			
Carpentry	1.32	1.32	
Civil servant	1	1.32	2.63
Driver	1	1.32	3.95
Farmer	62	81.58	85.53
None	6	7.89	93.42
Supply	1	1.32	94.74
Trader	4	5.62	
Total	76	100	
No formal education	28	38.36	63.01
Primary	18	24.66	93.15
Secondary	22	30.14	6.85
Tertiary	5	6.85	
Total	73	100	

Source: Field survey, 2020

Close to 96% of the cashew farmers in Oyo state belongs to one farmer's association or the other with 80% belonging to cashew growers' association. This gives a good sense of belonging to the farmers and could be channels where government reaches out to the cashew farmers in terms of credit/ input facilities, as well as training of farmers in good agricultural practices. The result further shows that majority of the farmers (85%) inherited their cashew farms thus indicating that cashew is a generational farm business that's been passed on from one generation to the other., only 8% purchased their cashew farmland while 1% was a gift.

Table 2: Distribution of farmers by Membership of Socio-Economic Association &Farms Ownership

Variables	Frequency	Percentages	Cumulative
Association Membership			
No	3	4.05	4.05
Yes	71	95.95	95.95
Total	74	100	
Name of Association			
Afan	6	8.45	8.45
Agfam	1	1.41	9.86
Ncan	3	4.23	14.08
Cashew Growers Association	57	80.28	94.37
National association of cashew	1	1.41	95.77
None	2	2.82	98.59
Society	1	1.41	
Total	71	100	
Mode of Land Acquisition			
Gift	1	1.54	1.54
Inheritance	55	84.62	86.15
Lease	2	3.08	92.31
Purchase	5	7.69	100
Total	63	100	

Source: Field Survey, 2021

Further demographic analysis shows the average age of the cashew farmers as 56 years indicating that they are relatively young farmers hence posses some strength to do farm work and coordinate farm activities to boost production. The average cashew farmer in the study area has 16 years of cashew farming experience and with an average household size of 10 and 6 persons assisting in the cashew farm. This shows that the farmers have relatively long years of experience in cashew farming with a relatively high household size indicating some high level of social responsibility on the farmers. Furthermore, majority of the famers has between 2-4 ha of land and on the average 164 bags of 90kg has been produced in the study area.

Planting history of the Cashew Farmers

Data on planting history were collected particularly on planting methods, varieties of cashew planted, sources of materials planted, as well as survival rate of cashew planted. This data was collected for the cashew's trees between 5-25 years of age.

The result shows that majority (96%) of the cashew farmers planted their cashew at stake while very few (1-2%) planted the seedlings to establish their cashew plantation. Further result analysis shows that 80-95% planted small- medium variety of cashew very few (2%) planted the jumbo variety. According to the farmers, the small and medium yielded more fruits and therefore increased in income and livelihood. As regards source of planting materials for cashew plantation establishment, most farmers (90%) source their materials from an existing farm nonetheless, they have over 80% survival rate of the cashew. This however has been an age long practice which needs to be avoided and a paradigm shift needed to enhance productivity by accessing improved materials from research institutes or other relevant agencies.

Table 3: Distribution of farmers by planting History

Planting methodology	Frequency.	Percentages	Cumulative
Planting at stake	32	96.97	96.97
Seedlings	1	3.03	3.03
Total	33	100	
Variety planted			
Jumbo	2	6.67	6.67
Medium	6	20	26.67
Small	13	70	43.33
Small and medium	4	13.33	83.33
Small, medium and jumbo	1	3.33	86.67
Small,medium and jumbo	4	13.33	100
Total	30	100	
Source of materials			
Existing farm	15	83.33	83.33
Fellow farmer	2	16.67	100
Total	18	100	
Do you			
Keep nursery			
No	61	87.14	87.14
Yes	9	12.86	100
Total	70	100	
Intercrop planted			
Banana	3	6.12	6.12
Cashew	3	6.12	6.12
Cassava	18	36.73	48.98
Guinea corn	1	2.04	51.02
Maize	19	38.78	89.8
Okro	1	2.04	91.84
Pineapple	2	4.08	95.92
Yam	2	4.08	100
Total	49	100	
Types of weeds			
Akintola	37	66.07	66.07
Akintola and carpet grass	4	7.14	73.21
Akintola and lemon grass	1	1.79	75

Akintola and spear grass	4	7.14	82.14
Akintola and sturborn grass	1	1.79	83.93
Akintola and sunflower	2	3.57	87.5
Carpet grass and akintola	1	1.79	89.29
Gbegiete	1	1.79	91.07

Source: Field survey, 2021

Cashew Agricultural Practices and Rehabilitation Methods

Furthermore, over 90% of the farmers do not keep nursery. Good agricultural practice (GAP) is germane to enhancing the productivity, income, and livelihood of the cashew farmers. The type of intercrop, weeding, soil testing, rehabilitation and type, planting distance among others were considered important in this regard. The result analysis shows that over 90% of the farmers planted cassava and maize as annual intercrop on their cashew plots. Other intercrops include vegetables, watermelon, and groundnut (2-10% of the farmers). This indicates that maize and cassava are the main staple intercrops and source of income for the farmers. This corroborates the findings of Lawal and Uwagboe (2017). Other tree crops intercropped with cashew includes Mangoes, Palm and Orange. The most prevalent weed on their cashew farm is the "akintola weed". Most of the farmers (45%) weed their farms manually while only 14% uses herbicides to such as Paraforce Force-up as means for controlling weed. They mostly use one cup per 15 liter of water in spraying their farms. Similarly, over 59% uses pesticides to control pest. These are applied twice in a year by majority of the farmers. According to the farmers, the pesticides are very effective in controlling the pest.On fertilizer application, majority of the farmers (94%) do not use fertilizer on their cashew farms. Fertilizer is not taken as important to cashew, and it is perceived that cashew is rugged and can do well on their soil without applying fertilizer. Major diseases /pest experienced by the farmers are the cashew stem borers (40%) Soldier ant and "salamo" (local name). Majority of the farmers (38%) do not take action on the disease infestation, 33% of them uses pesticides in tackling the pest and diseases while 6% uses cultural means for control.The analysis further shows that 62% constituting both hired and family labour was used in cashew farm operation. Virtually all the farmers (94%) do not keep records of their farming activities. This is mainly because they have not received any training on how to keep such nor do they see it as of any relevance. Seventy-seven percent of the farmers (77%) carry out one form of rehabilitation or the other of which coppicing is mostly practiced as well as pruning 93%. In some cases, total replanting was done. Some other farm practice they do includes use of chemicals, weeding pruning which virtually (93%) all the farmers do, Furthermore, result shows that over (98%) of the cashew farmers experienced change in cashew production due to climate change especially changes in temperature and rainfall as well as cloud cover.

Table 4: Distribution of farmers by AgriculturalPractices

Do you do soil test?	Frequency	Percentages	Cumulative
No	69	98.57	98.57
Yes	1	1.43	100
Total	70	100	
Do you carry out rehabilitation			
No	13	22.81	22.81
Yes	44	77.19	100
Total	57	100	
What methods of rehabilitation			
Coppicing	13	27.66	27.66
Partial Replanting	3	6.38	34.04
Selected Spacing	2	4.26	38.3
Selection Replanting	3	6.38	44.68
Selective Replacement	1	2.13	46.81
Spraying	1	2.13	48.94
Total Replanting	22	46.81	95.74
Total Replanting& Coppicing	1	2.13	97.87
Total replanting	1	2.13	100

Total	47	100	
Types of mgt practice			
Chemical Use	3	7.14	7.14
Regular Cutting of Grass	3	7.14	14.29
Regular Spraying	1	2.38	16.67
Routine Management	20	47.62	64.29
Spraying	7	16.67	80.95
Spraying And Weeding	3	7.14	88.1
Weeding	5	11.9	100
Total	42	100	
Do you prune			
No	4	6.9	6.9
Yes	54	93.1	100
Total	58	100	
Number Of Times for Pruning			
1	21	38.18	38.18
2	29	52.73	90.91
3	2	3.64	94.55
4	3	5.45	100
Total	55	100	
Other mgt practice undertaken			
Chemical	15	34.09	34.09
Chemical Spraying	3	6.82	40.91
Clearing	1	2.27	43.18
Cutting Of Grasses	1	2.27	45.45
Field Maintenance	1	2.27	47.73
General	1	2.27	50
Local One	1	2.27	52.27
Regular Hygiene	6	13.64	65.91
Regular Maintenance	4	9.09	75
Routine Management	3	6.82	81.82
Spraying	1	2.27	84.09
Spraying And Weeding	4	9.09	93.18
Spraying Of Chemicals	2	4.55	97.73
Weeding	1	2.27	100
Total	44	100	
Planting distance			
1.5-2m	1	1.75	1.75
10feet	18	31.58	33.33
12feet	1	1.75	35.09
15-20feet	1	1.75	36.84
2.5m	4	7.02	43.86
2m	14	24.56	68.42
5m	1	1.75	70.18
7m	1	1.75	71.93
Free Planting	8	14.04	85.96
Regular	8	14.04	100
Total	57	100	
Mode of harvesting			
Use Of Family	8	14.55	14.55
Use Of Family &Labour	5	9.09	23.64
Use Of Friends	2	3.64	27.27
Use Of Labour	22	40	67.27
Use Of Labour& Family	16	29.09	96.36

Use Of Labour& Friend	1	1.82	98.18
Use Of Labour& Friends	1	1.82	100
Total	55	100	
Method of weeding			
Chemical	8	14.55	14.55
Manual	25	45.45	60
Manual And Chemical	22	40	100
Total	55	100	
Herbicide use			
No	17	29.82	29.82
Yes	40	70.18	100
Total	57	100	
Firefox And Force-Up	1	2.7	2.7
Force Up	1	2.7	5.41
Force-Up	6	16.22	21.62
Forceup Glyphosphate	1	2.7	24.32
Glyphoshate	7	18.92	43.24
Glyphosphate	13	35.14	78.38
Paraforce	7	18.92	97.3
Sulphate	1	2.7	100
Total	37	100	
Dosage used			
1 Cup	1	4.35	4.35
1cup	21	91.3	95.65
4liter	1	4.35	100
Total	23	100	
Do you use pesticide			
No	19	40.43	40.43
Yes	28	59.57	100
Total	47	100	
Frequency of application /yr			
2times	30	100	100
Total	30	100	
Is the pesticide effective			
No	2	6.67	6.67
Yes	28	93.33	`100
Total	30	100	
Do you apply fertilizer			
No	46	93.88	93.88
Yes	3	6.12	100
Total	49	100	

Source: Field survey, 2020

Data on major constraints faced by the cashew farmers were collected and result analysis shows that : inadequate information on cashew production, high taxes and unfavorable government policy towards cashew, climate change, inability to access government assistance on production are rarely of importance to farmers as this are major constrains which they face in their cashew production. While; inability to access government assistance on production and marketing, high risk and uncertainty in agriculture, poor access road to farmers plots and poor credit facilities are constrains considered to be highly important to the farmers and therefore needs urgent intervention. Data on the awareness of basic information on cashew production were collected and analyzed. results shows that majority of the cashew farmers (91%) are not aware of proper use and types of agrochemicals used in cashew production, proper cashew plot sanitation, various cashew varieties research advancement on cashew, the various marketing channels, processing problems as well as cashew stakeholder value chain. this indicates that the farmers are not well informed on basic rudiments of cashew production hence the possibility of not attaining maximum yield in cashew. Further analysis on the perceived solution on cashew production from the farmers side shows that: information on improved cashew production technology, better government policy towards farm practice, information on how to mitigate against adverse climate change, training , setting up of marketing board to control price and quality as well as the provision of good infrastructure like good road to farmers plots , electricity to avoid youth migration and portable water are major desirable solutions proffered by the farmers.

Table 5: Distribution of farmers by Major Constrains, Awareness of Cashew Production & Proffered Solutions by the Farmers

Constraints of Inadequate Information on Cashew	Frequency	%	
Highly Important	12	21.82	21.82
Important	3	5.45	27.27
Less Important	21	38.18	65.45
Very Important	19	34.55	100
Total	55	100	
Unstable Government Policy on Farm Practice			
Highly Important	13	23.64	23.64
Important	5	9.09	32.73
Less Important	30	54.55	87.27
Very Important	7	12.73	100
Total	55	100	
Climate Change Affect Cashew Production			
Highly Important	34	56.67	56.67
Highly Important	9	15	71.67
Important	1	73.33	73.33
Less Important	10	16.67	90
Very Important	6	10	100
Total	60	100	
Inability To Access Government Assistance on Production			
Highly Important	1	1.72	1.72
Highly Important	28	48.28	50

Highly Important	8	13.79	63.79
Important	3	5.17	68.97
Less Important	7	12.07	100
Total	58	100	
Inability To Access Government Assistance in Marketing			
Highly Important	34	59.65	59.65
Highly Important	9	15.79	75.44
Important	2	3.51	78.95
Less Important	9	15.79	94.74
Very Important	3	5.26	100
Total	57	100	
High Risk & Uncertainty in Agriculture			
Highly Important	31	54.39	54.39
Highly Important	7	12.8	66.67
Important	8	14.04	80.7
Less Important	6	10.53	91.23
Very Important	5	8.77	100
Total	57	100	
Highly Important	57	65.52	65.52
Highly Important	7	12.07	77.59
Important	4	6.9	84.48
Less Important	7	12.07	96.55
Very Important	2	3.45	100
Total	58	100	
Poor Credit Facilities			
Highly Important	47	81.03	81.03
Important	4	6.9	87.93
Less Important	5	8.62	96.55
Very Important	2	3.45	100
Total	58	100	
Awareness On Use of Agrochemicals			
Aware	7	12.28	12.28
Not Aware	1	1.75	14.04
Not Aware	36	63.16	77.19
Rarely Aware	3	5.26	82.46
Very Much Aware	10	17.54	100
Total	57	100	
Awareness On Cashew Farm Sanitation Practice			
Aware	7	12.5	12.5
Not Aware	30	53.57	66.07
Rarely Aware	5	8.93	75
Very Much Aware	14	25	100

Total	56	100	
Varieties Of Cashew			
Aware	8	14.29	14.29
Not Aware	29	51.79	66.07
Rarely Aware	6	10.71	76.79
Very Much Aware	13	23.21	100
Total	56	100	
Planting Population			
Aware	5	9.26	9.26
Not Aware	30	55.56	64.81
Rarely Aware	12	22.22	87.04
Very Much Awar e	7	12.96	100
Total	54	100	
Research Advances in Cashew Production			
Aware	6	11.32	11.32
Not Aware	30	56.6	67.92
Rarely Aware	12	22.64	90.57
Very Much Aware	5	9.43	100
Total	53	100	
Marketing Chanels			
Aware	6	11.32	11.32
Not Aware	38	71.7	83.02
Rarely Aware	4	7.55	90.57
Very Much Aware	5	9.43	100
Total	53	100	
Processing Problem			
Aware	7	13.46	13.46
Not Aware	36	69.23	82.69
Rarely Aware	5	9.62	92.31
Very Much Aware	4	7.69	100
Total	52	100	

Conclusion and Recommendation

The survey showed that most cashew farmers in Oyo State are male and of an average age of 56years with cashew farming experience of 16 years. They are primarily farmers who are fairly educated and almost all belonging to cashew farmers association. Majority acquired their cashew farms through inheritance.

Most of the farmers planted small and medium cashew seeds at stake. They rarely keep nurseries. They planted other crops for livelihood sustainability. Quite a number of them use herbicide as well as pesticides/insecticides for insect however, some use indigenous methods for affected trees.

The farmers carry out some form of rehabilitation or the other on their cashew farm such as coppicing, replanting and pruning. They mostly made use of family and hired labour for their cashew farm operations especially harvesting. Most of them do not keep farm records. They all experience one form of cashew production changes due to climate change which are mostly adverse to cashew production.

Majority of the farmers considered constraints on inadequate information, unstable government policies, changes in climate, access to government assistance, access to government assistance in marketing and other constraints considered for the survey were found to be highly important constraints for the cashew farmers.

The cashew farmers are mostly not aware of some of the important variables considered to enhance cashew production such as: cashew farm sanitation practices, research advance in cashew production, the various marketing channels, and processing problems among others. These are germane in the enhancement of cashew production in Nigeria.

Recommendations

In view of the survey carried out and the result of analysis from the work, it is recommended that:

1. The farmers in Oyo State be properly trained in the area of good practices for cashew production this includes planting distances and population, weeding, pruning, chemical application and dosage, processing of cashew nuts and cashew juice among others.
2. Educate the farmers on proper record keeping and create awareness on the important variable that enhances cashew production.
3. Stakeholders be sensitized (policymakers, research institute and the cashew farmers etc) on way forward for cashew production and improvements along the value chain.

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Experimental Title: Cocoa Data Bank in Ogun State, Nigeria

Investigators: Oduwole, O.O., Oluyole, K.A., Akinpelu, A.O., and Orisasona, T.M.

Introduction

Nigeria is the World's fourth largest cocoa producer after Ivory Coast, Ghana and Indonesia, producing about 12 percent of the total world production. In Africa, Nigeria is the third producer (World Cocoa Foundation, 2014). Cote d'voire which was placed at a distant third position in Africa with 143,000 tonnes behind Nigeria's 196,000 tonnes in 1970 is now the largest producer of cocoa in the whole world with 12, 824, 717 tonnes while Nigeria with 298,029 tonnes is currently the fourth largest producer (FAO, 2019; ICCO, 2015). Nwachukwu *et al*. (2012) stated that cocoa is the most prominent export crop in Nigeria in terms of production and export capabilities. According to Adebile and Amusan (2011) cocoa contributes about 15 percent to the total Nigerian export in 1970 and also contributes $900 million to Nigeria's economy in 2012 (*The Sun*, 2013). Nigeria's cocoa production in 2011/12 was put at 300,000 MT, up from 280,000 MT in 2011. The increase is based on a favourable weather condition in addition to considerably higher grower prices, which encouraged farmers to increase their farm holdings (David and Nzeka, 2011). Cocoa and its products exported from Nigeria include cocoa beans (whole or broken, raw or roasted), chocolate and other food preparations containing cocoa, cocoa paste (whether or not defatted) cocoa powder and cake and cocoa butter (World Cocoa Foundation, 2014). United States of America, Spain, France, Germany, and Netherlands are the main importers of Nigerian cocoa. It was reported that Nigerian cocoa output declined from 399, 200 tonnes in 2010 to about 298, 029 tonnes in 2016 with a growth rate declining from 16.2% to about 12.2% during the period (FAO, 2019).

Objectives

The specific objectives of the study were to:

I. profile the socio-economic characteristics of the farmers in the study area
ii. identify cropping patterns and agronomic practices among the farmers
iii. identify marketing channels in the study area
iv. identify constraints in cocoa production in the study area

Methodology
The study was carried out in Ogun State, Nigeria in 2019. The study employed a multistage random sampling technique to select cocoa farmers. The first stage was a purposive selection of the state. This is because of the volume of cocoa production recorded in the state. The second stage was a purposive selection of Ijebu North Local Government Areas (LGA). The third stage was a random selection of forty-four (44) cocoa farmers within the selected LGA. Primary and secondary data were used for the study. Well-structured questionnaire was used for the primary data. Data were collected on age of the farmers, marital status of farmers, household size, farming experience, educational level, and membership of farmers' association. Data was analyzed using simple descriptive statistics (means, frequencies, percentages).

Results and Discussion
Socioeconomic characteristics of the respondents (cocoa farmers)
Table 1 shows the socio-economic characteristics of cocoa farmers in Ijebu North Local Government Area (LGA) of Ogun State. The table reveals that a little above half (56.82%) of the farmers were male. The implication of this is that cocoa farming in the study area is largely dominated by male gender. Girei *et al* (2013) reported that in Africa, men are more in a crop that is perceived to have commercial value. In addition, the result conforms to the findings by Taiwo *et al* (2015) who reported that about 68.7% of farmers that practiced cocoa rehabilitation techniques (CRTs) in Southwest and South-South agro-ecological zones of Nigeria are male. In addition, the table reveals that majority (90.90%) of the farmers were married. Moreover, the mean age of the farmers is 49 years with a Standard Deviation (SD) of ± 9.71. The implication of this is that cocoa farmers in the LGA are still in their productive years and thus cocoa production in the study area is expected to be on the increase. However, this is not in consonance with the findings by Adeogun *et al* (2010) and Adebiyi and Okunlola (2013) who reported that cocoa farmers in selected states of Nigeria were old and that most of the cocoa farmers in Oyo State have passed there productive age. Similarly, the table reveals that 45.00 percent of the farmers had access to secondary education. The implication of this is that the farmers may perhaps not have access to information on good agricultural practices (GAP) with respect to cocoa production. However, the result showed that majority of the respondents can read and write. Furthermore, the table reveals an average household size of 6 persons with ± 2.6 as SD. This implies that the farmers may perhaps utilize members of the household as labour for some operations relating to cocoa production and probably rehabilitation of farms. This may reduce some production costs expected to be incurred on the crop. Furthermore, the table shows that about 59.1% of the cocoa farmers had between 1-5 hectares of cocoa farms. This implies that cocoa production in the study area is still in the hands of smallholder farmers who probably may not have access to farm inputs to enhance their production activities.

Table 2 below shows the cropping patterns, varieties of cocoa grown and sources of planting materials by the farmers. The table reveals that majority of the farmers (81.80%) were involved in sole cocoa cultivation; about 54.50 percent practiced cocoa/tree crops while 29.60 percent of the farmers cultivated cocoa/arable combination. The implication of this is that sole cocoa cultivation is the most predominant cropping pattern in the study area. However, the result of cocoa/arable combination implies that the farmers maximized the use of available land that was not shaded to cultivate short duration crops. This conforms to a priori expectation. In addition, majority of the farmers (86.40%) planted F3 Amazon variety of cocoa while 11.40 percent, 6.80 percent planted Amelonado and Hybrid (CRIN) varieties, respectively. This implies that distribution of CRIN varieties of cocoa has not spread enough to the farmers, hence the cultivation of the old and low yielding varieties. Furthermore, it was revealed that 36.40 percent, 6.80 percent, and 2.30 percent of the farmers got their planting materials from friends, CRIN and Ministry of Agriculture, respectively. This implies that the old habit of getting planting materials from neighbours by cocoa farmers is still in existence. This may perhaps lead to recycling of pests and diseases on the farms.

Moreover, the table revealed that majority of the farmers (93.20%) carried out clearing operation on the farms while planting, weeding, and spraying were carried out by 86.40 percent, 90.90 percent, and 77.30 percent, respectively. Similarly, prunning and harvesting were both carried out by 79.50 percent of the farmers. The implication of these results is that the farmers are knowledgeable in all these agronomic practices in cocoa farming.

Table 3 below shows distribution according to the marketing channels among the farmers. The result shows that 75.00 percent of the farmers chose local buying agents as channels through which their product gets into the market while about 9.10 percent sell to exporters. The implication of this is that majority of the farmers are smallholders who see the local buying agents as a faster means of getting cash from the sale of their produce. In addition, it was revealed that about 47.73 percent of the farmers produced between 500-1000kg of cocoa from their farms while 22.72 percent produced above 1000kg. This justifies that the farmers farm on small hectarage of land. Furthermore, majority of the farmers sold their cocoa beans between 500-1000 naira/kg. The implication of this is that almost all the farmers had information on the prevailing market prices for their produce. However, the remaining farmers in the study area may perhaps be those in need of quick cash and thus sell at any amount without recourse to the quality of the cocoa beans. Moreover, about 56.80 percent of the farmers agreed they pay taxes to the government while taxes paid by majority (84.10) of the farmers are less than 500 naira per annum.

Table 4 below reveals the distribution of the farmers according to common insect pests and diseases on cocoa farms in the study area. The result shows that termite was seen as most common insect pest by about 45.50 percent of the farmers while 2 percent of the farmers saw locust as common pest and about 15.90 percent of the farmers showed indifference on the insect pests. This implies that the insects have not reached economic injury levels or perhaps they are still at the levels that the farmers can easily control or manage. Similarly, black pod disease and fungi were seen as the most common diseases by about 59.10 percent and 6.80 percent of the farmers respectively while 34.10 percent of the respondent's showed indifference to the diseases. This implies that blacpod disease remains a disease of cocoa in the humid region of Nigeria.

Table 5 below shows the distribution of farmers according to constraints and intention to increase cocoa production. It was revealed that about 65.90 percent of the farmers identified non-availability of improved varieties of cocoa as a constraint. Similarly, credit accessibility and high cost of agrochemicals were seen as constraints to cocoa production by 93.20 percent and 90.09 percent, respectively. However, contrary to a priori expectations, almost all the farmers (90.09%) had intentions to increase their production despite the identified constraints.

Conclusion and Recommendations

The study was carried out to have a data bank of the operations of cocoa farmers in the study area. The study showed that majority of the farmers is still producing at a small scale. Farmers should be encouraged to increase their farm holdings through the provision of enabling policies such as liberalization of cocoa markets, accessibility of improved varieties of cocoa and the removal or mitigation of identified constraints to cocoa production in the study area. However, there is need for adequate and up to date information on the need for the farmers to put these insects' population at minimal levels.

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Table 1: Socio economic characteristics of Cocoa Farmers in Ijebu North Local Government Area, Ogun State

Variables	Frequency	Percentage (%)	Mean	Std. Deviation
Gender				
Male	25	56.82		
Female	19	43.20		
Age (Years)				
31-40	13	29.55		
41-50	13	29.55		
40-49	29	33.34		
Above 50	18	40.90	49	9.71
Marital Status				
Married	40	90.90		
Single	2	4.55		
Widowed	2	4.55		
Educational Level				
No Formal Education	6	15.00		
Primary	16	36.00		
Secondary	20	45.00		
Tertiary	2	4.55	2.4	0.81
Membership of Farmers'Group				
Yes	43	97.70		
No	1	2.30		
Household Size				
1-5	13	29.60		
6-10	28	63.60		
Above 10	3	6.80	6.0	2.6
Farm Size (Hectares)				
< 1	7	15.90		
1-5	26	59.10		
6-10	8	18.20		
Above 10	3	6.80	6.1	6.3

Source: Field Survey, 2019 Std. Dev: Standard Deviation

Table 2: Cropping patterns and agronomic practices among the respondent farmers

Variable	Frequency	Percentage
Sole Cocoa		
Yes	36	81.80
No	8	18.20
Cocoa-Arable		
Yes	13	29.60
No	31	70.40
Cocoa/Tree Crops		
Yes	24	54.50
No	20	45.50
Amelonado		
Yes	3	6.80
No	41	93.20
F3 Amazon		
Yes	38	86.40
No	6	13.60
Hybrid (CRIN Varieties)		
Yes	5	11.40

No	39	88.60
Source of Planting Material		
Self/Own Farm	9	20.50
Inherited	11	25.00
Friends	16	36.40
CRIN	3	6.80
Agrodealers	2	4.50
Ministry of Agriculture	1	2.30
Clearing		
Yes	41	93.20
No	3	6.80
Planting		
Yes	38	86.40
No	6	13.60
Weeding		
Yes	40	90.90
No	4	9.10
Spraying		
Yes	34	77.30
No	10	22.70
Prunning		
Yes	35	79.50
No	9	20.50
Harvesting		
Yes	35	79.50
No	9	20.50

Source: Field Survey, 2019

Table 3: Distribution according to the Marketing Channels among the farmers

Variable	Frequency	Percentage
Quantity Produced (Kg)		
<500	13	29.55
500-1000	21	47.73
Above1000	10	22.72
Price of Cocoa beans (₦ /Kg)		
<500	1	2.30
500-1000	43	97.70
Marketing and Sales		
Local buying agents	33	75.00
Licensed buying agents	7	15.90
Exporters	4	9.10
Tax/Levy		
Yes	25	56.80
No	19	43.20
Amount of Tax (₦/Yr)		
<500	37	84.10
500-1000	3	6.80
Above 1000	4	9.10

Source: Field Survey, 2019

Table 4: Common insect pests and diseases on cocoa farms

Insects	Frequency	Percentage
Termite	20	45.50
Black Ant	12	27.30
Mirid	3	6.80
Locust	2	4.60
Indifference	7	15.90
Diseases		
Blackpod Disease	26	59.10
Fungi Disease	3	6.80
Indifference	15	34.10

Source: Field Survey, 2019

Table 5: Distribution according to constraints and intention to increase cocoa production

Variable	Frequency	Percentage
Improved Cocoa Varieties		
Yes	29	65.90
No	15	34.10
Land Availability		
Yes	17	38.60
No	27	61.40
Credit Accessibility		
Yes	41	93.20
No	3	6.80
High Cost of Agrochemicals		
Yes	40	90.90
No	4	9.10
Inadequate Marketing Channels		
Yes	14	31.80
No	30	68.20
Storage Facilities		
Yes	19	43.20
No	25	56.80
Fire Incidents		
Yes	8	18.20
No	36	81.80
Intention to increase production		
Yes	40	90.90
No	4	9.10

Source: Field Survey, 2019

Economics Section Achievements

1. The section carried out data collection on cocoa. The main objective was to have a data bank for the Institute's mandate crops. While data were collected for cocoa in Ogun and Oyo States, data were collected for cashew in Enugu State. These are as shown in the pictures below.

2. The section was also involved in Market Survey and Data collection on Kolanut and Cashew Marketing in both Ogun and Oyo States, respectively. The broad objective of these studies was to assess the market participation among different actors in the value chains of these crops.

Scientist from Economics Section during data collections

3. The section was involved in training cocoa farmers in Ondo State on Record Keeping and Resource Use. The objective of the study was to enlighten the farmers on the importance of record keeping in cocoa production and efficient use of farm resources with a view to improve the livelihood of the farmers.
4. The section was also involved in CRIN Igioro live phone-in Radio programme in Radio Nigeria Premier FM 93.5 Ibadan. Presentations were made on the importance of Farm Record Keeping on CRIN Mandate crops and Impact of Low Pricing on Cocoa, Cashew and Coffee, respectively.

Dr (Mrs) Lawal at the studio of Premier FM 93.5, Ibadan presenting the program

Statistics Section Achievements

The section was involved in the construction and installation of new meteorological station at the headquarters. The main objective of this was to make available reliable weather data to scientists interested members of the public in order to provide guidance on production of our mandate crops. The equipment was given by the Nigerian Meteorological Agency (NIMET), Abuja.

Extension Section Achievements

1. Continuation of CRIN Igioro live phone-in Radio programme in Radio Nigeria premier FM 93.5 Ibadan. Scientists across all disciplines in CRIN were involved in educating farmers, processors, marketers, consumers, and the general public on CRIN mandates crops and technologies. It was a medium to promote the image of CRIN.

   See pictures of presentations:

CRIN Executive Director Dr P.O. Adebola kick starting the Programme

Other prersenters at Premier FM Ibadan

2. Establishment of CRIN model demonstration farm for planting of cocoa hybrids (TC1-TC8) and improved seedlings of cashew, coffee, and kola. The size of the plot is 2 acres and is located close to Engineering section, zone one. The plants are doing well and is currently maintained by Extension. This plot serves as model demonstration farm for farmers, visitors on excursion, Industrial Training students (IT), Youth corps members, and other stakeholders. It is a good plot to facilitate adoption of our mandate crops.

   Pictures of activities:

Cross section of new CRIN model demonstration farm

3. Stocking of poultry pen with 200 birds in the Institute adopted village at Aba-Agbo Community Oyo State and adopted school at Mamu Community Comprehensive High School, Mamu Ogun State. The adopted village and School's concept are outreach centers for the transfer of CRIN technologies to farmers, 15km outside the Institute for awareness creation and adoption on-farm. Cocoa pod husk (CPH) was used to replace 20% maize in layers' mash. The birds layed eggs and performed well which implies that there was reduction in the production cost of feed with CPH fortified feed compared with birds fed with conventional feed. The essence of adopting a school is to encourage students in Agriculture (Catch them young) especially with respect to our mandate crops. This approach has been very helpful to the host communities. Extension established a cooperative society for farmers in Aba-Agbo community. The organization is known as Agbeloba Multi-Purpose Cooperative Society and the society operates a revolving loan scheme among themselves which is still sustainable till now. The project is a source of income and promote cooperation among beneficiaries. This project is very much in place and sustainable.

Pictures of the poultry activities:

Poultry at Mamu and Aba-Agbo with birds

Poultry birds at Mamu and Aba-Agbo

4. Extension staff attended to One thousand and Twelve (1012) visitors (students from secondary and tertiary institutions) on excursion to CRIN. They were exposed to the institute developed technologies to promote uptake and encourage commercialization.

5. CRIN partnership and collaboration with foreign investor: Extension facilitated the partnership with foreign investor to develop a supply chain for global demand for Nigerian produced kolanuts. This partnership helped in sourcing healthy and chemical free kolanuts and processed into kola energy powder by AACE Food Processing factory in Sango Otta, Ogun State, 2020

ED and other staff with the processed product ***Kolanut Energy drink***

6. Attendance and presentation of paper in the 38th Horticultural Science Society of Nigeria (Hortson) conference at University of Nigeria, Nsukka, Enugu State by some scientists from Extension. The title is Assessment of farmers' awareness and practices of coffee wet processing method in Kogi State from 25-31 October 2020 presented by Awodumila, D.A.

7. Publication of research papers in reputable scientific international journals showcasing CRIN research outputs in the year under review. These are:

Authors	Title	Year
1. Agbongiarhuoyi Anthony Eghe and Fawole Ogbaraeno Pippy	Determinants of Compliance with Standard Practices of Pesticides use Among Cocoa Farmers in Southwestern Nigeria. *Pelita Perkebunan, Coffee and Cocoa Research Journal,* 36(3) 2020:290-300.	2020*
2. Agbongiarhuoyi A. E., Uwagboe E. O., Agbeniyi S. O., Famuyiwa B. S., Shittu T. R.	Analysis of Farmers' Cashew Nuts Marketing Channels and Information Frequency: Implications for Cashew Sustainability in Nigeria. *World Rural Observations* 2020:12(3):23-30.	2020*
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Experimental Title: Knowledge Acquisition through by-product utilization among cocoa farmers in Aba Agbo: A CRIN Adopted village

Investigators: Adebiyi, S., Uwagboe, E.O., Agbongiarhuoyi, A.E., Famuyiwa, B.S., Abdul-Karim., I.F., Williams, O.A., Agbebaku, E.E.O., Orimogunje, O. A, Awodumila, D.J. and Oduwole, O.O.

Introduction

The inclusion of cocoa pod husk in both broiler and layers feeds which is one the technologies developed in the institute is a paradigm shift in turning waste to wealth in the present age of agricultural development. According to Olubamiwa and Hamzat (2001), the inclusion of cocoa phusk in layer mash will reduce quantity of maize from 60% to 40%. Invariably, 20% saved will be used will reduce cost of feed production and by so doing, the waste by-product has been converted to useful product. Abagbo is one of the Agricultural Research Outreach Centre (AROC) formed by CRIN in Collaboration with Agricultural Research Council of Nigeria (ARCN) in 2010 with the aim of transferring technologies developed by CRIN to farmers in rural areas. As part of the method to solve problem of fund for their farming activities, the community was formed into various groups this was latter metamorphosed to a formidable cooperative society operated under the Oyo State Ministry of Commerce, Trade, and Investment. In 2013, fund was released by West Africa Agricultural Productivity Programme (WAAPP) to build a small pen, but the fund released was not enough to stock it. The non-stocking of the pen has reduced the interest of cocoa farmers who have interest CRIN technology. In 2019, the pen was stocked with layers (80 point of lay) which serves as morale booster for farmers who have already lost hope in the project.

Objectives of the study

1. Encourage the utilization of cocoa pod husk (CPH) in poultry production by farmers.
2. Serve as capacity building for farmers.
3. Serve as income generation potential for farmers' cooperative society.

Methodology

The existing poultry pen was renovated and stocked with 80 layers purchased at point-of-lay in 2019. Automated drinker was installed, and this was used to replace manure drinkers which are more laborious in poultry management. Routine and occasional management such as feeding and general sanitation of the pen were carried out by an attendant as agreed by the farmers. Top feed layer mash was used to feed the bird in the first three months to acclimatize them with the environment after which feed formulated with cocoa pod husk was used to feed them. Records of the available birds, eggs laid, and percentage egg production was calculated in order to know the performances of the birds on a daily basis.

Results and Discussion

Results in the table 1 below showed the number of birds, expected number of egg in line with the birds available, eggs laid and percentage egg laid on a monthly basis. The table revealed that the percentage eggs laid between January and September is greater than 50% which is an indication that it was still economical to keep the birds. The table also revealed that there was a sharp reduction below 50% in the egg production between the month of September and December 2020, which is an indication that owing to the reduction in the number of birds and their age, it is no longer productive to keep the birds.

Table 1: Egg lay according to number of birds.

Month	Number of birds	Expected egg laid	Egg Laid	% Egg laid
January	80	2400	1450	60.4
February	80	2400	1465	61.0
March	78	2340	1480	63.2
April	76	2280	1300	57.0
May	73	2190	1260	57.5
June	73	2190	1220	55.7
July	69	2070	1195	57.7
August	68	2040	1125	55.1
September	67	2010	1102	54.8
October	66	1980	976	49.3
November	58	1740	835	48.0
December	52	1560	712	45.6

Conclusion

Poultry production is an opportunity for the farmers to get additional income. The technology improved their socio-economic standard of participants. The approach was participatory; thus knowledge gain from the activities was sufficient for the farmers to manage their own poultry farms.

Activities in pictures

Fig.1: Situation of the pen before Fig.2: CRIN staff and cocoa farmers displaying eggs laid by birds renovation and stocking

Experimental Title: CRIN *Igioro* Live Phone-in Radio Programme with Radio Nigeria Premier FM 93.5 Ibadan

Investigators: Agbongiarhuoyi, A.E., Uwagboe, E.O., Adebiyi, S., Famuyiwa, B.S., Abdul-Karim, I.F., Williams, O.A., Agbebaku, E.E.O., Orimogunje A. and Oduwole, O.O.

Introduction

The 4th edition of CRIN *Igioro* Live Phone-in Radio Programme with Radio Nigeria Premier FM 93.5 Ibadan continued in 2020. The achievements made in research and development efforts of CRIN mandate crops: Cocoa, Kola, Coffee, Cashew and Tea are extended to the public through Radio, Television, Newspaper, exhibition, training, internet, and other methodologies. Agricultural Radio programme has popularized CRIN technologies to larger number of farmers and other stakeholders along the value chains. The Extension Section of the Institute has adopted the use of Radio programme to reach out to our clientele with feedback to solve their problems and update knowledge where necessary.

The concept of Radio programme in CRIN started in 2017 with Amuludun FM titled *Agbe Onigioro*. In 2018, the first edition of ***Igioro*** (Tree of Wealth) programme took place in Radio Nigeria Premier FM 93.5, Ibadan. It was a 30 minutes' live phone-in weekly programme every Wednesday. It was 13-week programme and was aired from 6:30 to 7:00 pm farmers' time. The programme was communicated mostly in Yoruba with few cases of English Language. This was due to majority of the target audience been Yoruba farmers in rural farming communities in the Southwest.

The 2020 edition was flagged off by the current Executive Director/Chief Executive Officer, Dr. Patrick Olu Adebola CRIN on the Wednesday 25th November 2020 at 6:30-7:00pm in Premier FM studio Dugbe, Ibadan. Historically in 1933, Radio broadcast started in Nigeria with the introduction of the Radio Distribution in Lagos by the British colonial government. The Ibadan station was commissioned in 1939, followed by the Kano station in 1944. The Federal Radio Corporation of Nigeria (FRCN) which is currently operational was established in 1978 (Familusi and Owoeye 2014). Radio has many advantages which include low cost, easy access and the fact that it can easily speak to marginalized cultural groups in their own language. Radio ranked as the most popular means of disseminating information to a larger audience. It is very appealing because of some distinguishing features of interactivity, its capacity to provoke dialogue and to solicit the participation of local population with extreme versatility.

Over the years, CRIN made tremendous achievements and contributes significantly towards the Nigeria economy. These are in the areas of Technological advancement, value addition, training and capacity building of farmers, screening of pesticides recommended to farmers and publications. Some of the developed technologies are CRIN TC1-TC8 cocoa hybrids planting materials, cocoa bread, wines, Choco gari, cashew kernel, soap and cream. These research information needs to be communicated to the public to enhance adoption, productivity, income, food security and job creation.

Objectives

The objectives of the project were to:

i Create more awareness and disseminate CRIN developed technologies to farmers and other stakeholders.

ii Educate the public on the various aspects of Good Agricultural Practices (GAP) with respect to cocoa, kola, coffee, cashew, and tea crops.

Methodology

The programme was conducted in Radio Nigeria Premier FM 93.5 Ibadan Oyo State. Premier FM was chosen due to its wide coverage reaching out to farmers and other stakeholders in the Southwest. These include Oyo, Osun, Ogun, Ondo, Ekiti and Lagos States. The programme was designed to hold every Wednesday, which lasted 13 weeks. It is renewable after the duration for another edition. A 13-week work plan was designed by Subject Matter Specialist (SMS) from different disciplines. Each SMS goes with extension facilitator on a weekly basis to the Radio Studio and talk on specific subject for 30 minutes.

It was a live phone-in discussion programme involving outside listeners from 6:30 to 7:00 pm. The programme was communicated mostly in Yoruba with few cases of English Language. During every episode, listeners call the CRIN SMS live in the studio for questions and comments.

The target audiences were farmers and other stakeholders along the value chains of cocoa, kola, coffee, cashew, and tea crop farmers. The Igioro programme was anchored by Mrs Olaitan Adeitan and presented by Mrs Afolasade Osigwe. From the work plan, the following subject areas were outline and used during the programme. These include Cocoa and cashew value chains as source of livelihood to farmers and other stakeholders in Nigeria, improving productivity among farmers of CRIN mandate crops and nursery management, Others were diseases and insects' pest management, value addition and utilization.

Result and Discussion

In the first week, the Executive director (ED) was the special guest. He made a presentation on cocoa and cashew value chains as source of livelihood to farmers and other stakeholders in Nigeria. The highlights of his presentation were: CRIN cocoa hybrid planting materials, CRIN developed products, training, screening and recommendation of pesticides for cocoa production.

CRIN Executive Director Dr P.O. Adebola kick starting the Programme

The presenter and Dr S. Adebiyi at the Studio

Feedback: A total of four farmers called during the programme on how to access the hybrid materials and uptake CRIN developed technologies. They were encouraged to visit CRIN and request for them and they will be given. The ED advised farmers to get their planting materials from CRIN to ensure maximum yield.

The next presenter in the second week was Dr Adebiyi, S. His presentation was on improving productivity among farmers of CRIN mandate crops: Intervention through extension methods. The highlights were planning, farmers' need and outcome, group association, farming system approach and skills' acquisition. At the end of the presentation, three persons called, and we lost two calls due to network issues. They complained that even with their cooperative societies, they cannot access loans from bank and government. They said farm inputs are becoming expensive and they needed support. The presenter advised them to source money from their personal savings of the group as alternative means.

Suspension of the Radio programme: The *Igioro* Radio programme was however suspended due to the on-going strike by Research Institutes in Nigeria. We hope to continue it when the Subject Matter Specialists will be available.

TRAINING DEPARTMENT (Dr. S. O. Agbeniyi, Director Training)

CRIN/FMARD Training Workshop – Skills Acquisition by Cocoa Farmers

Cocoa Research Institute of Nigeria (CRIN) in collaboration with the Federal Ministry of Agriculture (FMARD) organised a training workshop for cocoa farmers in the south-west region of Nigeria themed: *Skills Acquisition by Cocoa Farmers* on 9^{th} and 10^{th} December 2020.

The training workshop was held at the Event Centre of the Cocoa Research Institute of Nigeria, Idi-Ayunre, Ibadan. It was well attended by cocoa farmers in the southwest region of Nigeria.

The Executive Director of the Institute, Dr P.O. Adebola, ably represented by Director (FSR) Dr A.O. Famaye and the Director (Training)/Workshop Coordinator, in person of Dr S.O. Agbeniyi welcomed the Permanent Secretary (FMARD), Director (FDA) and all the participants to the training workshop.

Many erudite scientists of the Institute took cocoa farmers in different sessions at the workshop, amongst which are Dr A.O. Famaye, Dr M.O. Ogunlade, Dr (Mrs) A.A. Muyiwa and Dr (Mrs) C.O. Jayeola. The following sessions were taken extensively; Cocoa Nursery Management, Integrated Soil Fertility Management, Field Establishment and Demonstration and Harvesting Fermentation and Processing.

There was field visit to the Nursery session of the Institute where participants were shown how grafting, propagation and so on were being carried out.

The feedback from the participants showed that the training workshop was well appreciated, and they prayed that such training could be done more frequently to keep farmers abreast of latest development of handling cocoa.

A tour of the nursery unit

Cocoa seedlings at the Nursery unit

CRIN/FMARD Training Workshop for Cocoa Farmers on Knowledge Transfer on Grafting

Cocoa Research Institute of Nigeria (CRIN) in collaboration with the Federal Ministry of Agriculture (FMARD organised a training workshop for cocoa farmers in the south-west region of Nigeria 25th – 26th March 2021. The training workshop was on Knowledge Transfer on Grafting for Cocoa Farmers.

The Executive Director, Dr P. O. Adebola, welcomed the Director (FDA), Dr Tobaba Ajayi, and cocoa farmers to the training workshop.

Dr (Mrs) Anna Muyiwa spoke on Cocoa Nursery establishment where she emphasized that any individual farmer who plans to establish a nursery for production of cocoa planting materials must think about the certified varieties. They must also think about the commercial viability of their business. Climate and weather condition in nursery location must be suitable for the variety planned. Water is important and poor water supply affects quality of planting materials. The nursery operator must understand the market requirements for cocoa planting materials.

She also told cocoa farmers about the Cocoa Nursery layout should have adequate structures including fencing to keep out domestic and other animals, provision should be made for the hardening area, propagation area, should be organised to make daily operations easy, and enable easy movement of plants.

Cocoa farmers were also taken to the Nursery Unit of CRIN where they were shown practical and the nitty gritty of grafting by Dr (Mrs) Muyiwa, assisted by Mrs E. A. Babalola of the Nursery Unit.

Cross section of cocoa farmers at the nursery

Dr (Mrs) A. Muyiwa with the nursery staff

The nitty gritty of cocoa grafting at the nursery section

Mrs Babalola listed the process of budding and grafting as follows:

Steps in budding and grafting

Budding process

- Collection of budwood
- Preservation of collected budwood (serviette paper, was, ice block)
- Disinfection of budwood and other budding materials with fungicide (e.g. Ultimax plus)
- Selection of Healthy rootstocks
- Detachment of a bud from the budwood
- Making a patch below the cotyledon level of the root stock
- Insertion of the bud (scion) into the patch made on the rootstock
- Tying up the union point with budding tape
- Careful arrangement of the budded materials into vegetative propagation shed
- Removal of the budding tape after 14 days

NOTE: Do not pour water directly to the point of budding rather, watering should be done with the use of kettle.

Grafting process

- Collection of Scion (Budwood)
- Preservation of Scion (Serviette paper, wax, ice block)
- Disinfection of scion and other grafting materials with fungicide
- Selection of healthy rootstock
- Cutting of scion to contain about 2 or more budeyes
- Careful slicing of the Scion at opposite end
- Horizontal dissection of the root stock
- Insertion of the Scion into the dissected rootstock leaving 3 -4 leaves below
- Tying up of the union point for firmness
- Cover the inserted scion with grafting cap
- Carefully arrange the grafted materials into vegetative propagation shed
- Untie the cap at 21 days

Note: If sprouting occurs before 21 says, the cap should be removed.

Materials needed for budding and grafting

- Secateur
- Budding knife
- Paraffing waz
- Grafting cap
- Fungicide
- Buddwood rack
- Budding tape
- Serviette paper
- Label
- Recording book

FMARD Cocoa Desk Officer, Rep. of Minister of Agric., ED CRIN & Director (Training) at the High Table

A cross section of participants with the Executive Director CRIN at the Events Centre, CRIN

FMARD Cocoa Desk Officer and his team with Director (Training) CRIN at the Nursery Section

Dr S.B. Orisajo

Dr S. B. Orisajo spoke on Responsible use of Pesticide in Cocoa where he explained that

1. Prevention......better than cure! Keeping the pest populations below action threshold, create unfavorable conditions for pest development and inoculums production
2. Protection....action-oriented measures; targeting a particular pest population with a bid to manage them and are never intended to 'stand - alone', but are rather integrated into "preparation and prevention" He gave farmers the list of pesticides currently approved for use on cocoa farms as shown below:

	Trade name	Formulation	Active Ingredient	Recommended dosage	Distribution Company in Nigeria	Target pest
1	Funguran OH	Wettable powder (WP)	Copper Hydroxide (50% or 500g/kg)	60g/15 Litres of Water	INSIS	Black pod
2	Champ DP	Wettable powder (WP)	Copper hydroxide (37.5% of 375g/kg)	50g/15 Litres of Water	SARO	Black pod
3	Ridomil Gold	Wettable powder (WP)	Copper (1) Oxide 600g/kg + Metalaxyl-M 60g/kg	50g/15 Litres of Water	SYNGENTA	Black pod
4	Copper Nordox 75 WP	Wettable powder (WP)	Copper Hydroxide (75% or 750g/Kg)	50g/15 Litres of Water	DIZZENGOFF	Black pod
5	Ultimax plus	Wettable powder (WP)	Metalaxyl 12% + Copper (1) Oxide 60%	50g/15 Litres of Water	HARVESTFIELD	Black pod
6	Kocide 2000	Wettable powder (WP)	Copper hydroxide (53.8% or 538g/kg)	50g/15 Litres of Water	VANCOL	Black pod
7	Red Force/Jorkemil Plus	Wettable powder (WP)	Copper-1-Oxide 60% + Metalaxyl 6%	50g/15 Litres of Water	JUBAILI/JORKEMIL	Black pod
8	Pergado	Granule (G)	Mandipropamid 125g + Mefenoxam 100g	30g/15 Litres of Water	SYNGENTA	Black pod

9	Carbrio Duo	Emulcifiable concentrate (EC)	Pyraclostrobin 40g/L + Dimethomorph 72g/L	50/65 mls in 10 Litres of Water	BASF	Black pod
INSECTICIDES						
10	Actara 25 WG	Wettable Granule (WG)	Thiamethoxam 98%	6g/10 Litres of Water	SYNGENTA	Mirid
11	Esiom 150 SL	Soluble liquid (SL)	Acetamiprid 100g/L + Cypermethrin 50g/L	8.33mls/10 Litres of water	INSIS	Mirid
12	Proteus 170 O Tec	Oil Technology (O-Teq)	Thiacloprid 150g/L + Deltamethrin 20g/L	27 mls/10 Litres of Water	SARO	Mirid
13	Confidor 200 O Tec	Oil Technology (O-Teq)	Imidacloprid 200g/L	36.4 mls/10 Litres of Water	HARVESTFIELD	Mirid
HERBICIDES						
14	Touch down	Soluble liquid (SL)	Glyphostate (36.8% or 368g/IW/V)	200 mls/15 Litres of water	SYNGENTA	Weed
15	Clear weed	Soluble liquid (SL)	Glyphostate (36% or 360g/IW/V)	200 mls/15 Litres of water	HARVESTFIELD	Weed
16	Round up	Soluble liquid (SL)	Glyphostate (49% or 490g/IW/V)	200 mls/15 Litres of water	CANDEL	Weed
FUMIGANTS						
17	Phostoxin	Tabletized (T) or Pelletized (P)	Aluminium phosphide 500g/kg	3-4 tablets/ton of well stacked cocoa bags	GONGONI	Storage pests

He concluded that pesticides should be used responsibly only if the preventive practices fail and there will be less concern about residue in soil and contamination of cocoa beans and there will be access to safe and quality cocoa for the production of chocolate.

The feedback from the participants showed that the training workshop was well appreciated, and they prayed that such training could be done more frequently to keep farmers abreast of latest development of handling cashew. They were all given certificate of attendance and participation.

CRIN/FMARD training workshop on proper handling of solar collapsible cocoa dryer for cocoa farmers.

The Cocoa Research Institute of Nigeria (CRIN) in collaboration with the Federal Ministry of Agriculture (FMARD) organized a training workshop for cocoa farmers in the south-west region of Nigeria 25th – 26th March 2021. The training workshop was on Proper Handling of Solar Collapsible Cocoa Dryer for Cocoa Farmers.

CRIN, Dr O. Adebola welcomed participants to the Training Workshop

Cocoa Desk officer, Abuja, Rep. of Minister of Agric., ED CRIN, D(T) (L-R) at the Events Centre --CRIN

Cross section of participants at the Events centre, CRIN

Dr (Mrs) Lawal talked on Certification and Traceability: the means to achieving Sustainable Cocoa Production in Nigeria

She said an enterprise is sustainable when it that has low negative impact and high positive economic viability, environment, and social equity on the people.

Sustainable production trains the farmers to grow cocoa responsibly, increase their yields, improve farmer's livelihood, and increase their income so that farmers can invest in their farms and communities.

She also said Certification is one of the available tools in the market to ensure the application of principles for sustainable production of commodities, like cocoa.

Which comprises a set of principles addressing social and economic concerns of farmers, farmer groups and communities including environmental requirements.

Dr Lawal went further to say the farmers need to comply with the determined requirements, and compliance is verified by independent auditors, through regular audits (frequency varying per scheme).

The key changes to adapt to certification happen at farm level, however responsibilities for and costs of certification are distributed through the value chain.

Certification schemes operate in similar ways and have as key objective to promote sustainable practices in the cocoa supply chain and improve the livelihoods of farmers.

She said sustainability could be achieved through Farmers in groups

Good Agricultural practices, Adoption of new hybrid planting materials

- responsible use of chemicals (pesticide/insecticides); appropriate use of fertilizer and crop protection
- avoidance of child labour in all shades
- Resource-use efficiency
- proper record keeping on farm activities
- Timely operations on the farms: gapping-up, ideal spacing, weeding, pruning, spraying

- Proper post-harvest handling of beans: stick breaking, box fermentation (5days), drying
- Proper storage of cocoa beans: good ventilation
- Regular trainings
- Ban on child labour on cocoa farm
- Improved agro-forestry/afforestation
- Increased productivity and access to markets
- Increased income and improved livelihood
- improve food security, access to clean water, education, women empowerment

She also explained traceability as a step beyond the certification process.

- The scope for traceability is from production up until retail level of certified product.
- Certification helps traceability and help farmers earn more.
- It helps to identify farmers producing the beans at all locations.
- help to collaborate on curbing deforestation, child labour and extreme poverty.
- Consumers' increase in concern about food safety and concerns of the processes in food supply chain triggered it.

She emphasized on child labour as the menace to certification and traceability

- Children younger than 15 are not employed in any form.
- Children younger than 18 do not conduct heavy or hazardous work, or any that could jeopardize their physical, mental, or moral well-being.
- No forced, bonded or trafficked labor is allowed in any shape or form if certification is a standard.
- On small scale/family run farms, children are allowed to help their families, but only if: the work does not interfere with schooling; it's not physically demanding or hazardous; an adult relative always accompanies the child.

Dr (Mrs) Jayeola spoke on Cocoa Harvesting, Fermentation and Processing. She talked extensively on Proper harvesting techniques, Damage to beans during opening of fruit, Proper fermentation and curing, Proper drying of beans (Moisture content) and Insect and animal infestation of stored beans

Dr (Mrs) Jayeola went further to highlight the technique of pre-harvesting and the tools needed as itemised: Healthy crops lead to good products. Environmental hygiene in harvesting areas and Harvesting tools must be ready and it includes:

- Sharp cutlass,
- A sharp knife with short handle
- A sharp knife attached to a long pole (go-to-hell)
- A clean basket
- Harvest time
- When its ripe
- Crop protection protocols
- Safe pesticide "window"

She also talked about pre-fermentation stage and said cocoa farmers should ensure the following important steps are taken into recognition; Allow the pods to rest for at least two days, ensure correct nib acidification, enhance pre- fermentation activity inside beans, facilitate rapid rise in temperature and impart stronger chocolate flavor. They should make sure that when they are breaking pods, ensure the use of club or wooden object, pods are broken without causing damaged to beans, only good beans are collected, diseased, germinated, and caked beans are discarded.

On pre-fermentation, she said they should ensure that after splitting, they remove wet beans from the pods, any defective or damaged beans are removed, fermentation to be done 12 to 24hrs after pod breaking, wet beans are fermented for 5 to 6 days (until strong odour develops) , beans should be turned every 48 hours which is responsible for chocolate flavour and external browning

On drying of cocoa beans, they should use sun to dry cocoa on a raised platform, slow but progressive loss of moisture, loss of a stringency and bitter taste, loosening of the shell from the beans, moisture content reduced to 6%.

She said during drying, the beans must be turned every 2 to 3 hours to ensure beans uniformly dried as well as preventing overheated beans

They should protect cocoa beans during drying from rain and dew. The cocoa beans should be heaped and covered at night or during rainy weather to avoid re-wetting.

She said when packaging, flat beans slaty beans, shrivelled beans, black beans, mouldy beans, small and/or fused beans, germinated beans, beans with insect damage should be removed before bagging and packaged in clean hydrocarbon-free jute bags securely sealed.

She also talked about labeling; bagged cocoa beans must be placed in storage sheds that are weatherproof, well aerated, cleaned, free from dampness and insect pests and away from smoke.

Only non-toxic ink or paint should be used for marking and should not be allowed to come in contact with the beans.

A Field visit to the drying and fermentation unit of CRIN was made where cocoa farmers were shown different types of drying methods and Engr. Mofolasayo displayed solar collapsible cocoa dryer for the farmers, showed the intricacy of using the machine.

Engr. Mofolasayo talking on solar collapsible cocoa dryer

ED, CRIN with Directors at the solar collapsible cocoa dryer stand

Cocoa Farmers at the solar collapsible dryer

Presentation of Certificate to participants

A cross section of participants at the Workshop

Cocoa Sun dryer

Cocoa farmers at the classroom

Mr Tobaba Ajayi, cocoa desk officer, FMARD gave the closing remark

ED, CRIN welcomed participants to the training workshop

CRIN/FMARD training workshop on skill acquisition on agrochemicals application and safe handling for cashew farmers.

The Cocoa Research Institute of Nigeria (CRIN) in collaboration with the Federal Ministry of Agriculture (FMARD) organised a training workshop for cashew farmers in the south-west region of Nigeria on 15th – 16th March 2021. The training workshop was on Skill Acquisition on Agrochemicals Application and Safe handling for Cashew Farmers.

The Executive Director, CRIN, Dr. P. O. Adebola, welcomed cashew farmers in the presence of Director (Tree crops), Abuja, in person of Mr. B.C. Ukattah, and Director (Cashew Value chain), Mr. T.T. Usman and Tree crops officer, Mr. Ohinoyi Christopher to the training workshop

A cross section of participants with the ED, CRIN at the Events Centre, CRIN

Director Tree Crops, Abuja, Director Cashew Value Chain, Abuja and Director (Training) CRIN

The first training was taken by Dr Ibiremo who talked on Management of Cashew Soils for Improved Yield. He mentioned that in selecting site for cashew the following should be put into cognizance: Visual observation, which involves presence and types of trees, types of weeds and presence of worm cast. He also mentioned Soil characteristics as; Soil depth 1-1.5m, Gentle slope, grows on a wide range of soil, Ideal, slight sandy to sandy loam soil with not less than 60% sand Well drained soil, no water logging, Soil pH 5-7.5 and Steady and continuous supply of nutrients.

Cashew farmers should take note of these, Proper site selection, Soil testing before fertilizer recommendation and application and integrated nutrient management.

Dr Ibiremo talking on Management of Cashew soils for improved yield

Mrs E. Adeyemi also talked on *Nursery & Field Establishment of Cashew*. She said cashew is a tropical crop, native to Brazil, introduced into Nigeria in1950s and its grown primarily for its nut. She said in establishment of cashew farm, they must take note of the Topographically suitable & accessible site, Fell trees, cross cut & remove logs, Establishment by seeds or seedlings, Sow / Plant at 9.0 x 9.0 m (123 plants / ha) or 6.0 x 6.0 m (278 plants / ha).

She emphasized steps to take on harvesting of cashew as:

- Pick nut on dropping or pick with apple from tree
- Harvest spans from Dec. to May; peak in Feb/Mar
- Pick nuts before rains
- Fruiting starts 2 - 3 years old; mature yield in the 7th year She gave the acronyms of CASHEW as:
- C Come
- A And
- S See
- H How
- E Easy
- W Wise, Work, Wine & Win

So: PET (Plant, Eat & Trade) Cashew

Good Plantation = Good Yield = Great Cash

A field visit was made to cashew plantations in the estate.

Dr Aroyeun talking on Value Addition in the Cashew Industry

The other session was taken by Dr Aroyeun who talked on Value Addition in the Cashew Industry. He said that cashew is an example of perishable fruits, it consists of a kidney shaped NUTS and a fleshy, juicy, and sweet apple attached to the NUT, it is rich in Vitamin C and has been richer in vitamin C when compared to some other tropical fruits.

Cashew is ready for harvest when it has soft skin, yellow or red colour of the skin, contains more water, sweet taste and less acidic.

He explained home based cashew nut processing as follows: In this process, raw cashew nuts are boiled in a large drum or open pan (25min), Sun drying 24hrs, Mechanical deshelling to remove the kernels, kernel drying 7hrs.

He said cashew can be made into cashew chocolate, cashew kernel biscuit, cashew ice cream, cashew kernel yogurt, cashew nut protein concentrate, cashew kernel butter.

The next session was on Pests and Diseases of Cashew in Nigeria and their Control Measures which Dr Adedeji done justice to by defining pest, major pest, and minor pest as; pest is generally used to mean insects, other invertebrates and vertebrates that cause damage to our crops and livestock. Major pests: These are pests that cause serious damage to crop irrespective of their population. Minor pests: These pests are known not to cause economic damage to the crops even when their populations are large. They cohabit with the crops without much problem.

From his teaching insect pest of cashew are:

- Cashew stem girdler *(Analeptes trifasciata)* – Causes 53% - 75% loss
- Cashew Pseudo-Apple scrapper *(Pachnoda cordata)*
- Termites *(Nasutitermes spp*
- Grasshopper *(Zonocerous variegatus)*
- Leaf miners *(Acrecercops synagramma)*
- Tailor ant (*Oecophylla longinoda)*
- Cashew giant bug (*Anoplocnemis curvipes)*

The following can be used as controlled Cultural measures; Pruning, Weeding, Timely harvesting of ripe apples, Phytosanitary harvesting, Destruction of termite mounds, Removal of King/Queen

While the approved Insecticides are:_Actara, Proteus, Esiom and Confidor
Other diseases of cashew are Kernel rot of cashew:
Symptoms: deep brown, grey intense yellow as compared with light yellow kernel of normal cashew kernel
Control: Cleaning of the cashew nuts during harvest (Picking) and before processing

Rot of immature cashew nuts:

Symptoms: Dry rot of the nuts, Nuts shrivels and becomes dark in colour

Control: spraying systemic or contact fungicide and insecticides, Rot of peusdoapple in the plantation.

Complex of fungi associated with fruit flies

Symptoms: From the area of bruise white fungi mycelia is seen sporulating followed by putrefying odour

Control: Timely harvest of cashew apples.


*Dr. Orisajo talked on Responsible Pesticide Use in Cashew. He explained the AESA - **Agro Eco-System Analysis***

- The health of a plant is determined by its environment.
- Includes abiotic factors (i.e. sun, rain, wind and soil nutrients) and biotic factors (i.e. pests, diseases and weeds).
- All these factors can play a role in the balance, which exists between pests and their natural enemies.
- If we understand the whole system of interactions, we can use this knowledge to reduce the negative impact of pests and diseases.

He gave the threshold action on Cashew pests damage level at which it makes sense to control it.

Threshold key	***Decision***
0 - 5% damage	***Do not spray***
6 – 25% damage	***Do spot application***
Above 25% damage	***Do blanket spraying***
If 70 – 75 % of the apples will be ready for harvest in 2 weeks	***Do not spray***
If 85% of cashew nuts are already harvested	***Do not spray***

Dr S.B. Orisajo talking on Responsible Pesticide Use on Cashew

Presentation of Certificate to Participants

Vote of thanks from the Secretary Cashew farmers Association

Alhaja, secretary of the group on behalf of all the cashew farmers, appreciated the Federal Ministry of Agriculture and Rural Development and CRIN for the thoughtful training workshop for farmers and prayed for continuous training and empowerment to reach unto others in the community and the country at large.

Experimental Title: Capacity Building on Cashew Value Addition through processing cashew apples into cashew juice on 16^{th} of April 2021

Introduction

Training on cashew juice processing to salvage wastage of cashew apple which are seldom consumed during its peak season was organized by Nigerian Export Promotion Council In collaboration with our Institute Cocoa Research Institute of Nigeria to add value to cashew, CRIN was engaged as facilitator to train the farmers on how to produce cashew juice from the wasting cashew apple. CRIN was ably represented by me and Mr Tayo Bamgbose from the engineer section to operate the cashew juice extractor

Training Objectives

To create awareness and enlightenment on the utilization of cashew apple which will provide more employment opportunities and increase in profit margin from the same Cashew tree

Training

The training took place in Joga Orile village in Yewa North, Ogun state. The capacity building involved training of 70 cashew farmers from Yewa North; using on-farm demonstration techniques and participatory approach.

The practical training was facilitated by the Cocoa Research Institute CRIN.

Over the years, farmers are only interested in the sale of raw cashew nut while the fruits rots away. Invariably cashew juice contains five times of vitamin C than that of oranges which can help eliminate various disease conditions such as scurvy. The juice is made from pure cashew apple without addition of water and sugar.

The processes involved the farmers plucking only mature and ripe apples. I engaged the farmers in sorting, cleaning, blanching, extraction of the juice and bottling into cashew juice. The participatory training was a demonstration of the different Cashew value chain processes, requirements for labelling and Packaging, how to obtain NAFDAC, Barcode and NEPC registration.

Observation

The farmers were very happy for the training and expressed their joy and promised to start instantly as this will boost their revenue from cashew. Cashew farmers were advised to group themselves and form cooperatives so as to enable them have access to loans. The farmers were encouraged to go into mass processing of Cashew apple into juice for sale at this season at affordable price all over the local government that produces cashew in Ogun State and all cashew producing states in Nigeria for local consumption and for export

Recommendations

I recommend that this type of training be repeated in cashew producing states in Nigeria in order to showcase CRIN, create job opportunity for unemployed youths and also increase the nations multiple streams of income

Administrative charges

A sum of twenty thousand Naira (#20,000) was paid by Nigerian Exports Promotion Council to the cover of the Institute as administrative charges. The receipt of payment is hereby attached with this report.

Appreciation

My appreciation foremost goes to the representatives of Nigerian Exports Promotion Council, Ibadan Office under the leadership of Mr. Idowu for sponsoring this capacity building on cashew value addition, moreover, I want to sincerely thank the Executive Director of Cocoa Research Institute of Nigeria Dr. P.O. Adebola for the opportunity granted me to be the facilitator of this training.

Dr. Jayeola at the training venue

LIBRARY, INFORMATION AND DOCUMENTATION DEPARTMENT
(Head: Fagbami, O.O.)

Objective
The main objective of the Department is to acquire, process, organize, store and disseminate information with a view to stimulate and guide research on CRIN mandates crops. Library Information and Documentation Department (LID) comprises of three (3) divisions which are: Library, Information Communication Technology (ICT) and Documentation divisions. These three (3) divisions supported the research activities of the institute by providing services.

Personnel: There were thirteen (13) staff working at LID department. These were; three (3) Librarians, two (2) Programme Analyst, four(4) Library Officers, one(1) Chief Printer, one(1) Data Processing Officer, one(1) Chief Typist and one(1) Clerical Officer

Library Division (Aboderin A.K – Acting Head, Library Division)
The library division is saddled with the responsibility of providing information resources to its users through printed or electronic format. The library division performed the duty by ensuring that the institutes' staff both researchers and non-researchers got the needed information to carry out their day-to-day activities.
The Users query both printed and electronic forms were also attended to.
Current Awareness Services (CAS) and Selective Dissemination of Information (SDI) were done for profiled Researchers.
The division Trained six students who were on Industrial Attachment.
The library division has four sections: Acquisition, Reference, Circulation, Cataloguing and Classification.

Personnel
There were eight (8) staff in the library division, while Dr (Mrs) Ogunjobi T.E. is on Sabbatical leave at University of Ibadan.

Activities and Achievement
In the year under review (January to June 2020), the records shown that 316 researchers used the information resources of the library, 265 non-research staff also used the library, 202 visitors were received and 404 industrial training student and crops members visited the library.
The highest used library resource was Annual report total 297. This could be attributed to the increased in numbers of researcher in the institute due to the recruitment of staff. Copies of 2000 to 2012 annual reports were distributed to the newly employed scientist.

ICT Division (Ibe Osita – Acting Head, ICT Division)
The Information Communication and Technology (ICT) division is composed of two sections: Internet/Website and Library Automation.
Personnel
The Internet/website and Library Automation have four (4) personnel.
Functions
The division is saddled with the following functions:
- Provision of Internet access to the staff of the Institute
- Troubleshooting and fixing of all Internet equipment
- Provision of computer related services in offices
- Administration/maintenance of the Institute's website
- Provision of computers and peripherals solutions to staff
- Training of Interns

Activities and Achievement
1 Update of Institute's website with value chain products.
2 Creation of Information Technology (IT) closed Whatsapp group to address the IT needs of staff remotely.
3 Troubleshooting and repair of Internet connection defects
4 Handling of official correspondences
5 Organised training for staff on online meeting using zoom
6 Ogranised zoom meeting between the Executive Director and the Institute Board Members
7 Training of interns
8 Procurement of switches for the Indoor and Outdoor signal distribution.

Documentation Division: (Fagbami, O.O. and Babafemi Ibitope B. Acting Head, Documentation Division)
Activities and Achievement
1. Cocoa Research Institute Database on Nigeria (CRIDAN), collection continued.
2. Work continues on processing of reprints.
3. Crop book on cocoa was still outstanding and this has delayed its printing.
4. Staff Identity card data were collated and printed on request as approved.
5. Compilation of bibliographies is on-going
6. A designated computer for CRIDAN, photographs of events were put in place.
7. The Username and Password of Research 4life was made available for use of Scientists.

ENGINEERING DEPARTMENT (Head, Engineer Bakare T)

Preamble
During the year under review, 2016 till date, the Engineering /Works Division operated as hitherto into three (3) technical sections and fourteen (14) operational units. This help to effectively utilize the available manpower and to deliver maximally in all fronts of the official responsibility of the division tom support and service the Research mandated goal of the Institute.
Sections:
The three technical sections are arranged below:
(1) Civil Engineering
(2) Electrical Engineering
(3) Mechanical Engineering

Units
We have fourteen operational units, which are listed below
(1) Civil
- Carpentry
- Mansory and Bricklaying
- Roads

(2) Electrical
- Generation & Protection
- Networks & Installations
- Billing & Metering

(3) Mechanical
- Agricultural & Equipment
- Fabrication & Welding
- Plumbing & Water supply
- Generation, Refrigeration & Air-condition
- Machine shop
- Motor vehicles
- Special Duties (Maintenances, Planning & Monitoring)

Personnel

Names of all Staff in Engineering Division

`S/N	NAME	DESIGNATION
1	Engr. Bakare Taiwo	Chief Maintenance Engineer/HEW
2	Engr. Ikpefan Patrick	Principal Maintenance Engr. l
3	Mr. Titiloye Isaac	Senior Maintenance Engr.
4	Mr. Olutola Ola	Chief Tech. Officer
5	Mr. Agwimah Emmanuel	Chief Tech. Officer
6	Mr. Ajiboye Gbenga	Asst. Chief Tech. Officer
7	Mr. Yinusa Sakiru Adedoyin	Principal Tech. Officer l
8	Mr. Awe Jacob	Principal Tech. Officer l
9	Mr. Ogunsuyi Busuyi	Principal Tech. Officer l
10	Mr. Gold Ahmed	Principal Tech. Officer l
11	Mr. Oduntan Samson	Principal Tech. Officer l
12	Mr Oyawale Muniru	Higher Tech. Officer
13	Mr. Ogunwumi Oluseye	Higher Tech. Officer
14	Mr. Ajayeoba Babatunde	Higher Tech. Officer
15	Mr. Ogbechie Micheal	Higher Tech. Officer
16	Mr. Mathews Dare	Senior Works Superintendent
17	Mr Akintoroye Ambrose	Senior Works Superintendent
18	Mr Ogbechie Christopher	Senior Works Superintendent
19	Mr. Adeyanju Stephen	Higher Works Superintendent
20	Mr. Balongun Roland	Higher Tech. Officer
21	Mr. Adedoyin Nkanlola	Higher Works Superintendent
22	Mrs. Togun Olubukola	Higher Tech. Officer
23	Mr. Oyeniran Sunday	Works Superintendent
24	Mr. Oyebanjo Toyosi	Works Superintendent
25	Mr. Ironua Samuel	Senior Foreman
26	Mr. Ibiyemi Adewale	Senior Foreman
27	Mr. Oke Babatunde	Works Superintendent
28	Mr. Ojo L. Idowu	Senior Foreman
29	Mr. Adeogun Morufu	Senior Foreman
30	Mr. Uwaifo l. Andrew	Senior Foreman
31	Mr. Adekanbi Aderemi	Asst. Tech. Officer
32	Mr. Ismaila Salami	Senior Craftsman
33	Mr. Ojo Moses	Senior Craftsman
34	Mr. Adesida Ad umi	Senior Craftsman
35	Mr. Adeboye Kehinde	Foreman
36	Mr. Oladimeji Taofeek	Craftsman
37	Mr. Boluwade Sunday	Senior Craftsman
38	Mr. Faniyi Jimoh Abiola	Senior Craftsman
39	Osun Micheal	Senior Craftsman
40	Mr. Adio Dare	Asst. Technical Officer
41	Mr. Alade Gboyega	Senior Craftsman
42	Mr Adedayo Salaudeen	Senior Craftsman
43	Mr Adekanbi Segun	Senior Craftsman
44	Mrs. Ajekigbe Femi	Secretarial Asst. l
45	Mr. Ajayi Olalekan	Agric. Field Attendant l
46	Mr. Gabriel Ibhazakor	Agric. Field Attendant ll
47	Mr Rotimi Ipinmoroti	Motor Driver Mech.
48	Mr. Oladipupo Kayode	Senior Work Superintendent
49	Mr. Ajiroba Taiwo	Senior Work Superintendent
50	Mr. Enodumwenben Anthony	Senior Work Superintendent

51	Mr. Kpeleye Friday	Work Superintendent
52	Mr. Odeku Olufemi	Work Superintendent
53	Mr. Tijani Fatai	Chief Motor Driver Mechanic l
54	Mr. Muraina Lukman	Chief Motor Driver Mechanic l
55	Mr Osungbade Ayoade	Higher Technical Officer
56	Mr. Ogunkunle Gbadebo	Senior Motor Driver Mechanic
57	Mr. Arumemi Christian	Senior Motor Driver Mechanic
58	Mr. Arowobusoye Akinrinsola	Senior Motor Driver Mechanic
59	Mr. Oluwole Segun	Senior Motor Driver Mechanic
60	Mr. Adesuyi Busuyi	Senior Motor Driver Mechanic
61	Mr. Oyedele Bolaji	Senior Motor Driver Mechanic
62	Mr. Iyeh Moses	Senior Motor Driver Mechanic
63	Mr. Nome Peter	Motor Driver Mechanic
64	Mr. Rabiu Akeem	Motor Driver Mechanic
65	Mr. Ajewole	Motor Driver Mechanic
66	Ismaila Tajudeen	Motor Driver Mechanic

Achievement of the division

1. General maintenance of buildings, equipment, vehicles, and road network within the Institute
2. Erection of fencing Poles and wires along the Institute outside Lawn
3. Supervision of all Contract works like road construction, the Laboratory complex, installation of solar/inverter system in the Institute and so on.
4. Re-roofing of the Event Centre.
5. Redd-roofing of the Engineering workshop.
6. General transport activities.

Functions and Responsibilities of Engineering Division

1. Initialize and develop a process plan to service the research mandate goal.
2. To design, construct, install and maintain any engineering related equipment to support the research mandate goal.
3. Daily Maintenance of vehicle fleets, building, machinery, and equipment's that drives the research mandate goals.
4. Prepare tender document to facilitate excursion of capital projects.
5. To advice the Executive Director and CRIN management on the tenets of the ethnics of the engineering profession.

Challenges (major and minor)

Major challenges faced by the Division:

- Lack of readily available working fund to solve immediate maintenance needs.
- Also, poor or rather no imprest reimbursement.
- Lack of an upgrade of equipment and tools in commensurate with available manpower.
- Insufficient training and re-training of staff to meet up with the global trends in maintenance techniques

Minor challenge faced by the division:

- Lack of an engineering inventory store which will enable closeness to maintenance spare items thereby eradicating long down time delay.
- Also, the Engineering Division lack daily logistics like availability of vehicle to move materials finished work to the site, a direct projection of poor funding.

Scope for Future Recommendation

1. Provision of upgrade equipment /tools for the day to day running of the division
2. Training of staff to meet with the recent global technology
3. Provision of daily needed maintenance items in the inventory store to eradicate delays in the execution of maintenance plans.
4. The farm machineries could be used for hiring in-order to generate IGR
5. Construction of a 33KV transmission line or a dedicated line to solve the problem of light in the Institute which could also be a source of IGR.

FINANCE AND ACCOUNTS DEPARTMENT (Ag Head, Sorinolu Oluwatoyin)

The department has four (4) divisions based on new Finance and Accounts restructuring method by the Federal Government of Nigeria.

I. Final Accounts Division

a. Pension Section

b. Budget and Monitoring Section

ii. Cash / E-Payment Division

iii. Payroll / IPPIS Division

Final Accounts:

The Final Accounts Division is responsible for the preparation of end of year trial balance and statement of affairs for the Institute. The duties of Final Accounts capture all summary of financial events/transactions that occurred during the year.

Final Accounts has ten (10) energetic staff saddled with different schedule of duties. It is sole responsibility of final accounts to work hand in hand with the federal auditors and the institute external auditors.

Sections under final account

Pension:

The section is saddled with the responsibility of computation, preparation and payment of exited and retired staff of the institute plus updating NHF record of all serving staff and retirees.

Budget and monitoring:

The section deals with submission of each department yearly budget and saddled with the responsibility of monitoring the on-going and completed capital project both at the headquarters and substations.

Cash/e-payment

The division deals with receipts of all monies to the Institute and payment of approved claims and bills. The department also covers maintenance of relevant books of account in respect of income received or payment made.

Payroll division

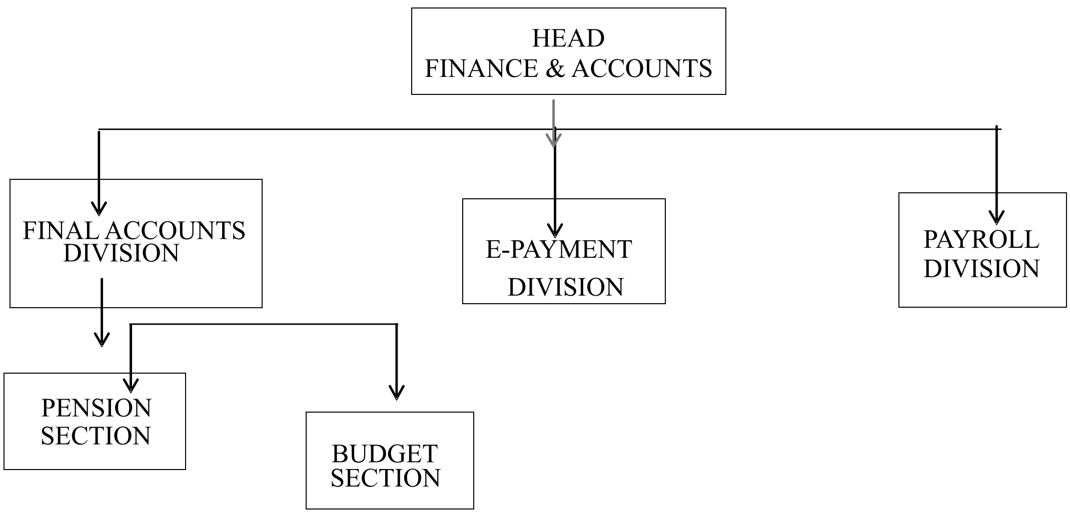
This is the division saddled with the responsibility of preparation and payment of personnel emolument. It also includes payment of all sorts of personal allowances and other issues relating to staff emolument.

Payment cycle

For any payment to be made, it must have passed through all due process and got the Executive Director's approval. Also, for payment to be effected on any approved request, the following procedures are follows;

- The request is forwarded to Executive Director's office
- The request is sent to audit section for Auditor's recommendation for Executive Director's approval
- After ED's approval, it will be directed to Head finance and accounts department for further action
- The voucher will be raised, checked, and controlled by relevant senior officers
- The voucher together with the request will be taken to audit for prepayment checking
- The then voucher, attached with the request is sent to e-payment division
- The payment is then made based on the availability of fund as the moment or wait till allocation(s) is/are received from the Federal Government.

The diagram below shows the existing structure in Finance and Accounts Department



Presently, the staff of F&A for both Hqtrs and Six (6) Substations as at 31 December 2020 is as follow;

S/N	PARTICULAR	HOD	Final Accts	E/Pmt	Payroll	Pension	Budget	S/S	TOTAL
1	Ag. HFA	1	-	-	-	-	-	-	1
2	Chief Accountant	-	2	-	-	-	-	-	2
3	Assist Chief Accountant	-	1	1	1	1	-	-	4
4	Principal Accountant	-	-	-	-	-	2	-	2
5	Senior Accountant	-	2	2	2	-	-	-	6
6	Accountant 1	-	-	-	-	-	-	-	-
7	Accountant 11	-	-	-	-	-	-	1	1
8	C.E.O.	-	-	1	-	-	-	-	1
9	A.C.E. O.	-	-	1	1	-	1	-	3
10	P.E.O.1	-	-	-	-	-	-	1	1
11	P.E.O.11	-	1	-	-	-	-	-	1
12	S.E.O.	-	3	2	-	-	-	1	6
13	H.E.O.	-	-	-	-	-	-	2	2
14	E.O.	-	-	-	-	-	-	-	-
15	A.E.O.	-	1	-	1	-	-	-	2
16	Secretarial	1	-	-	1	-	-	-	2
17	Clerical	1	1	-	-	-	-	-	2
18	Driver	1	-	-	-	-	-	-	1
	Total	**4**	**11**	**7**	**6**	**1**	**3**	**5**	**37**

Note: Mr Abodunrin Peterkin, a Principal Accountant attached to Budget section is currently on leave of absence from the Institute.

INTERNAL AUDIT (Ag Head, Kuforiji E.O.)

The internal audit division was designed to monitor, control, appraise, evaluate and examine the financial and operating activities in the Institute. We have the mandate to provide a complete and continuous audit of the accounts and records of revenue and expenditure, assets, allocated and unallocated stores of the Institute as provided in section **1702** of the Financial Regulations. We are responsible to the Chief Accounting officer who is also the Executive Director of the Institute.

Staff strength

Our staff are qualified professionals with expertise in the field of auditing and investigation, and financial reporting. As at 31st of December 2020, the division had sixteen (16) staff. This is as detailed below:

Accountants	7	Executive Officers	8
Secretary	1		

Note: - 1 of the Executive Officers (Mrs Christopher Mimiola) is on a study leave absence as approved.

Responsibilities

In addition to exercising our core mandates of providing a complete and continuous audit of the accounts and records of revenue and expenditures, assets, allocated and unallocated stores of the Institute as spelt out in section **1701** sub section **(i)** and **(ii)** of the federal republic of Nigeria Financial regulation (as revised'2009), the division perform amongst others the following duties: -

- Maintenance of adequate checks against fraud and misappropriation of assets.
- Verification of assets and liabilities at regular intervals.
- Examination and constant scrutiny of all system of authorization of payment to ensure adequate control of expenditure.
- Ensuring that various policies as put in place by the Management are strictly adhered to.
- Ensuring that information required by the Management for effective performance is reliable, complete, and timely.
- Conducting periodic examination of internal checks to ensure accuracy and efficiency.
- Reviewing accounting system and related internal controls.
- Examination of financial and operational information for management, including detailed testing of transactions and balances.
- Reviewing the economy, efficiency, and effectiveness (Value for Money Audit) of operations and functioning of both financial and non-financial controls.
- Conducting special investigations; and
- Any other related functions as may be assigned by the Chief Accounting Officer.

Achievements

The following are some of the heights we have attained during the year under review

- We have ensured transparency and accountability in the conduct of the Institute's businesses.
- Reviewed, monitored, and ascertained accounting and internal control systems put in place by the management.
- We have been able to keep cost of items/materials requested within reasonable and acceptable limits without impairing the quality and quantity of its intended use.
- In many ways we have ensured compliance with extant rules and regulations vis-à-vis Financial Regulations. We have ensured that expenditures incurred are wholly, reasonably, exclusively, and necessarily incurred in the interest of the institute.
- public service rule, government official gazettes and circulars, and management policies.
- We have safeguarded the institute's property by confirming their existence, rights & obligations, completeness, valuation, and allocation.
- Proper monitoring and evaluation of the internal control mechanisms put in place by the management of the Institute.
- Ensure compliance with government rules and regulations, and other official gazettes and circulars.
- Increase in the level of compliance with the different control measures (preventive, detective, corrective, directive and compensating) put in place.
- Cost reduction and controls have improved drastically, as we have been able to manage these by ensuring the best quality of items or material is bought for the institutes use.
- The rate of retirement of advances by staff have improved compared with the previous years as the rule of no retirement of previous advances before getting another was strictly enforced.
- No extra budgetary spending: expenditures were wholly, reasonably, exclusively, and necessarily incurred.
- On a regular basis, physical inspection of the Institutes assets was carried out for update on existence, current value, completeness, rights & obligations and allocation of these assets.

Challenges

Our major challenge is inadequate fund. Auditing is a continuous exercise that require gathering of sufficient, appropriate, relevant and reliable evidence on which our findings and recommendations are based. This cannot be achieved without proper and adequate funding. Though we realise that delay in the release of funds by the government warrant this at times. We encourage the management to prioritise audit assignment in the institute. Another challenge of the division is the perspective of staff as to what audit stands for. Many see our job as a witch hunt exercise rather than for the good of the institute; there is need for reorientation.

Conclusion

Finally, our role as auditors is to join in the crusade of judiciously creating values for the Institute, protecting these values from being distorted or tarnished and managing the available resources to achieve the mandate of the Institute. This we are committed to as a machinery of government. We therefore enjoin you to join in the crusade of value addition so as to take the institute to greater height.

PRODUCTION AND SUBSTATIONS (Head: Dr Ogunlade M.O.)

The advent of total lockdown occasioned by covid-19 pandemic had a great devastation on the productivity of the Department in year 2020.

Cocoa hybrid pods were produced through hand pollination and distributed during the year 2020.

A total of twenty thousand seven hundred and sixty-two hybrid pods (20,762) were distributed.

Raising and distribution of seedlings of CRIN mandate crops.

Seventy thousand hybrid cocoa seedlings were propagated for sales and distribution.

Twelve thousand cashew seedlings were raised for commercial purposes

Five thousand of Kola seedlings were also produced.

Five hundred coffee seedlings were produced.

Periodic maintenance of the plantations and the premises

Harvesting and processing of a total of one hundred and twenty-three thousand two hundred and three (123,203) cocoa pods from the Cocoa plantations at the Headquarters.

Two thousand, two hundred and eighty-nine kilogram (2,289kg) of dried cocoa beans was produced during the year.

PLANTATION AND ESTATE MA NAGEMENT DEPARTMENT (Plantation Manager Akande, M. A. Mrs.)

A. Staff Strength / Disposition.

S/N	Unit	Effective Hectare	No of Senior & Admin Officer	No of Supervisor	Field / Junior Staff & Admin	Total Work Forces	No of PCW
1	PEM	-	5	-	1	6	
2	Zone 1	34.79	6	2	12	18	
3	Zone 2	15.14	7	3	6	13	
4	Zone 3 & 4	15.19	4	2	6	10	
5	Zone 5	27. 63	6	2	10	16	
6	Zone 6	26.00	4	2	15	19	20
7	Zone 7	23.85	3	2	8	11	
8	Zone 8	41. 05	6	2	13	19	
9	Zone 9	22.89	5	3	9	14	
10	BCOO	6.00	2	-	1	3	
11	Fermentary	-	4	2	5	9	
12	Ground Maintenance	-	10	3	26	36	2
13	Palm Oil Milling	-	1	1	4	15	
14	Total	-	63	24	116	179	

During the period under review PEM was given fifteen new staff, comprising of three (3) Higher Agric superintendents, one (1) clerical staff, and 11 field staff. Messer's Kunle Akande, Godwin Mufutau and Olayemi Oyebanjo, were transferred to BCOO Moor Plantation, Engineering Department and ED's office. In addition, Mr Ojo Moshod retired from active service, while Mr kasali Adeleke was announced dead.

Achievements

Plantation Activities: The plantation activities were effectively carried out in all the existing zones in the zones and BCOO plot at Moor- plantation.

During the year under review, the covid- 19 pandemic affected our normal cultural farm practices between March and mid- October 2020. Nevertheless, skeletal activities which include harvesting of cocoa pods, and clearing of CRIN frontage, were carried out. After resumption, all farm activities such as harvesting, and processing of cocoa, and oil palm, weeding, pruning of old plots, clearing of access roads, removal of mistletoes, and chupons resumed back to normal in various zones and plots while the ground maintenance section took care of the clearing of all open grounds, which include the office complex, residential environment, lawn and pruning of hedges.

Detailed analysis of the harvested farm produce within the year under review is itemized below:

COCOA

ZONES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1	2548	-	336	-	4928	-	-	-	-	-	3526	1017	12409
2	1976	200	-	-	2109	-	-	-	-	-	1752	510	6547
3 & 4	677	-	-	-	2042	-	-	-	-	-	1674	2000	6393
5	3939	-	-	-	7732	-	-	-	-	-	2903	2144	16,718
6	2887	824	-	-	5197	-	-	-	-	-	1686	1619	12,213
8	11800	1548	716	-	6380	-	-	-	-	-	7113	9896	37,453
9	2295	1142	-	-	5963	-	-	-	-	-	7219	2922	19,541
BCOO	2413	430	-	-	-	-	-	-	-	-	7686	1400	11,929
DEMO	-	-	-	-	195	-	-	-	-	-	294	-	489
CFC	-	-	-	-	8055	-	-	-	-	-	-	-	8055
TOTAL	28,535	4,144	1,052	-	42,601	-	-	-	-	-	33,853	21,562	131,747

OIL PALM

OIL PALM	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1	116	65	71	-	-	-	-	-	-	-	52	72	376

RECORD OF OTHER HARVESTED FARM PRODUCE.

ZONE	KOLA PODS	CASHEW NUGTS (kg)	BANANA BUNCHES	PLANTAIN BUNCHES	COFFEE (kg)	AFRICAN STAR APPLE
3 & 4	-	99.5	-	7	-	-
7	1, 809	-	8	-	-	-

FERMENTARY UNIT

Cocoa

During the period under review

i. The total dried cocoa beans produced was 2 tonnes, 289.2kg.
ii. The dried cocoa beans brought forward from the previous year (i.e. 2019) was 2 tonnes, 367.6kg.
iii. The total dried beans sold was 3 tonnes, 655kg
iv. The total beans issued out for research work was 50kg.
v. The remaining dried cocoa beans in the store was 951.8kg.

Cashew Nut

Medium size of cashew nut sold was 6kg while 115.6kg and 50.8kg of Jumbo size were issued out respectively.

Challenges and Constraints

- Shortage / inadequate supply of manpower greatly affects our production and maintenance activities.
- There is the need to revisit old and abandoned cocoa plots the way it was done the previous year.
- Porosity of zonal / unit office complex gives room for pilfering of farm produce.
- Delay in release of fund for the running of PEM.
- Late and inadequate supply of agro- chemicals allow over growing of weeds which compete with crops.
- Inadequate supply of farm tools and protective clothing materials.
- Monitoring / supervising exercise is difficult because of unavailability of functional motocycle or utility vehicle.
- All the bazuki's tricycles attached to PEM are grounded.
- The zonal and unit leaders have no personal and conducive office to retire to after each day work from the farm

Conclusion

We thank God for being merciful to us and for seen us through the COVID -19 pandemic period. Also, we deeply appreciate the Executive Director and the entire management for their support and encouragement from time to time. We say thank you sir. More power to your elbow.

Nursery Development and Management Section (Babalola E.O.)

The Nursery section comprises of two units, Sexual propagation unit and Vegetative propagation unit. The activities of each unit in the year reported upon are as follows:

Sexual propagation unit (SPU): The following activities were carried out in this unit:

- Propagation of all mandate crops through sexual means
- Maintenance of seedlings of all mandate crops
- Maintenance of plantain orchard
- Supply of seedlings all mandate crops to farmers for commercial and research purposes
- Training of Students on industrial attachment, farmers on field trips, Students on excursion and other visitors
- General cleaning of Nursery and its environment
- Maintenance of WCF plot.

Vegetative propagation unit (VPU): The activities performed by this unit are as listed below:

- Vegetative propagation of all mandate crops through grafting, budding and stem cutting.
- Maintenance of all bud wood gardens.
- Maintenance of old cocoa clonal and seed gardens
- Establishment of new cocoa clonal garden for bud wood collection and seed collection purposes
- Supply of budded and grafted cocoa, cashew, and kola to farmers and CRIN garden
- Training of visitors, students, and farmers
- General maintenance of Nursery

Other activities carried out include:

- Rehabilitation of one number of shades net by the Management
- Successful vegetative propagation of kola and coffee stem cuttings for research purposes
- Successful grafting of cashew for field research purpose by cashew programme
- Provision of technical assistance on research activities as demanded by Research Scientists

Tools and Equipment: The following tools and equipment were given to the section for effective service delivery:

a. Chemicals:
   1. Herbicide (clear weed and weed crusher)
   2. Insecticides (termex)
b. Spraying pump
c. Spraying coat
d. Nose mask
e. Hand gloves
f. Wheelbarrow

Training: All Nursery were trained except those who were not regular during the period

Staff strength: The staff strength of the section is 32 (5 supervisors and 28 Staff)

Achievement: The following achievement were recorded within the period reported upon:

- Sales of 70,000 hybrid cocoa seedlings to farmers
- Sales of 12,000 cashew seedlings
- Sales of 5,000 Kola seedlings
- Sales of 500 coffee seedlings

Challenges: The nursery section is being faced with some challenges despite the achievement which include:

- Dilapidation of some shade nets
- Irregular transportation of staff to and fro Nursery
- Lack of security personnel
- Lack of farm tools and office equipment/facilities

Recommendation: More attention should be given to Nursery section to improve the production of healthy seedlings and clones.

SUBSTATIONS

AJASSOR

CRIN Ajassor substation is the largest Substation with a landmark of about 768 hectares. However, only about 88Ha of these lands had ever been cultivated with CRIN mandate crops. There are 56.86Ha of effective cultivated plots while about 23.7Ha and 7.5Ha are categorized as non-effective and abandoned plots, respectively. These figures are exclusive of the ground cover of approximately 113,436m^2 of land area that accommodates the Administrative and Planation Management Blocks, Staff Residential Quarters, Crop Nursery and Post-Harvest Unit, Mechanical Workshop, Rest House, Fermentary Building, Cocoa Dryer Compartment, a Staff Clinic as well as a Primary School (now under the control of Cross River State Government). In addition to the main substation in Ajassor, there are two other experimental outposts (Rantimankonor and Okundi) Rantimankonor in Enoghi community near Kalime, along Ikom –Ajassor Border Road and mainly cultivated with T.38 clone of Cocoa while Okundi the second outpost is located at Ikom-Okundi-Etome Road and predominantly cultivated with Cocoa and Coffee.

Ajassor Substation, engaged in exclusive training programme and extension services by disseminating research findings and many relevant information to the farmers, cooperative societies, corporate organizations, local and state governments in her immediate neighborhoods, and other surrounding States.

A training/workshop was organized for more than 50 cocoa farmers on Best Global Practices for Sustainable Development in Cocoa Production at Ikom, Cross River State on the 27th of November, 2020.

CRIN Ajassor Sub-station 50 KVA transformer was connected to PHED National Grid on the 20th of February 2020. However, the Substation is still awaiting electricity to be supplied. Internally generated revenue for the year 2020 was two million, one hundred and thirty-four thousand, nine hundred and seventy five naira only (N2,134,975). Periodic maintenance of the plantations.

Staff Disposition

As at 31 December 2020 the staff strength across different sections were 33 including the Head of Station who is a Research Officer, 1 Agricultural Superintendents, 2 Chief Clerical Officer (Administration), 2 Accountants II, 1 Executive Officer (Account), 1 Store Keeper, 1 Principal Nursing Sister I, 1 Health Asst, 1 Senior Secretariat Asst. I, 2 Foremen, 4 Security men, 15 Field officers, 1 Mechanic/Driver. It is pertinent to inform CRIN Management that most staff of CRIN Ajassor, especially those on the field and in the Security, Section are very few and mostly old people. There is an urgent need to recruit more young and vibrant persons into the system.

Table 1: Updated list of Ajassor Sub-Station Staff in order of Seniority as of 31st December, 2020

S/N	Name	PF No.	CONRAISS and step as at 29/12/2020	Designation	Date of 1st appointment
1.	Dr. Eghosa Osas Uwagboe	251	13/03	Chief Research Officer (Head of Station)	11/12/2001
2.	Mr. Samson O. Odedele	314	12/02	Asst. Chief Agric Superintendent	08/04/2008
3.	Mrs. Joy Awunghe Takim	390	09/03	Principal Nursing Sister I	01/04/2010
4.	Mr. Nmeregini Uwadiaru	1206	08/03	Accountant II	17/07/1995
5.	Mrs. Eunice O. Ojua	1143	08/01	Senior Executive Officer (Acct.)	17/07/1986
6.	Mrs. Esther Ntomo Echi	1293	07/03	Chief Health Asst.	01/12/1997
7.	Mrs. Maureen Duruaku	1897	07/01	Acct. II	05/12/2011
8.	Ms. Pauline Ukpeukiema Ugi	1566	07/01	Senior Secretariat Asst. I	23/12/2008

9.	Mrs. Blessing Ekama Isong	1288	06/11	Chief Clerical Officer	01/12/1997
10.	Mr. Effiong Nathaniel Udoh	1142	06/05	Senior Foreman	16/07/1986
11.	Mr. Ezekiel Asuquo Effiong	1289	06/04	Chief Agric Overseer	01/12/1997
12.	Mr. Edet Akpan Robson	1541	06/04	Chief Agric. Overseer	02/06/2003
13.	Mr. James Ibiang Okoi	1543	06/04	Snr Foreman	10/06/2003
14.	Mr. Okpokam Ozong Edim	1556	06/04	Chief Store Keeper	10/04/2008
15.	Miss Precious Magagi	1820	06/02	Chief Clerical Officer	06/07/2011
16.	Mr. Sunday Nkanta Ekereobong	1700	06/01	Chief Field Overseer (Security)	02/01/2009
17.	Mr. Abraham Samuel Inyang	1701	06/01	Chief Field Overseer	02/01/2009
18.	Mr. Samuel James Udoh	1702	06/01	Chief Field Overseer	02/01/2009
19.	Mr. Idagu Godwin Echa	1703	06/01	Chief Field Overseer	02/01/2009
20.	Mr. Onah Peter Ogar	1704	06/01	Chief Field Overseer	02/01/2009
21.	Mr. Iwara Eteng Okoi	1706	06/01	Chief Field Overseer	02/01/2009
22.	Mr. Sunday Ime Asua	1705	05/02	Asst. Chief Agric Field Overseer	02/01/2009
23.	Mr. Azogor Isong Echeng	1707	05/02	Asst. Chief Agric Field Overseer	02/01/2009
24.	Mr Augustine Eteng Ubi	1698	05/02	Asst. Chief Agric Field Overseer	02/01/2009
25.	Mr. Emeng Ele Eleng	1708	05/02	Asst. Chief Agric Field Overseer (Security)	02/01/2009
26.	Ms. Mercy Umontia	1814	05/02	Asst. Chief Agric Field Overseer	29/04/2011
27.	Mr. Peter Godwin	1815	05/02	Asst. Chief Agric Field Overseer (Security)	29/04/2011
28.	Mr. Idorenyin Okpo	1950	04/05	Senior Agric Field Overseer	26/04/2012
29.	Mr. Udoh Akpan Johnny	1951	04/05	Senior Agric Field Overseer (Security)	26/04/2012
30.	Mr. Anthony David	1816	03/09	Agric Field Attendant 1	29/04/2011
31.	Mr Monday Echi Enya	1974	02/02	Driver/Mechanic II	5/3/2020
32.	Mr Emmanuel Takon Ayiba	1979	01/02	Agric. Field Attendant III	5/3/2020
33.	Miss Patience Takon Ayiba		01/02	Agric. Field Attendant III	5/3/2020

Table 3: Staff who left CRIN Ajassor in 2020

Plantation Management

S/N	Name	Designation	Date of Exit	Cause of Exit
1.	Oyeledun Kehinde	Principal Agric. Superintendent II		Transfer to Headquarters
2.	Mr Adariku Patrick Iyaji	Asst. Chief Field Overseer PF 1706 Senior watchman PF 1699	2/1/2020 2/1/2020	Retirement
3.	Mr Augustine Akwagiobe Uzichu			Retirement

There were various challenges such as inadequate labour force (field workers) as well as unavailability of enough agro-chemicals for field and ground maintenance. Inadequate cultural maintenance of all the Cocoa, Coffee, Kola, and Tea plots under CRIN Ajassor were done throughout the period under review due to the covid-19 pandemic.

Table 4: Plantations/ Research plots with their hectares and maintenance status in Ajassor as at 31 December 2020

Cocoa Research Plots	Hectares	Status
Cocoa plots		
1967 Trinidad	2.9	Abadoned
1975 F_3 Amazon	1.6	Abandoned
CRIN/NIFOR 1	6.0	Abandoned
CRIN Elite Seed Multiplication	2.2	Maintained
T38 Kalime	2.8	Maintained
Commercial 1	2.0	Abandoned
Cocoa Cuttings	1.0	Maintained
15 Acres Extension	2.0	Maintained
Amelonado	2.0	Maintained
1973 F Amazon	2.0	Abandoned
Seed Garden Multiplication	2.2	Maintained
Okondi	10.69	Maintained
Planting at stake	1.6	Maintained
Farming System Experiment	2.0	Maintained
Adaptability/Tolerant Trial	2.1	Maintained
65 Lines Experiments	1.0	Abandoned
CRIN Elite Seed Multiplication	2.2	Maintained
Cocoa Research Plot	1.32	Maintained
Ornamental Cocoa Plot	0.5	Maintained
Okundi (Cocoa) Plot	0.4	Maintained
Kola Research Plots		
Kola Progeny	1.6	Moribund
Kola Cuttings	0.65	Maintained
Kola Germplasm	2.92	Maintained
Kola Fertilizer Trials	2.0	Abandoned
Coffee Research Plots		
Okundi	1.46	Moribund
1989 Ajassor	1.57	Moribund
Tea Research Plots		
Tea Ajassor	0.28	Abadoned

Research Experiments

A pocket of research experiments was on-going at CRIN Ajassor Substation as at 31 December, 2020 as indicated in Table 5 below

Table 5: Research experimental work on-going at Ajassor Sub-station in 2019

S/N	Description	Crop	Researcher	Remark
1.	Coconut/Cocoa experiment	Cocoa	Dr. O. A. Famaye	Established 2019
2.	Screening of fungicides to control black pod disease	Cocoa	Dr. Kolawole and others	Carried out in 2019
3.	Cocoa germplasm experiment	Cocoa	Dr. (Mrs) Muyiwa and others	On-going
4.	Tea Agroforestry experiment	Tea	Mr A. A. Oloyede and others	Started 25/10/2018
5.	Kola experiment	Kola	Dr. Ugioro	Established 2019
6.	Coffee nursery experiment	Coffee	Dr. K. O. Ayegboyin	„
7.	Cocoa Bread Bakery	Cocoa	Dr. O. O. Oduwole	On-going

Vehicles/Motorcycles/Generators at CRIN Ajassor Sub-station

The list of the vehicles/motorcycles/generators/other equipment (and their conditions) are as below:

1. Toyota Hilux Van with registration number FG 09 V03 (Not functioning. Recommended for auction).

2. 404 Pick-Up with registration number FG 2326 B034 (not functioning; recommended for auction).

3. Mercedes 911 Water Tanker with registration number FG 237 B02 (functioning but below optimal level; should be overhauled as soon as possible).

4. The Eicher Truck with no registration number FG 740 B03 (Not functioning. Recommended for auction).

5.Mitsubishi L200 Van with registration number FG 741 B03 (not functioning but could be repaired for the use of CRIN Ajassor Substation).

6. Bedford with registration number FG 238 BO3 (already a scrap; recommended for auction)

7. Tractor 1 (serviceable) with registration number FG 239 B03 MF 265 (functioning but its tires and few parts needed replacement).

8. Tractor 2 (unserviceable) already a scrap; recommended for auction.

9. Motorcycles 3: We have 1 Daylong Wolf150 is functioning but need servicing but the 2 Suzuki 185 motor bikes with registration numbers FG 334 B03 and FG 335 B03 are old and not functioning, and are recommended for auction

10. 1 Tricycle Bazuki 200 TRC (functioning. Needs servicing)

11. Generators: 50 KVA Generator plant 1 (functioning but some of its parts needed replacement), 1 Elepaq 10KVA Petrol generator functional, 1 Tiger 2700 (functioning), 1 Sumec SPG 2500 (functioning) and 1 Tiger T 950 (functioning)

12. Farm/Field equipment: 1 Hand driven mower, 1 Hand mower, 1 Water pump, 1 Harrow, 1 Plough, 1 Ridger

13. visual equipment: 1 Overhead projector DLP LG,

14. Laboratory Equipment: 1 Autoclave, 1 Micrscope

15. Electronic machines: 1 HP Scanner G4010 (functioning), 1 HP Printer P1006 (Faulty), 2 HP Laptops, 3 HP Laserjet printer (2 faulty, 1 functioning), 1 Desktop computer (Samsung) (Faulty)

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Infrastructure/Capital Projects

CRIN Ajassor didn't receive any capital fund for project in the period (2020) under review. The slab and tarpaulin are obsolete and non-presentable. We recommend their replacement with more recent and highly acceptable raised platforms and durable tarpaulin. The 3 shade nets for raising seedlings need urgent replacement as they are in bad condition.

Environmental Sanitation

At CRIN Ajassor, we know that 'health is wealth' and so we placed a high premium on the cleanliness of our offices and the residential quarters. Against this backdrop, a Monthly Environmental Sanitation on every last Saturday of the month was observed throughout the year under review. We also implore CRIN management to provide more public toilets for the staff in their residential quarters in 2021.

Visitors to the Substation in 2020.

More than 150 visitors came to CRIN Ajassor sub-station in 2020 but only 26 of them were sampled for this report. The names, addresses and purpose of visit of the sampled visitors are reflected in Table 6.

Table 6: Name, address, and purpose of visitation of some sampled visitors to CRIN Ajassor sub-station in 2020

S/N	Date	Names	Address	Purpose
1.	9/1/2020	Maria Eju	Ajassor	Official
2.	12/01/2020	Odo Joshua	Ikom	Official
3.	15/2/2020	Gertrude Osadim	PHC	Official
4.	21/2/2020	Olouyole, K. A.	CRIN hqtrs, Ibadan	Official
5.	16/3/2020	Taiwo, O. A.		Official
6.	26/3/2020	Borjor Obi	Ekimaya	Cocoa pods
7.	24/4/2020	Loe Ati	Ikom	Cocoa pods
8.	28/4/2020	Ogar Oscar	Ikom	Cocoa pods
9.	10/5/2020	Osang Lawrence	WCS	Cocoa seedlings
10.	18/5/2020	Patrick Isong	Water falls	Cocoa pods
11.	18/6/2020	Sunday Ova	WCS	Cocoa seedlings
12.	23/6/2020	Abua Jonas	Police Etung	Official
13.	27/6/2020	Okozi Jude	Boki	Test
14.	02/7/2020	Joseph K	Hqtrs	Official
15.	17/7/202	Accoyin K.N	Nde Ikom	Personal
16.	14/8/2020	Sunday Okpikan	Ikom	Cocoa seedlings
17.	18/8/2020	Mbang Oboyi	Obubura	Cocoa
18.	6/9/2020	Faith Echeng	Ikom	Personal
19.	25/9/2020	John Ojang Agbor	Bashua	Personal
20.	13/10/2020	Sam Eko	Ekori	Cocoa seedlings
22.	7/11/2020	George Arrume	Edor	Cocoa pods
23.	20/11/2020	Agbor Edotri	Mfum border	Cocoa pods
24.	2/12/2020	Dr. Adebiyi S	CRIN Hqtrs	Official
25.	4/12/2020	Dr. Abua K. B.	Calabar	Official
26.	18/12/2020	Mr Etuk Ntim	Ikom	Cocoa pods

Internally Generated Revenue for 2020

A total amount of Two Million, One Hundred and Thirty FourThousand and Nine Hundred and Seventy Five Naira (**N2, 134,975**) only was generated by CRIN Ajassor Sub-station in 2020. The breakdown of the revenue generated is in Table 7 below:

Table 7: Internally Generated Revenue Analysis for 2020 (January-December)

	Items	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.	Total
								Farm produce (A)						
1	Cocoa pods		129,9000		-	-		-	-	-			150,000	279,900
2	Dry Cocoa beans		-		-	-	-	-	-	-		248,000		248,000
3	Cocoa Seedlings							1,500,000						1,500,000
4	Kola nuts		-	-	-	-			-	-		-	3,975	3,975
5	Palm oil		-	-	-	25,000			-	- -	-	-	-	25,000
	SUB TOTAL (A)		129,900	-	-	25,000	-	1,500,000		-				2,056,875
								Services (B)						
1	Rents		12,200		55,100	-	-	-		- -	10,800	-	-	78,100
2						-	-	-	-	- -	-	-	-	
	SUB TOTAL (B)		12,200		55,100	-	-	-		- -	10,800	-	-	78,100
	Total (A + B)		142,100		55,100	25,000		1,500,000		-	10,800	248,000	153,975	2,134,975

Challenges and Prospects

Some of the challenges and prospects in CRIN Ajassor Substation are as follows:

Internally Generated Revenue (IGR): It was observed that revenue reduced this period (2020) due to Covid-19 pandemic, (the state/interstate lockdown and field workers stay at home due to the pandemic) and intensive heat resulting from climate change. Hired labour was used to open some of the abandoned plots for share cropping in late 2020 in order to increase IGR for the station in subsequent years.

Inadequate workforce: We are the largest substation in CRIN yet with only 15 Field staff. We need more staff to adequately maintain all our plots and watch over them. The substation has the capacity for expansion and increased productivity if more staff is engaged. This problem has resulted into the situation where most of our productive plantations are abandoned which, of course, gives room for pilfering of our farm produce, more encroachment and much lower productivity. We urgently need to salvage the situation and produce at our optimal level. To this end, CRIN Ajassor requires nothing less than 60 field staff to cope with the weeding, spraying, harvesting, pruning and other cultural practices on our 56.86 ha of cocoa, kola, coffee, and tea plots. Therefore, there is a need to employ additional 45 Field Attendants to complement the existing 15 Field Staff.

Besides, in order to effectively secure lives, properties and forestall against theft of our farm produce, we need additional 20 Watchmen to complement our 4 current Watchmen at the moment.

Funds: There was no capital fund released to the station in 2020. We use this medium to appeal for Overheads and Capital Votes to CRIN Ajassor Sub-Station as soon as possible. It is extremely difficult to run a Substation with 33 Staff without overheads. We need to repair and fuel our Toyota Hilux, Tractor, Water Tanker as well as Bazuki, machines, equipment, and generators especially as we mobilize our field men to go into our 3 outposts at Assena-sen (Okundi). Rantimankonor near Kalime, NIFOR etc. We are already struggling to meet our target of higher revenue next year, but it is already becoming extremely difficult without enough funds and the Covid-19 pandemic.

Training/Workshop: A training/Workshop was organized for Cocoa farmers on Best Global Practices for Sustainable Development in Cocoa Production in Cross River State on 27th November 2020 at Cocoa Association of Nigeria Secretariat Hall, Ikom. Some issues that needed to be attended to which generated from the workshop include seeking for a space in CAN Secretariat complex to exhibit and sell CRIN products, extension of the training to cocoa growing communities, more extension services required in the cocoa growing areas etc.

Other pressing needs of CRIN Ajassor Substation:
Vehicles: One new Hilux Pick-up Van and one 18-Seater Staff Bus
Motorbikes: Based on the volume of the field work and the need for constant patrol of our plots by the security, there is a need to have 5 functioning motorbikes at our substation.
Surveying and fencing of the station: Surveying of our lands is the only way CRIN can permanently stop the encroachment problem presently being faced by the station. Wire or Perimeter fencing with Oil-palm will also be an added advantage.
Construction of concrete and metallic signposts in all plots for easy identification of name of plants, year of establishment, varieties of plant used, size of each plot, location, and general history of all our plots and plants.
Tarring or grading of road from Border Road to CRIN Ajassor main gate which is becoming unmotorable.
An internet connection: This could be a broadband internet facility that will facilitate speedy surfing of the web and transfer of research related information to the headquarters. This will help the station to key into the present policy of internet administration strategy in CRIN.
Renovation of residential quarters: The buildings at CRIN Ajassor are all dilapidated while toilet facilities are becoming a mirage. Although, government quarters had been monetized, an urgent rescue mission on our Residential buildings to avoid total collapse of these 'farmhouses'. Once collapsed, the tenants and staff will move out of the quarters and that will spell doom for the safety of all farm produce at the station.
Construction of farmhouses in the zones for the field workers to serve as coverage during rainy season.
Renovation of nursery seedling shade nets which are in very bad state.
Installation of inverter at the station to bring down the running cost on gasoline/diesel operated generator.
Repairs of meteorological station which quotation has been submitted and awaiting approval
Re-printing and painting of the CRIN Ajassor Sub-station signpost at the entrance of the station
Renovation of the fermentation house, purchase of tarpaulin for drying of cocoa beans, drying oven shed and construction of raised platforms for drying cocoa.
Provision of a modern and better equipped laboratory for CRIN Ajassor.
Completion of Cocoa bread bakery in the station

OWENA (Head of Station, Dr. K.A. Oluyole)

Staff Disposition: The staff list is shown below

S/N	Designation	Owena	Alade	Onisere
1	Chief Research Officer	1		
2	Principal Agric. Superintendent 1	3		
3	Principal Executive Officer II	1		
4	Chief Health Assistant	1		
5	Higher Executive Officer	2		
6	Executive Officer	1		
7	Work Superintendent	1		
8	Chief Agric. Field Overseer (CAFO)	2		1
9	Asst. Chief Agric. Field Overseer (ACAFO)	4		
10	Senior Motor Driver Mechanic Grade 1	1		
11	Senior Agric. Field Overseer	3		
12	Agric. Field Attendant 1	3	1	
13	Agric. Field Attendant II	2		
	Total	**25**	**1**	**1**

Land Area

At Owena main Substation, the size of all the plantations is 17.95ha but the effective hectarage is 10.4ha; at Alade Outstation, the total hectarage is 0.5ha and the effective hectarare is 0.3ha while at Onisere Outstation, the total hectarage is 2.5ha and the effective hectarage is 1.0ha.

Activities

On-going research experimental plots were maintained in collaboration with the scientists involved. Some of the experiments under the station's supervision include:

1. Cocoa Soils core trial experimental plot (Dr. Ogunlade *et al.*)
2. Evaluation of field establishment of tea under shade plant and organic manure and low cocoa ecology of Nigeria (Mr. Adeosun)
3. Life mulch weed control system on the development and growth of seedling of cocoa (Mr. Idrisu Muhammed)
4. Effect of varying light intensities and organic manure on the growth of Tea (Mr. Adeosun)
5. Genetic diversity studies on Robusta coffee (Coffea canephora) assisted by molecular markers (Mr. Muhammed Baba-Nitsa)
6. Fungicide screening activities were carried out to determine the efficacy of fungicides Tandem, Overgo, Jorkemil and Michorhiza (Lens and Plus).
7. Establishment of Breeder's plot (New Cultivar) (Dr. Muyiwa et al).
8. Establishment of Breeder's plot (WCF replanting) (Dr. Muyiwa et al).

Achievements

1. Efforts were made to maintain our plantations at Owena main-station and outstations with the little resources and available labour.
2. Establishment and maintenance of 2-hectare cocoa plantation planted with TC1-8
3. Revenue: A total sum of One million, three hundred and thirty-two thousand, seven hundred and ninety five Naira Only (N1,466,225.00) was realized from the sales of farm produce and other services. This is an improvement over the previous year's own.

Proper maintenance and supplying of the missed stands at the newly established 2Ha Cocoa Varieties (TC1-TC8) plantation. Establishment of bakery infrastructure (Courtesy of incubation platform project anchored by Dr. O.O. Oduwole). The objective of the project was to train young school leavers on how to produce cocoa bread vis-a-vis to boost internally generated revenue for the Institute.Erection of muti-functioning meteorological equipment at Owena Substation by Cocoa Soils core trial site at Owena and for others who might need the weather data. Training of four incubatees under the IFAD/FGN/ONDO-LIVEND program. The incubatees who were youths were trained on the establishment of a good cocoa plantation. Provision of 2.5KVA Elepaq generator and water pump by IFAD/FGN/ONDO LIVEND program as seed capital for the trainees of the four incubatees on cocoa production. Renovation of Head of Station's residential quarters.

Challenges/Constraints

1. There is paucity of fund, and this affects the station negatively. Station's overhead which cares for the expenses of the day to day running of the station is not forthcoming and this makes the running of the station difficult.
2. Considering the enormity of the work in our plantation, the present field staff is grossly inadequate to take care of the work.
3. The present number of security staff is inadequate for effective guarding of the office, staff quarters and plantations.
4. The advent of pandemic Covid 19 restricted the operation during the year.
5. The road linking the staff quarters with the office is totally spoilt and this makes it difficult to be plied by vehicles.

Suggestions for improvement

1. The overhead should be revived so that it will be regular. This will make it easy for the station to be taking care of her day-to-day expenses.
2. The Substation's guest house needs a light renovation in order to make it a more habitable for our researchers that are coming from the headquarters to carry out research work at the substation.
3. The ongoing renovation of the office building should be fast-tracked for early completion so as to put it on use on time.
4. Considering the enormity of the work in our plantations, there is a need for more farm workers to complement the few numbers on ground. The additional staff request by cadre is as follows:

Field Attendant 1	10
Field Attendant II	10
Security Guards	4

However, if the above categories of workers are not available, it will be highly appreciated if we can be allowed to recruit contract workers to replace them.

APPENDIX

Internally Generated Revenue

Items	N
Cocoa Beans	1,048,850
Cocoa Pods	330, 400
Palm Oil	21, 000
Rent	66,375
	₦1, 466,225

MAMBILLA (HOS, Dr Aikpopodium P.E.)

Report on the activities carried out during the year January – December 2020.

Plantation: General plantation maintenance of the two (2) mandate crops (Tea and Coffee Arabica) plots using both methods of weed control. A total of 39 litres of herbicides (27 litre of force up weed herbicides and 11 litre of clear weed herbicides) were used during the year 2020 in spraying the weeds on the field. Furthermore, other methods of weed control implore was slashing using cutlasses and hand hoeing. In addition, contract weeding of the plantation which the CRIN management sent some money from CRIN-Headquarters Ibadan to be engaged outside labour for the weeding was also carried out.

All these methods were used aim at reducing weed density on the field since the issue of corona virus (convid 19) pandemic lock down and many months during the year were mostly essential duties carried out on the station.

Pruning: Selected portions of tea plot with overgrown tea bushes were pruned from time to time during the period under review. The tea germplasm was pruned in order to preserve tea cuttings planting materials. Dr. Olaniyi O. O. experimental tea plot was also pruned all aim at reducing plucking height and maintaining good plucking table, furthermore, it will re-juvenate the tea plants for more fresh tea leaves shoots and increase tea yield for IGR for the station.

Coppicing: The commercial coffee Arabica plantation that was established since 1968 and the coffee plants were old and cannot longer produce well in terms of yield. There was high need to do coppicing as advised by the Director Head of coffee programme. During the year about 95% coffee Arabica plot was coppiced, aim at enhancing normal plucking height of coffee berries and yield.

Fire tracing: Cutting of fire traces round the plantation was one of the activities carried out during the end of the year as the commencement of dry season at the last (4th) quarter of the year 2020. This is aim at checking out fire encroachment into the plantation.

Harvesting: The following crops were harvested for internal generated Revenue (IGR) for the station during the year 2020.

1.	Plantain	-	one (1) Bunch
2.	Avocado Pear	-	2 bags
3.	Tea Leaves	-	1,300 kgs
4.	Banana	-	14 Bunches
5.	Coffee berries	-	70KG

Planting: A total of 131 eucalyptus seedlings were transplanted to the field during the year 2020. Aim at revenue generation in the near future.

Nursery: A new nursery shade was constructed near the office premises by Dr. Olaniyi O.O, Director Dr. Impimoroti and others research scientist from CRIN-Headquarters during the period under review. A total of 1,816 tea cuttings were set in the tents in the nursery for the research work of the scientist who sponsored the nursery activities. A total of 131 eucalyptus seedlings were raised in the nursery and later issued out to field when the seedlings were ready for transplanting.

Green Tea Training Workshop: A team of 7 Research scientists led by Dr. S.O. Aroyeun / Mrs. Yahaya Susan from CRIN-Headquarters Ibadan came to Mambilla Substation and organized a training workshop for small scale tea processing farmers on green tea processing which is far better in high income and easier to produce manually or using few machines.

This training was carried out during the last quarter of the year 2020 and the training was successful as many invited tea farmers turned out was encouraging. The trained tea farmers/ processors were advised to go home and train others in their villages on how to process green tea.

Staff Strength: CRIN-management employed 2 field staff during the year of report bringing the total number of staff from 24 at the beginning of the year to 26 staff in the station.

Security: The security unit of the station has 5 securities instead of normal 8 numbers and that makes the securities in Mambilla station to work for 12 hours daily against official 8 hours shift because of inadequate manpower in the security unit.

Library: A total of 2 numbers of Handbook on tea processing practical were donated by the team of scientist who visited the station from CRIN-Headquarters during the Green tea processing farmers training programme.

Mayo-Selbe Experimental Station
The following activities were carried out during the year 2020 at Mayo-selbe.

Weed Control: Weeding was the major field activities on the plantation of cocoa and tea plot of the station. A total of 18 liter of glyphosate herbicides chemicals were used in spraying on the 2 mandate crops plots during the period of report to control weeds on the field.

Watering/Mulching: Wetting of cocoa and young tea on the plantation during drought was carried out. Aim at supplementing water to the young plants which are yet to be well established. Mulching was also carried out on young cocoa on the field during the dry period of the year 2020.

Gapping Up: A total of 520 healthy cocoa seedlings were used in gapping up vacant spaces caused by termites damaged to the young plants on the field. During the period, a total of 360 tea seedlings were transplanted onto the tea plot as infillings for the season.

Cocoa Plot Maintenance: Light pruning of cocoa branches, removal of mistletoes/climbers and chupons were among the activities performed during the period.

Cocoa Harvest: Ripped cocoa pods were harvested and processed during the year under review. A total of 150.8 kgs of dry beans were recovered for the year 2020 and this would go a long way in Generating Revenue for the station (Institute).

Contract Field Clearing: Outside labours were engaged in field weed clearing on the plantation which was a welcome idea by CRIN-Management to reduce weed density on the plantation since we have inadequate field workers in the station.

Pest/Disease Control: during the period of the year 2020, ten (10) sachets of ultimax Gold plus (fungicide) was sprayed on cocoa pods And trees to control black pod disease and 250mls of perfect killer was sprayed on stems of young plants of cocoa/tea on the field against termites and other pests of the mandate crops.

Nursery: The nursery unit was kept tidy during the period under review. A total of 340 polythene pots were filled with soil and coffee Robusta seedlings were pricked into pots preparing for next year season gapping up field program on coffee plot.

Fire Tracing: Making of fire tracing round the plantation against fire outbreak was done during the 4th quarter of the year.

Staff Strength: A total of six (6) staff were on the station Mayo-selbe during the period of this report and all performed their duties well.

Security: The securities performed their duties well as there was no theft report.

Weather Record
the amount of rainfall and temperature recorded within the year (January – December) 2020. The records are shown below appendix 1 A&B.

Rain Fall Appendix (1) A

Month	Rainfall (Mm)	Rain Days	Mean Rainfall (MM)
January	Nil	Nil	Nil
February	Nil	Nil	Nil
March	50.8	3	16.9
April	209	12	17.4
May	478.9	24	19.5
June	223.2	19	11.7
July	630.3	21	30
August	79.9	11	7.2
September	436.3	24	18.1
October	219.2	15	14.6
November	Nil	Nil	Nil
December	Nil	Nil	Nil
Total			

Average Mean Temperatu re January – December 2019 Appendix (I) B

	8am mean Temp. (^{o}C)	1pm mean Temp (^{o}C)	4pm mean Temp(^{o}C)
January	19.27	31.18	28.36
February	19.02	32.17	30.35
March	23.32	29.09	28.76
April	22.24	28.92	27.06
May	22.87	26.83	23.85
June	23.22	25.69	21.67
July	20.84	25.05	22.49
August	18.97	25.88	23.40
September	20.80	28.18	24.91
October	22.85	26.33	22.73
November	23.86	28.30	23.82
December	21.82	30.69	27.72

List f 8 Experiments Sited on the Station are all shown below n Appendix (Ii)

S/N0	Title of Experiment	Size	Year	Researcher	Remarks
1	Setting of 75 Nigerian China (NGL) 1-5 tea clone (15 cuttings each)		2012	Mr. Olaniyi O.O.	In progress
2	Simultaneous selection and genotype x environment interaction of tea in Nigeria (1) Kusuku	0.048	2014	Mr. Olaniyi O.O.	In progress
3	Effect of Neem fortified fertilizers on tea yield.	-	2015	Dr. Ipinmoroti	In progress
4	Effect of te a yie ld in the open an d under the eucalyptus	-	2015	Dr. Ipinmoroti	In progress
5	Simultaneous selecti on and genotype environment int eraction of tea in Nigeria (11) Mayo-selbe	0.048	2016	Mr. Olaniyi O.O.	In progress

Internally Generated Revenue (IGR)

The sum of one hundr ed and sixty-seven thousand, nine hundred and fifty naira (N167,950) was generated as Revenue for the year 2020 and the summary of the breakdown of the IGR is stated below on appendix (iii) below.

Summary Of (I GR) For January–December 2020 Appendix (iii)

S/N	Items	Jan 2020	Feb 2020	Mar 2020	April 2020	May 2020	June 2020	July 2020	Aug 2020	Sept 2020	Oct 2020	Nov 2020	Dec 2020	Total
1	Rented Quarters	-	-	7,375	-	2,500	-	6,125	10,000	13,750	3,000	-	13,750	56,500
2	Plantain	600	-	-	-	-	-	-	-	-	-	-	-	600
3	Pear Avocado	2,500	-	-	-	-	-	2,000	-	-	-	-	-	4,500
4	Tea Leaves Sales	-	-	6,000	-	-	-	8,000	15,000	-	-	-	10,000	39,000
5	Banana Sales	-	-	2,700	-	-	-	950	-	-	-	-	1,700	5,350
6	Land Loan Recovered	-	-	-	-	-	-	-	2,000	3,000	-	-	-	5,000
7	Cocoa Beans Sales	-	-	-	-	-	-	-	-	-	-	50,000	-	50,000
8	Coffee Berry	-	-	-	-	-	-	-	-	-	-	7,000	-	7,000
	Total	3,100	-	16,075	-	2,500	-	17,075	27,000	16,750	3,000	57,000	25,450	167,950

The Substation's Dispensary

Appendix (Iv) Below Shows the Ailment Record For January To December 2020 In The Station:

Dispensary Report January – December 2020 Appeindix (Iv

Diseases	Jan	Feb	March	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
Malaria	28	17	30	11	18	6	4	2		7			121
Backpain	16	-	9	-	14	-	-	10	12	-	-	11	99
Cough	23	8	-	14	-	9	1	-	-	12	5	-	78
Catarrh	16	-	18	-	11	-	-	7	2	-	7	10	71
Heart burn	19	7	-	1	-	12	14	4	-	9	11	-	72
Body pain	11	6	17	-	-	11	-	-	12	-	-	19	76
Loss of appt.	12	14	-	13	7	-	9	8	-	-	13	-	76
Sore mouth	-	-	16	-	-	19	-	13	-	-	-	17	65
Diarrhoe	6	10	-	-	11	-	19	-	16	-	1	-	63
Accident	-	-	-	1	3	2	-	-	1	-	-	-	7
Sleepless night	12	-	11	-	-	14	-	-	1	-	-	-	38
Side pain	9	-	-	1	6	-	-	-	7	-	8	7	38
Vomiting	-	14	-	7	15	-	9	-	7	10	-	-	62
Typhoid fever	16	-	12	-	-	10	-	13	-	9	-	14	74
Cold	-	9	-	-	16	17	-	11	-	-	9	11	73
Chill	7	-	3	-	-	-	1	-	-	1	-	-	11
Stomach pain	8	8	-	-	11	-	12	-	14	-	19	-	59
Oedema	1	-	3	-	2	-	1	-	-	6	-	-	13
Neck pain	-	1	-	4	-	-	-	-	7	-	9	-	21
Hypertension	10	-	2	11	-	11	-	13	-	2	6	16	71
Headaches	21	17	22	1	-	-	14	-	15	-	1	-	91
Total	206	704	143	64	114	111	75	81	787	56	89	105	1,335

Visitors to Crin Mambilla Substation

A total of visitors visited the station within the year January – December 2020 appendix (v)

Date	Name	Address	Remarks
/01/2020	Adeyemi A. R.	CRIN – Headquarters Ibadan	
" " "	Akinwande O. O.	" " " "	
" "	Adukoya Olawlu	" " " "	
20/02/2020	Olaniyi O.O	" " " "	
" " "	Oloyede A. A.	" " " "	
" " "	Thomas Bukam	Local Government Area Gembu	
" " "	Mohammed Ali	" " " "	
14/8/2020	Ibrahim Bako	Patu Kamino Kurmi L. G. A.	
" "	Bako Yakubo	" " "	
18/4/2020	Prof. Vincent Ado Tenebe	VC Taraba State University, Jalingo	
" " "	James DSS BOSS	Local Government Area Gembu	
" " "	Mr. Thomas Tentishe Luka PhD Student	University of Calabar	
2/9/2020	Giidiga Johnson O.	Internal Auditor CRIN Ibadan	
" " "	Bakare Adeyemi	" " " "	
22/10/20	Sajoh F. Endince	National Identity Management Commission Gembu	
25/11/2020	Dr. S. O. Aroyeun	CRIN – Headquarters Ibadan	
" "	Dr. C. O. Jayeola	" " " "	
" " "	Dr. K. A. Oluyole	" " " "	
" " "	Dr L. E. Yahaya	" " " "	
" " "	Dr. R. O. Igbinadoler	" " " "	
" " "	Yahaya A. T.	" " " "	
" "	Agbebaku Edurance	" " " "	
" " "	Mr. Segun Oluwole	" " " "	
	Mr. Malande Caluraojule	" " " "	
7/12/2020	ALH. Sani Bakusi	Furmi Village	
10/12/2020	Mohammed Abubakar	Gembu	
15/12/2020	Kahya S. Shuaibu	NRCRI KURU JOS	
" " ""	Daniel A.	" " "	
18/12/2020	Haji Abubakar	Taraba State university	

Mambilla Substation's Needs

1. Four number of wheelbarrows for field work
2. Ten thousand poly pots and 4 rolls of poly sheets for raising tea cuttings in the nursery for gapping up and to increase tea holdings.
3. Ten (10) liters of pesticides/insecticides for the control of termites and other insect pest attacks on the field of the mandate crops.
4. Farmhouse for field workers
5. Mayo-selbe experimental station office building is at the verge of collapsing due to termite's damage to roof. There is need for renovation to arrest the situation.
6. Renovation of Rest House/HOS quarters and other staff quarters that are in deplorable condition.
7. NAFDAC Registration number on green tea.

IBEKU

Staff Disposition

The staff strength as of December 31, 2020, stood at nineteen (19). This comprises of eight senior staff, that is, the HOS, Station Accountant, three (3) Agric Superintendents, one (1) Secretariat Assistant and two (2) Chief Clerical Officers – one in store and the other in account, and eleven junior staff, that is, two (2) motor mechanic/driver, 1 watchman, 1 other watchman on borrow from the field, 6 field staff in Ibeku and only 1 field staff in Ugbenu Outstation.

Table 1. Staff list of CRIN Ibeku Substation as at 31st December, 2020

S/N	Name	Gl	Pf	Design.	Date of Birth	Date of 1st Appoint.
1	Dr. Okeniyi Michael O.	13/4	254	HOS/Chief Research Officer	10/12/70	02/01/2002
2	Mrs. U.N. Nmeregini	13/4	281	ACAS	21/10/68	25/09/2002
3	Mr. Borokini Olufisayo	11/4	367	PAS 1	27/03/79	08/02/09
4	Mr. Agbor Charles	8/6	432	PAS II	27/05/78	13/10/2010
5	Mr Ayoade Oluwole P				Deseased	
6	Mrs Nya Emem	7/3	534	HAS	17/12/90	03/03/2020
7	Mr. Onwubiko Michael	7/2	1521	CD	17/08/64	01/06/2003
8	Mr. Onyemuwa J.C.	5/2	1736	SMD/MI	15/05/66	17/03/2010
9	Mr. Eze Joseph	5/3	1680	ACAFO	13/06/67	02/01/2009
10	Mr. Animba Michael	5/3	1686	ACAFO	28/01/65	02/01/2009
11	Mr. Nwachukwu Benedict	3/12	1678	HW	10/06/67	02/01/2009
12	Mrs. Chibuo Oluchi	4/2	1679	AFA I	02/01/70	02/01/2009
13	Mrs. Ihueze Chinedu	3/12	1681	AFA I	15/08/68	02/01/2009
14	Mr. Chimaobi E. I	4/3	1683	AFA I	15/03/68	02/01/2009
15	Mr. Ani Cyril	3/6	1684	AFA I	18/11/63	02/01/2009
16	Mr. Nwachukwu Anthony	4/2	1890	AFA I	12/12/75	14/12/2011
17	Mr, Uwakwe Innocent	2/10	1892	AFA I	14/03/65	14/12/2011
18	Mr. John Muo	1/3	1976	FA	06/11/76	05/03/2020
19	Mr. Uwakwe Christopher	2/2	1976	FA	06/11/76	05/03/2020

Land Area

Please find below the landmark of CRIN Ibeku Substation:

Total land area: 80.0 hectares.

Effective hectares: 43.36 hectares

Ugbenu Cashew Experimental Outstation

Total land area: 19.33 hectares

Effective hectares: 11.20 hectares

Total Effective hectares: (43.36 + 11.20) hectares = 54.56 hectares

Activities

Field Activities: General maintenance of research and commercial plots - slashing, pruning, spraying, pollination, removal of mistletoes, fire tracing, harvesting, and processing of pods and ground maintenance of both office blocks at Ibeku and Ugbenu were taken care of.

Grass Cutting Using the Mower

Slashing of bushy areas

Achievements

Resuscitation of abandoned five hectares of cocoa plantation established in 1987

Establishment of 0-5 hectares cocoa germplasm

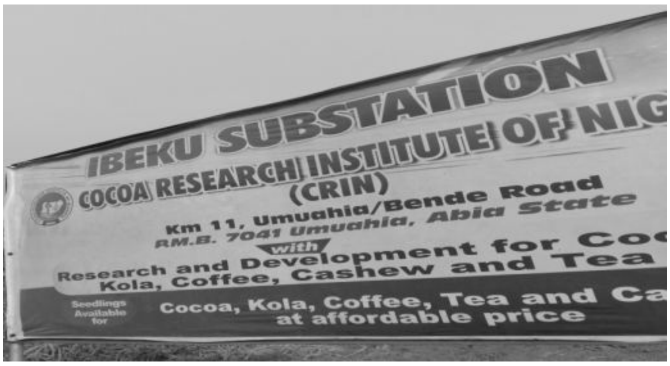
Maintenance of peace between the station and the host communities.

Internally Generated Revenue: A total sum of Four Hundred and Eighty-Nine Thousand and Ninety Naira only (N489,090) was realized in the year 2020. Below is the breakdown.

Table 2. CRIN IBEKU IGR

Sn	Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	Cocoa Beans	97,350	57,750	81840	-	-		-	-	-	-	65860	67340	370,140
2	Cocoa Pods	-	30,000	-	-		-	-	-	-	-	5000		35000
3	Agbalumo	-	-		-	-	-	-	-	-	-	-	-	
4	Ogbono	-	-		-	-	-	-	-	-	-	-	-	
5	Plantain	5300	19000	17,840	-	-	-	-	-	-	-	7600	-	49740
6	Banana	-	-		-	-	-	-	-	-	-	-	-	
7	Cashew Nut	-	-	30000	-	-	-	-	-	-	-	-	-	30000
8	Firewood	-	-	-	-	-	-	-	-	-	-	-	-	
9	Cocoa Seedlings	-	-	-	-	-		-	-	-	-	4200	-	4200
10	Palm Fruit	-	-	-	-	-		-	-	-	-	-	-	
	TOTAL							-	-	-	-	-		
		102,650	106,750	129680								82660	67340	**489,080**

Erection of New Signpost at the Station boundary: the signpost was erected to prevent land encroachment in Ibeku sub-station



Peace: We were able to maintain peace in the station and communities.

Office and Ground Maintenance: Regular maintenance of the office premises, cutting flowers/lawn thereby maintaining neatness of the office as commended by all visitors of the station in spite of the few labour we have.

Admin Block Frontage   Cutting of Grass with Hand Mower

Field Activities: General maintenance of research and commercial plots - slashing, pruning, spraying, pollination, removal of mistletoes, fire tracing, harvesting, and processing of pods and ground maintenance of both office blocks at Ibeku and Ugbenu were taken care of.

Cocoa Seedlings: Seedlings were raised to boost our IGR and for replacing dead cocoa trees in some of our plots.

Erosion and Slippery Floor Control: The station over the years have been suffering from erosion and slippery floor. We were able to control this by sand-filling the affected areas.

From the Gate to the Carpenter Shed

Pathway to Admin Block

Visitors: The following persons visited our office in the course of the year, Dr. Mrs Adeigbe, Dr. Adenuga, Dr. Olaniyi, Dr Olasupo and Mr Ajiroba

Challenges/Constraints

Lack of Adequate Work Force: Both Ibeku and Ugbenu lack adequate work force.

Chemical Spraying: The substation is in need of fungicides, herbicides and insecticides without which the crop productivity will be grossly reduced. Considering the humid weather at the substation, black pod disease is ravaging the pods coupled with high density of weeds due to shortage of labour and pesticides

Overhead: There is high dependency on fuel to keep the substation running effectively. Due to the fact that, out of the 6 substations CRIN Ibeku Substation is the only substation without residential quarters and electricity. The imprest is drastically too small and does not even come on monthly bases.

Vehicle Maintenance: The tyres of the station's utility Hilux Project vehicles need replacement. The NCSGP Hilux is currently faulty and needs a total overhauling.

Clinic: We urgently need a nurse and health attendants to administer drugs and first aid services in case of emergency like snake bite or accidental cutlass cut injury. There is neither Nurse nor Health attendants in an isolated place like CRIN Ibeku Substation since 2012.

Ugbenu Experimental Station: The outstation has only a staff since 2013 and supported by two Project Contract Workers engaged in 2016. No security staff in the outstation. No office in the outstation.

Furniture: Lack of good furniture. All furniture in the station are those that were in the office since inception of the station.

Road: Lack of good road from the station entrance to Admin Block to combat the serious erosion that has taken up CRIN Ibeku office.

Additional Staff Request by Cadre:

Security	10	(8 in Ibeku and 2 in Ugbenu).
Field Staff	48	(Following the standard set at the headquarters, CRIN Ibeku Substation will require nothing less than 55 field staff to cope with the current 54.56 effective hectares. Therefore, an additional 48 staff at the moment is needed to complement the existing 7 field staff.)
Nurse	1	
Health Attendant	2	
Secretarial Assistant	2	(The only Secretarial Assistant we have will retire this year.)
Clerk	2	
Driver	1	
Total	66	

Suggestions/Way Forward

Imprest: The imprest is drastically too small and doesn't even come monthly. An increase in the imprest will be highly appreciated and receiving it monthly will help us a lot.

Furniture: We need furniture in all offices of the station. The furniture we have are mostly bad and obsolete, they have been the ones there since inception of the station.

Equipment and Stationery: A brand new laptop and toner-based HP printers are needed in the station. The secretarial staff has nothing to work with since the PC in her office is totally bad and beyond repair. For over two years all typing is done in the accountant's office. We need reams of A4 printing papers, toners, staplers and other stationeries for the smooth administrative running of the substation.

UHONMORA (HOS**:** Dr. Adejobi K)

S/N	Name	Designation	Phone Number
1	Dr. Famuyiwa Busayo Solomon	HOS	08033978146
2	Edibo Gabriel	ACAS	08066545507
3	Philip Oguigo	ACAS	07033181107
4	Asein Oyakhire	SEO	08036657855
5	Oaihena Lydia (Mrs)	HEO	07031888644
6	Alaba Umahoin	CAFO	08062399335
7	Okpåise Idowu (Mrs)	CAFO	07060701641
8	Onoja Joseph	CD/M	07068129566
9	Iruobe Elizabeth	CCO	08067179194
10	Ifidon Ikhuoshio	PHA	07085713536
11	Anijese Funmilayo (Mrs)	CAFO	08065709602
12	Dannis Ojimah	ACAFO	08075154789
13	Amedu Achonu	ACAFO	08106290329
14	Ebale Benjamin	ACAFO	07083647934
15	Edeh Sim0n Tochukwu	ACAFO	07032472593
16	Nwagala Charles	ACAFO	08067179166
17	Amaze Augustine	ACAFO	08139184020
19	Joseph Ehidiamen	ACAFO	07037138092
20	Kokori Paul	AFA 1	08071310591
21	Imumolen Jeffery	FAF 1	08134881918
22	Okedion Friday	AFA 11	08135924292
23	Ehimika Ketu	AFA 11	09066749259
24	Jamgbadi Imoudu	AFA 111	09030653041
	Total	23	

Staff List and Disposition: The staff list at the station during the year under rev-iew is as shown below

Staff Disposition

Staff	Senior Staff	Junior Staff	Totalstaff
HOS	1		1
Agric Sup	2		2
Account	2		2
Transport	1		1
Health Officer	1		1
Field		9	12
Security		4	4
Total	10	13	23

Land Area
The Substation was established in 1967and situated along Uhonmora/Ekpoma road,

Crops planted
1. Cocoa
2. Cashew
3. Oil palm
4. Plantain

Research Activities
On-going research experimental plots were maintained in collaboration with the scientists involved. Some of the experiments under the station's supervision include:
1. Establishment of 1.2 hectares of budded and grafted cacao clones in D1 plot, in collaboration with World Cocoa Foundation (WFC) and African Cocoa Initiative (ACI)
2. Establishment of 0.5 hectares of Cocoa germplasm with plantain for distribution to cocoa farmers
3. Establishment of a research plot to determine the appropriate time and height of coppicing in a rehabilitated cacao plantation
4. Establishment of research plot to evaluate the effect of planting pattern of cacao seedlings intercropped with plantain on cacao establishment in the face of prevailing climate change
5. Field evaluation of cocoa pod husk biochar fortified with fertilizer on cocoa yield and soil pshysiochemical properties
6. Field establishment of Tea (*Camellia sinensis*) under varying watering regimes and different plantain shade levels
7. Effect of different geometry cacao intercropping with cocoanut in ideal and marginal cacao environments of Nigeria
8. Pesticides residue assessment across some cacao ecologies in Edo

Structural Development
Renovation of Account Apartment building that was started in 2020.

Achievements
1. Efforts were made to maintain our plantations with the little resources and available labour.
2. Nursery irrigation system
3. Production of 5,000 cocoa seedlings
4. Purchase of farm inputs
5. Revenue: A total sum of five hundred and seven thousand, eight hundred and thirty-one Naira Only (N507,831) was realized from the sales of farm produce and other services.

Potentials
1. The Substation is at an advantage of land mass if well-funded could have generated more IGR
2. Availability of stable electricity to power investment such as bakery
3. The Guest House can be furnished for use to generate more IGR
4. Establishment of germplasm materials in Cocoa to augment for Headquarters supply to farmers

Achievement
Internally generated revenue was five hundred and seven thousand, eight hundred and thirty-one naira only (N507,831) for year 2021. Five thousand cocoa seedlings worth N500,000 were freely supplied to Cocoa Association of Nigeria as directed by the Headquarters. Renovation of Account Apartment building Regular plot maintenance.

Challenges/Constraints
1. There was paucity of fund, and this affected the station negatively. Station's overhead which cares for the expenses of the day to day running of the station is not forthcoming and this makes the running of the station difficult.
2. Considering the enormity of the work in our plantation, the present field staff is grossly inadequate to take care of the work.
3. The field officer were not equipped with enough equipment such as cutlasses, files, safety boots and farm wears to work with
4. The Health Centre is moribund short of and health facilities to take care of the staff
5. The present number of security staff is inadequate for effective guarding of the office, staff quarters and plantations.
6. The effect of pandemic Covid 19 and the consequent sit at home by the Federal Government, culminated by the staff strike restricted the operation during the year.
7. No drinkable water to service the station
8. Serious fire out break

Suggestions for improvement

1. The overhead should be revived so that it will be regular. This will make it easy for the station to be taking care of her day-to-day expenses.
2. Provision of working inputs such as herbicides, pesticides, cutlasses, files, safety boots and farm coats
3. Provision of drinkable water either by borehole or well
4. The Substation's guest house needs to be furnished for our researchers that are coming from the headquarters to carry out research work at the substation.
5. Considering the enormity of the work in our plantations, there is a need for more farm workers to complement the few numbers on ground. The additional staff request by cadre is as follows:
   Field Attendant 1 10
   Security Guards 4

APPENDIX

Internally Generated Revenue

S/N	Item	Amount
1	Land Rent	99,500
2	Cocoa seedlings	200,000
3.	Palm oil	60,000
5	Plantain	40,000
6	Cocoa Pods	10,231
7	Access fee	8,100
	Total	**507,831**

OCHAJA (HOS Dr Oyedokun A.V.)

Table 1: The number of staff, their names, cadres/designation, and levels in the order of hierarchy in the Substation as at the time of this report:

S/N	Names	CONRAISS	Designation
1	Dr. A.V. Oyedokun	13	CRO/HOS
2	Mr. Uloko B.A.	13	CAS
3	Mr. Elugbe M.O.	12	ACAS
4	Mr. Okonta Patrick	11	PAS 1
5	Mr. Magaji Muhammed	11	PAS 1
6	Mr. Ibrahim Wasiu Adewale	8	HEO, ACCT.& AUDIT
7	Mr. Musa Ibrahim Yahaya	7	HEO, ACCT. & AUDIT
8	Mrs. Samuel Ladi E.	7	SSA 1
9	Mr. Oguche Nathaniel	6	CAFO
10	Mr. Ibrahim Noah	6	CD/MECH.
11	Mr. Opaluwa Pius	6	CAFO
12	Mrs. Aye Fatima	5	SAS
13	Mrs. Abah Janet	5	SHHA
14	Mr. Musa Abdullahi	5	ACAFO
15	Mrs. Yahaya Musa Adishetu	5	ACAFO
16	Mr. Nda Okpanachi	5	ACAFO
17	Mr. Alfa Ndah	5	ACAFO
18	Mr. Alih Muhammed	5	ACAFO
19	Mr. Attah Ojone	3	AFA 1
20	Mr. Unubi Attah	3	AFA 1
21	Mr. Alu Friday	3	AFA 1
22	Mr. Atawodi Jibrin	3	AFA 1
23	Mr. Otanwa John	3	AFA 1
24	Mr. Nifu Yahaya	3	AFA 1
25	Mr. Husseni Yahaya	3	AFA 1
26	Mr. Abubakar Yahaya	3	AFA 1
27	Mr. Simon Sunday	2	AFA II
28	Mr. Umoru James	2	AFA II

Land Resource of the Substation and Utilisation

Total land coverage of the Substation -351 Hectares
Total land area already cropped with cashew -59.2 Hectares
Total land area encroached upon by Indigenes - 17 Hectares
Newly cultivated Cashew Plot in 2018 & 2019 - 12 Hectares
Total land area under permanent crops cultivation - 71.2 Hectares:

Table 2: Details of the established plots in CRIN Ochaja Substation, Kogi State

Name	Spacing	Pedigree	Year Planted	Purpose	Hectarge
1.Demonstration Plot	9M X 9M	Oro Selection Cashew	1997	Commercial	2.0
2. Demonstration Plot	3.1M X 3.1M	Cocoa Trial Plot	2011/2012	Trials	0.45
3. Plot NE2/NW2	3.1M X 3.1M/ 9M X 9M	Cocoa/Oil palm Geometry	2009	Expt. Trial	2.0
4. Plot SE 5	9M X 9M	ashew Nut Size Trial/Oro Collection	1999	Expt. Trial	7.0
5. Plot SW 1	6.2M X 6.2M	Small Nut Cashew	1976	Commercial	3.2
6. Plot NW 1	6.2M X 6.2M	Medium and Small Nut Cashew	1976	Commercial	3.2
7. Plot NW/7	6.2M X 6.2M	Germplasm Collection	1977	Germplasm	2.2
8. Plot SW/2	6.2M X 6.2M	Small and Medium Nut Cashew	1977	Fertilizer Trial Expt.	4.2
9. Plot NW/9	3.2M X 3.2M	Varied Nut Cashew	1988	Intercrop Expt.	0.45
10. Millennium Plot	9M X 9M / 8M X 8M / 6M X 6M	Small and Medium Nut	2000	Systematic Spacing Experiment	4.0
11. Plot SW/3	6.2M X 6.2M	Small and Medium Nut	1976/1977	Pruning Experiment	6.4
12. Plot SW/4	9.1M X 9.1M	Small and Medium Nut	1982	Experimental Plots	2.0
13. Plot SW/5	6.2M X 6.2M	Germplasm	1976/1977	Germplasm collection	4.1
14. Plot NW/4	6M X 6M	Varied Nut Cashew	2011	Commercial	2.0
15. Higher Density Plot	9M X 9M / 8M X 8M / 6M X 6M	Varied Nut Cashew	2001	Experimental Trial	5.0
16. Germplasm Plot	6M X 6M	Oro Collection	2009	Germplasm Collection	5.0
17. Plot NW/3	4M X 4M	Varied Nut Sizes	2001	Nut size and Planting Spacing Expt.	1.5
18. CRIN Acharu	9M X 9M	Kola	2011/2012	Demonstration Plot	2.5
19. Newly Planted		Improved Cashew ariety	2018 & 2019	Commercial	12.0
Total Hectarage					71.2

Research Plots

Table 3: Research Plots and the corresponding Scientists

S/N	Project/Experiment Title	Scientist (Experimenter)
1.	Physical effects of intercropping cashew with some arable crops (completed her PhD work on the plot)	Dr.Mrs. Nduka B.A.
2.	Growth and yield of cashew as influenced by leguminous cover crops	Mrs. Iloyanomon C.J.
3.	Preliminary studies on yield differential and soil nutrient status of cashew plantations of different nut sizes in Ochaja Substation, Kogi State.	Mrs. Iloyanomon C.J,
4.	Leaf litter fall and soil nutrient dynamics of cashew plantations of different ages in Ochaja Substation, Kogi State	Mrs. Iloyanomon C.J.
5.	Field establishment of cashew as influenced by shade plants and phosphate fertilizers	Dr. Ibiremo O.S.
6.	Effect of coppicing period and height on cashew rehabilitation	Mrs. Adeyemi E.
7.	Cashew hybrid trials	Dr. Festus Olasupo
8.	Setting up of beehives to enhance cashew productivity project	Dr. Ibiremo O.S. *et al.*

Infrastructure

Table 4: Details of the Substation Infrastructure

S/N	TYPE	QUANTITY	DESCRIPTION	REMARK
1.	Office complex	7 Office Rooms, 1 Waiting Room, 1 Store, 1 Laboratory space	The Office Complex is the Administrative Block of the Substation.	The offices and the rest rooms require some levels of renovation. All the tables and chairs in the offices are obsolete and dilapidated, hence due for replacement. Periodical termite control is required to keep in check the economic damage effects of termites on the building complex. General ground maintenance around the office complex is being carried out as and when due.
2.	A	1	4 Bedroom Flat	Some facelifts and repairs were done in 2019 and the roof was completely removed and replaced. The building was renovated and termites eaten woods were changed. The facility was re-netted and painted. However, periodical termite control, replacement of all doors eaten by termites, buying of beds for the rooms and adequate plumbing work/installation to be done
3.	B	3	3 Bedroom Flat	Requires some levels of facelifts and periodical termite control
4.	C	1	3 Bedroom Flat	Ditto
5.	D	7	2 Bedroom Flat	In very bad state and requires serious renovations. One of the quarters (Quarter D4) was renovated by a contactor sent from the Headquarters.
6.	E	5	4 Units of 1Bedroom	All in very bad state and require serious renovation to improve the state of the facilities
7.	Rest House	1	2 Bedroom Flat	Renovated in 2019 to give it some facelifts especially the uncovered and leaking ceilings. The beds, mattress and bed sheets have to be replaced.

Other facilities include:

a. Central Toilet: 4 room central toilet for staff quarters' general use. Requires facelifts.
b. The Store: The Produce Store has no Raw Cashew Nuts as at the time of filing this report. The Cashew Nut Processing Factory gets its raw materials from this stock. Other Store materials (Technical and Stationeries).
c. The Cashew Juice Processing Factory has manually operated equipment that is not in too good conditions and thereby requires renovation and/or automation.
d. Cashew Nut Processing Factory also has manually operated equipment that requires automation in order to make profit from the business. Similarly, the Cashew Nut Processing Factory needs serious renovation, ceiling fixing and floor tiling in order to meet the standard of regulatory bodies like NAFDAC and SON.
e. The Substation Dispensary needs to be upgraded to provide Primary Health Care needs of the staff of the Substation as well as the host community (Ochaja). However, some drugs, materials and mini equipment are not available in the dispensary.
f. Water Borehole: A functional borehole is within the premise of the Substation with 8000 Liters Capacity Storage Tanks installed. This can be improved upon to ease the period of incessant pumping of water.
g. Power Generating Sets:
   i. A 50 KVA Electricity Generating Plant (Functional, no battery to start and no fund to power the se
   ii. 2.5 KVA Electricity Generating Set for Office Complex Use – very old, tattered and needs replacement with a new one.
   iii. Sumec 3800 Electricity Generator- for borehole use- functional
   iv. Portable Generator for Rest House Use – functional
k. Mini Weather Station – Non-functional except the obsolete Rain gauge. It requires overhauling and installation of digital weather station that is holistic in its functions.
l. Poultry House: It is within the Power Generating Set axis. This requires general renovation and overhauling as it had been seriously damaged by termite attack and the roof leaks seriously whenever rain falls.
m. The Security Post at the main entrance of the Substation needs urgent renovation and total change of the seriously leaking roof.
n. All the roads leading to and within the Substation require urgent attention. Many wooden electricity poles had been eaten up by the termites and are fallen on the road and this necessitates changing of the poles to concrete type before general grading of the roads.

Vehicles

Table 5: Details of the vehicles in he Substation

Vehicle	Condition	Remarks
Toyota Hilux (Petrol Engine)	Functional	Roadworthy but requires serious maintenance, servicing and running cost of the vehicle
Toyota Hilux (Diesel Engine)	Not functional	Engine needs overhauling, tyres and upholstery are to be replaced with new ones, to complement the only working Hilux Vehicle. However, it has been listed for boarding.
Bedford Lorry (Water Tanker)	Grounded for years	Already listed for boarding by the team of Auditors from Headquarters
Pegeout 504 Station Wagon	Grounded for years	Ditto
Pegeout Pick-up Van	Ditto	Ditto
MF Tractor with Trailer	Ditto	Ditto
Motorcycle TX 185	Not functional	Total overhauling required or new one should be bought. Listed for boarding.
Bazuki Tricycle	Functional	New Tyres and general servicing required
Motorcycle CG 125	Functional	Use for field work and minor runs of the Substation. New one is required

The main crop and only viable source of revenue in Ochaja Substation is Cashew, which the station head (H.O.S) and subordinate (co-staff) had been working very hard to protect and make sure revenue were generated and subsequently remitted to the purse of CRIN through the account department of Ochaja Substation.

The work force had already cleared the bush and are waiting for cashew fruiting and subsequently harvest when the pandemic (COVID 19) struck around March 2020.

Year 2020 was engulfed with by pandemic at a time we were expecting the cashew fruiting and harvest of cashew produce.

At this time federal government gave a directive for all workers below CONRAISS 12 to stay at home and there was no staff to call upon thereafter.

Cashew season (fruiting and harvesting) comes in between March and May or June sometimes, the fruiting and production period fell into the period of this stay at home ordered by the government due to the pandemic and there was no staff on ground to pick cashew produce from farm or prevent the villagers from stealing from the farm.

This gave the villagers a huge opportunity to invade the farmland and took away all the available farm produce and we were left with nothing, therefore the substation was unable to generate any revenue for the year ending 2020.

Fund Received from Headquarters

One Hundred and Ninety-Nine Thousand, Seven Hundred Naira only. (N199,700) was sent from CRIN Headquarters to Ochaja Substation twice, for the clearing and weeding of Ochaja Substation productive farm and quarters.

The return for the said amount has been rendered and submitted to the headquarters through the office of the Director, Production and Substations.

Office Maintenance and Upkeep Grant (Imprest)

Office maintenance and upkeep grants were not sent to Ochaja Substation in the year 2020, this maade it difficult for the station to maintain the available office and farm equipment, Bazuki Tricycle and other equipment that will be needed for the coming season.

Submitted for your information and further directives sir,

Yours faithfully

Capital Project

No capital project was carried out in the Substation within the year but a sum of N199,700.00(One Hundred and Ninety-Nine Thousand, Seven Hundred Naira Only) was given twice from the Headquarters to weed the plots and quarters in Substation making a total of N 399,400.00 (Three Hundred and Ninety-Nine Thousand, Four Hundred Naira Only)

Cash Received and Spent

No money or fund was sent to the Substation as overhead during the 2020.

Cashew Nut Kernel Production

Presently, the Cashew Processing Factory had some of the damaged equipment (Manual Nut Deshelling Machines and Roasting Chamber) due to persistent usage in the past and they are no more functional. A lot of requests had been made to refurbish the factory and give it a facelift renovation so as to become economically viable, but all efforts are to no avail.

Cashew Juice Production

In the year under review, there was no Cashew Juice production due to some materials challenges, coupled with COVID-19 pandemic lockdown.

Ground Maintenance

The ground maintenance of the quarters and office complex of the station was carried out promptly in the year 2020 to enhance cleanliness and proper sanitation of the environment. There were a lot of termite infestations which were combated chemically with the available chemicals in store at the Substation. Similarly, weed control was done periodically using herbicides, hand weeding and mechanically with the aid of hand mower before the COVID-19 Lockdown was declared by the Federal Government on 26th March 2020.

Achievements

The only achievement in 2020 was the clearing of plots and the staff quarters with the fund provided by the headquarters and fire tracing exercise to prevent fire from entering our plots.

Inspection, renovation and management of Kenyan Top Bar Beehives set up in the Substation. Unfortunately, Fulani Herdsmen harvested the honey and other by-products at about a week before we could harvest the honey and other by-products and they (Fulanis) burnt down many of the hives in the process of harvesting the honey. Fire tracing of about 60 hectares of total land areas cropped with cashew. Periodic maintenance of research and commercial plots.

Internally Generated Revenue (IGR)

The IGR of the station is mainly dependent on raw cashew nuts harvested from the Substation cashew plots. However, other sources of IGR in the Station include cashew nuts as planting materials, revolving loans, rent, processed cashew kernels and arable crops produced in the Substation. It is noteworthy that Cashew production this year could not be harvested due to COVID-19 Pandemic Lockdown declared by the Federal Government as it fell within the Cashew harvest period in Ochaja. No staff was on ground to work since the lockdown had been declared. This gave high rate of theft of the produce on the field by surrounding communities like Efikpo, Efekpe, Ijoji, Egume and Ochaja. These incidents have left the station with no harvest of cashew nuts for IGR in 2020.

General Observations

It was generally observed that the Substation had been neglected in terms of funding and the paucity of fund is thereby making Substation to function far below its capacity as an outreach center of the CRIN Headquarters.

The Substation can contribute immensely into the IGR of the Institute if properly funded to function as required as and when due.

Paucity of fund allocation to the Substations should be adequately addressed, in which capital projects like periodical road maintenance, power generation, processing facilities, plantation expansion, and boundary demarcation should be funded.

Manpower base of the Substation has to be expanded in the Security Unit of the Institute (presently, there are 2 Security Officers remaining b and also in the Field Production Unit to maintain the plots adequately as well as expanding the plantations. This can be made effective by employing Casual Workers (Special Project Staff) on a regular basis as Security Officers and also to see to plot maintenance and plantation expansion.

Additional staff need and request by cadre

(i)	Agricultural Field Attendants	-	15
(ii)	Watchmen	-	8
(iii)	Foremen	-	2
(iv)	Health Attendants	-	2
(v)	Rest House Attendant	-	1
			28

Challenges and Suggested Remedies

The Substation is poorly funded for maintenance of the Station and vehicle, motorcycle, and tricycle available being used in Station.

The Substation faces a lot of challenges in the area of theft of farm produce and other personal properties from neighboring communities like Ijoji, Efikpo, Egume, Efikpe and even Ochaja. Fund should be made available for constant patrol by the police especially at nights within the Substation's Residential Quarters and Farm.

It is therefore noteworthy that the Substation is short-staffed especially in the Security Unit that used to have 12 Officers which has now been reduced to 2 Officers, most of whom are aged and are not even sufficient for the job. The Station has no Foreman again who can do some repairs and other minor jobs that are highly essential within the Substation. The Substation also needs more Field Officers for maintenance of the old and new plantations as well as other plots. This can be made effective by employing Casual Workers (Special Project Staff) on a regular basis to see to plot maintenance and plantation expansion.as well as Casual Security Officers for patrol and vigilance both at the Residential Quarters and the field.

It was generally observed that the Substation had been neglected and thereby made to function far below its capacity as an outreach center of the CRIN Headquarters.

The Substation can contribute immensely into the IGR of the Institute if properly funded to function as required.

Paucity of periodic and adequate fund allocation to the Substations should be promptly addressed, in which capital projects like road maintenance, power generation; automated processing facilities, plantation expansion, and boundary demarcation with economic trees like oil palm, juggernaut and castor plant should be funded by the Headquarters.

Recruitment of new staff should be done at the Substation level especially where we have gap through retirement, shortage of manpower and even unfortunate situation like death.
Approval should be given Substation to involve Nigerian Security apparatus to curb the rate of theft of farm produce and other farm products in the Substation.
Capital projects that will enhance output from the Substation as well as enhancing the sustainable livelihood of Staff and the host community should be provided for.
The Headquarters have to be prompt in responding to the needs of the Substation before things go out of hand.
Establishment of functional Digital Weather Station in the Substation is essential and needful.
Renovation of the laboratory space within the office complex and acquisition of handheld equipment like GPS, USB Microscope, Environ-meter and other small laboratory equipment that could be powered by small generator to run some experimental procedures have to be provided to the Substation as this will help any resident and/or visiting scientists in their work at the Substation.
Renovation and Stocking of the station's Library with books, periodicals, and journals for the extension of CRIN findings to student and other stakeholders that will be visiting the Substation is germane and needful.
Also, indigenes encroach on the Institute's land for farming activities without the consent or approval of the Institute and every attempt to curb those people usually results in some friction between the perpetrators and Institute's staff. Similarly, the indigenes engage in wood felling activities on our plots and other Institute's land mass along Ochenwa Road and the Rivers Okura and Ideli Banks. Every move to stop them had not been fruitful despite reporting to the Area Command of Nigeria Police in Anyigba and termination letter served to one Mr. Zaccheus Ubolo who was given permission by the Headquarters prior to my resumption as HOS in 2016 to enter our plot for such activity. If we can bring in the service of Security apparatus like SARS and/or Civil Defence Officers, I believe it will curb their activities. If this act of deforestation is not curbed, it will eventually affect the Substation in the long run.
Fulani Herdsmen are invading our quarters, arable farm by the Institute and staff as well as newly established plots, burning bush, vandalizing beehives, and setting them on fire.

Conclusion

We deeply appreciate the Almighty God, for making it possible for us to have served the Institute in the year 2020, we trust in His grace and mercy for a more fruitful 2021.

Annexure

Figure 1: Renovated Rest House at the Substation

Figure 2: Quarters D4 at the Substation after renovation

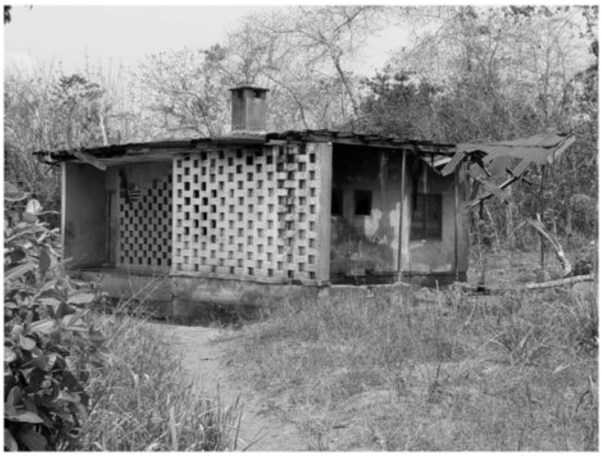


Figure 3: Quarters D4 at the Substation before renovation

Figure 4: Burnt plot where Beehives were set up after Fulanis had harvested the honey and set the hives

ADMINISTRATION AND SUPPLIES DEPARTMENT

The administrative and Supplies Department of the Institute applied itself meritorious to its primary responsibilities of supporting and assisting the Executive Director in the day-to-day administration of the Institute in conformity with the Institute's mandate and mission statement.

Structure of the Department

To facilitate the activities of the Department, the Department is structured into four (4) Division, Supplies Division and Health Services Division.

Two of these Divisions are further structured into the following sections.

Human Resources Management Division - Personnel Registry, Confidential Registry & Pension
Legal and Corporate Matters Division - Legal, Corporate, Catering Services & Open Registry
Supplies Division - Supply Section and Stores Section
Health Services Division - Dispensary and Maternity

Staff Strength

The Department has a total number of 100 staff.
They are summarized as follows:
26 professionals in Administration, 26 Executive Officers, 1 Confidential Secretary, 1 Data Processing Officer, 8 Secretarial Assistant, 6 Clerical Officers, 8 Nurses, 1 Higher Environmental Health Officer, 1 Health Information Record Officer, 1 Health Assistant, 2 Health Attendants, 1 Data Processing Assistant, 2 Catering Officers, 3 Catering Assistants, 5 Store Officers, 1 Storekeeper and 7 Field Assistants.

Functions/Activities of the Department

Detailed reports of the functions of the Department are as follows:

(i) Cost-effective management of a; the administrative activities of the Institute, including all elements of personnel function, Legal and Corporate Matters, incorporating Governing Board affairs and Public Relations.

(ii) Planning, organizing, co-coordinating and control of all activities, personnel, funds, materials, equipment and infrastructural resources in the Administration and Supplies Department of the Institute.

(iii) Identifying, articulating, formulating and reviewing from time to time and administrative activities of the Institute in compliance with statutory mandate of the Institute, current Government policies and priorities, as well as all rules and regulations for the management of Government Institutions and they affect the Institute, the demands of farmers for the Institute mandate crops and manufacturers of products derivable from the Institute's mandate crops, promotion of staff welfare and public image of the Institute.

(iv) Human Resources Management, including appointments, staff training and development, promotions, discipline, disengagement, post-disengagement, and staff welfare. Records of the administrative functions are highlighted below:

Achievement/Progress of the Department

Total staff strength

Year 2020 the total strength of the Institute's staff is 910 i.e Male: 595 and Female: 315

Promotions

Junior staff promotions done in year 2020, 78 junior staffs were promoted while 4 were given inter-cadre/conversion.

Senior staff promotions done in year 2020, 96 senior staff was promoted.

Training

As of 31 December 2020, no training due to COVID-19.

Left the Service

Total number of seventeen (17) staffs left the service based on length of service/age/death/resignation/transfer.

Leave Matters

All staff that requested for annual leave and casual leave got approval in year 2020, while five (5) staffs on maternity leave one (1) staff on leave of absence, one (1) sabbatical leave, four (4) staff on study leave without pay, four (4) staffs on compassionate leave and ten (10) staffs on exam leave.

Internal Management Committee Meetings

In year 2020, the Internal |Management held meetings seven times.

Governing Board Meetings

Governing Board had one physical meeting and two visual meetings in year 2020.

Corporate Visits

Four (4) corporate organization pay courtesy visit to the Institute.

INSTITUTE'S REST HOUSE

Activities of Institute's Rest House

1. Provision of menu refreshments for Governing Board members and other staff recruitment exercise facilitators.
2. Accommodation of staffs from CRIN substations on redeployment to CRIN Headquarters, Ibadan for the first 28 days.
3. Accommodation of guest during Senior and Junior Staff recruitment exercise for a week.
4. Accommodation of sixteen newly recruitment staff for the first 28 days.
5. Accommodation and provision of refreshment for IPPIS Officials for staff data capturing exercise.
6. Accommodation of a corper on national assignment at CRIN Headquarters, Ibadan.
7. Accommodation of auditors from Auditor general office, Abuja.
8. Accommodation of SSA Sectorial delegates for a week at CRIN Rest Houses.
9. Accommodation of NIMET officials from Abuja on Metrological assignment.
10. Accommodation and feeding of farmers delegates from Southwest State on Training at CRIN Headquarters, Ibadan (FMARD Training).
11. Generation of reasonable revenue from accommodation sales at CRIN Rest house.
12. General cleaning and maintenance of clean guests' rooms and surroundings couples with other Ad-hoc assignments.

Challenges/Constraints

1. Lack of regular electricity for guest usage and provision of wholesome water (lack of solar power).
2. Inadequate bedding materials and window curtains
3. Inadequate/old guest's towels and foot mats.
4. Renovation and refurbishing of the chalet buildings.
5. Inadequate staff as a result of staff statutory retirement.
6. Poor plumbing system.
7. Lack and poor wiring TV system.
8. Termite and bat invasion of the institute rest house as result of non-regular fumigation exercise.
9. Non-regular release of provisional approval sectional

monthly imprest.

10. Lack of cooperate revolving imprest for the occasional provision of large refreshment during any CRIN official functions.
11. Non-regular payment of approved cash request and reimbursement.

Achievement /Scope of the Future

The guest house has been generating reasonable revenue for the institute and immediately the guest house was given face-lift through renovation works, good image maker for the Institute because of warm reception tactics and good maintenance of CRIN mandate crops planted at the frontage of the Rest House.

HEALTH SERVICE

Dispensary

Between January – December 2020, total number of 3,990 patients were seen.

Maternity

From January-December 2020 total number of 1,090 patients were seen.

Delivery

Fourteen (14) babies delivered normally by Spontaneous vaginal delivery without any complication.

Family Planning

Sixty-six (66) clients attended the clinic.

Death

No death was recorded

Sick Off

Sick off were given to staff and casual depending on the medical condition presented at the clinic.

Referrals

Staff/non staff were referred to hospital for better management.

Imprest

Nil imprest received during the reporting year.

Immunization

Seven hundred and seventy-four (774) children were immunized against preventable disease, while the pregnant mothers too were immunized against Tetanus infection.

Staff Education

None of the staff Nurses or subordinates' staff was sponsored for any seminars/workshop in the reporting year.

Babies Party

This annual event does not hold due to COVID-19.

Achievements Within the Year

1. Presently the Division has an Environmental Health Officer
2. Both junior and senior staffs in the Division due for promotion were promoted to their next level in January 2020 and of course for the first time in the history of the Division, a position of Assistant Director in Nursing was obtained as due in NARIS and other Federal Government establishment. To God be the Glory.
3. Some of the nurses are now B.Sc. holders due to their quest for more knowledge.
4. Two (2) Nurses were sent for workshop at Centre for Management and Development (CCM), Lagos. Theme "Efficiency and performance improvement workshop" between 18-21 June 2019.

Challenges

1. Shortage of water especially during dry season at the health Centre.
2. Epileptic power supply making some procedures difficult especially during night shift.
3. Failure to implement the NHIS programme since accreditation.
4. Nonpayment of uniform allowances to Nurses.
5. Nil payment of imprest.
6. Lack of seminar/refresher course for staff.
7. Staff of internet facility.8. The low-turn out of patronage from April to July 2020 was because of Global Pandemic of COVID-19 necessitating rendering of skeletal services by the Medical and Paramedical staff.

SUPPLIES DIVISION

Year 2020 annual report of Supplies Division from 02 January – 31 December 2020. Some of the activities performed during the period under revie are as follows:

1. End of the year physical counting exercise was successfully carried out.
2. All items delivered into Institute Store are properly checked and certified to ensure the conformity of the materials to the quantity and quality required.
3. Receiving material into store and arranged them on the rack accordingly.
4. Tally cards were balance and always intact on the rack with the materials.
5. Sore ledger book was checked and balanced at the end of every month.
6. Taking materials uncharged accordingly.
7. Materials issued and releasing of fuel and lubricant were done without delay.
8. General cleaning of store houses and rearranging of stock were carried out.
9. Keeping vigilant of Store houses and stock.
10. Report writing
11. Internal and External Auditors were well attended to during their visit to the Division.
12. Obsolete materials were fished out for disposal.

Notes: Details and relevant documents of all the above listed activities are available in the Store.

Contract

Apart from purchased made by Procurement or individual, materials were also delivered into the Store through contractors or supplies. They are as follows:

1. Supply of Laboratory equipment by Ashfords Scientist Ltd., vide Pd2.
2. Supply of Rotary Evaporator by Moses Adewuyi Nig. Ltd., vide PD270/Vol.ll/33.
3. Supply of Laboratory Chemical by JC Richard Interbiz Service Ltd., vide PD270/Vol.ll/13
4. Supply of chemical and glass wear by JC Richard Interbiz Service Ltd vide PD270/Vol.ll/13.
5. Supply of Laboratory equipment by Moses Adewuyi Nig. Ltd vide PD270/Vol.ll/33
6. Supply of field tools by JC Richard Interbiz Service Ltd vide PD270/Vol.ll
7. Supply of CRIN community Radio studio materials by Mikkyway Multi Ventures Ltd., vide PD270/Vol.ll/29.
8. Supply of Steel grid & Co for Somatic Embryo Genesis by Ashford Scientific Ltd.
9. Supply of Air-condition & kit Reakyem Opa Consulting Ltd.
10. Supply of Television & DSTV by Halow-sway Consulting Ltd.
11. Supply of office materials & Furniture by Larry-well Mao & Co., Ltd. Vide PD270/Vol.ll/32.
12. Supply of working tools by Boboy Investments Ltd. Vide PD270/Vol.ll/235

Challenges of the division

1. Harmful and obsolete chemicals are yet to be disposed.
2. Protective and preventive materials are needed for safety of store personnel.
3. Computerization of store is required to enhance our performance of duties
4. Building of toilets at technical store.
5. Provision of working materials e.g., stationery, furniture, computer, and office equipment.
6. Store personnel training are highly required for more effective productive productivity in store activities.
7. Electricity connection at Research Store yet to be corrected.
8. More staffs are needed in the Division
9. Fumigation of store is required to stop the snakes, rats and vamps' disturbance.
10. Hazard allowance is required to motivate staff performance.
11. Strong doors and burglary proof for security purpose is yet to be attended to.
12. Protective nylon for tally cards.
13. Construction of net at medical store.
14. Imprest account to maintain the division is required.

The Future Expectation

- Computerization of the functions of Admin. & Supplies Department.
- Upgrading of inverter for the Department.
- Provision of good file cabinet.
- Provision of office equipment i.e., complete sets of computers, laptops, refrigerators, and air conditioners.
- Provision of impress regularly

ANNUAL REPORT

OF THE

COCOA RESEARCH INSTITUTE OF NIGERIA, IBADAN

2021

TABLE OF CONTENTS

.

COCOA PROGRAMME

Experimental Title: Structure and Use Pattern of Labour among Cocoa farmers in Nigeria

Investigators: Oluyole, K.A., Akinpelu, A.O. and Yahaya, A.T.

Introduction

Nigerian agricultural sector is dominated by small-scale farmers whose farms vary between 0.10 and 5.99 hectares in size and constitute about 80.35% of all the 29,800 million farm holdings in Nigeria (Ayanwale, 2002). Their farmers used traditional technologies called hoe-cutlass culture and their capital structure is in form of small tools and predominant usage of family labour (Oluyole *et al.*, 2009). Human labour is about the only main source of labour available to smallholder farmers in Nigeria. Smallholder farmers contribute over 85% of domestic agricultural output in Nigeria, hence, human labour accounts for domestic food supply in Nigeria. Therefore, the need to continue supplying food for the ever-growing Nigerian population anchors on human labour productivity. In Nigerian agriculture, hired labour is predominantly used. In fact, it carries 88% of the total labour used on farms (Okuneye, 2000). Apart from hired labour, the other types of labour that could be employed are family labour and cooperative labour. The availability of labour has been found to have impact on planting precision, better weed control, timely harvesting and crop processing (Oluyole *et al*., 2007). Therefore, labour is a major constraint in peasant production especially during planting, weeding and harvesting (Gocowski and Oduwole, 2003). According to Lele and Stone (1989), rapid growth in population which increases farm labour supply exerts so much pressure on land and reduces farm size per hectare. Empirical evidence has shown that available labour force comprised mostly of old people to the exclusion of young men and women within the active working age thus having a negative impact on agricultural productivity. This is because the role of youths in agricultural production cannot be over-emphasized.

With the foregoing, it could be observed that human labour plays a very significant role in agricultural development especially in the developing countries in which the level of technological development is still very low. In view of the importance of labour in agricultural production, this study was designed to investigate the structure and use pattern of farm labour in the study area.

Methodology

The project was carried out among cocoa farmers in Ondo State. Ondo East Local Government Area (LGA) was purposively selected from the State and from the LGA, Laagba community was also purposively selected because cocoa farmers are mostly concentrated in the community. Simple random sampling technique was used to collect data from a total of 144 farmers randomly selected from the community. Data were collected from the respondents with the aid of structured questionnaire and the data obtained from the questionnaire were analysed using Descriptive analysis. Descriptive Statistics was used to describe the socio-economic characteristics of the farmers as well as the structure and use of labour pattern in the study area.

Results and Discussion

The result of the socio-economic characteristics of the farmers is shown in Table 1. The table shows that 74.99% of the total respondents are above 50 years of age indicating that the proportion of old people among the respondents was very high. Meanwhile, only 25.01% of the total respondents were 50 years and below. The low number in the proportion of the youths is a bad pointer to cocoa production efficiency as younger farmers are more active on farm work than the aged ones. Table 1 also shows that 79.17% of the respondents were males. This is quite obvious in that farm work is a tedious work and is only men that could cope effectively with it. Apart from this, most of the farms were inherited and some traditional cultures permit only the male children to inherit farms. As regards the educational level of the respondents, the result of the analysis shows that 75.07% of the respondents were having formal education. This would improve the efficiency of the farmers in as much that literate farmers would find it easier to adopt new technologies on cocoa than the illiterate ones. The analysis on farm size shows that 66.67% of the respondents had farm size of 5 hectares and below which shows that most of the farmers are small scale farmers. Table 1 also shows that 50.0% of the farmers had the age of their farms greater than 30 years showing that most of the farms are old and hence the farm's productivity would reduce, therefore such farms needs to be rehabilitated. This is a good pointer to an increased productivity. Table 1 also revealed that majority (75.00%) of the farmers had purchased farms while just 12.5% inherited their farms.

Table 1: Socioeconomic Characterisics of Farmers

Variables	Frequency	Percentage
Age of farmers (years)		
≤ 30	6	4.17
31-40	6	4.17
41-50	24	16.67
51-60	48	33.33
>60	60	41.66
Total	144	100.00
Sex of farmers		
Male	114	79.17
Female	30	20.83
Total	144	100.00
Educational Status		
No formal education	36	25.00
Primary education	36	25.00
Secondary education	54	37.50
Tertiary education	18	12.50
Total	144	100.00
Marital Status		
Single	0	0.00
Married	126	87.50
Widow/widower	12	8.33
Divorced	6	4.17
Total	144	100.00
Farm size (Ha)		
≤ 5	96	66.67
6-10	30	20.83
11-15	18	12.50
Total	144	100.00
Age of farm (years)		
≤ 10	6	4.17
11-20	24	16.66
21-30	42	29.17
31-40	36	25.00
41-50	18	12.50
>50	18	12.50
Total	144	100.00
Nature of ownership		
Inherited	18	12.50
Purchased	108	75.00
Rented	12	8.33
Sharecropping	6	4.17
Total	144	100.00

Source: Field survey, 2021

Table 2 shows the structure of labour according to the different types of labour used for different activities in cocoa farming. The table shows that contract type of labour was majorly used for most activities in cocoa farming. However, cooperative labour was seldom used for any activity; this shows that cooperative labour is no more utilized in cocoa farming in the study area. Family labour was also utilized for all activities but at different magnitude. Activities such as land clearing, planting, weeding, application of chemicals, removal of misletoes, harvesting of cocoa pods, conveyance of cocoa pods to the pod breaking point, breaking of cocoa pods and conveyance of cocoa beans to the point of fermentation were majorly carried out by contract labour. This was because 75.0%, 83.32%, 95.83%, 91.67%, 87.50%, 87.50%, 95.83%, 100.0% and 88.33% of the farmers respectively indicated that they utilized contract labour for such activities. However, activities such as drying of cocoa beans, parking of dried cocoa beans and storage of cocoa beans were majorly carried out with family labour

Table 2: Distribution of labour by types of labour used for different activities in cocoa farming

Activities	Types of Labour					
	Family		Contract		Cooperative	
	Freq	%	Freq	%	Freq	%
Land clearing	36	25.00	108	75.00	0	0.00
Planting	18	12.5	120	83.33	0	0.00
Weeding	6	4.17	138	95.83	0	0.00
Application of chemicals	24	16.67	132	91.67	0	0.00
Application of fertilizer	12	8.33	108	75.00	0	0.00
Removal of mistotoes	6	4.17	126	87.50	0	0.00
Harvesting of cocoa pods	30	20.83	126	87.50	0	0.00
Conveyance of cocoa pods to the point of pod breaking	24	16.67	138	95.83	0	0.00
Breaking of cocoa pods	42	29.17	144	100.00	0	0.00
Conveyance of cocoa beans to fermentation spot	42	29.17	120	88.33	0	0.00
Fermentation of cocoa beans	42	29.17	96	66.67	0	0.00
Conveyance of cocoa beans from the fermentation spot to the drying spot	38	25.00	108	75.00	0	0.00
Drying of cocoa beans	144	100.00	12	8.30	0	0.00
Parking of dried cocoa beans	144	100.00	6	4.17	0	0.00
Preservation of cocoa beans	144	100.00	0	0.00	0	0.00

Source: Field survey, 2021.

Table 3 shows the distribution of the labour used for cocoa farm activities based on the gender of the labour. The table shows that male labour was mostly utilized for all the activities as indicated by most respondents. On the other hand, female labour were sparingly utilized for some activities such as land clearing, planting, application of chemicals (spraying of chemicals), removal of mistletoes and harvesting of cocoa pods as only 8.33%, 0%, 8.33%, 4.17%, 0% and 12.5% of the farmers. However, female labour were mostly used for conveyance of cocoa pods to the point of pod breaking, breaking of cocoa pods, conveyance of cocoa beans to the spot for fermentation and drying of cocoa beans.

Table 3: Distribution of labour by the gender of labour used for different activities in cocoa farming

Activities	Gender of labour			
	Male		Female	
	Freq	%	Freq	%
Land clearing	144	100.00	12	8.33
Planting	144	100.00	0	0.00
Weeding	126	87.50	12	8.33
Application of chemicals	126	87.50	6	4.17
Application of fertilizer	114	79.17	24	16.67
Removal of mistletoes	126	87.50	0	0.00
Harvesting of cocoa pods	114	79.17	18	12.50
Conveyance of cocoa pods to the point of pod breaking	120	83.33	126	87.50
Breaking of cocoa pods	126	87.50	132	91.67
Conveyance of cocoa beans to fermentation spot	144	100.00	138	95.83
Fermentation of cocoa beans	120	83.33	12	8.30
Conveyance of cocoa beans from the fermentation spot to the drying spot	120	83.33	132	91.67
Drying of cocoa beans	138	95.83	120	83.3
Parking of dried cocoa beans	126	87.50	30	20.83
Preservation of cocoa beans	132	91.67	24	16.67

Source: Field survey, 2021

Conclusion

The study was carried out on the structure and use pattern of labour among cocoa farmers. The study found out that labour could be structured according to the types of labour (family labour, contract/hired labour and cooperative labour) and according to the gender of the labour. The study further revealed that contract labours were mostly used for activities such as land clearing, planting, weeding, application of chemicals, removal of mistletoes, harvesting of cocoa pods, conveyance of cocoa pods to the pod breaking point, breaking of cocoa pods and conveyance of cocoa beans to the point of fermentation while family labour was mostly used for drying of cocoa beans, parking of dried cocoa beans and preservation of cocoa beans. However, it was revealed that cooperative labour was no more used as a form of labour in the study area.

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Experimental Title: Cocoa Pests Index Mapping: Case Study of Ondo and Osun States, Southwestern Nigeria

Investigators: Dongo, L.N., Adeniyi, D.O., Asogwa, E.U., Orisajo, S.B., and Adeji, A.O.

Introduction

Cocoa production is common to smallholder farmers in the regions of high biodiversity, which is also characterized with varieties and pests' complexes. Several factors have contributed to the decline and dwindling production of cocoa in which black pod disease is key in Nigeria and Africa among many other pests. Cocoa unfortunately is threatened by many biotic and abiotic constraints resulting in significant yield losses. Among biotic constraints, diseases and insect pests are the most damaging which compromise the yield in terms of quality and quantity.

Research reports have indicated associations of many pests (virus, fungi, nematode, weed etc) with cocoa and economic implication of these pests on cocoa yield and quality varied among growing communities in Nigeria. *Phytophthora* probably causes more production losses globally than any other disease of cocoa; pathogen has several hundred recorded hosts and is of universal importance in cocoa, causing global yield losses up to 20 to 30% and tree deaths of up to 10% annually, although individual farms in wetter cocoa-growing areas may suffer total loss. However, variations and genus diversity have been recorded in many growing communities especially with the most virulent *P. megakarya* common to West Africa.

In lieu of this, the experiences with pests in other producing countries demonstrate that an early action is of the utmost importance in management and limiting production losses. Unfortunately, despite the socio-economic and environmental importance of cocoa in Nigeria, data on pest index mapping are scarce to obtain. However, such country-specific data especially on cocoa will serve as pre-requisite for development of efficient management strategy and a guide for investor in cocoa production in Nigeria.

The study aim of this study is to fill this gap by compiling an inventory of pests (insects, fungi, nematodes, viruses, weeds, parasites etc) associated with cocoa production across varied ecologies.

The objective is to develop a compendium and banks of pests of concern in cocoa production in growing ecologies of Nigeria.

Materials and Methods

The survey/inventory (distribution and damage characteristics) of pests were carried out in selected cocoa farms in Ondo and Osun states (South-West), Nigeria. The pest's sampling was carried out between September and October 2021 in three (3) farms each in three (3) different Local Government Areas of the States. The farms were sampled by systematically traversing the plots at both diagonals and longitudinal ends. Cocoa trees were closely observed for insect species, diseases symptoms and weed association on the trees and farms. Farm data was taken which comprised of location, farm name/owner, LGA, crop, date, and plant part collected.

The intercepted insects were identified and characterized. Infected pods, leaves were collected after observation and labelled in sterile Ziploc bags and transported to laboratoryfor further studies. Samples of soils were randomly collected across the farm sites in sterile sample bags and assayed for nematode population. All the farms' sites were geo-referenced, and the GPS coordinate recorded.

Cocoa samples and fungi isolates were subjected to morphological (identification, photomicrographs) and molecular (DNA extraction, Electrophoresis, PCR, Sequencing) characterization at the molecular facility of UPENDO Bioinformatics Services, Ibadan, Nigeria. The percentages of insect pest infestation of the farms were assessed and the pest mapping of the areas were carried out using four (4) points scale as follows: 10-25% farm infested (low pest incidence), 30-50% farm infested (average spread), 55-75% farm infested (moderately spread),), 76-100% farm infested (widely spread). The nematode assay was conducted by staging the randomly collected soil samples in a sieve underlined with sterile tissue paper layered in doubles. The staging was carried out for five to seven days and nematode population collected in Eppendorf bottles were quantified using stereo microscope.

Result and Discussion

Symptoms Description of intercepted disease: The Black pod developed by an initial symptom with a small translucent spot-on cocoa pod, around 2-3 days after infection, then turns brown, eventually darkens and the spot cover the entire pod between 7 – 14 days under humid conditions. Whitish spores may be produced three to five days after the appearance of the first symptom depending on species. Black pod disease symptoms due to *P. megakarya* are however, characterized by multiple lesions which spread fast and coalesce showing abundant bloom of white zoosporangia on the lesion except for about a centimeter from the advancing margin of the lesions and varied stages of pod development may be infected (Adeniyi, 2019).

Morphological characterization of the intercepted pathogen: White, cotton-like appearance, with dense cottony mycelium. Mycelia are white and fluffy; hyphae are hyaline but multinucleate (coenocytic). Globose oogonia are spherical, with diameter of 25–33 µm). Possess sympodial sporangiophores and spherical amphigynous antheridia. Oospores are globose and aplerotic. Another isolate showed the mycelia as white and fluffy; hyphae are fairly uniform and hyaline. Globose oogonia are pyriform, 22–30 µm in diameter. Oogonium is tapered at the base to a funnel shape. Possess sympodial sporangiophores and elongated amphigynous antheridia. Oospores are globose and plerotic (fills the oogonium). Yet another isolate showed whitish grey mycelial with dense, fluffy culture. The colony was uniform, cottony to greyish brown, became dark olivaecious with dense aerial mycelium. Mature conidia were septate, colored, and oval-shaped with irregular longitudinal striations.

Microscopic characterization of the intercepted pathogen and sequencing: These activities are on-going and at advance stage of completion.

The nematode assayed showed presence of species of *Melionigyne*and *Parelentycus*in large numbers and many other unidentified species at juvenile stages of growth in all the soil samples.

Developmental stage of black pod disease dependent on susceptibility of cocoa pod (Ndoumbe-Nkeng 2002), there was a link between the fruit developmental stages and pod rot incidence and immature fruits were more susceptible (Deberdt *et al.,* 2007). However, under field conditions, fruit susceptibility to black pod disease depend on the genetic composition of the pathogen population (Ducamp *et al.,* 2004), the climatic conditions (Ndoumbe-Nkeng *et al.,* 2009), and on infectious potential of the pathogen. Susceptibility of a fruit to a disease is a factor of infection efficiency; ratio of lesion density to inoculum density (Xu and Robinson 2010).

The susceptibility of cocoa fruits depended on the developmental stage but not on the position of the fruit on the tree (Takam Soh, 2013), however, Martijn ten Hoopen et al., (2012) stated that susceptibility of cocoa fruit depended on the position of the fruit on the tree, this contradiction was cleared by by the age of the trees in the study farms where increasing amounts of inoculum are deposited on the tree trunk. Susceptibility estimates showed that cherelles were more susceptible to pod rot than young and adult pods and no significant difference in susceptibility between the young pods and adult pods. *Phytophthora megakarya* is the most aggressive fungal pathogen on *Theobroma cacao* L. and poses a major threat to cocoa production in West and Central Africa. It was originally identified in Nigeria in 1979 (Brasier *et al.*, 1981), currently *P. megakarya* is the predominant species responsible for black pod disease of cocoa in the sub region (Opoku *et al*., 1997, 2000). Every stage of pod development is susceptible to infection, but immature pods are the most susceptible. The first symptom observed on cocoa pods infected by *P. megakarya* is the appearance of a small translucent spot about 2 to 3 days after infection. Under humid conditions, the spot turns brown and then darkens and spreads rapidly to cover the entire pod within 7 to 14 days. Three to five days after the appearance of the first symptom, whitish spores are produced. Pod rot symptoms due to *P. megakarya* however, are characterized by multiple lesions which spread fast and coalesce with an abundant bloom of white zoosporangia on the lesion except for about a centimetre from the advancing margin. *Phytophthora megakarya* has become the main yield-limiting factor for cocoa production in affected areas (Opoku *et al.,* 2000), the documented host range of *P. megakarya* is limited.

Ondo State Pests mapping

Survey of Bolorunduro LGA, Ondo

Farm 1
Village : Fagbo village
Latitude: 7'6"13°N
Longitude: 4'58"19°E
Diseases intercepted: Black pod
Pathogens intercepted: *Phytophthora speices*
Insects intercepted: Mirids, Termites, Pod husk borer & Grasshopper
Weeds intercepted: *Dryopteris,* Green carpet (*Mosses*)
Nematode population: 75

Farm 2
Village: Arugbo village
Latitude: 7'4"34°N
Longitude: 4'58'27°E
Diseases intercepted: Black pod, Cherelle wilt
Pathogens intercepted: *Lasiodiplodia*species, *Phytophthora* species
Insects intercepted: Insects intercepted: Termites, Pod husk borer & Grasshopper
Virus intercepted: Red vein banding on young cocoa flushes (CSSV suspected)
Weeds intercepted: *Dryopteris*
Nematode population: 3

Farm 3
Village : Fagbo Oja
Latitude: 7'5"45°N
Longitude: 4'58"3°E
Diseases intercepted: Black pod
Pathogens intercepted: *Phytophthora* species, *Lasiodiplodia*species
Insects intercepted: Termites, Pod husk borer & Grasshopper
Weeds intercepted: *Dryopteris*
Nematode population: 108

Survey of Idanre LGA, Ondo

Farm 1
Village : Aponmuoke-maye village
Latitude: 7'10"32°N
Longitude: 5'2"22°E
Diseases intercepted: Black pod, Cherelle wilt, yellow okra
Pathogens intercepted: *Phytophthora* species, *Lasiodiplodia*species
Insects intercepted: Mirids, Termites, Pod husk borer & Grasshopper
Weeds intercepted: green carpet (*Mosses*), Mistletoes
Nematode population: 34

Farm 2
Village : Owena village
Latitude: 7'11"59°N
Longitude: 5'1"28°E
Diseases intercepted: Black pod
Pathogens intercepted: *Phytophthora* species, *Lasiodiplodia*species
Insects intercepted: Termites, Pod husk borer & Grasshopper
Virus intercepted: red vein banding on young cocoa flushes (CSSV suspected)
Nematode population: 163

Survey of Akure South LGA, Ondo

Farm 1
Village : AponmuOlokuta
Latitude: 7'13"55°N
Longitude: 5'5"0°E
Diseases intercepted: Black pod
Pathogens intercepted: *Phytophthora* species
Insects intercepted: Mirids, Stem borer, Shield bug, Termites, Pod husk borer & Grasshopper
Nematode population: 152

Farm 2
Village : Aponmu
Latitude: 7'13"53°N
Longitude: 5'5"0°E
Diseases intercepted: Black pod
Pathogens intercepted: *Phytophthora* species
Insects intercepted: Mirids, Stem borer, Shield bug, Termites, Pod husk borer & Grasshopper
Virus intercepted: red vein banding on young cocoa flushes (CSSV suspected)
Weeds intercepted: *Dryopteris*
Nematode population: 289

Farm 3
Village : Aponmu Loba-Loba
Latitude: 7'4"'41°N
Longitude: 5'3"19°E
Diseases intercepted: Black pod, Cherelle wilt
Pathogens intercepted: *Phytophthora* species
Insects intercepted: Mirids, Stem borer, Shield bug, Termites, Pod husk borer & Grasshopper
Weeds intercepted: *Dryopteris,* Green carpet (*Mosses*)

Table 1: Summary index of major cocoa pests in Ondo State farms

Intercepted pest	Percentage (%) pest Incidence in all farms									Average
	Ondo East LGA			Idanre LGA			Akure South LGA			
	F1	F2	F3	F4	F5	F6	F7	F8	F9	
Diseases										
Black pod disease (*Phytophthora megakarya*)	20	54	18	22	45	20	10	22	15	25.1%
Cherelle wilt		12		45						6.3%
Yellow okra				35						
Cocoa Swollen Shoot VirusDisease (CSSVD)		+			+			+		100%
Insect pests										
Cocoa mirids (*Sahlbergellasingularis*)	3	0	0	5	0	0	7	6	5	2.9%
Cocoa stem borer (*Eulophonotusmyrmeleon*)	0	0	0	0	0	0	2	0	1	0.3%
Termites *(Macrotermesbellicosus*)	7	5	9	6	4	0	5	10	8	6%
Shield bug (Bathycoeliathalassina)	0	0	0	0	0	0	4	2	1	0.8%
Pod husk borer *(Characomastictigrapta)*	3	5	7	2	4	0	6	3	3	3.7%
Psyllid *(Mesohomotomatessamanni)*	0	3	0	0	4	0	2	0	1	1.1%
Grasshopper (*Zonocerous variegatus)*	4	2	1	5	3	0	3	1	4	2.6%
Mistletoe (*Tapinanthusbangwensis)*				35						3.8%
Mosses	5			6					6	1.8%
Dryopteris	6	16				7		4	5	4.2%
Squirrels	4	5	7	5	4	6	4	3	5	4.8%

Osun State Pests Mapping

Survey of Atakumosa West LGA, Osun

Farm 1

Village : Awori

Latitude: 7'37"13°N

Longitude: 4'41"46°E

Diseases intercepted: Black pod

Pathogens intercepted: *Phytophthora* species

Insects intercepted: Mirids, Termites, Pod husk borer & Grasshopper

Weeds intercepted: green carpet (*Mosses*)

Nematode population: 14

Farm 2

Village : Awori 2

Latitude: 7'21"28°N

Longitude: 4'99"32°E

Diseases intercepted: Black pod, Cherelle wilt

Pathogens intercepted: *Lasiodiplodia*species

Insects intercepted: Mirids, Termites, Pod husk borer & Grasshopper

Virus intercepted: red vein banding on young cocoa flushes (CSSV suspected)

Weeds intercepted: *Dryopteris,* Green carpet (*Mosses*)

Nematode population: 145

Farm 3

Village : Aba Odole

Latitude: 7'36"59°N

Longitude: 4'41"37°E

Diseases intercepted: Black pod

Pathogens intercepted: *Phytophthora* species

Insects intercepted: Mirids, Termites, Pod husk borer & Grasshopper

Weeds intercepted: green carpet (*Mosses*)

Nematode population: 164

Survey of Atakumosa East LGA, Osun

Farm 1

Village : TemidireIwara

Latitude: 7'30"1°N

Longitude: 4'41"54°E

Diseases intercepted: Black pod

Pathogens intercepted: *Phytophthora* species

Insects intercepted: Mirids, Stem borer, Termites, Pod husk borer & Grasshopper

Weeds intercepted: green carpet (*Mosses*)

Nematode population: 114

Farm 2
Village : Iwara 2
Latitude: 7'30"1°N
Longitude: 4'41"54°E
Diseases intercepted: Black pod
Pathogens intercepted: *Phytophthora* species
Insects intercepted: Mirids, Stem borer, Termites, Pod husk borer & Grasshopper
Weeds intercepted: green carpet (*Mosses*)
Nematode population: 54

Farm 3
Village : Olukiri Junction
Latitude: 7'30"31°N
Longitude: 4'42"20°E
Diseases intercepted: Black pod
Pathogens intercepted: *Phytophthora* species
Insects intercepted: Mirids, Stem borer, Termites, Pod husk borer & Grasshopper
Virus intercepted: chlorosis/ vein clearing on mature leaf
Nematode population: 22

Survey of Ayedade LGA, Osun

Farm1
Village : Agoowu 1
Latitude: 7'10"17°N
Longitude: 4'5"50°E
Diseases intercepted: Black pod, Cherelle wilt
Pathogens intercepted: *Lasiodiplodia*species
Insects intercepted: Mirids, Stem borer, Shield bug, Termites, Pod husk borer, Psyllids & Grasshopper
Nematode population: 83

Farm 2
Village : Agoowu 2
Latitude: 7'10"20°N
Longitude: 4'5"57°E
Diseases intercepted: Black pod, Cherelle wilt
Pathogens intercepted: *Lasiodiplodia*species
Insects intercepted: Mirids, Stem borer, Shield bug, Termites, Pod husk borer, Psyllids & Grasshopper
Nematode population: 50

Table2: Summary index of major cocoa pests in Osun State farms

Intercepted pest	Percentage (%) pest Incidence in all farms									Average
	Atakunmosa West			Atakunmosa East			Ayedade LGA			
	F1	F2	F3	F4	F5	F6	F7	F8	F9	
Diseases										
Black pod disease (*Phytophthora megakarya*)	25	40	30	15	14	10	11	25		18.8%
Cherelle wilt							25	10		3.8%
Cocoa Swollen Shoot Virus Disease (CSSVD)		+				-	-			25%
Insect pests										
Cocoa mirids (*Sahlbergellasingularis*)	13	20	10	25	15	10	40	35	0	18.7%
Cocoa stem borer (*Eulophonotusmyrmeleon*)	0	0	0	3	2	1	7	10	0	2.6%
Termites *(Macrotermesbellicosus*)	7	15	9	7	14	10	15	20	0	10.8%
Shield bug (Bathycoeliathalassina)	0	0	0	0	0	0	5	3	0	0.9%
Pod husk borer *(Characomastictigrapta)*	5	7	10	6	4	7	16	13	0	7.6%
Psyllid *(Mesohomotomatessamanni)*	2	0	3	0	2	1	4	2	0	1.6%
Grasshopper (*Zonocerous variegatus*	6	5	3	7	4	2	8	6	0	4.6%
Other pests										
Mistletoe (*Tapinanthusbangwensis)*										
Mosses	50	30	50	25	28	-	-	-	-	20.3%
Dropteris			50							5.5%
Squirrels	5	7	3	6	4	5	4	2	5	4.6%

Conclusion and Recommendations

The farmers in most of the farms visited do not know about the CRIN Elite Cocoa varieties. They simply collect pods from their neighbors' or their plots to plant. Only very few of the farmers in all locations have gotten any form of assistance from the Government.There is therefore the need for CRIN to embark on aggressive training/sensitization programmes for the farmers as to encourage them. The government should set up processing industries in the various states for the utilization of the readily available cocoa beans in these farms.

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Experimental Title: Empirical Establishment of the Productivity of CRIN Cocoa Hybrids TC_1-TC_8 in Nigeria

Investigators: Adedeji A. R., Lawal, J. O., Famuyiwa B. S., Taiwo O. A., Orisasona T. M. and Ayegboyin, K. O.

Introduction

The importance of agriculture to the Nigerian economy cannot be under-estimated. In Nigeria, Cocoa occupies about 0.6 million hectares and production stands at 383,000 tonnes in 2012 (FAOSTAT, 2014). The average cocoa yield in West Africa is about 0.5 tonnes/ha while for Nigeria it is around 0.4 tonnes/ha. This suggests that yield in Nigeria is low compared to the world average. Cocoa remains one of the highest foreign exchange earners among all agricultural export crops in Nigeria. After its introduction into the zone of West Africa sub- region in 1890, the area planted to cocoa increased rapidly to its present 0.7 million hectares and yield increased to peak of 310,000 tons in 1965 (Daramola, 2004) but the output declined over the years.

In 2018, Nigeria's earnings from cocoa were put at over N103 billion. The country produced about 270,000 metric tons last year, in the 2020/21 year, up from 250,000 in the 2019/20 season. And it was insinuated that this year's 2021/2022 output could fall to 250,000mt.

Some other factors responsible for the reduced cocoa output is the weather issue and late rainfall, high cost of inputs and also gradual depletion of soil fertility in cocoa growing agro-ecologies; soils with rapidly degraded properties and highly acidic due to the nature of their parent materials and leaching of the nutrients in some areas. Many other studies attributed the cocoa yield decline essentially to soil nutrients imbalance and poor planting materials (Ayanlaja, 2002 and Ojeniyi, 2010).

Problem Statement

Despite the vast hectares of land been used for cocoa farming in Nigeria, the productivity has been low. The Cocoa Research Institute of Nigeria (CRIN) introduced some new cocoa hybrids named (TC_{1-8} series) to the farmers in 2011but the empirical determination of the average number of cocoa beans per Kg, actual number of dry cocoa beans per Kg, number of pods that make one Kg of dry cocoa beans and the number of pods per tree as well as the average annual yield per hectare of cocoa hybrids TC_1 to TC_8 have not been established to determine the simple but very vital information for sustainability and profitability of its production in Nigeria. To this end, it became pertinent to determine these parameters at the CRIN headquarter and at the farmers' farms. Hence the urgent need to critically examine the yield parameters of the new varieties of cocoa.

Specifically, this research study was based on the following objectives:

1. To determine the average number of cocoa beans in a pod.
2. To evaluate the average number of pod production per tree per year.

Methodology

The study was carried out in four different states while purposive sampling technique was used for selection of the four states namely: Ondo, Ogun, Oyo and Cross River

States. In each of the states, 6 Local Government Areas (LGAs) were selected for sampling. In Ondo State, Owena, Ile-Oluji/Okeigbo, ldanre, Akure-South, Irele and Akure-North LGAs were covered and for Ogun State, Ijebu-North, Ijebu-East, Egbado-North, Egbado-South, Obafemi Owode/Ota and Abeokuta-North were covered. In Oyo State, the LGAs covered were Oluyole, Atiba, Afijio, Ido Akinyele, and Ogo-Oluwa while for Cross River State the LGAs sampled were Ikom, Etung, Boki, Obubra, Ogoja and Akamkpa. A total of 24 LGAs were used for the study. However, two farmers with different farms were randomly selected from the list of those that had collected the hybrid cocoa podsTC_{1-8} series from CRIN in 2011 and six trees were tagged from each farmer's farm for the purpose of this study. The respondents were asked to harvest and record the pods from all tagged trees of TC_{1-8} series to achieve the study's objectives. In all, 48 farmers' farms were sampled, and 288 cocoa trees tagged for the study.

The farmers were trained on how to take data on the tagged trees while relevant data on the average beans in a pod as well as the actual number of pods per tree yield per year were collected to achieve our aims and objectives. The data collected were analyzed using descriptive statistics.

Results and Discussion

Respondents' Knowledge of Good Agricultural Practices (GAP)

Table 1 shows the respondents' knowledge of GAP. Majority (68.4%) of the farmers indicated that they have fair knowledge of GAP while only 14.9% had high knowledge. This is an indication that majority of the farmers who collected the hybrid cocoa materials did not strictly follow Good Agricultural Practices (GAP) which are the basic requirements for optimum performance of the hybrid crops. Hence, this also reveals that many cocoa famers in Nigeria might not be following right production techniques and could have contributed to the current decline in the general cocoa productivity in Nigeria.

Table 1: Showing Respondents' Knowledge of GAP

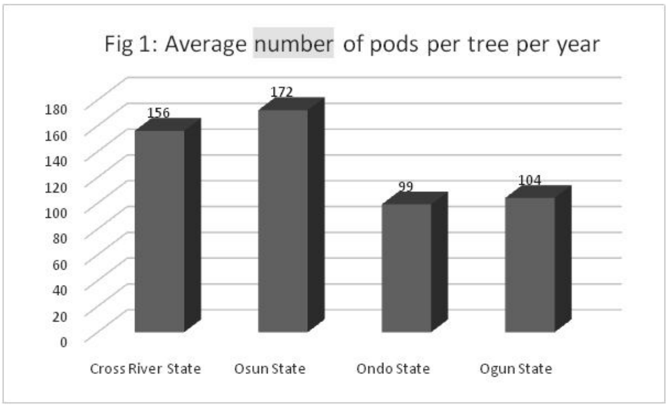
Knowledge Level	Scores	Frequency	Percentage
High Knowledge	>46.27	43	14.9
Fair Knowledge	>13.4<46.27	197	68.4
Low Knowledge	<13.4	48	16.7

Source: Field survey, 2020

Yield of pods per tree per year

Figure 1 shows average yield per tree per year per State

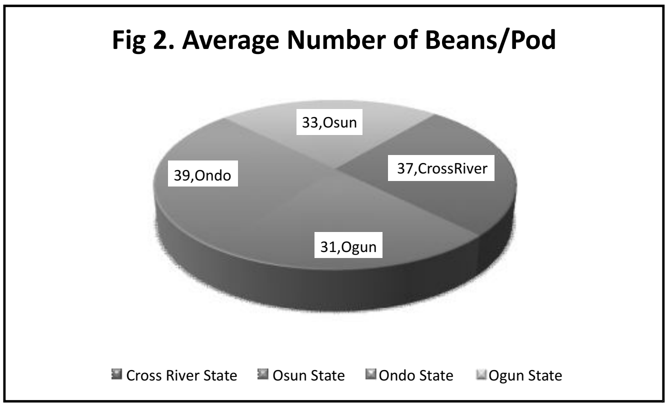
The mean yield per tree per year was 130 pods while Osun State recorded the highest yield (172) and Cross Rivers (156) pods per tree per year however, the least (99) was recorded by Ondo State. This result may be a consequence of farmers' knowledge of good agricultural practices and handling of the hybrid materials.



Source: Field survey, 2020

Average Number of Beans per Pod

Figure 2 shows the average number of beans per pod recorded from each state. The highest (39 beans/pod) was recorded in Ondo State followed by Cross River State (37 beans/pod), while the least (31beans/pod) was from Ogun State. However, the mean cocoa beans per pod from the study area was 35 beans per pod



Source: Field survey, 2020

Conclusion

Majority of the farmers had fair knowledge of Good Agricultural Practices (GAP) for optimum production of cocoa hybrid materials in Nigeria. This shows that most cocoa farmers in the country might not have the knowledge of good cocoa nursery, selection of field with properties required for optimum cocoa production, adoption of recommended sowing methods, correct planting distances, adequate weeding and pruning of trees, control of pests and diseases, maintenance of farm hygine, proper pods harvesting as well as adequate fermentation processes of cocoa beans, yet 130 pods and 35 cocoa beans were recorded as the Average Number of Pods per Tree per Year and Average Number of Beans per Cocoa Pod respectively on Farmer's Farms. This result is consistent with the qualities exhibited by TC_{1-8} cocoa assertions at the experimental field of Cocoa Research Institute of Ibadan in 2011. However, the average productivity of both the farmers and their planting materials will increase with adequate training of these cocoa farmers on GAP.

Recommendation

More awareness and training on the management of the CRIN hybrids should be made available to the farmers, while the hybrid materials should also be available to the farmers to improve their yield and consequently increase their livelihood.

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Experimental Title: Diagnostic Survey of Organic Cocoa Production in Nigeria and Selection of Conventional Cocoa plantations for Conversion to Organic

Investigators: Ogunlade M.O., Adedeji A.R. Oyedokun V.A., Adejobi K.B, Oluyole K.A, Famuyiwa B. and Olasupo Festus

Introduction

Consumers' consciousness about the safety of what they consume and the increased awareness of the need for safety of the environment has brought organic cocoa production into the limelight. Organic cocoa is a bit more acidic and bitter (astringent) than normal cocoa. Organic cocoa is (mainly) used by premium chocolate brands to make chocolates. It is also used in personal care products as organic cocoa contains nutrients such as minerals, vitamins, antioxidants, and other essential analogues which are beneficial for maintaining a healthy skin. Demand for premium chocolate brand by consumers is increasing which is in turn escalating the demand for organic cocoa

Consumers are fond of chocolates, but they are also conscious about their health which allows these chocolate brands to manufacture chocolate using organic cocoa. Consumers are demanding for natural chocolates without the use of any chemicals and artificial ingredients. Due to this, there is an increasing growth of organic cocoa market.

Nigeria has great potential for exploiting organic cocoa market as there is large market demand for organic cocoa in developed countries especially in Europe and America.

This study aimed at

a. determining the status of organic cocoa production in Nigeria

b. producing organic cocoa by:

I. Converting cocoa plantation from conventional to organic farming

ii. New establishment of organic cocoa while ensuring compliance with requirements of organic certification with a view to extend the technology to Nigerian cocoa farmers.

iii. Improving the income and sustainable livelihood of an average cocoa farmer in Nigeria

Methodology

Diagnostic survey

The survey was conducted in three Southern States in Nigeria. The States were Ondo, Oyo, and Cross River States. In each of the States, three cocoa producing cocoa producing local government areas (LGAs) were purposively selected for the study. In each of the chosen LGAs, one community was selected thus making a total of nine communities chosen for the study. A total of 172 respondents were randomly selected for the study. Information was collected from the respondents with the use of structured questionnaire. The data retrieved from the information collected were analysed using descriptive statistics.

Selection of conventional cocoa plantations for conversion to organic cocoa farm

One cocoa plantation at CRIN Headquarters located at Zone 9 with Latitude 7.21348833 and longitude 3.854928 was selected. Ten core soil samples were collected randomly from the selected plot at two depths of 0-20cm and 20 - 40cm. The core samples were bulked into two composite samples for each of the depth. In Owena, a cocoa plantation located within latitude 7.201258333 and longitude 5.026525 was selected. Ten core soil samples were also collected randomly at two depths and bulked int two composite samples.

The soil samples were air dried under room temperature, sieved through 2mm sieve and sent to the laboratory for routine analysis using standard laboratory methods.

Results and Discussion

Table 1 shows the socioeconomic characteristics of the respondents. The Table shows that majority (80.2%) of the respondents were males while 46.5% of the respondents were above 50 years of age. The Table also shows that majority (72.7%) of the respondents were having formal education. This is a good indication as most farmers would be able to read instructions.

Table 1. Socioeconomic characteristics of the farmers

Variables	Frequency	Percentage
Age of farmers (years)		
≤ 30	20	11.6
31-40	29	16.9
41-50	43	25.0
51-60	30	17.4
>60	50	29.1
Total	172	100.0
Sex of farmer		
Male	139	80.2
Female	33	19.2
Total	172	100.0
Educational status of the farmer		
No formal education	47	27.3
Primary education	46	26.7
Secondary education	54	31.4
Tertiary education	25	14.5
Total	172	100.0
Marital status		
Single	11	6.4
Married	156	90.7
Widow	5	2.9
Total	172	100.0
Nature of ownership of the farm		
Inherited	74	43.0
Purchased	74	43.0
Rented	12	7.0
Sharecropping	12	7.0
Total	172	100.0
Membership of socio-economic group		
Member	129	75
Non-member	43	25
Total	172	100.0

Source: Field survey, 2022

Table 2 shows that 61.1% of the farmers did not know about organic cocoa production while 34.9% claimed that they know organic cocoa production. However, 25% of those that claimed that they know about organic cocoa production got the information from CRIN. 93% of the respondents did not have organic cocoa farm.

Table 2. Status of organic cocoa production

Variables	Frequency	Percentage
Do you know about organic cocoa production?		
Yes	60	34.9
No	112	65.1
Total	172	100.0
If yes, from which source?		
CRIN	43	25.0
ADP	2	1.2
Farmer's Field School (FFS)	6	3.5
Television	1	0.6
Family friends	5	2.9
No response	115	66.9
Total	172	100.0
What is your understanding about organic cocoa production?		
Production of cocoa without using any chemical	88	51.2
Production of cocoa with exclusive use of chemicals	6	3.5
Production of cocoa with the use of both chemicals and botanicals	8	4.7
No response	70	40.7
Total	172	100.0
What do you think is the benefit derivable from organic cocoa production?		
Farmers are less exposed to chemical hazards	34	19.8
Soil ecology is conserved naturally	7	4.1
Increase in cocoa yield	4	2.3
Premium price	3	1.7
Produce devoid of chemical contaminations	1	0.6
All of the above	50	29.1
No response	73	42.4
Total	172	100.0
Do you have organic cocoa farm?		
Yes	12	7.0
No	160	93.0
Total	172	100.0

Source: Field survey, 2022

The soils of the two sites were slightly acidic ranging from 6.31 to 6.54 as shown in Table 3. Organic carbon and nitrogen contents of the soils were very low. Available phosphorus, exchangeable potassium, and calcium of the soils of the two sites were also low and below the soil critical value for cocoa. Considering the low soil fertility status of the selected sites, organic amendment using organic fertilizer will be required to boost the productivity of the selected plantations while converting them to organic farms.

Table 3: Cocoa Plantations selected for conversion to Organic cocoa plots at Ibadan and Owena

Soil Properties	Ibadan	Owena
pH	6.31	6.54
Organic Carbon(g/kg)	0.096	0.109
N (g/kg)	0.011	0.01
P(mg/kg)	4.79	5.4
K(cmol/kg)	0.09	0.28
Ca(cmol/kg)	2.60	2.35
Mg(cmol/kg)	0.57	0.65
Na(cmol/kg)	0.30	0.35
Al+H(cmol/kg)	0.11	0.08
ECEC (cmol/kg)	3.66	3.72
Base Saturation (%)	97.00	97.85
Mn (mg/kg)	13.55	35.60
Fe(mg/kg)	31.75	25.70
Cu(mg/kg)	0.74	1.08
Zn(mg/kg)	2.69	2.43
Sand (%)	752	812
Silt (%)	174	134
Clay (%)	74	54
Textural class	Sandy loam	Loamy sand

Experimental Title: Awareness and Impact of Corona virus Pandemic and lockdown on Productivity of Cocoa Farmers in Nigeria.
Investigators: Ogunjobi T.E, Adedeji R, Famuyiwa B.S and Awodumila D.J.

Introduction
Covid-19 is an infectious disease caused by the coronavirus, SARS-CoV-2, which is a respiratory pathogen. In January 2020 the World Health Organization (WHO) declared the outbreak of a new coronavirus disease in Wuhan, China and called it Covid-19. WHO stated that there was a high risk of Covid-19 spreading to other countries around the world from Wuhan, China. in March 2020, WHO characterized it as pandemic disease (WHO, 2020). Since then, WHO and public health authorities around the world are acting to curtail the Covd-19 spread.
Coronavirus is more dangerous than ebola, because it starts infecting individual before the signs show, as a result, doctors and nurses are facing the risk of being infected and possibility of losing their lives in the process of attending to an infected patient. Consequently, other countries governments such as China and Italy took a proactive action to slow down the COVID-19, these include lockdown, stop all movement in and out of an area until all the virus is defeated, no travel and no mass gatherings. Just only essential movements are allowed. Similarly, the Federal Government of Nigeria and some states took a similar decision to restrict the movement to prevent the spread of COVID-19. As the World Health Organization (WHO) has set out, most people infected with the COVID-19 virus will experience mild to moderate respiratory illness and recover without requiring special treatment. Older people, and those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness. Common symptoms include fever, tiredness, and dry cough. Other symptoms include shortness of breath, aches and pains, sore throat, and very few people will report diarrhoea, nausea, or a runny nose. The best way to prevent and slow down transmission is to be well informed about the COVID-19 virus, the disease it causes and how it spreads. The COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes (IFLA, 2020). The presence of COVID-19 in Nigeria was first reported on February 2020 (Nigeria Centre for Disease Control, NCDC, 2020). As at October 2021, the number of confirmed cases from the 36 states of the Federation has risen to 207,709 (Nigeria Centre for Disease Control (NCDC), 2021). On March 2020, the Federal Government of Nigeria (FGN) imposed lockdown across the country which was done in phases (FGN, 2020). The Government implemented further strict measures such as night curfew, ban on interstates and international travels, closure of domestic and international airports, closure of land borders, schools, suspension on all public gatherings such as religious gatherings, weddings, burials and parties as well as restrictions in the operation of food market outlet and open-air market. The lockdown was extended until August 2020 when the Presidential Task Force on COVID-19 (PTF COVID-19) announced a gradual ease of the lockdown. These measures taken by federal government of Nigeria to manage the pandemic affected the agricultural sector and livelihoods.

In Nigeria, agriculture plays a critical role in the economy and has a significant role to play in sustainable development of the country. It is the largest employer of labour in the country, providing jobs for more than one-third (35%) of the total work force (World Bank, 2020) and contributes about 24% to the Gross Domestic Product (GDP) (National Bureau of Statistics (NBS), 2020) The Nigerian agricultural sector remains the key to the country's economic diversification plan (PWC,2020). Despite, the significance of the agricultural sector to the Nigerian economy, challenges such as climate change, limited agricultural inputs, outdated systems of agriculture, poor infrastructure, lack of access to finance, absence of value chain and supply chain linkages, widespread insecurity including the Boko Haram crisis, armed banditry and cattle rustling in the North as well as incessant farmer-herder clashes in the South and Middle Belt has affected the economy (PWC, 2020). The emergence of COVID 19 pandemic has further worsened these already existing problems. The COVID-19 pandemic and the measures put in place by the Nigerian government to curb the spread of the disease affected farmers and agricultural workers in several ways. These measures caused a disturbance in agricultural activities and value chain such as inputs supply into agriculture, production, distribution, transportation, marketing, and consumption of agricultural products (Aromolaran *et al.,* 2020; Oseni *et al.,* 2020). Covid 19 also contributed to shortage of labour for agricultural production (Ilesanmi *et al.,* 2021). The effect of the pandemic on agriculture in Nigeria was very severe because the timing of the lockdown of the economy due to the outbreak coincided with the planting and harvesting seasons of many crops. The pandemic also disrupted transportation of agricultural products and supply chains in different parts of the country due to the travel restrictions put in place. Although, the guidelines announced by the PTF Covid-19 allowed the movement of persons providing essential services such as health workers, movement of agricultural produce, petroleum products and some manufactured goods, movement restrictions were implemented by the security operatives indiscriminately and recklessly. Also, obtaining the necessary permit often proved difficult as offices were closed or had restricted working hours or limited personnel available to process requests (FAO, 2021b). This had some effects on farmers (cocoa farmers inclusive) as access to farms and markets were restricted. Also, since, most farmers do not have storage facilities, they incurred a lot of post-harvest losses forcing some to sell their produce at very cheap prices (SWOFON, 2020). In addition, the closure of markets and borders affected inter and intra-country trade in agricultural inputs such as seeds, chemical fertilizers, and farm equipment and hindered farmers from selling there produce (Kassa and Zeufack, 2020). The study therefore investigated awareness and impact of corona virus pandemic and lockdown on productivity of cocoa farmers in Nigeria.

Justification for the Study

Preliminary study revealed that there is no study carried out on awareness and impact of covid 19 pandemic and lockdown on productivity of cocoa farmers in Nigeria, hence this necessitates the study.

Objectives of the Study

The main objective of the study is to find out awareness and impact of Covid 19 pandemic and lockdown on productivity of cocoa farmers in Nigeria. The specific objectives are to:

1. State various symptoms of Covid19 pandemic by cocoa farmers
2. Ascertain preventive measures against covid19 pandemic by cocoa farmers
3. Find out the effect of lockdown on various farming activities (weeding, harvesting, chemical application, storage) carried out by cocoa farmers in Nigeria
4. Identify effect of lockdown on family life of cocoa farmers in Nigeria
5. Examine the impact of covid 19 pandemic and lockdown on marketability of cocoa produced by cocoa farmers in Nigeria
6. Determine the join contribution of Covid 19 pandemic and lockdown on cocoa farmers' productivity in Nigeria
7. Find out the relationship between Covid19 pandemic, lockdown and cocoa farmers productivity in Nigeria.

Methodology

The study was carried out in Edo State Nigeria. Three cocoa producing local government area were purposively selected. In the three selected local government, twenty pieces of questionnaires were administered to Cocoa Association of Nigeria and Cocoa Farmers Association of Nigeria in each local government totalling sixty (60) pieces of questionnaire. All the questionnaires administered were returned making hundred percent returned rate.

Results and Discussion: Ongoing

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Experimental Title: Creation of Awareness and Dissemination of Crin Developed Technologies Selected Cocoa Growing Communities in Cross River State

Investigators: Uwagboe, E. O., Agbongiarhuoyi, A. E., Adedeji, A.R.

Introduction

Nigerian economy in the past decades depended greatly on agriculture as it provides employment opportunities for the teeming population and contributes to the growth of the economy (Oji-Okoro, 2011). The discovery of oil in the late 60's lead to a drastic shift from agriculture which was the central hub of Nigeria economy to crude oil production. Since the oil boom, agriculture, which was the major contributor to the Gross Domestic Product (GDP) of the country, has been relegated to the background (Jimoh, 2005).

Cocoa is a sub-sector in Nigeria's agriculture and it has been noted that it is capable of increasing not only per capita income; but can reduce spatial inequalities between rural and urban areas and reduce rural-urban migration (Abayomi, 2006). Nigeria produce cocoa in fourteen out of its thirty-six states and they are grouped into three categories according to their level of production. The groups are higher producing states (Ondo, Cross River and Osun); medium producing states (Edo, Ogun, Oyo, Ekiti, Abia, Delta and Akwa-Ibom) and less producing states (Kwara, Kogi, Taraba and Adamawa)

Brief description of Cross River State

Cross River State is one of the 36 states of Nigeria. The present Cross River State came into being in September 1987 when the old Cross River State was split into Akwa Ibom and Cross River States. It is made up of parts of old Calabar and Ogoja Provinces divided into 18 administrative units called Local Government Areas. The Local Government Areas include Obanliku, Obudu, Bekwara, Ogoja and Yala in the North Senatorial District, Boki, Ikom, Etung, Obubra, Abi and Yakurr in the Central District and Biase, Akankpa, Odukpani, Calabar Municipality, Calabar South, Akpabuyo and Bakasi in the Southern Senatorial District.). Out of a total of eighteen Local Government Areas (LGAs) in the state, fourteen (14) produce cocoa.

It lies between latitudes 5°32' and 4°27' North and longitudes 7°50' and 9°28' East. However, the Obudu and Obanliku Plateau with an altitude of 1,575.76 meters above sea level enjoys a climate typical of the temperate regions of the world National Population Commission (NPC) (2006).

Agriculture is the leading sector in Cross River State. It employs about 80% of the state's labour force and contributes about 40% to the Gross Domestic Product (GDP). The most important cash crops are cocoa, coffee, cotton, bananas, rubber, palm oil and kernels and groundnuts. The main food crops are plantain, cassava, corn, millet, and sugarcane. The state has modern agricultural estates and several smallholder farms in the local government areas. The climate allows growing a wide variety of crops. Export crops are the focus of agricultural production and research of the state with livestock, fishing, and forestry as pillars of the economy.

In Cross River State subsistence farmers account for a greater proportion of cocoa farm holdings and they are the backbone of the agricultural sector in the state. The three Local Government Areas known to be the largest cocoa producing areas in the State are Boki, Ikom and Etung.

Justification of the project

Nigeria smallholder cocoa farmers are mostly engaging in the marketing of raw cocoa beans to cocoa merchant who export the beans to the international markets. This practice has reduced the consumption of cocoa finished products and led to reduction in the revenue generated from cocoa production in the country.

Some research surveys conducted by Cocoa Research Institute of Nigeria (CRIN), showed that many cocoa farmers are still unaware of the activities of CRIN Sub-station at Cross River state due to non-availability of processing unit at the station. The awareness of CRIN developed products is very low in some parts of the country which affects the value addition sector of cocoa value chain. There is need to investigate the level of awareness among farmers in the state to recommend ways to increase value addition and consumption to relevant stakeholders and policy makers. If there are gaps created by current practices of farmers, it is therefore necessary to create awareness and sensitize cocoa farmers on the available technologies in CRIN for best global practices in cocoa procesing for sustainable production, improved livelihood, and economic productivity to farmers in Cross River State.

Objectives

1. Identification of the cocoa growing communities in Cross River State

2. Introduction of CRIN Ajassor Sub-station to the cocoa farmers

3. Train the farmers on the activities of CRIN Ajassor Sub-station

4. Introduce some of the CRIN developed technologies to the farmers

5. Administer questionnaire to ascertain the level of awareness of some exhibited CRIN developed products

Methodology

Selection of locations and cocoa farmers

Four phases of selection were adopted in the selection of farmers in the project, in the first phase of the project, multi-stage random sampling technique was used in the selection of the Local Government Areas, Communities and the cocoa farmers. In stage 1: Two (2) Local Government Areas (LGAs) were selected. In Stage 2: Two (2) communities were selected based on contiguity and proximity to the farmers centers as follows**:** Etung LGA: Effraya and Ikom LGA Akparabong, the selection of only two centers for the exhibition was due to paucity of fund.

In stage Three (3): Sixty (60) farmers were selected from five (5) communities around Effraya and Akparapong giving a total of five (120) cocoa farmers. A pre-visit for the legitimization of the project was carried out using village facilitators in all the communities before the actual execution of the project. In each community some CRIN developed technologies (Black soap, Cocoa Powder, Cocoa cream, Cocoa balm, Cocoa, and Kola wine) were exhibited for farmer's awareness and sensitization.

Results and Discussion

1.0 Socio economic characteristics of cocoa farmers in Etung and Ikom local government areas, Cross River State

Table 1 shows the socio-economic characteristics of cocoa farmers in Etung and Ikom Local Government Areas (LGAs) of Cross River State. The table reveals that majority (91.7%) of the farmers were male. The implication of this is that cocoa farming in the study area was largely dominated by male gender and thus may be able to withstand the tasks of adopting value addition to cocoa produce by processing. Similarly, Girei *et al.,* (2013) reported that in Africa, men are more in a crop that is perceived to have commercial value. Majority (46.7%) of the farmers were between 39 and 48 years old. The implication of this is that cocoa farmers in the LGA are still in their productive years and thus cocoa production in the study area is expected to be on the increase for sustainable availability of raw materials for processing of cocoa products. However, this was not in consonance with the findings by Adeogun *et al*., (2010) and Adebiyi and Okunlola (2013) who reported that cocoa farmers in selected states of Nigeria were old and have passed their productive age.

Similarly, the table reveals that highest proportion (48.0%) of the farmers had access to secondary education. The implication of this was that the farmers may perhaps have access to information on value addition to cocoa along the value chain in respect to cocoa processing.

Table 1: Socio economic characteristics of the respondents

	Effraya LGA Sample size=60		Akparabong LGA Sample size=60	
Variables	Freq.	%	Freq.	%
Sex				
Male	55	91.7	53	91.7
Female	5	8.3	57	8.3
Age (Years)				
39- 48	28	46.7	30	50.0
49 -58	19	31.7	17	28.3
Above 58	13	21.6	13	21.7
Educational Level				
Primary	17	29.0	11	18.3
Secondary	29	48.0	37	61.7
Tertiary	14	23.0	12	20.0

Source: Field Survey, 2021

Table 2 below revealed that very low proportions of the farmers were aware of some CRIN technologies exhibited. Some of the farmers that were aware could be attributed to attendance of training organized by CRIN which is a confirmation of positive impact the substation has made in the state. However, large proportion of the farmers in Etung and Ikom LGAs are not aware of Cocoa powder (91.7%), Cocoa Bread (90.1%), Cocoa wine (88.8%), Chocolate (86.9%),, Liquid soap (89.4%), Black soap (87.5%), Cocoa cream (90.8%), Cocoa balm (94.2%) of the farmers has no knowledge. This is expected based on the unavailability of processing unit at CRIN Ajassor Sub-station. According to Adebola (2022), the federal and state governments are to encourage local consumption of cocoa as this will translate to economic benefit.

Table 2: Awareness of some CRIN technologies by the respondents

	Effraya % Sample size=60		Akparabong % Sample size=60	
Variables	Yes	No	Yes	No
Cocoa Powder	8.3	91.7	7.3	92.7
Cocoa wine	11.2	88.8	10.2	89.8
Cocoa Bread	9.9	90.1	9.7	90.3
Chocolate	13.1	86.9	12.5	87.5
Black soap	12.5	87.5	10.5	89.5
Cocoa cream	9.2	90.8	6.7	93.3
Cocoa Liquid soap	10.6	89.4	12.6	87.4
Cocoa Balm	5.8	94.2	7.8	92.2

Source: Field Survey, 2021

Conclusion and Recommendation

Based on the findings of this study, most of the CRIN technologies are not known by majority of the farmers who may be willing to invest in the processing of their produce into some of the products. CRIN should make these products available in large quantity to Cross River State to create awareness for interested investors and establish processing unit at Ajassor Sub-station. Furthermore, CRIN should continue with series of trainings on value addition to cocoa along the value chain and encourage farmers and other stakeholders in processing of cocoa to boost more revenue generation into the industry.

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Experimental Title: Diversity based on DNA sequencing of Lasiodiplodia spp. and Phytophthora spp. Associated with Cashew and Cocoa Diseases in Nigeria

Investigators: Adeniyi, D.O. and Adedeji, A.R.

Introduction

Cocoa is an important cash crop and major source of income to many smallholder farmers in the forest region of West Africa. It is estimated that 90 % of worldwide cocoa production comes from small holdings and most of this production occurs in areas of high biodiversity of varieties and pests' complexes. Several factors have contributed to decline and dwindling production of cocoa of which black pod disease is key factor (Adegbola, 1972). There is rare report of diplodia pod rot disease of cocoa in growing countries of the world, it is classified as an invasive species on cocoa. Cashew is very prone to wide range of pathogens which infect different parts: stems, leaves, inflorescences, apples, and nuts resulting into significant and economic losses in yield and quality. Phytophthora megakarya is the most aggressive fungal pathogen on Theobroma cacao L. and poses a major threat to production. It was originally identified in Nigeria in 1979 (Brasier *et al.*, 1981).

Currently, P. megakarya is the predominant species responsible for black pod disease of cocoa in the sub region (Opoku *et al.*, 1997, 2000). Every stage of pod development is susceptible to infection, but immature pods are the most susceptible. Pod rot symptoms due to P. megakarya however, are characterized by multiple lesions which spread fast and coalesce with an abundant bloom of white zoosporangia on the lesion except for about a centimetre from the advancing margin. Phytophthora megakarya has become the main yield-limiting factor for cocoa production in affected areas (Opoku *et al*., 2000), the documented host range of P. megakarya is limited. Lasiodiplodia theobromae is a cosmopolitan fungus with a worldwide distribution in the tropics and subtropics with a wide host range. This pathogen has been associated with pod rot of cocoa and causes blight and dieback of cashew inflorescence and twigs in Nigeria. This study however focuses on established pathogens of pod rot and black pod of cocoa, inflorescence blight and twig dieback of cashew and subjected to DNA sequencing to determine diversity or similarity on cocoa and cashew.

Methodologies

Study location: Field survey was carried out during cocoa pod production and cashew fruiting, targeting major pathogens of the crops in in Ondo, Oyo and Cross rivers state. Cocoa pods showing typical symptoms of pod rot and black pod were aseptically collected from farms in selected communities (Figure 1). Disease samples were collected in sterile Ziplock sample bags and isolation procedure carried out at the laboratory of CRIN. The infected samples were subjected to routine sterilization, inoculated on selected growth media and incubated at appropriate temperature for 7days. Pure cultures of isolates were transferred to Inquaba laboratory facility, for morphological character descriptions, identification and nucleotide sequences according to Kwon *et al*., (2011).

Figure 1: Map showing area of sample collection points

Results and Discussion

Percent occurrence of associated fungi with diseased parts and crops varied with study locations, with a total of eight genera on cocoa and cashew. Each of Lasiodiplodia theobromae and Aspergillus niger had highest occurrences (25%), A. flavus, Colletotricum gloeosporoides and Aspergillus spp. had 3.6%. Phytophthota megakarya had 7.1%, 14.3% and 17.8% of Fusarium spp. and Botryosphaeria mamane respectively (Figure 2).

Figure 2: Occurrence of isolates with disease conditions of cocoa and cashew

Lasiodiplodia theobromae, A. niger and Fusarium spp. were cultured from pod rot at Bolorunduro, Owena, Idanre and Akure (Ondo state). *Botryosphaeria mamane, A. flavus* and *Fusarium* were also present in Ondo state. Botryosphaeria mamane, shared similar features with *L. theobromae* and common in black pod in all locations except Akure. Pod rot at Idanre also recorded *B. mamane*. *Colletotricum gloeosporoides* was also cultured from inflorescence blight (Table 1). *Colletotricum gloeosporoides* has been reported as causing diseases on inflorescence, twig, nuts and anthracnose in Tanzania (Zhongrun and Masawe, 2014), however this study is the first report of C. gloeosporoides from inflorescence blight of cashew in Nigeria, although pathogen is associated with anthracnose disease. Record of Lasiodiplodia pod rot of cocoa was rare in Nigeria except for the incidence of pathogen on young cocoa seedling causing dieback, the disease was first reported in Bangladesh in 2010 (Shamsi *et al*., 2010)

Variations were reported in morphological characters: growth rate, sporulation, pycnidial production, colony texture and colour of Lasiodilplodia spp. in cashew inflorescence. Although all Lasiodiplodia isolates have one septation, but the septa size and conidia dimension also varied with isolates source across study locations (Adeniyi *et al*., 2016).

Table 1: Mycoflora associated with disease conditions of cocoa and cashew

Disease	Condition/Crop	Location
Pod rot/cocoa	Black pod/cocoa	Cashew blight/dieback
L. theobromae	B. mamane	Bolorunduro
A. niger		
L. theobromae	B. mamane	Owena
A. niger	A. niger	
B. mamane	B. mamane	Idanre
Fusarium spp.	Fusarium spp.	
L. theobromae	L. theobromae	Akure
A. niger	Fusarium spp.	
Fusarium spp.		

L. theobromae P. megakarya Inflorescence blight: L. theobromae, A. niger, C. gloeosporoides Idi-Ayunre
Aspergillus spp. Twig dieback: L. theobromae, A. niger
Fusarium spp. Nut blight: L. theobromae, A. niger
P. megakarya Ajassor

The nucleotide sequences of isolates initially reported as L. theobromae through morphological descriptions showed L. pseudotheobromae (CUZF1QNA), L. pseudotheobromae (PLM-590A), Botryosphaeria rhodina (UCD1028BC), L. theobromae (670004), and L. theobromae (isolate 8) from cashew inflorescence (Adeniyi and Asogwa, In-press) and occurrence of Cophinforma atrovirens on inflorescence of cashew was first reported in Nigeria in 2020 (Adeniyi et. al., 2020). In this study, L. theobromae also showed varied strains in pod rot of cocoa: L theobromae (ELS4), cultured at Bolorunduro, L. pseudotheobromae (UY1356) at Owena, B. mamane (CBS117444) at Idanre and L. theobromae (BT02) isolated at Akure. The L. theobromae (zm13581) was cultured from black pod disease and pod rot of cocoa at Idi-Ayunre, Oyo state while Aspergillus species and Fusarium were associated with pod rot at Idi-Ayunre. Varied strains of P. megakarya were cultured from black pod at Idi-Ayunre (Oyo state) and Ajassor (Crossrivers state), PPG4 and 61J5 strains respectively. The L. theobromae were also occurred in varied strains in cashew disease conditions; GUCC9240, SKJM1103 and gi from inflorescence blight, twig dieback and nut blight respectively at Idi-Ayunre, Oyo state. Aspergillus niger was commonly associated Lasiodiplodia species on cashew (Table 2).

Deoxyribonucleic acid (DNA) sequences from the NCBI nucleotide database were aligned using ClustalW, and a phylogenetic tree from consensus nucleotide sequences was constructed using the neighbor joining method and visualized with Tree View. Numbers above the branches indicate bootstrap values. Bars indicate number of nucleotide substitutions per site. The present isolate infecting Theobromae cacao and Anacardium occidentale were is marked in italics (Figure 3).

Table 2: Nudeotide sequences of pathogenic isolates in cocoa and cashew

Target crop	Matched organism		Location
Cocoa	Pod rot Black pod		
	L. theobromae (ELS4)	B. mamane (CBS 117444)	Bolorunduro
	L. pseudotheobromae (UY1356)	B. mamane (CBS 117444)	Owena
	B. mamane (CBS 117444)	B. mamane (CBS 117444)	Idanre
	L. theobromae (BT02)	L. theobromae (BT02)	Akure
	L. theobromae (zm13581)	P. megakarya (PPG4)	Idi-Ayunre
	B. mamane (CBS 117444)	Twig	Idi-Ayunre
	P. megakarya (61J5)		Ajassor
Cashew	Inflorescence	Nut	
	L. theobromae (GUCC9240)	L. theobromae (SKJM1103)	L. theobromae (gi)
	Idi-Ayunre		

Figure 3: Phylogenetic tree using internal transcribed spacer (ITS) sequences showing closest known relatives of Lasiodiplodia and Phytophthora.

Conclusion and Recommendation

Morphological description showed that B. theobromae is common to all disease conditions and P. megakarya cultured from specific locations. However, nucleotide sequences of same isolates showed diverse species identities. Botryosphaeria mamane (black pod), L. pseudotheobromae (pod rot), different strains of P. megakaya (Cross river (strain 61J5), Oyo (strain PPG4). Lasiodiplodia theobromae (pod rot) but of varied strains and likewise were the strains of L. theobromae (twig, inflorescence, nuts). The genetic diversity in this study indicates knowledge gap in previous identity of Lasiodiplodia species and P. megakarya in Nigeria.

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Experimental Title: On-Farm Demonstration of CRIN Liquid Soap to farmers in 2 locations in Southwestern Nigeria toward sustainable livelihood

Investigators: Yahaya L.E, Adedeji A.R, Adebiyi S

Introduction

Cocoa cultivation remains one of the major agricultural practices in the Southwestern part of Nigeria. This has always been a source of income to the farmers that engage in this practice. However, most of these farmers are peasant and most often generate little from their cultivation due to small size farming. Also, women are equally involved in the cocoa business and as such will have to engage in other farming practices that will support what they already have. Soap production is one of such practices that can be involved in and that will generate revenue to the would-be- investor. One of the raw material, Cocoa pod husk is readily available on the farm which often liters the entire farm. The training was carried out to help farmers to diversify into soap production and be able to generate income for them and consequently sustaining their living. This training has aslo helped to clean up the farm environment, hence reducing pathogenic host which would have been caused by heaps of rotten cocoa pod husks.

Materials and Method

Farmers were trained on soap production using cocoa pod husk. This was done using the participatory approach method. The saponification process as modified by Yahaya *et al*, 2004 for soap production was employed while involving the farmers in the production process. Farmers were made to participate in the training so that they can have mastery over the process of production and were able to take up the skill at the end of the training.

Results and Discussion

At the end of the training session, participants were fully acquainted and equipped with the method and skills of producing liquid soap using cocoa pod husks. They were also happy to have received the training on soap production using a seemingly waste material. Many among the participants promised to take up the technology as a means of livelihood.

Conclusion and Recommendation

It was practically obvious that soap training among cocoa farmers is possible. It was a fruitful experience among the participants. It is therefore recommended that this type of training should be extended to other cocoa producing areas to maximize the value addition of their crop.

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CASHEW PROGRAMME

Experimental Title: Technology Awareness and Adoption: A case study of Cashew Farm Rehabilitation in Kwara and Osun States, Nigeria

Investigators: Akinpelu, A.O., Adeyemi, E. A., Agbongiarhuoyi, A.E., Ibiremo, O.S., Mokwunye, I. U and Adeniyi, D.O.

Introduction

Cashew grows almost everywhere in Nigeria, but it is concentrated primarily across the three southern geopolitical zones as well as the middle belt. The major producing States are Kogi, Kwara, Benue, Enugu, Abia, Anambra, Imo, Oyo and Ekiti. The National Cashew Association of Nigeria (NCAN) reported that Nigeria earned US$ 402Mn (N144.7bn) from the export of raw cashew nuts to Vietnam and other countries in 2017.

Rehabilitation as a word has been used in many ways and contexts. It has long had a merging conceptual framework. Traditionally, the word has been used to describe a range of responses to incapability. Rehabilitation in this context is to enable moribund, unproductive cashew farms to rejuvenate for enhanced productivity. Rehabilitation techniques for cashew developed by CRIN include coppicing, complete replanting, side grafting, top grafting, phased farm replanting, fertilizer application and gapping up.

However, it has been observed that farmers are reluctant to adopt these technologies probably because of the low awareness and lack of knowledge in the economic benefits inherent in the techniques on the long run. Thus, it is expedient to assess the level of awareness and adoption of the rehabilitation techniques among cashew farmers in Nigeria.

Objectives

1. profile available rehabilitation techniques for cashew
2. assess the level of awareness of these techniques among farmers
3. estimate factors determining willingness to adopt the techniques among the farmers
4. ascertain the constraints to awareness and adoption of the techniques among the farmers in the study area

Methodology

The study was purposively conducted in Kwara State. The second stage was a purposive selection of two Local Government Areas (LGAs) in the State based on the volume of cashew production. The third stage involved a random selection of forty (40) cashew farmers in Osun and Isin LGA of the State for questionnaire administration and group interaction. Primary and secondary data were used for the study. The total sample size was eighty (80) respondents. Well structured questionnaire was developed and administered for primary data collection while past literatures and bulletins were adopted for secondary data. Each of the cashew rehabilitation techniques (CRTs) developed by the Institute (Coppicing, Sidegrafting, Planting under matured cashew trees, Phase Replanting, Total Replanting and Gapping up of missed stands) was demonstrated to the farmers on a farm selected by the farmers in the study areas. Data was analyzed using descriptive (means, frequencies, and percentages) and multinomial regression analysis.

Results and Discussion

Table 1 below shows the summary statistics of socio-economic characteristics of cashew farmers in Kwara State, Nigeria. The table reveals that the mean age of the farmers is about 55 years. The implication of this is that cashew farmers in the study area are ageing and are at the peak of their productive years and this perhaps may be responsible for the average farm size of about 9 hectares put into cultivation of the crop by farmers. Similarly, the table reveals that the maximum educational level of the farmers was tertiary education. However, a mean educational level of about three (3) years shows that majority of the farmers had no formal education. The implication of this is that the farmers may perhaps not have enough and adequate access to information on improved production packages of the crop which may include but not limited to the rehabilitation techniques. This assertion corroborates the findings of Agbongiarhuoyi *et al* (2013). Furthermore, the table reveals an average household size of 3 persons. This implies that the farmers may perhaps utilize members of the household as labour for some operations relating to cultivation of the crop. However, the farmers may perhaps engage the services of hired labour. This may probably increase some transaction costs that may be incurred on the crop.

Furthermore, it was shown that the average age of the cashew farms was about 14 years. This implies that the farms are relatively new and thus the farmers may be reluctant to carry out rehabilitation techniques. Moreover, the table revealed an average farming experience of about 15 years.

Table 2 below shows the percentage distribution of cashew farmers according to levels of awareness and adoption of cashew rehabilitation techniques (CRTs) in Kwara State, Nigeria**.** The table reveals that about 52.50% of the farmers are not aware of coppicing. In addition, 60.00% and about 51.25% were not aware of side grafting and phase rehabilitation, respectively. This probably may affect the adoption level of these techniques. However, about 51.25% and 45.00%, repectively are highly aware of planting under matured cashew trees and gapping up of missed stands. This implies that these operations may have certain levels of adoption.

Furthermore, it was revealed that 71.25%, 77.50%

respectively of the farmers did not adopt coppicing and sidegrafting, respectively despite their levels of awareness. This perhaps may be because these are operations in cashew farms that require technical knowledge and commitment which can only be achieved by farmers that have low risk aversion level. However, planting under matured cashew trees had the highest level of adoption (73.75%). This is expected based on the level of awareness described above. Also, this technique appears simple, and it is a routine like operation which majority of the farmers found easy to practice.

Table 3 below shows the determinants of awareness level of rehabilitation techniques (RTs) among cashew farmers in Kwara State, Nigeria. The table reveals that age had an inverse relationship to the awareness level of coppicing. It shows that a unit decrease in age of the farmers leads to about 5% decrease in awareness level of coppicing at 10% level of probability. The implication of this is that the older a farmer is the lower the strength and ability to take risk of cutting a cashew tree. Also, the results show that a unit increase in the farmers' ability to plant under matured cashew trees leads to about 7% level of awareness at 10% level of probability. Though, the result is not in tandem with the a priori expectation as this technique is a common practice among the farmers. Similarly, the table revealed that age of cashew farms negatively determined the awareness level of total replanting. It shows that a unit decrease in the age of cashew farms leads to about 22% decrease in awareness level of total replanting at 1% level of probability. The implication of this is that as the cashew farms advance in age farmers may find it difficult to eradicate the farms to plant new cashew seedlings. This is expected as the farmers may not have any reliable source of income pending the time new farms will mature for harvesting. Furthermore, a unit increase in the educational level of the farmers had about 6% level of awareness to coppicing at 1% level of probability. This is equally applicable to sidegrafting. A unit increase in educational level of the farmers leads to about 83% level of awareness of the technique at 1% level of probability. This implies that educated farmers have the understanding of the long-term benefits of coppicing and sidegrafting techniques, respectively.

Table 4 below shows the determinants of adoption level of rehabilitation techniques (RTs) among cashew farmers in Kwara State, Nigeria. The table reveals that a unit increase in age of the farmers leads to about 7% increase in adoption level of coppicing and sidegrafting, respectively at 5% level of probability. The implication of this is that the older a farmer is the higher is the adoption level. This may probably be due to his years of experience in farming cashew. Similarly, the table revealed that age of cashew farms negatively determined the adoption level of coppicing. It shows a decrease of about 19% in adoption level at 5% level of probability. The implication of this is that as the cashew farms advance in age farmers may find it not convenient to coppice the cashew trees probably due to inherent traits noticed by the farmers in relation to the trees. This is expected as the farmers may not have any reliable source of income pending the time new farms will mature for harvesting. Furthermore, a unit increase in the educational level of the farmers had about 76% adoption level though at 10% level of probability. This implies that education has a positive relationship to coppicing as a rehabilitation technique.

Moreover, the table reveals that a unit increase in the household size of the farmers leads to about 82% adoption level of phase replanting of cashew farms and it is highly significant at 1% level of probability. The implication is that the higher the numbers of persons in the household the higher the probability of adopting phase replanting. This may mean availability of more labour to carry out the operation. However, a unit increase in farm size leads to about 14% increase in adoption level of phase replanting at 10% level of probability. Furthermore, a unit increase in quantity harvested on cashew farms leads to about 13% increase in adoption level of coppicing at 5% level of probability. The implication of this is that expected yield from coppiced cashew trees may be an incentive to the adoption level of the technique.

Table 5 below shows the percentage distribution of constraints to awareness and adoption levels of rehabilitation techniques (RTs) among cashew farmers in Kwara state, Nigeria. The table revealed that high cost of agrochemicals was very severe and ranked first among the constraints identified. It contributed about 88.00% to the constraints. However, lack of knowledge of the techniques was severe and contributed about 43.00% to the constraints.

Conclusion and Recommendations

The study assessed technology awareness and adoption of cashew farm rehabilitation in Kwara State, Nigeria. The mean age of the farmers is an indication that cashew farmers in the study area are ageing. Hence, it is recommended that efforts should be made to encourage ageing farmers to stay on the farm. This can be done by making farming attractive to both youths and adults. Moreover, more awareness campaigns should be aggressively embarked upon by the Institute to drive home the inherent benefits of adopting these techniques for rejuvenation of old farms and hence improve the productivity. This could be done by making the extension arm of the Institute more committed in advocacy and dissemination of research findings to cashew farmers and other stakeholders.

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Experimental Title: Nursery Performance of Brazilian Biotype, Polyclonal Progenies Cashew and their Response to Natural Disease infection

Investigators: Adeniyi, D.O., Olasupo, F.O., Olorunfemi, O., Adedoyin, A. and Adebola, P.O.

Introduction

Cashew is a perennial tree crop, in family *Anacardiaceae*. Originated from North-Eastern Brazil and introduced into West Africa in the 16th century by the Portuguese settlers (Abdul and Peter, 2010). This crop is valued mainly by its article of trade, which is the nuts, been a major foreign exchange earner for many developing countries in the tropical and subtropical regions. Around 45% of the world's cashew production comes from West Africa, which comprised of Ivory Coast, Ghana, and Nigeria being major producers (Monteiro *et al*., 2017). However, a prime factor identified to limit the productivity of cashew have been low nut yield and nut weight. (Adu-Gyamfi, *et al*., 2019; Dadzie *et al*., 2014). This is also complicated by the new trend where nut weight is used as major criterion that determines the market value of raw cashew nuts in international trade. Low cashew productivity could be partly attributed to pest and diseases infestation, but high global demand for cashew nut from increasing world population, coupled with farmers request for varieties that provide high early yield per unit area with big nuts that can earn premium price suggest need for development of new varieties with high genetic potential for higher nut yield per unit area and improved nut quality (Gyamfi *et al*., 2020). Some indigenous cashew materials have the genetic potential to compete with exotic varieties to meet the demand for yield and quality, thus indigenous Brazilian cashew biotypes were evaluated in the nursery with polyclonal seeds of Ghana origin.

Materials and Methods

The Polyclonal Seeds (PS) was of Ghana origin, obtained through PROCashew-Nigeria project. The Brazilian Large (BL) was obtained at Ochaja substation of Cocoa Research Institute of Nigeria (CRIN). Both planting materials were of the current year cashew fruiting season (2021). The moisture content of the raw cashew nuts (RCN) was determined, nut count, weight according to Lihong *et al*., (2014) and kernel outturn according to Dieng *et al*., (2020). The RCN was sown in soil filled in a 20cm by 10cm polythene planting bags with one nut per bag. Routine nursery activities were carried out with cultural weeding and regular watering. Cashew seedlings were observed, data obtained on emergence, germination, height, girth, number of leaves, leaf area and branching were subjected to one – way ANOVA using SAS software package and the mean values were separated using Duncan Multiple Range Test (DMRT) at $P \leq 0.05$. Deviations/deformations in normal physiological growth of cashew parts were observed for symptoms and categorized according to Zhongrum and Masawe, (2014).

Results and Discussion

The number of RCN in 1kg PS ranges from 144 – 147 nuts while BL had nut count of 117 – 121 nut/kg. The weight of BL and PS nuts showed that both belong to size of large cashew nut, however the weight per nut is higher in cashew BL (10.0g/nut) than 8.5g/nut recorded in PS (Table 1).

The moisture content of RCN is directly proportion to the kernel output ratio (KOR)/outturn, which is a functional of storage. Decrease in moisture of RCN results into a reduction in outturn values, good storage enhances KOR, but poor storage system brings down the kernel outturn. The outturn is important to processors, while shelling percent is one of major factor considered in materials aimed for a breeding program. The RCN of BL and PS were planted at moisture of 8.0%, KOR 48.5lbs and 5.5%, KOR 47.5lbs respectively (Table 1).

Table 1: Data on Brazilian large biotype and Polyclonal seed progenies cashew

Parameter	Polyclona l seed (PS)	Brazilian large (BL)
Source of planting material	Ghana/Tanzania	Ochaja, Nigeria
Nut count (average)	145	119
Nut weight (g)	7.0 – 8.5g	6.0g – 10.0g
Moisture content (%)	5.5 – 6.7%	8.0 – 10.0%
Outturn of RCN	48 – 56lbs	48 – 54lbs
Outturn of material at planting	47.5lbs	48.5lbs
Moisture of material at planting	5.5%	8.0%
Shelling percent (%)	34%	32%

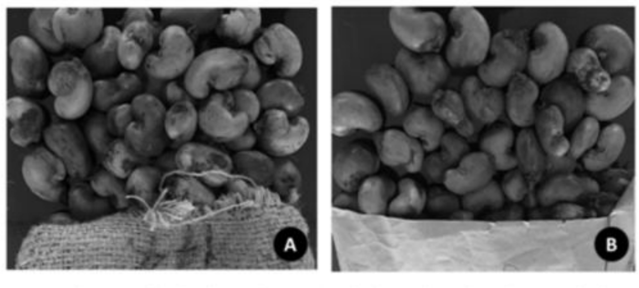

Plate 1: Polyclonal seed progenies (A) Brazilian large biotype (B)

Emergence of RCN was observed on 12th day after planting (DAP) in BL and PS, with 23.53% and 10.34% respectively. Percent germination of PS was 32.07% at 2 weeks after planting (WAP) and 88.97% at 4WAP while BL recorded 55.46% at 2WAP and 95.79% at 4WAP. The percentage increase in germination from emergence to 4WAP was 11.62% and 24.56% in PS and BL respectively. While the percent increase in germination between 2WAP and 4WAP was 36.05% (PS) and 57.89% in BL (Table 2).

Table 2: Emergence of Brazilian large biotype and Polyclonal seed progenies cashew

Parameter	Polyclonal seed (PS)	Brazilian large (BL)
Day of emergence	12DAP	12DAP
Percent emergence (%)	10.34%	23.53%
Number of foliar at germination	4 – 5 Leaves	4 – 6 leaves
Percent germination at 2WAP	32.07%	55.46%
Percent germination at 4WAP	88.97%	95.79%
Percent increase from emergence to 4WAP	11.62%	24.56%
Percent increase from 2WAP to 4WAP	36.05%	57.89%

*DAP (Day after planting), **WAP (Week after planting)

Table 3 showed the performances of BL and PS in the nursery. The height of BL was significantly higher (24.41cm) than 20.64cm recorded in PS at 4WAP. Significantly higher number of leaf and branch were also recorded in BL, while the girth and leaf area were the same in both PS and BL at 4WAP. At 6WAP, there was significant similar growth in girth, number of leafs, leaf area and branch with exception of height which was significantly higher (29.34cm) in BL compared to 25.30cm recorded in PS (Table 3).

Table 3: Performance of Brazilian large biotype and Polyclonal seed progenies cashew

Cashew material	Height (cm)	Girth (mm)	Number of Leaf	Leaf area (m^2)	Branch
		4 Weeks After Planting			
Polyclonal seed (PS)	$20.64^{b}\pm0.88$	$0.28^{a}\pm0.02$	$7.73^{b}\pm0.28$	$9.10^{a}\pm1.40$	$0.00^{b}\pm0.00$
Brazilian large (BL)	$24.41^{a}\pm0.83$	$0.26^{a}\pm0.02$	$9.27^{a}\pm0.58$	$9.31^{a}+0.84$	0.25s$\pm$0.33
		6 Weeks After Planting			
Polyclonal (PS)	$25.03^{b}\pm1.23$	$0.31^{a}\pm0.01$	$10.13^{a}\pm0.56$	$44.60^{a}+3.11$	$1.00^{a}\pm0.68$
Brazilian large (BL)	$29.34^{a}\pm1.06$	$0.34^{a}\pm0.01$	$11.73^{a}+0.72$	$44.97^{a}\pm2.85$	$2.50^{a}\pm0.55$

Natural infections with symptoms of physiological disorders common in nursery operations were assayed: wrinkled leaf, damping off, leaf spot and dieback. The seedlings recorded no incidence of damping off, however deviations from normal physiological growth were observed in varied degrees. Wrinkled leaf (Plate 2) was observed at 2WAP in 4.43% of PS and 2.67% BL, but incidence was not on the increase throughout the nursery period. Higher incidence (3.23%) of leaf spot (Plate 3) was recorded in PS to 1.78% in BL. Although dieback incidence (Plate 4) was minimal in both PS and BL, however higher (0.89%) in BL than 0.41% recorded in PS (Table 4).

Table 4: Physiological disorders in Brazilian large biotype and Polyclonal seed progenies cashew

Cashew material	Wrinkled leaf	Leaf spot	Damping off	Dieback	Survival count (%)
Polyclonal seed (PS)	4.43%	3.23%	0	0.41%	87.93%
Brazilian large (BL)	2.67%	1.78%	0	0.89%	95.79%

Plate 2. Wrinkled leaf: Polyclonal seed progenies (A), Brazilian large biotype (B)

Plate 3. Leaf spot: Polyclonal seed progenies (A), Brazilian large biotype (B)

Plate 4. Seedling dieback: Polyclonal seed progenies (A) Brazilian large biotype (B)

Conclusion and Recommendation

The indigenous cashew material evaluated compared significantly with the polyclonal seeds and can be a good bases in selection for breeding especially when up to date records of yield, quality status of raw nuts and extensive genetic profiling of the materials can be obtained.

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Experimental Title: Gender Assessment of Cashew Farmers Involvement in Cashew Enterprises In Kogi State

Investigators: Orimogunje Alex A.O, Agbongiarhuoyi A.E and Aboderin A.K

Introduction

In the past, men were regarded as farmers while women were regarded as farmers' wives who assisted men on the farms. In recent times however, the contributions of women to agricultural productivity have started gaining attention. The role of women in agriculture is fundamental, as they are key players in the agricultural value-chain. Women form the core of the economics of sub-Saharan Africa, comprising about 60% of the informal sector and providing about 70% of total agricultural labour. Viatt, *et al.,* 2009, noted that women constituted the mainstay of the agricultural sector, the farm labour force, the food systems and day-to-day family subsistence.

Men and women are involved in the production of different agricultural crops like cocoa, cashew, maize, kola, etc., and in animal husbandry. But cash crops such as cocoa, kola, coffee, cashew etc. are often considered as male crops, while food crops such as cassava, maize, cowpea etc, are recognized as female crops. This was as a result of earlier colonial policies, where men's attention was directed towards cash crop production while food crop production was left to the women. In the production of cashew, men and women are generally involved in operations such as pre-planting, post-planting/processing, and marketing of cocoa products. However, men are assumed to perform the harder work of land preparation (site selection, bush clearing, tree felling etc.), while women are concerned with the planting, weeding, harvesting, processing, and marketing.

Objectives

The general objective of the study assessed the gender involvement in cashew enterprises in Kogi state.

Specific objectives were to

determine the selected personal characteristics of cashew farmers in the study areas,

identify the constraints faced by male and female cashew farmers in the study areas and

determine the level of involvement of male and female in cashew enterprises in the study areas.

Hypothesis of the study

$H0_1$: There is no significant difference between male and female cashew farmer involvement in cashew enterprises in the study area

Methodology

The research was conducted in Kogi state. A multistage sampling approach was used to carry out the study. Kogi state was purposively selected because it is the highest producer of cashew in Nigeria. The two highest producing Local Government Areas (LGAs) were purposively selected, namely Yagba East and Ijumu. Furthermore, two villages were randomly selected in each LGAs and 30 farmers were selected using simple random sampling selected per village. A total number of 120 respondents were interviewed for the study. The data obtained was be analysed using descriptive statistics (frequencies, means, percentages) and inferential like T-test and Chi-square.

Expected output: ascertaining different enterprise activities carried out by men and women in other to improve and encourage more female gender in cashew enterprise.

Data analysis: On going

Experimental Title: Analysis of Cost and Returns of Cashew Production in South-West, Nigeria

Investigators: Orisasona, T.M, Ibiremo, O.S and Abdulkarim I. F

Introduction

The cashew tree (*Anacardium occidentale* L.), native of Brazil, was introduced to Mozambique and then to India in the sixteenth century by the Portuguese as a means of controlling coastal erosion. It is interesting to note that cashew spread within these countries with the aid of elephants that ate the bright cashew fruit along with the attached nut. The nut was too hard to digest and was later expelled with the droppings. It was not until the nineteenth century that plantations were developed, and the tree then spread to a number of other countries in Africa, Asia and Latin America (Harish, 2009).

Subsequently, the tree spread to a number of countries in Africa, Asia, Latin America and West Indies. Cashew is now widely cultivated for its kernel, fruit, cashew nutshell liquid and other products. However, it is mostly found in the coastal regions of South Africa, Madagascar, Tanzania, and South Asia, from Sri Lanka to the Philippines.

Research into the cultivation, uses and economic of cashew actually commenced in 1972, by Cocoa Research Institute of Nigeria (CRIN). Presently in Nigeria, cashew grows successfully in virtually all agro-ecological zones, including the semi-arid areas, but with a high concentration in the middle belt areas in smallholder farms and plantations. Cashew production comes from over 20 States. These include: Kogi, Kwara, Oyo, Edo, Ondo, Anambra, Enugu, Benue, Cross River, Imo, Sokoto, Nassarawa, Ogun, Osun, Plateau and Kebbi among others (Ezeagu, 2002). The increased awareness of the economic benefits of the crop has led to astronomical increase and renewed interest in the agri-business of the crop (Hammed and Anikwe, 2008).

Apart from the juice of the apple that is rich in vitamin C and sugar which can be fermented to produce alcoholic drink, the cashew nut is known to contain the fat soluble vitamins A, D and K, also vitamin E to the level of 200-2100mg/100g (Opeke, 2005).

The progressive decline in average yield of major crops is of great concern as Nigeria would be unable to feed its teeming population based on rainfed agriculture alone. Demographic growth coupled with rising income has substantially increased the demand for food in the country. Rapid increases in food production needed to feed the population will have to come from increased yield per hectare from both rainfed and irrigated agriculture. Shortfall of these will have negative effects on the production efficiency of the farmers.

Objective of the Study

The broad objective of the study is to analyse the cost and returns of cashew production in South-West, Nigeria. The specific objectives are to:

i. describe the socio-economic characteristics of the farmers in the study area,
ii. determine the cost and return structure of cashew production in the study area,
iii. determine the constraints that influence the production output levels of the cashew production in the study area.

This study is meant to assess farmers' level of efficiency by decomposing it to production efficiency. This decomposition could help to understand area(s) where corrective measures needed to be taken. In addition, the study intends to identify constraints militating against food production in the study area with a view to recommending appropriate solution. The study will also form a basis upon which crop production and improvement policies will be formulated by the government towards achieving sufficiency in food production. Empirical information that will be provided in this study could provide basis for further studies on cashew production particularly in the study area. Premised on the foregoing, the study is deemed justified.

Research Methodology

The Study Area

The study was carried out in Osun State. Two Local Government Areas (LGAs) were selected from State, using Purposive sampling techniques. The local Government Area are lwo and Ogbomosho respectively. Sixty respondents were randomly selected from each of LGA thus totaling one hundred and twenty respondents.

Sources and Methods of Data Collection

The data used for this study were mainly from the primary and secondary source. They were obtained through the well-structured questionnaire which was administered by trained enumerator.

Sampling Techniques

Multistage sampling method was employed in selecting the respondents. Sixty respondents were randomly selected from each of LGA thus totaling one hundred and twenty respondents. This process gave a total of 120 of sampled cashew farmers on which the survey instruments were administered and were used for the study.

Methods of Data Analysis

Both descriptive and inferential statistics were used in analyzing the data to be collected in line with the study objectives.

Socio-economic characteristics of Cashew Farmers

Descriptive statistics such as frequency distribution tables, percentages and measures of central tendency were used to achieve objectives 1.

Cost and Return Structure of Cashew Production

Budgetary analysis was used to determine the cost and return structure of cashew farming in the study area. The model to be used is specified below. The Gross Margin technique is expressed as:

$$GM = GR - TVC \quad (1)$$

$$NI = GM - TFC \quad (2)$$

$$TC = TVC + TFC \quad (3)$$

Where:

GM = Gross Margin naira per tonne
NI = Net Income (naira)
GR = Gross Revenue in naira
TVC = Total Variance Cost in naira
TFC = Total Fixed Cost (naira)
TC = Total Cost (naira)

Total Variable Cost (TVC) included cost of procuring planting materials, labour cost, transport cost, e.t.c. Total Fixed Cost included depreciation on fixed inputs like cutlasses, shovel e.t.c.

Where:

NI = Net Income
TR = Total Revenue
TC = Total Cost
TFC = Total Fixed Cost
TVC = Total Variance Cost

Results and Discussion

Socio-Economic Characteristic of Cashew Farmers.

The table below showed the socio-economic characteristics of cashew farmers in the study area with respect to their age, sex, household size, educational, years of experience e.t.c

Age of Respondents

The age of the respondents is an important factor that affects their level of productivity and overall coping ability within the business. Age is believed to influence the level of physical work. Table 1 showed the distribution of the respondents.

Table1: Age Distribution of Respondents

Age –Group	Frequency	Percentage
Below 30 years	6	5.0
31-40 years	14	11.7
41-50 years	36	30.0
51-60 years	38	31.7
Above 60 years	26	21.7
Total	**120**	**100.0**

Source: Field Survey, 2022

The age of the food crop farmers ranged between 30 years and above 60 years with a mean of 58.3. Majority of the food crop farmers (31.7%) were within the age bracket of 51-60 years and this indicates that the farmers were aging. This finding is in collaboration with the result of Ekunme *et al.*, (2008) and Orewa and Izekor (2012), who stated that small scale farmers in Nigeria were aging with mean of 53 and 51 respectively.

Table 2: Distribution ofrespondents by household size.

Family size	Frequency	Percentage
1-3	10	8.3
4-6	54	45.0
7-9	39	32.5
10-12	12	10.0
Above 12	5	4.2
Total	120	100.0

Source: Field Survey, 2022.

According to Omolola (1988), the size of the household largely depends on the status of farmers and particularly on the number of wives the farmer has. One of the most important factors affecting production level and productivity among farmers is the composition and size of the farming family; As regards household size, majority 45.0%, had 4-6 persons per household. The average household size was 4.25 persons per household. This shows that majority of the farmers had relatively low household size which might be good economically in terms of the households welfare as there would be less pressure on farmers' output and invariably income. This justifies Orewa and Izekor (2012).

Educational Status of Respondents

Formal education is a widely known avenue for improving knowledge and rate of skill acquisition Formal education is also important in business because it determine the degree of level of adoption of innovation and new technologies. It also determines the degree of excellences in any activity the distribution of education status of the respondents is shown in 3. The number of years in which the respondents have been involved in cooperative society could be used to measure their efficiency. Experience is expected to have a significant positive impact on the managerial ability of the respondents. Therefore, the more experienced they are, ceteris paribus, the more efficient he would be in management because the acquired experience over the years would be brought to bear on their activities.

Table 3: Distribution of Respondents by Farming Experience.

Experience in farming	Frequency	Percentage
Below 5 years	3	2.5
5-10 years	9	7.5
11-15 years	11	9.2
16-20 years	27	22.5
Above 20 years	70	58.3
Total	120	100.0

Source: Field Survey, 2022

The range and mean of farming experience of the food crop farmers was between 5 and 20 years and 29.8 respectively, with majority (58.3%) having more than twenty years of experience. This finding is in agreement with the work of Nmadu and Simpa (2014); Musa *et al*., (2011), who had 89.4% and 78.4% for farming experience of than ten years respectively. The years of farming experience shows that the farmers are relatively experienced and there was some level of specialization and this would help in cost minimization and achieving greater efficiency.

Cashew Production Cost and Return

Table 4: Cost andReturnStructure of Cashew Production

Inputs	Mean
Bush clearing	11835.33
Land preparation	13036.67
Weeding	13366.00
Planting	6838.00
Agro chemical application	1043.33
Harvesting	5828.00
Planting material	553.33
Fertilizer	1366.67
Insecticides	260.00
Transportation cost	17313.33
Total Variable Co st	**72819.33**
Cost of land	5000.25
Rent	2260.00
Knife	1610.67
Axe	5948.33
Cutlass	14034.00
Shovel	144.00
Boot	212.00
Total Fixed Cost	**24209.00**
Total Cost	97028.33
Total Revenue	154919.33
Gross Margin	82100.00
Net Income	**57891.00**
Profitability Index	**1.67**
Rate of Return on Investment	67.07

Source: Field survey, 2022

Table 4 shows the result of the gross margin analysis carried out for the study. It was showed that the mean gross margin was estimated to be N82, 100.00, mean net profit was estimated to be N57, 891.00 and the mean total revenue was estimated to be N154, 919.33 while the mean total cost was N97,028.33. The mean total variable cost was estimated to be N72819.33 and the mean total fixed cost was estimated to be N24209.00.

The profitability ratios calculated to establish levels of profit in cashew production enterprise shows that the average profitability index (PI) recorded for the study area was 1.67 indicating that out of every naira earned, about N1.67 accrue to the cashew farers as net income.

Also, with rate of return on investment (RRI) of 67.07, an average cashew farmer therefore earns N67.07k profit on every naira spent on cashew production.

Constraints Encountered by Cashew Farmers in the Study Area

Constraints could be seen as hindrances or difficulties faced by farmers in production. The major constraints to the effective production of cashews in the study area are presented in Table 10. Lack of credit facility was the major constraint to cashew e production in the study area 44% as reported by the respondent. Access to agricultural credit has been positively linked to agricultural productivity in several studies (Nwaru *et al.,* 2004). Yet this vital input has eluded smallholder farmers in Nigeria. Banks with large loan funds are generally difficult to access as issues of collateral and high interest rates screen out most rural smallholders. Cooperatives, friends and family members dominate the sources of farm credit among the farmers in the study area.

Weather and Disease 35% as indicated by the farmer ranked the second most serious constraints faced by farmers in the study area. Lack of road and high cost of transportation (30%) was ranked as the next most severe constraint. Transportation costs were considered very high and road conditions were very poor, and these limit access to purchased inputs, credit, and output markets, and reduce the transmission of market signals. High transport costs are significant constraints to agricultural productivity, reflecting the poor state of rural transport infrastructure in the study area. About 17% of the farmers complained of the problem of low price and poor market outlet. Marketing of horticultural crops such as cashew is quite complex and risky due to the perishable nature of the fruit, post-harvest food losses; seasonality of production and bulkiness. Low output price and poor marketing among other things can be attributed to how the cashews were harvested, handled and stored. Improper handling of harvested cashews reduces the quality thereby leaving farmers at the mercy of the merchants in determining the price of the output. About 16% complained of the problem of high post harvest loss of cashews. This is because of the perishable nature of cashews which accounts for the acute post harvest losses.

About 12% complained of lack of herbicides and a further 9.7% complained of the problem of lack of land. Communal systems of land ownership is the practiced among famers in the study area, in which individual ownership of land is embedded in group or kinship ownership. Communal ownership of land in Nigeria has been associated with such problems as limited tenure security, restrictions on farmers mobility and the inevitable fragmentation of land holding among rural famers. The lack of storage facility ranked second to the last of the constraints faced by 3.4% of the farmer and high cost of labour was considered the least among all the constraints faced by the pineapple farmers in the study area. This could be linked to the large family size of the farmers in the study area which constitute large percentage of family labour in cashew production in the study area.

Table 5: Constraints to cashew production in the study area

Constraints	Frequency	Percentage
Lack of credit facility	53	44
Weather and disease	42	35
Lack of road and high cost of transport	36	30
Low price and lack of market outlet	20	17

Conclusion and Recommendation

This study concluded that cashew production is profitable in the study area. The major challenge to the enterprise is Lack of credit facility, weather and disease, lack of road and high cost of transportation, low price and poor market outlet communal systems of land ownership, lack of storage facility and high cost of labour. Based on these, the study recommends that cashew nut marketers should form registered trade unions through which solution could be sought to the challenges of market price fluctuation, lack of market information as well as lack of market coordination in the study area, farmers should be provided with required credit at reasonable rate of interest. Since there is high labour requirement and higher wage rate, there is a scope to evolve labour saving technologies.

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COFFEE PROGRAMME

Experimental Title: Efficacy of fertilizers and improved agronomic practices on the rehabilitation of old coffee plots in Kusuku

Investigators: Ipinmoroti R.R.; Oloyede, A.A. and Daniel M.A

Introduction

Coffee is a major commodity crop of economic importance in the international market. It is cultivated for the berries which are of value for good health of man Nigeria has fared prominently in the cultivation of coffee in the past but Nigeria contribution to the world market presently have been dwindling over the past few decades due to oil boom that had led to farms to be abandoned by the poor resource farmers. The old age of the farms, soil fertility problems and detrimental climate change are additions to the hindrances to optimal coffee production in Nigeria.

The present shifts of Nigeria government from petrol depended on economy to broad based multi-facet resources economy and more importantly, looking at the possibility of improving the economy through cultivation of agricultural commodity crops of which coffee is germane, calls for interest in investment in new establishments and rehabilitation of old coffee plots in Nigeria. Presently, lots of research findings have evolved on Coffee Research by Cocoa Research Institute of Nigeria in this regard. However, for rehabilitation of old coffee plots, the use of coppicing method to generate new chuppons and planting of improved coffee seedlings under old stands are common. This is usually done along with proper soil management through soil test reports as well as coffee leaf sample analysis. The use of coppicing, soil test and coffee leaf analysis and evaluation were engaged in this study at Kusuku, Taraba state.

Materials and methods

The study was a field experiment at Kusuku with two field locations A and B Location A was an on-station site at the old and moribund coffee plantation in Kusuku CRIN Sub-station, while location B was on-farm sites in Kusuku, Mambilla plateau. The experimental plots were mapped out to contain 40 stands of coffee plants that were identified and subsequently coppiced at 30cm to the ground level. The cut surface of each coppiced coffee plant was painted with red coloured paint. Before coppicing, candidate leaf samples were collected for laboratory analysis. There were 3 fertilizer types which includes NPK (15:15:15), poultry manure and NPK (15:15:15) + poultry manure at 50:50 mixture ratio (Organo-mineral), and the control (No fertilizer) for a total of 4 treatments. Each treatment was applied to 10 coppiced coffee plants randomly and tagged accordingly. The coppiced coffee stands were left for generation of chuppons for which only the two that were close to the ground level were retained. Growth parameters in terms of girth, height, number of leaves, branches will be collected on the retained chuppons at 3 months interval. This will continue for 36 months and fruits yield collected per treatment. Soil samples at 0-30cm were collected randomly on the plots at 10 different points using soil core sampler. The soils collected per plot were mixed to form composite sample that represents each plot.

Collected soil samples were air dried in the laboratory, sieved through 2mm sieve and analysed using standard laboratory methods (AOAC, 1990) for the textural soil separates, pH, organic C, total N, available P, exchangeable cations which includes the K, Ca, Mg, Na and the exchangeable acidity (Al^{+3} + H^{+}). The ECEC and base saturation levels were calculated. The micro-nutrient contents were determined and they include Mn, Fe, Cu and Zn. Similarly, the coffee leaf samples were oven dried at 70 ^{O}C to constant weight and milled with stainless harmer mill and analysed for the N, P, K, C, Ca, Mg and Na contents in percentage, as well as the Mn, Fe, Cu and Zn contents in mg/kg.

Results and Discussion

Soil textural properties

The soil separate analysis showed that the soils contained 63.8-68.8% sand, 25.8-29.4% silt and 4.8-6.8% clay (Table 1). The soil separated distribution indicates that the soils were generally sandy loam in texture. The silt + clay contents ranged from 33.2-36.2%, which was higher than the critical level of 32% reported ideal for coffee soils and other tree crops (Egbe *et al*., 1989).This entails that the soils would be able to hold sufficient water for the coffee plants usage, reduce seepage loss and guide against surface run-off that can lead to soil structural damage.

Tables 1: Soil physical properties

Properties	On-Station Plot	On-Farm Plot	kola/coffee plot
Sand (%)	63.8	68.8	65.8
Silt (%)	29.4	26.4	29.4
Clay (%)	6.8.	5.8	4.8
Texture	Sandy loam	Sandy loam	Sandy loam

Soil pH, Organic and nutrient contents

The soil pH, organic C, macronutrients and ECEC contents are shown in Table 2. The soil pH range of 4.44-4 – 5.40 indicates that the soils were acidic. However, the on-station plot was more acidic compared with the on-farm and coffee/kola intercropped plots. The soil pH for both the on-farm and coffee/kola intercropped plots were within the soil pH range ideal for coffee cultivation, while it was below the range for the on-station plot. The soil organic C for the on-farm and coffee/kola plots was 3.48 and 3.21% respectively, while it was 2.27% for the on-station plot. While the on-farm and coffee/kola plots had soil Organic C levels above the critical level of 3.0%., the on-station plot was below the critical level. The very low soil organic C of the on-station plot must have resulted to the very low pH level of the soil. The soil organic C must be improved upon through the use of organic fertilizers or judicious management of farm wastes and mulching materials on the plot. This act will help to correct the acidic nature of the soils on the on-station plot.

Table 2: Soil macronutrient contents across the coffee plots

Properties	On-Station plot	On-Farm Plot	Coffee/kola plot
pH	4.44	5.10	5.90
N (%)	0.145	0.186	0.213
Org. C (%)	2.27	3.48	3.21
P (mg.kg)	27.09	20.84	18.97
K (cmol/kg)	0.32	0.58	0.41
Ca (cmol/kg)	1.861	6.060	7.480
Mg (cmol/kg)	0.603	0.845	1.151
Na (cmol/kg)	0.360	0.520	0.480
Al^{+3}+H^{+} (cmol/kg)	0.127	0.135	0.132
ECEC (cmol/kg)	3.171	8.135	9.620
BS (%)	95.99	98.34	98.63

The soil total N ranged from 0.145 – 0.213%, the value was higher for the coffee/kola intercropped plot and least for the on-station plot. However, the values were higher than the critical level of 0.09% for soils suitable for coffee (Table 3). To maintain continuous sustainable coffee production on th plots, there is need for rational application of nitrogen supplying fertilizers. The soil available P ranged from 18.97 – 27.09 mg/kg soil. The values were least for the coffee/kola plot. This might be as a result of the additional demand and competition for same by the kola plants in the intercrop. However, the soil available P across the plots were higher than the soil critical level of 6.0 mg/kg soil for coffee.

The soil exchangeable cations indicated that K was 0.32 – 0.58 cmol/kg soil. It was least for the on-station coffee plot and highest for the on-farm coffee plot. The values were lower than the soil critical level of 4.0 cmol/kg soil. The soil Ca content ranged from 1.86 – 7.48 cmol/kg soil. The value was least (1.86 cmol/kg) for the on-station plot and highest (7.48 cmol/kg) for the coffee/kola plot. However, the Ca contents across the plots were lower when compared to the critical level of 8.9 cmol/kg soil. The soil Mg content ranged from 0/503 – 1.151 cmol/kg soil. The values followed similar trend as described for the soil Ca content. The values were lower compared to the soil critical level of 8.0 cmol/kg soil. The soil Na content was 0.36 – 0.52 cmol/kg soil. The values were low and could not pose any threat to coffee plants and the soil structure.

Table 3: Coffee soil and foliar nutrient critical levels

Sample	N	P	K	Ca	Mg
	%	mg	→ cmol	←	
Soil	0.09	6.0	4.0	8.9	8.0
	←	%		→	
Foliar	1.10	0.07	1.40	0.37	0.13

On the overall, the lower levels of the exchangeable cations compared to their critical levels for coffee soils indicated the need for the application of appropriate fertilizers that will supply adequate amount of the nutrients to the soils for optimal coffee growth and berry yield on a sustainable level. This was in ttrend with reports by Ipinmoroti and Ogeh (2014). The use of organic fertilizers or manures will be more appropriate so that the advantage of improving the soil organic matter content could be achieved. The soil contents for Mg and K showed that the Mg/K ratios were 1.45, 1.57 and 2.48 for the on-station, on-farm and the coffee/kola intercropped plot respectively. It indicated that the coffee plots had nutrient imbalance problem, this is because, the soil Mg/K ratio should be 2/0. Fertilizer application efforts should be geared towards correcting this in the soil nutrient management activities.

The soil exchangeable acidity (Al^{+3}+H^{+}) contents showed a range of 0.127 – 0.135 cmol/kg soil. The level of soil exchangeable acidity was however very low compared to the exchangeable cations. This was reflected in the soil base saturation levels of 96.00 – 98.63% calculated for the soils. The soil effective cation exchange capacity (ECEC) ranged from 3.17 – 9.62 cmol/kg soil. The value was least (3.17 cmol/kg) for the on-station plot and highest (9.62 cmol/kg) for the coffee/kola intercropped plot.

Micro-nutrients

The soil micro-nutrient contents (Table 4) showed that the soil Mn ranged from 14.45 – 48.05 mg/kg soil, while Fe content was 25.2 – 42.8 mg/kg soil, it was 3.295 – 5.15 mg/kg soil for Cu and 16.81 – 61.73 mg/kg soil for soil Zn content. Generally, the soil micro-nutrient levels were sufficient for coffee plants production on the field. The sufficient amount of these nutrients in the soil forecloses the problem of micron-nutrient deficiency in the proper nutrition of the coffee plants on the various field plots. However, the use of fertilizer materials that could supply some quantity of the various micro-nutrients in the soil will be an added advantage in helping to replenish the soils of nutrients removed by crops through harvests of the berries.

Table 4: Plots soil micronutrient contents

Properties	On-Station plot	On-Farm Plot	kola/coffee plot
Mn	14.45	48.05	42.95
Fe	25.2	42.85	41.05
Cu	3.495	3.295	5.150
Zn	16.81	61.73	32.85

Coffee foliar nutrient contents

The leaf N content ranged from 0.85 – 1.09% (Table 5) with the least value for the om-station plot and highest for the on-farm plot. The values were however lower compared with the critical level of 1.10%. it was observed that despite the high soil content for N, it does not reflect in the leaf content. This might be as a result of fixation in the soil. The leaf P content ranged from 0.04 – 0.11%. The on-farm and coffee/kola intercropped plots were higher in P contents than the critical while it was lower than critical for the on-station plot. This is a sign of P fixation in the soils of the on-station plot. This might be due to the very low organic C contents of the soil with resultant low organic matter and high acidic nature, with high tendency for P fixation.

The coffee leaf Ca contents (Table 5) showed that Ca contents ranged from 0.61 - 0.74% with the on-station having the highest value of 0.74%, which was followed by the on-farm plot (0.64%) and it was least (0.61%) for the coffee/kola intercropped plot. The coffee leaf Ca contents were higher than the critical value of 0.37% and were considered adequate for the coffee plants. On the other hand, the coffee leaf Mg content ranged from 0.10 – 0.12% which was lower than the critical value of 0.13% and hence, considered not adequate for the coffee plants across the plots. Similar trend to this was obtained for the leaf K content which ranged from 019 – 0.52% which were lower than the critical level of 1.40%

The coffee leaf micro-nutrient contents showed that Mn, Fe, Cu and Zn ranged from 202 – 271mg, 905 – 952mg, 30.8 – 40.40mg and 197.3 – 293.2mg respectively. These values were considered to be very high when compared to the soil contents for the elements. It showed that crop removal was higher than their supply to the soil and this could not maintain sustainable optimal coffee berry production on the plots.

Table 5: Coffee foliar nutrient contents across the plots

Properties	On-station Plot	On-farm plot	Coffee/kola Intercrop plot
N (%)	0.89	1.09	1.07
P (%)	0.04	0.09	0.11
K (%)	0.19	0.41	0.52
Ca (%)	0.74	0.64	0.61
Mg (%)	0.11	0.12	0.10
Na (%)	0.33	0.31	0.29
Org. C (%)	17.83	22.57	20.41
C/N ratio	20.03	20.71	19.07
Mn (mg)	202	264	271
Fe (mg)	905	952	944
Cu (mg)	30.8	24.2	40.4
Zn (mg)	293.2	20.71	248.1

Fertilizer and poultry manure

The N:P:K (15:15:15) contains 15% each of N, P and K (Table 6) while the poultry manure contains Ca, Mg, Fe, Cu Mn and Zn in addition to the N, P and K. the C/N ratio was 8.72 which indicates it can easily be decomposed and mineralised to release nutrients to the soil for planted coffee usage. The organic C content makes the manure a veritable material that could help to build up the soil organic matte and improve on the soil buffer capacity.

Table 6: NPK (15:15:15) and poultry manure nutrient contents

Properties	Poultry manure	NPK 15:15:15
N (%)	1.63	15
P (%)	0.34	15
K (%)	0.51	15
Ca (%)	3.59	-
Mg (%)	0.24	-
Na (%)	0.18	-
Org. C (%)	14.21	-
C/N ratio	8.72	-
Mn (mg)	441	-
Fe (mg)	2160	-
Cu (mg)	51.8	-
Zn (mg)	177	-

Recommendations

The study revealed the need for soil and plant nutrient content auditing in order to know the plantations' true condition and the appropriate ways to correct or ameliorate the situation. The coffee plots were very low in the soil organic C, Mg, K and micro-nutrients. The short supply of N and P in the plant leaves requires that steps need be taken to reduce nutrient fixation in the soils. This could be achieved through appropriate organic fertilizer utilization to supply the nutrients and also helps to build up the soil buffer capacity

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Experimental Title: Consequences and Coping Strategies to Covid-19 Pandemic on Activities of Small holder Coffee Farmers in Some Selected States in Nigeria

Investigators: Awodumila D.J, Ipinmoroti R.R., Abdulkarim I.F and Orisasona T.M.

Introduction

Coronavirus or COVID-19 pandemic, which broke out in late 2019 in the Wuhan city of China, has directly and indirectly affected each and every sphere of life across the world. Till April, 2022, it has affected more than five hundred million people with a death toll of over six million people worldwide (WHO, 2022). Plan International (2020) highlights that the COVID-19 pandemic has interrupted way of life and has further disrupted individuals, families and communities putting them under stress of health and economic burdens. The shocks and stress of the COVID-19 crisis pandemic also have much broader impact on the livelihoods of the people leading to worldwide economic disruptions. The evidence from Ebola in Africa in 2015-2016 shows that panic and quarantines led to spike in hunger and malnutrition (Figuié, 2016). Lockdowns and movement restrictions have become major features in fighting the pandemic throughout the world. A growing list of economic indicator makes it clear that the outbreak is having a significant negative impact on global economic growth (Mapping the Spread of the COVID-19, 2020). Apart from the global economic growth, food security implications of a COVID-19-triggered economic slowdown, an extensive spread of the disease in a poorer and more food insecure country could take a heavier toll on the economy than it has in those countries which currently see a rapid spread of the virus.

Beltrami (2020) states that while the food and agricultural sector were supposed to be less affected by the pandemic than other sectors, the illness-related labour shortages, transport disruptions, quarantine procedures restricting activities on farms, as well as access to markets and supply chain has engender food insecurity. This is supported by Danley (2020) who opined that as companies across all sectors, including agriculture, are banning travel for workers and instituting work-from-home programs, a challenge emerges for farmers and their workers who need to be on the fields to produce. Sociologically, the pandemic has caused global social disruption by limiting global social relations. The idea of "social distancing" negates regular social interaction, which is the bedrock of human society (Amzat and Razum, 2014). A contagious disease of global health importance also disrupts the usual norms of close physical contacts since the disease transmits through contact with individuals who already contracted the disease. COVID-19 deglobalizes the world in terms of human migration with airports shut, and social events (sports, festivals and the like) postponed indefinitely. The "stay-at-home" campaign and proscription of (large) social gatherings mean that social interaction has been limited. The covid-19 pandemic constitutes an enormous additional challenge to the global coffee sector that has experienced a prolonged period of low prices. Against this background, the International Coffee Organization (ICO) launched a survey on the impacts of covid-19 on exporting Member countries. The objective was to (i) assess the short- and long term impact of covid-19 on their coffee sectors from farm to export gate and (ii) to identify mitigation measures and additional resources required

The extent at which a country is currently impacted by the covid-19 pandemic is determined by the number of infections, the capacity of the health system, and the containment measures that have been put into place. Therefore, country like Nigeria, in which the coffee harvest coincides with the peak of the pandemic, was severely affected, since labour supply is largely restricted. The severity of the covid-19 impact on the harvest was also felt. Based on the negative impacts of this pandemic on coffee farming activities, this project was designed to examine the consequences and coping strategies employed by coffee farmers.

Objectives of the study

The specific objectives of this study are to;

1. examine the socio economic characteristics of the respondents.
2. examine farming activities engaged in by the respondents
3. determine the effects of covid-19 pandemic on coffee farmers
4. ascertain the coffee farmers coping strategies against covid-19 pandemic

Methodology

Sampling procedure and sample: A four-stage random sampling technique was used for the selection of respondents for the study. Stage one: involved purposive selection of kogi state being the highest producer of Robusta in Nigeria. At stage two, 3 agricultural zones were randomly sampled from the states. In stage three, from each of the selected 3 agricultural zones, 1 rural farming community was randomly selected from each of the zone to make a total of 3 rural farming communities for the study. Lastly, stage four: from each of the selected farming communities, 30 respondents were randomly selected giving a total of 90 respondents.

Status: The project is On-going

Experimental Title: Analysis of Farm Efficiency on the Profitability of Coffee production in Kogi, Nigeria.
Investigators: Orisasona, T.M; Ipinmoroti, R.R ; Agbebaku; E,E.O and Abdul-karim,I.F

Introduction

Agriculture is the mainstay of the Nigerian economy from the standpoint of its various contributions to the economy. Coffee is a member of the Rubiaceae family. Coffee is one of the most important export crops in Africa and Latin America countries (Opeke, 2005). It was introduced to Nigeria around the same time as cocoa. It is commercially grown in 13 States namely, Taraba, Kogi, Ondo, Oyo, Ogun, Osun, Edo, Kwara, Ekiti, Adamawa, Plateau, Abia and Cross River (CRIN, 2014). According to the United States Department of Agriculture (USDA) among 95% of Nigerian coffee farmers, compatibility problem has been observed to be a major factor limiting yield to 600-800 kg /ha. This makes investment in coffee production less profitable (Omolaja, 1999). The empirical results become useful tools for policy makers in agricultural planning and this will lead to better production performance and overall productivity.A study of this nature is however, very pertinent because it give the actual picture of the effects of farm efficiency on the profitability of coffee production which will help address coffee value chain issues .The findings from this study suggest solutions to the constraints encountered by the coffee farming households in Nigeria.

Objectives of the Study

The overall aim of the study is to examine the effect of farm efficiency on the profitability of coffee production in Kogi, Nigeria

The specific objectives of the study are to:

examine the socio-economic characteristics of coffee farmers in the study area;

estimate the effect of farm efficiency on the profitability of coffee production.

Research Methodology

The study was carried out in Kogi State, Nigeria, It's capital is Lokoja, located in north central of Nigeria, Kogi State occupies a total land area of 29,833 square kilometres. The wet season ranges from the month of April to October while the dry season is between November and March. The annual rainfall is between 1000mm and 1500mm, the annual temperature varies between 27°C and 37°C with relative humidity between 30 and 40% in January and rising between 70 and 80% in July to August. The soil in the study area is predominantly sandy loam in texture. The study made use of primary and secondary data. A multi-stage sampling technique was used for the study, In the final stage of sampling, simple random sampling proportionate to size was again used to select the respondents that were administered structured questionnaire and the final sample size for the study is 400. (Ijumu,116, Kabba –Bunu, 139 and Yagba East,145) *The data collected will be analyzed using descriptive statistics and Net Revenue (NR)*

To Estimate the Effect of Farm E fficiency on the Profitability of Coffee Production.

The Tobit model: If a continuous random variable X has pdf *f*(x) and a is a constant, thenS

$$f(x/x>a)=\frac{f(x)}{\Pr ob(x>a)}$$

If x has a normal distribution with mean μ and standard deviation σ, then

$$\Pr ob(x>a)=1-\Phi\left(\frac{a-\mu}{\sigma}\right)=1-\Phi(\alpha)$$

Where α = (a-μ)/σ and φ(.) is the standard normal cdf. The density of the truncated normal distribution is then

$$f(x/x>a)=\frac{f(x)}{1-\Phi(\alpha)}=\frac{(2\pi\sigma^2)^{-1/2}e^{-(x-\mu)2/(2\sigma^2)}}{1-\Phi(\alpha)}=\frac{\frac{1}{\sigma}\phi\left(\frac{x-\mu}{\sigma}\right)}{1-\Phi(\alpha)}$$

Where φ(.) is the standard normal pdf. The truncated standard normal distribution, with μ = 0 and σ= 1.

Likewise, the discrete random variable is the truncated at Zero Poisson distribution,

$$\Pr ob\left|Y=y/y>0\right|=\frac{(e^{-\lambda}\lambda^y)/y!}{\Pr ob[Y>0]}=\frac{(e^{-\lambda}\lambda^y)/y!}{1-\Pr ob[Y=0]}=\frac{(e^{-\lambda}\lambda^y)/y!}{1-e^{-\lambda}},\lambda>0, y=1,...$$

Implicit form;

$Y^*_{ij}=\beta'X+?_i$	$?_i\sim N(0,\sigma 2)$
$Y_{ij}=Y^*_{ij}$	for $Y^*_{ij}>Y_i$
$Y_{ij}=Y_i$	for $Y^*_{ij}=Y_j$

Where

Y = The profitability index ($\frac{NI}{TR}$) as a proxy of farm profit (ratio in figure).
X_1= Farm income (naira)
X_2 = No of products for sale per farm (coffee)
X_3 = Total value of all the products sold in the last session (naira)
X_4 = Total amount of money spend on production in last session (naira)
X_5 = Age of the farmer (number)
X_6= Educational level of the farmer (number of year spent in school)
X_7 = Sex of the farmer (male = 1; 0 if otherwise).
X_8 = Household size (number)
X_9 = Size of the farm X_{10} = Amount of loan accessed in last production year (naira)
X_{11} = Experience in coffee farming (year) X_{12} = Presence of other occupation (yes = 1; 0 if otherwise

Results and Discussion

Table. 1 Distribution of Respondents by Sex

Sex	Frequency	Percentage
Male	311	77.8
Female	89	22.2
Total	**400**	**100.0**

Source: Field Survey, 2019

Table 1 showed that majority of the respondents, (77.8%) were male while 22.2% were females.

This tends to show that any likely increase in farm efficiency of coffee production would be as a result of the predominant involvement of male farmers who are most likely to be more agile than their female counterparts. This implies that coffee farming activities in the study area is gender sensitive**.**

Table 2. Distribution of Farmers According to Years of Experience

Farming Experience	Frequency	Percentage
<10 years	32	8.0
11-20 years	121	30.3
21-30 years	122	30.5
31-40 years	77	19.3
41-50 years	39	9.8
>50 years	9	2.3
Total	400	100.0

Source: Field Survey, 2019

Table 3 Effect of Farm Efficiency on the Profitability of Coffee Production.

Variables	Co-efficient	t value	Marginal effect
Constant	0.208	0.491	0.208
Farm income	0.113**	2.026	0.113
Number of products for sale per farm	0.019	0.051	0.019
Total value of all the products sold in the last session	0.014	0.338	0.014
Total amount of money spend on production	-0.017	-0.722	-0.017
Age of the farmer	0.227	0.866	0.227
Educational level of the farmer	0.091	0.816	0.091
Sex of the farmer	0.847*	1.687	0.847
Household size	-0.000	-0.455	-0.000
Size of the farm	-0.048	-0.845	-0.048
Amount of loan accessed in last production year	0.000	0.242	0.000
Experience in coffee farming	0.000	0.105	0.000
Presence of other occupation	-0.036	-0.051	-0.036

Sources: Field Survey, 2019.
* = Significant at 10%
** = Significant at 5%
*** = Significant at 1%

Out of the 12 variables modeled, only farm income and male gender were statistically significant in determining the profitability of coffee production in the study area.
The coefficient of farm income is statistically significant and positive in determining the profitability of coffee production in the study area. This showed a direct relationship between farm income and the profitability of coffee production in the study area. This implies increase in the farmars income and this will lead to increase in the profitability of coffee production in the study area.
The coefficient of male gender is statistically significanta. This showed a direct relationship between male gender and the profitability of coffee production in the study area. This implies that coffee production will increase with more involvement of male gender.

Conclusion and Recommendation

From this study, it can be concluded that farm income and gender were statistically significant in determining the profitability of coffee production in the study area. The major challenge to the enterprise is Lack of credit facility, weather and disease, lack of road and high cost of transportation, low price and poor market outlet communal systems of land ownership, lack of storage facility and high cost of labour and fire outbreak. An analysis of the determinants of production efficiency was carried out and it showed that production efficiency in coffee production could be created by increased labour employment, seed quantity and volume of herbicides used. Inadequate capital was among the limitations of the coffee farmers. Thus, government and other lending agencies should also do more in assisting the farmers with soft loans in order to reduce the problem of inadequate capital among the coffee farmers in Kogi state, are recommended. In order to increase efficiency, famers should their use of resources such as improved land, labour, fertilizer and farm implement, agro chemicals to attain higher efficiency level and hence more profit. Rehabilitation of old/unproductive coffee farms by coppicing at 30 cm to improve growth and berry yield through improved chupon regeneration by grafting. Government should find way of reducing the high cost of input and provide good roads.

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Experimental Title: Experimental Title; Assessment of Coffee Genotypes for Vegetative Propagation Techniques

Investigators: Adepoju, A. F., Baba Nitsa, M., Sobowale, I. O., and Solomon, O.

Introduction

Production of healthy and vigorous seedlings is important for the establishment of coffee plantation. Many years back, coffee plantations were established through seed. Farmers used seedling obtained from the seed of open pollinated plants as planting material. The nature of Robusta coffee is self-incompatible, so it tends to be cross-pollinated (Hetzel, 2015; Moraes *et al*., 2018). Robusta coffee seedlings produced through the seeds tend to be genetically different from the parents. Today effort is on toward establishment of coffee plantation through vegetative propagation techniques. Angelo *et al*., (2018) recommended shoot grafting or cutting for vegetative propagation in Robusta coffee. Studies have shown that Robusta coffee establishes through grafting techniques were found to be stable and high yield when compared to those propagated by seeds (Sumirat *et al*., 2013). Increase in coffee production can be achieved through selection of the best coffee genotypes for multiplication through clonally propagation techniques. This can be either by grafting, stem cutting or in vitro propagation.

Cutting for propagation in coffee is taken from vertical autotropic branches that were vertical. The vegetative parts used for cuttings are generally stems, leaves, and roots. Oliveira *et al*. (2001) found out that in C. *canephora*, herbaceous stem cutting with a node was superior to woody cutting with a node. Cutting ensured maximum crop homogeneity, it is economical, requiring only limited space, and quick to establish (Partelli *et al*., 2014). Loss of genetic integrity due to inadequate propagation protocol had contributed to poor genetic makeup of individual coffee species (Krishnan *et al*., 2013). Findings had shown that pollens from other coffee species reduce genetic value s due to cross contamination (Krishnan *et al*., 2013). Non duplication of coffee collections for a longer-term can lead to erosion of promising genotypes which called for urgent intervention through vegetative propagation techniques (Anthony *et al*., 2007).

Materials and Methods

Different propagation techniques were adopted with the aimed of identifying the technique that will give the best result. The techniques adopted were seed propagation, grafting and stem cutting. For seed propagation, about Seven different Robusta coffee genotype were harvested this includes D57, T1049, G129, T45, GE87,G129, and Zn5. Wet method was used to process the harvested ripe coffee cherries, and air dried before planting on the pre-nursery beds. For the grafting techniques; genotypes D57/G129, Zn5/C11, Zn1/T1049, G129/T1049, T45/C36, T24/A81, and C108/D57. Robusta coffee rootstocks plants were grown in nursery and prepared before grafting of scion. For the stem cutting, genotype A81, C36, H139, A16, M36, T1049, and C111 were used. Cuttings were taken from vertical autropical branches of C. *canephora* planted at CRIN coffee germplasm, with the use of sharp secateurs. The cuttings were planted as deep as 1 node in upright position into a medium consisting of a mixture of top soil and sawdust (2:1). Cuttings were planted in rows and covered with white nylon. The propagated seeds; stem cuttings, and grafted seedlings were watered every two days on the nursery until they were ready for transplant into the field.

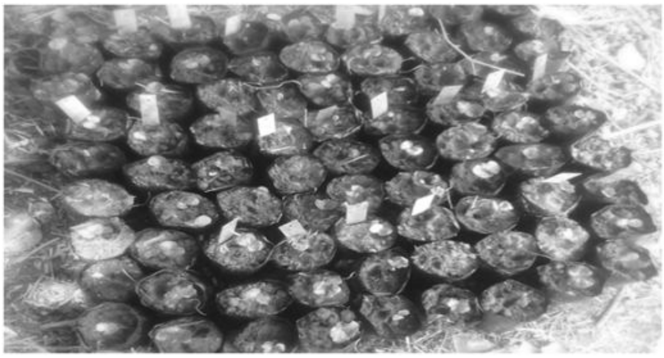

Plate 1 Seed Propagation

Plate 2 Grafting

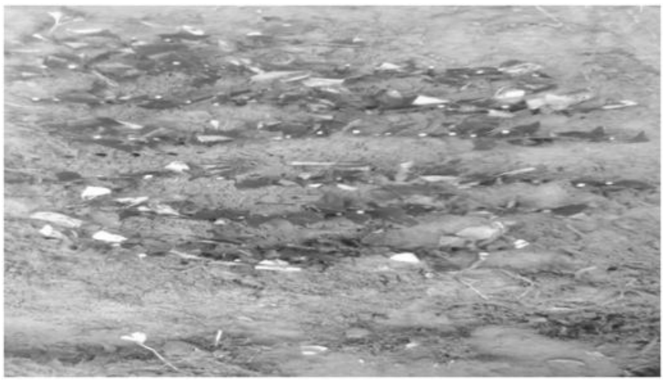

Plate 3 Stem Cutting

Result

The survived seedlings were taken into field for continue evaluation.

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TEA PROGRAMME

Experimental Title: Field Establishment Of Tea Under Varying Watering Regime And Different Shade Levels In Lowland Agro-Ecologies Of Nigeria

Investigators: Adeosun, S.A., Aiyegboyin, K. O., Akanbi, O. S. O., Yahaya A.T and Famuyiwa, B.S.

Introduction

The discovery of tea is dated back to 2700 BC by Chinese Emperor, Shen-Nunga. (Oi, 2004; Famaye *et al*., 2006). Since its discovery, its cultivation has spread to many parts of the world including Nigeria. Its beverage has been reputed for high level of antioxidant with its attendant health benefits of lower susceptibility to cancer and cardio-vascular diseases (Balentine, 2001); helping to prevent heart diseases (Mitscher *et al*., 2001) and being anti-inflamatory, antifibriotic and a cardioprotective agent (Aroyeun *et al*., 2013). An evenly distributed rainfall of 1500-3000mm is required for optimum growth and development of tea (Bonheure, 1991). Tea thrives under ambient temperature of 18-30 ^{0}C (Jannedra *et al.,* 2007) and dies at temperature of <5 ^{0}C and >30 ^{0}C. Tea thrives well on Mambilla highlands owing to its cool climate, and slightly acidic soil (Ipinmoroti, 2006). However, the warm temperature in lowland of Southern Nigeria is detrimental to tea growth.

Justification

Tea, when exposed to full day light, hot and dry air in the lowland, dies and fails to survive the first dry season (Adeosun *et al*., 2019), thereby jeopardizing its growth and establishment in the field. However, tea has been grown successfully in plastic pots under palm fronds sheds and on the field under natural shade of plantain (Adeosun *et al*., 2019 and 2022). Besides, inadequate and poorly distributed rainfall in the greater part of the year in the lowland has successfully constrained tea production in this area. This called for the need to fashion means of ameliorating the harsh weather of the dry season in order to maintain tea growth and development all year round and ultimately ensure high field establishment. That is the essence of this trial. Cessation of rain in the dry season has made irrigation inevitable. Although, there is extremely dearth of information on artificial application of water to tree crops to enhance their field establishment, information obtained from field experience shows that cocoa farmers have to practice manual irrigation in order obtain high field establishment in successive dry seasons after seedling transplant. Therefore, this trial was aimed at assessing the growth and field seedling establishment of tea plants under varied watering regime and different shade levels in Ibadan, Uhonmora and Ajassor.

Objectives

To determine the effects of watering on the growth performance of established tea cuttings during the dry season.

To determine the optimum water regime that would enhance ≥ 70% seedling survival at the end of the second dry season after seedling transplant.

To determine the interaction effects of watering regime and plantain shade on survival rate of cultivated tea plants at first two dry seasons after seedling transplant.

Materials and Methods

This experiment was carried out Ibadan (Oyo State), Uhonmora (Edo State) and Ajassor (Cross Rivers State). It is a factorial of 3 factors which include plantain shade at 2 levels (plantain shade and zero shade), 4 watering regimes - watering at 2 L/day, 2 L/in 2days, 2 L in 3days, zero watering (as control); 2 tea cultivars (143 and 318) giving 16 treatment combinations laid out in Randomized Complete Block Design (RCBD) arranged in Split-Split Plots with 3 replications. The shade levels served as main plots, watering regimes as subplots and tea cultivars as sub-subplots. A gap of 2m was created between the subplots. A suitable site of 0.2 ha was selected. The land was cleared of vegetation and field layout was done. Composite soil samples were collected from the sites for pre-cropping laboratory analysis for physico-chemical soil properties. Plantain suckers were planted at a spacing of 3 x 1.5 m (Adeosun *et al.,* 2022). The established plots were weeded 3 times per annum. Two thousand (2000) tea cuttings (Cultivars 143 and 318) were raised in CRIN Substation, Mambilla, Taraba State.

Results and Discussion: The result of pre-cropping soil physico-chemical properties is being awaited. The project is ongoing

Conclusion and Recommendations: The project is ongoing

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Experimental Title: Intercropping of Tea With Eucalyptus: Implication on Soil Fertility And Green Tea Quality Parameters

Investigators: Aikpokpodion P.E, Okunade A.F and Asowata F.E.

Introduction

Tea cultivation on the Mambilla plateau is common among farmers on the plateau due to favorable climatic and soil conditions. Most of the farmers are small scale farmers with small land holdings. Despite the fact that Mambilla plateau is good for tea cultivation, availability of land for large scale tea farming is limiting because, greater proportion of the land on the plateau is used for grazing. Hence, farmers are left with limited area of land for cultivation. In order to maximize land use, 74% of tea farmers intercrop tea with varieties of crops. Some intercrop tea with arable crops like maize and beans while 41.10 % intercrop tea with eucalyptus which is the only source of timber on the Mambilla plateau. Another reason why tea farmers intercrop tea with eucalyptus is the poor financial returns from the sale of tea leaves. In order to augment financial returns from farming, the farmers purposely plant eucalyptus among tea stands for the purpose of being sold as timbers after 8 – 10 years. Eucalyptus being a perennial crop can be nutrient and water demanding which could lead to nutrient deficiency in tea soil as a result of competition for nutrient and water. In order to evaluate if the combination of both crops on same land has significant impact on tea quality and nutrient availability, it became necessary to

Objectives

To evaluate the impact of tea-eucalyptus intercrop on nutrient status of the soil

To evaluate the impact of tea-eucalyptus intercrop on tea quality with respect to bioactive polyphenolic compounds in tea leaves

To evaluate the impact of tea-eucalyptus intercrop on soil chemical parameters

Materials and methods

Soil samples and tea leaves (1 leaf and 1 bud) were collected from selected tea-eucalyptus intercropped farms in Kusuku, Kakara and Sabongari at the depth of 0-20cm with soil auger. Since the study was a comparative investigation, similar sampling was equally done in adjacent mono-cropped tea farms. The samples were collected from ten (10) points within each farm and mixed together to form a composite sample. The obtained composite soil samples were air-dried in the laboratory under ambient temperature. And sieved with 2mm sieve. The tea samples were subsequently processed into green tea according to standard procedure.

Soil analysis

Determination of macronutrients was done by leaching the samples with 1N ammonium acetate. The leachate was analyzed for exchangeable cations (Ca^{2+}, Mg^{2+}, K^{+} and Na^{+}) determination according to Schollenberger and Simeon (1945). Soil pH was measured with glass electrodes in 1:1 soil-water suspension. The organic carbon was determined according to Walkley and Black (1934). Total Nitrogen was determined by the Macro Kjedahlmethod (Bremner,1996). Available Phosphorus was determined using Mehlich 3 method (Mehlich, 1984). Mehlich 3 extracting solution was preferred to Bray 1 solution owing to the inability of Bray 1 solution to extract available phosphorus from the soil samples at detectable level.

Determination of Polyphenolic derivatives in green tea samples

Caffeine, epicatechin, epigallocatechin, epigallocatechin gallateand gallic acid determination was done according to the methods of Allen, (1979) while total phenol was determined according to Titto, (1985).

Results and Discussion

Soil sample analysis shows a percent increase of 4.6, 4.6, 9, 17, 10.24, 64, 23, 12 27, and 13% in the concentration of pH, available Phosphorus, exchangeable K, Ca, Mg, total nitrogen, organic carbon, Cu, Zn and Mn respectively in tea plantations intercropped with eucalyptus in Kusuku compared with tea farms without eucalyptus intercrop (Table 1). The same observable increase in soil nutrients was recorded for tea farms intercropped with eucalyptus trees in Kakara and Sabongari compared with mono-cropped tea farms within the same environment (Table 1).

The increase in soil macro and micronutrients in plantations with tea-eucalyptus intercrop was mainly due to the increased in soil organic matter from the leaf litter of eucalyptus tree. The organic matter decompose and undergo mineralization which causes a built up of soil organic matter. This also serves as substrate for soil biota and enhances microbiological activities within the soil. The soil ecosystem is also drastically improved by the presence of canopy formed by eucalyptus trees. The trees serve as wind and prevent wind erosion of top soil within the tea-eucalyptus intercropped farms. Trees significantly enhance soil organic matter in a cropping system by 50-100% in many cases through pruning, litter fall, root slough and exudates (Young, 1989). This additional organic matter serves as increased food for microbes, which in turn boost soil microbiological activities by 30% (Young, 1989). The increased soil organic matter that trees add to farm also result in higher cation exchange capacity in soils which allows soils to retain nutrients and prevent leaching. According to Liu and Balasubramanian (2012), eucalyptus leaf contains 46% carbon and 1.23% nitrogen. The nutrients locked up in the leaves are made available for plant uptake when they undergo decay and mineralization. Sarkar et al, (2010) also reported an increase in soil pH, organic matter, total N, available P, exchangeable K, Ca and Mg in soils due to leaf litter fall. Apart from increase in soil fertility, soil structure is also enhanced by the decay and mineralization of leaf liter fall. Shankarnarayan (1984) reported an increase in organic matter, nitrogen and phosphorus on soil under crop intercropped with trees compared with *Prosopis* species of same farm without trees. Under agroforestry system involving *Populus deltoids* and eucalyptus hybrid canopies, enhancement in soil nutrient was 33-83% organic carbon, 38-69% nitrogen, 3-33% available phosphorus (Anonymous, 1987)

Result of green tea analysis shows that total phenol ranged from 8618 - 9593mg/100g green tea from mono-cropped tea farms across the selected farms in Kusuku. Kakara and Sabongari (Table 2). On the other hand, total phenol in tea harvested from tea-eucalyptus intercrop ranged from 8761 – 9756mg/100mg sample with an increase of 1.7, 1.04 and 1.67% in tea sample from Kusuku, Kakara and Sabongari respectively compared with mono-cropped tea. In a similar manner, caffeine content of tea intercropped with eucalyptus also increased by 5.42, 5.26 and 3.4% compare with mono-cropped tea obtained from the selected tea farms in Kusuku, Kakara and Sabongari respectively. Gallic acid in tea sample from mono-cropped tea ranged from 2450-2464mg/100g sample while it ranged between 2531 and 2637mg/100g of tea sample obtained from tea-eucalyptus intercropped farms. Gallic acid increased by 7.0, 2.17 and 3.31% in tea samples obtained from tea-eucalyptus intercrop compared with monocroped tea in samples from Kusuku, Kakara and Sabongari respectively (Table 2). Epicatechin in tea sample from tea-eucalyptus intercrop increased by 12.6,18.7 and 13.91% compared with tea samples from mono-cropped tea farms in Kusuku, Kakara and Sabongari respectively. Similarly, epigallocatechin increased by 4.95, 3.98 and 8.22% in tea samples from tea-eucalyptus intercrop in relation to samples from mono-cropped tea farms selected in kusuku, Kakara and Sabongari respectively. Epigallocatechin-3-gallate in tea samples from tea-eucalyptus intercrop increased by 20.31, 12.93 and 15.44% compared with tea samples from selected mono-cropped tea farms in Kusuku, Kakara and Sabongari respectively. Epigallocatechin (EGC), Epigallocatechin (EGC), Epicatechin gallate (ECG), Catechin gallate (CG) and Gallo catechin (GC) increased in all samples obtained from tea farms intercropped with eucalyptus compared with samples from farms solely cropped with tea.

Catechins are the main bioactive molecules in tea and are the most frequent (Cabrela et al. 2003), the six catechin derived polyphenols in tea leaves are epicatechin, epicatechin gallate, gallocatechin, epigallo catechin and epigallocatechin gallate. Catechin accounts for 6-12% of the dry tea weight of green tea leaves with ECGC containing 10-50% and being the most bioactive due to its degree of gallation and hydroxylation (Stewart et al. 2004). The health benefits of green tea has been attributed to the strong antioxidant activity of catechins and other polyphenolic compounds (karori et al. 2007) that protect the body against free radical induced oxidative stress (Pourmorad et al. 2006). In addition, tea phenolic compounds have been associated with amelioration of inflammation (Kakori et al. 2008), Inhibition of diabetes (Sabu et al. 2002), Prevention of intestinal damage and anti-diarrhea properties (Astar et al. 2003). Polyphenols have been found to enhance oral health (Wu and Wei, 2002) and the potential to improve cognitive learning ability.

The increased concentration of catechins and its derivatives in tea samples obtained from tea-euclyptus intercrop must have been influenced by two factors. First is the improved soil organic matter occasioned by leaf litter fall from eucalyptus trees and the second factor is attenuation of direct solar ultraviolet radiation scourge on tea plant by eucalyptus canopy cover. The increased soil organic matter in soils under eucalyptus intercrop created conducive environment for microbial activities which enhanced the enzymatic oxidation of polyphenols in tea crop under eucalyptus. The synthesis of bioactive compounds in tea under eucalyptus intercrop must also have been enhanced by the boosted ecosystem created by the canopy cover of eucalyptus.

The second factor is connected to reduction of the direct solar radiation getting to the tea crop under eucalyptus intercrop. Currently, the impact of climate change and global warming with its attendant increase in temperature cannot be denied. The ultraviolet portion of solar radiation has a higher penetrating power than the visible part of the solar radiation. Direct irradiation of intense sunshine on sunny days especially during the dry season can be harmful to young shoots of tea plant. When the temperature of air around the surface of tea leaf is higher than the temperature of the leaf, tea plant closes its stomates in attempt to control moisture loss through evapotranspiration. This mechanism is put in place to prevent water stress in the tea plant. During stomates closure, absorption and translocation of water and nutrients from the soil to tea plant is slows down since the closed stomates are not readily opened for transpiration and exchange of gas at the leaf surface. In situation where the temperature is so intense, the closure of stomates to reduce water loss from the tea plant is overwhelmed and the tea plant significantly losses water through excessive transpiration leading to water stress and may even cause the death of affected plant if there is no external intervention. On the other hand, such scenario is not likely to happen in tea intercropped with eucalyptus in which the canopy cover from eucalyptus trees serves as barrier and filter direct solar radiation getting to the young tea shoots by cutting off near infrared solar flux and transmit sufficient light intensity for optimum photosynthesis. Shading by trees provides a number of known benefits to tea plantations including microclimate improvement and resultantly higher growth rates and better quality of tea leaves as well as better economic returns. Shade trees covering the tea plantation protect the crop from direct sunlight, scorching heat and warm air currents. As a result, the air temperature at the surface of the tea leaves is minimized and the exchange of gas between the tea leaves and its environment is unhindered. This favorable condition enhances absorption and translocation of water and plant nutrients from the soil to the various parts of tea plant for adequate synthesis of plant phytochemicals including catechins and its derivatives. The observed increase in phenolic compounds in the study is in consonance with the report of Zhang et al., (2022) in which tea grown under shade had higher total phenols (17.27%) compared with tea grown in the open (14.92%)

Conclusion and recommendation

Intercropping tea with eucalyptus imparted soil nutrient status positively. The increased soil organic matter through litter falls and created enabling environment for microbial activities in the soil which made decomposition and mineralization of organic material easy leading to increased build up of macro and micronutrients in the studied tea-intercropped farms compared with mono-cropped tea farms. Intercrop of tea with eucalyptus also enhanced the synthesis of polyphenolic and bioactive compounds in tea leaves.

As good as the outcome of the study is, the possibility of competition for nutrients and water between tea and eucalyptus it must be borne in mind. In a situation where eucalyptus density within the tea farm becomes higher than necessary, the shade from canopy cover will prevent sunlight from reaching the tea plant and photosynthesis will be hampered. The unnecessary shade cover could also encourage the emergence of diverse pathogenic organisms due to the moistly environment.

It is therefore recommended that, intercrop of tea with eucalyptus be done in such a way that adequate aeration, sunlight, and water supply is not hindered.

Table 1: Chemical properties of soil under tea-eucalyptus intercrop and mono-cropped tea farms

Parameters	Kusuku			Kakara			Sabongari		
	Open	Under Eu	% Inc	Open	Under Eu	% Inc	Open	Under Eu	% Inc
pH	4.80	5.02	4.6	4.68	4.92	5.12	4.77	4.85	1.67
Available P ($mgkg^{-1}$)	9.50	9.94	4.6	10.90	11.20	3.00	9.55	9.76	2.19
Na ($cmolkg^{-1}$)	0.32	0.33	3.0	0.22	0.23	4.50	0.31	0.33	6.45
K ($cmolkg^{-1}$)	0.34	0.37	9.0	0.21	0.23	9.50	0.11	0.12	9.0
Ca ($cmolkg^{-1}$)	1.29	1.51	17.0	0.75	0.82	9.30	0.99	1.06	7.0
Mg ($cmolkg^{-1}$)	1.27	1.40	10.24	0.40	0.44	10.00	0.66	0.72	9.0
Exc. Acidity	0.26	0.27	3.84	0.16	0.17	6.25	0.14	0.15	7.14
N (%)	0.28	0.46	64.0	0.19	0.22	16.00	0.22	0.30	36.0
Organic Carbon (%)	4.40	5.40	23.0	4.24	4.63	9.00	4.56	4.98	9.2
Cu ($mgkg^{-1}$)	0.89	1.00	12.0	1.05	1.12	7.00	0.60	0.62	3.0
Zn ($mgkg^{-1}$)	2.87	3.65	27.0	5.45	5.73	5.00	9.78	9.85	1.32
Mn ($mgkg^{-1}$)	13.45	15.28	13.0	2.45	2.64	7.80	5.45	6.30	15.0
Fe ($mgkg^{-1}$)	13.93	13.93	-	39.15	39.18	0.10	26.00	26.83	3.19

Key: Euc – Eucalyptus; % Inc - % increase in parameters; Open – Open field/Mono -cropped

Table 2: Biochemical parameters of green tea from tea -eucalyptus intercrop and mono -cropped tea farms

Parameters (mg/100g)	Kusuku			Kakara			Sabongari		
	Open	Under Eu	% Inc	Open	Under Eu	% Inc	Open	Under Eu	% Inc
Total phenol	9593	9756	1.70	8753	8844	1.04	8618	8761	1.67
Catechin	57.12	57.76	1.12	50.80	51.12	0.63	47.84	48.48	1.33
Caffeine	3320	3500	5.42	3240	3410	5.26	3112	3218	3.40
Gallic acid (GA)	2464	2637	7.00	2389	2441	2.17	2450	2531	3.31
Epicatechin (EC)	813	915	12.6	567	673	18.70	600	684	13.91
Epigallocatechin (EGC)	2055	2200	7.00	1980	2099	6.00	1901	1986	4.47
Epigallocatechin gallate (EGCG)	7120	8567	20.31	6453	7288	12.93	6842	7899	15.44
Epicatechin gallate (ECG)	1490	1654	11.00	1383	1506	9.00	1368	1484	8.48
Catechin gallate (CG)	7	7.14	2.00	6.50	6.62	1.85	6.20	6.32	1.94
Gallocatechin (GC)	250	265	6.00	241	253	5.00	236	247	4.66

Key: Euc – Eucalyptus; % Inc - % increase in parameters; Open – Open field/Mono -cropped

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Experimental Title: Comparative Study of Tea Marketing in Kano and Benue State of Nigeria
Investigators: Yahaya, A.T; Oluyole, K.A and Oladokun, Y.O.M

Introduction

Tea has become the world's first most popular beverages after water, it is the cheapest beverage in the world and consumed by over 3 million people across religion and culture. It represents one of the major components of world's beverage market (IISD, 2019; UNCTAD, 2016, Anderson, 2014). It is a commodity of high value with extensive value addition capacity for economics of scale (IISD, 2019; Blueprint, 2017). Tea has contributed largely to the Gross Domestic Product (GDP) and Gross National product (GNP) of growing countries and has growing international market in health and food industries. The demand for tea is increasing and continued to increase across the world (Ethical Tea partnership, 2019; Solidaridad Network, 2014).

Global Tea sales (7.76 billion tons in 2018) recorded a good performance attributed largely to urban population growth (UNCOMTRADE, 2020). Tea sector is projected to experience continued and increasing growth due to increasing demand primarily from Asian and Pacific countries. Increase demand for tea is attributed to increasing income, growing clientele among young urban consumers, interest in the health benefit of drinking tea, expansion of new products and flavouring such as ready-to- drink /instant tea, premium tea, herbal and fruit fusion (Bolton, 2019, Kumar, 2019, FAO, 2018, Mordor, 2018 and Zion, 2018, Technavo, 2017).

Nigeria is one of Tea producing countries in the World; Nigeria, tea production was estimated at an average 82,234 tons per year (NBPC, 2011) and it increased to 167,324 metric tons in 2018, an average consumption level of 100kg/ person/ year (NBPC, 2019, Oluyole, et al, 2017). Tea production in Nigeria is a significant economic activity; approximately 10,000 people depend on Tea as source of livelihoods. In Nigeria Tea is a source of raw materials for industry producing value added products in many parts of the country and is a vital part of beverages market in Nigeria (CRIN annual reports, Oluyole et al, 2018).
Consumption of tea is done across religion and culture in Nigeria but predominantly in the Northern part (CRIN annual reports, CRIN @ 50).

Objective

The study assessed marketing activities in tea across three LGA's each, in Kano and Benue states of Nigeria vis-a-vis:

1. the market outlook and volume of tea trade in each region for comparative advantage and competitiveness of tea trade in Nigeria.
2. determine the opportunities for business relationship for small- holders' farmers and processors
3. analyze the constraints to tea marketing in these region
4. examine the various stages and actors in tea marketing in Nigeria.
5. provide a policy recommendation for tea crop as a good source of revenue for Nigerian economy.

Materials and Methods

The study was carried out in Otkupo, Gboko & Markudi LGA's, in Benue and Fagge LGA of Kano states respectively. Multistage sampling techniques was used to select Otkupopo, Main and Nwukuru markets of Benue and Singa market of Kano State respectively. The second stage was selection of respondent for the study. The third stage was selection of 241 respondents from the selected markets. Information was collected with the use of structured questionnaire, which seeks information on cost incurred on inputs and output, volume of sales, prices of inputs and output, supply chain, sources of materials for sales, buyers, channel of marketing, levels paid to government at different levels, subsidy received from government, constraint to marketing among others. Data were analysed with the use of descriptive statistic and Policy Analysis Matrix (PAM). The indicator of competitiveness in PAM was employed.

Results and Discussion

The results of the social-economic characteristics of the respondents were presented in Table 1. The result showed that in Kano, 65.56% of the respondents are between 40-50 years. There is a positive correlation between age and efficiency. Youth are more meticulous in carrying out their activities and they easily embrace new technology. However, the result show that in Benue, 67.22% of the respondents are between 40-50 years. This indicates that the marketers are in their active and productive age. It is also observed that in Kano, larger percentages (96.27%) of men are into tea marketing. Males are more involved in buying and selling, while their female counterparts are into managing family activities owing to religious reasons. On the other hand, more females (69.98%) are into tea marketing in Benue along sides their male counterpart (34.02%). This indicate that both male and female are actively involved in tea marketing in Benue. Results for Kano shows that majority of the respondent (70.54%) had no education at all whiles (23.65%) had only basic education. This informed their method of business dealings in the areas. Nevertheless, (85.89%) of the respondent in Benue had secondary school education and (5.81%) had primary education, while (8.30%) of them had no education at all. This informs efficiency in their business dealings in the areas.

Table 2 show the cost and returns of tea marketing in the study areas using the policy analysis (PAM). The estimated private budget for tea marketing in Kano and Benue states are presented respectively. Table 1 showed that in Kano state, the estimated total cost incurred was N7,010 per ton. The component of the cost includes input cost of (Generator cost, building cost, Vehicle cost), factor cost (such as cost of rentage, transportation cost, electricity cost, cost of fueling, interest on loan) as well as labour cost. The estimated input cost was N 273,284. The value of factor cost was N383,488 while that of labour cost was N500,000 at private cost. The estimated revenue per ton was N185,588.88 per ton at private prices, hence, a net profit of N178,578.88 per ton was derived at private prices.

Table 2 also showed that in Benue state, the estimated total cost incurred was N5,295 per ton. The component of the cost includes input cost of (Generator cost, building cost, Vehicle cost), factor cost (such as cost of rentage, transportation cost, electricity cost, cost of fueling, interest on loan) as well as labour cost. The estimated input cost was N 150,000. The value of factor cost was N220,000 while that of labour cost was N689,188 at private cost. The estimated revenue per ton was N3,553,031 per ton at private prices, hence, a net profit of N 3,547,736 per ton was derived at private prices.

Table 3 shows the supply chain of tea in the study areas. It shows the sources of tea market open to traders dealing in tea in Kano and Benue states respectively. From the table, high percentage (85.89) of the marketer in Kano source their materials for sales from the packagers while (55.19) marketer in Benue source theirs from processors. Its however worthy of note that marketers in the study areas do not have access to business relationship with tea farmers.

Table 4 shows the buyers of tea from marketers in Kano and Benue state respectively. The table shows that in Kano majority (41.49) of tea marketers sell their good to countries like Niger Republic, Chad, Cameroun. This is unique features of tea marketing in these areas. Also, the table also shows that 36.10 percent of marketers sell their products directly to the consumers. However, in Benue, majority of marketer sell to retailers while 37.34 are sold to consumer.

Table 5 shows the constraints to tea marketing in Kano and Benue states respectively. The table shows that major problems to tea sales in Kano and Benue states respectively are not getting sufficient tea for sales and insecurity in the land. The table shows that in Kano 65.98 marketers complain they do not have enough tea to sell while 20.75 claimed insecurity constitute another major problem to the marketing activities. Similarly, in Benue state, majority 37.34 also complain of lack of enough tea materials for sales. Tea marketing in Benue is also affected by insecurity as 29.46 percent of the marketer's complaint. This is an indication of marketing opportunities for small holders' farmers and processors in Mambilla, Taraba States who complains of lack of markets to sell to.

Table1. Social Economic Characteristic of the respondents

Variable	Kano		Benue	
Age	Freq.	Percent	Freq.	Percent
≤ 40	13	5.39	57	23.62
40-50	158	65.56	162	67.22
51-60	68	28.22	19	7.88
>60	2	0.83	3	1.24
Total	241	100.00	241	100.00
Gender				
Male	232	96.27	82	34.02
Female	9	3.73	159	65.98
Total	241	100.00	241	100.00
Educational Status				
No Education	170	70.54	20	8.30
Primary Education	57	23.65	14	5.81
Secondary Education	14	5.81	207	85.89
Total	241	100.00	241	100.00

Source: Field Survey 2021

Table 2. Estimated Budget for Tea Marketing in Kano and Benue state

Variable	Kano price (₦)	Benue price (₦)
Tradable inputs	273,284	150,000
Domestic factors	383,488	220,000
Labour	500,000	689,188
Total cost	1,156,772	1,059,188
Cost/ton	7,010	5,295
Revenue/ton	185,588.88	3,553,031
Profit/ton	178,578.88	3,547,736

Field Survey, 2022

Table 3. Source of material for sales

	Kano		Benue	
	Freq	Percentages	Freq	Percentages
Farmers	0	0	0	0
Processors	34	14.11	133	55.19
Packagers	207	85.89	108	44.81
Total	241	100	241	100

Field Survey, 2022

Table 4. Marketing and sales

	Kano		Benue	
	Freq	Percentages	Freq	Percentages
Consumers	87	36.10	90	37.34
Retailers	34	14.11	139	57.68
Distributors	20	8.30	12	4.98
Export	100	41.49	0	0
Total	241	100	241	100

Field Survey, 2022

Table 5. Constraint to Marketing

	Kano		Benue	
	Freq.	Percent	Freq.	Percent
i. High Tax	0	0	50	20.75
ii. High Prices inputs	2	0.83	10	4.15
iii. Non-Availability of Tea for sales	159	65.98	90	37.34
iv. Proximity to source of raw materials	5	2.07	0	0
v. Storage Facilities	0	0	0	0
vi. Credit Accessibility	25	10.37	20	8.30
vii. No- support from Govt.	0	0	0	0
viii. Non-Existence of Tea Policy	0	0	0	0
ix. Insecurity	50	20.75	71	29.46
Total	241	100	241	100

Field Survey, 2022

Conclusion and Recommendations: Tea marketing is done majorly by youths in their active working years in the study areas. Tea sales is competitive given the net profit derived by marketers in the study areas. The supply chain of tea in the areas is such that tea are sourced from packagers and processors who sell to marketers who in turns sell to consumers, retailers or sell to neighboring countries. Major problems to marketing in the study areas are inability to get enough tea materials for sales and insecurity. This study thereby recommends a link between small- holders' farmers and cottage processors in Mambilla Taraba state who yearn for market to sell their produce to improve their livelihoods.

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Experimental Title: Development and characterization of health friendly flavored green tea blends

Investigators: Yahaya L.E, Okunade A.F, Ajewole A.O, Jayeola C.O, Olorundare B, and Igbinadolor R.O

Introduction

Tea (*Camellia sinensis* L) is one of the most widely popular nonalcoholic beverages, consumed by over two thirds of the world's population due to its medicinal, refreshing, and mild stimulating effects. There are four main types of made tea used for tea infusion based on their respective processing methods. These includes black or red, oolong, green and white. Green tea remains one of the most favorite choices of beverage among tea drinkers across the globe. This is occasioned by its associated health benefits accruable from it. It is made of pan-fired leaves having high amount of epigallocatechin Gallate (EGCG). The principal catechins present in green tea such as (-)- epicatechin (EC), (-)-epigallocatechin (EGC), (-)-epicatechin - 3-gallate (ECG), (-)-epigallocatechin-3-gallate (EGCG) and (-)-gallocatechin gallate (GCG) are indicated as major part of biologically active substances (Ho et al., 1994; Sharma et al., 2014). EGCG is the most common polyphenol found in green tea and represents up to 10% of its dry weight and includes 60-70% of its total catechins. Many of the green tea has health promotion abilities that are attributed to EGCG (Patil *et al.*, 2016). Value addition remains one way to diversify product. According to (Herath and De Silva, 2011), value addition of tea can be achieved through product differentiation such as spicing. Spicing of tea is one way of product differentiation and brand development. Spices are mainly used for flavoring and they also have certain medicinal properties. A spice consists of a dried seed, fruit, root, bark or vegetative substance used in nutritionally little quantities as a food additive for flavor, color, or as a preservative that is inimical to harmful bacteria or prevents their growth. So, addition of these spices with tea can play an important role in public health and can be used for medicinal purposes. Cinnamon contains unique healthy and healing property due to the presence of active components. Naturally, green tea taste is bitter, hence might not appeal to many; however, spicing can help resolve this challenge. This paper therefore reports the development and characterization of spiced green tea.

Materials and Method

Green Tea Processing: A bud and two leaves were obtained from the plant *Camellia sinensis*. The leaves were subjected to withering after which it was pan-fired and then rolled. The rolled tea leaves were then dried in an oven. Spice (cinnamon) used for this work was obtained from the open market. The processed tea leaves were pulverized, and blending was carried out.

Preparation of spice green tea. The spice (cinnamon) was added to green tea in powder form and green tea without spice as control sample were used for this study. Blending was done on a weight-to-weight ratio (w/w) (0, 10, 20, 30, 40, 50%) of spice to processed teas. Proximate characteristics of Green Tea blend were carried out according to standard methods, mineral and antioxidant profile were also carried out.

Results and Discussion: The proximate composition of the tea blend is presented in Table 1. It is obvious that moisture content was maximum at 10% inclusion of spice while the least was obtained at 50%. On the other hand, highest value of 14.9% was recorded for tea blend of 40% inclusion for crude fibre. There was a general decrease in total ash with increase inclusion of spice. This may be as a result of the inherent high content of the additive. Caffeine content increased with increasing spice inclusion while water extract and ether extract assumed irregular pattern in the course of the study.

Table 2 shows the antioxidant profile of the tea blend. Free radical scavenging activity (DPPH), Ferric reducing antioxidant power (FRAP)and total polyphenols values indicates that inclusion of spice in green tea further enhances the antioxidant capacity of the product and could therefore scavenge free radicals in the body. The sensory property results (table not shown) also indicates that 20% inclusion of the spice was the preferred and accepted level of inclusion for tasters.

Table 1. Proximate characteristics of Green Tea blend

Sample Code	Moisture Content (%)	Crude Fibre (%)	T. Ash (%)	Protein (%)	Ether extract (%)	Water extract (%)	Catechin (%)	Caffeine (%)
A	7.26	13.62	15.88	6.41	43.41	2.15	4.88	7.36
B	7.41	13.81	12.12	6.72	41.01	2.61	3.74	7.41
C	7.38	13.89	11.66	7.69	40.39	2.83	3.28	7.69
D	7.33	14.22	11.29	7.81	40.11	3.11	3.54	7.93
E	7.14	14.92	10.51	8.84	39.68	3.42	3.18	8.01
F	7.09	13.71	10.05	8.99	39.09	3.44	3.21	7.91

Table 2. Antioxidant profile of Green Tea blend

Samples code	DPPH (%)	FRAP (Mm $FeSO_4$/100g)	Total phenolics (%)
A	86.9	0.45	18.19
B	86.6	0.26	18.00
C	86.2	0.24	17.83
D	85.7	0.19	17.71
E	84.4	0.13	17.24
F	83.6	0.13	17.37

Conclusion and Recommendation: The study shows that blending green tea with spice can add to its nutritional status as well as health benefit. Organoleptic assessment revealed that 20% inclusion remained the best choice for taster. It can therefore be recommended that green tea should be spiced to help increase its health benefit to its consumers.

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Experimental Title: Adsorption of heavy metals ions using spent tea leaves and its derivatives

Investigators: Yahaya L.E, Odeyemi E. F, Osikoya T, Olalekan-Adeniran M.A, Atanda J

Introduction

The increasing rate of industrialization often generate heavy metal load into the environment, and this has constituted serious threat to plant and animal lives today. Among these heavy metals is lead, a toxic metal commonly found in industrial workplaces. These contaminations are derived from various activities such as mining of ores, tanneries, electroplating, vehicular movements as well as petrochemical refineries. Heavy metal contamination to the environment even at low concentration can be toxic (Ahluwalia, S. and D. Goyal, 2005). Different methods exist for the treatment of metal ions from aqueous solutions and this include chemical and surface chemistry processes such as precipitation, adsorption, membrane processes, ionic exchange, floatation, electrochemical coagulation chelation etc (Mittal et al, 2005; Muruganandham and Swaminathan, 2006). However, these techniques have their own drawbacks such as less efficiency, sensitive operating conditions, and production of secondary sludge requiring further costly disposal [Fil et al, 2012]. These setback, coupled with the need for more economical and efficient methods for recovery of heavy metals from wastewater have resulted in the development of alternative separation technologies. The tea industry generates a large volume of spent tea leaves, STL, which has not been adequately harnessed into in tea plantations. This study was thus aimed at exploiting opportunities for agricultural waste management.

Materials and Method: The batch adsorption experiments were carried out on the removal of two heavy metal ions (Pb (II) and Zn (II) from aqueous solution to study the kinetics, mechanisms, and thermodynamics properties. In the kinetic experiments, the batch adsorption studies were carried out by shaking 0.5 g of the spent tea leaves (STL) with 25 mL of different concentrations (10 – 100 mg/L) at varying pH (1-8) containing the metal ions for various contact times (10 - 180 min) over a range of temperature. The influence of pH on the sorption behavior of the metal ions was carried out within the range that would not be influenced by metal precipitated. The initial pH of each solution was thus adjusted to the desired pH by drop wise addition of 0.1M HNO_3 and/or 0.1M NaOH solution. At the end of each contact time, the mixture was filtered and the residual concentration was determined using Atomic spectrophotometer, AAS (Buck scientific model 210 VGP). The amount of Pb (II) and Zn (II) removed from solution by STL was taken as the difference between initial and residual concentrations of the metal ion. All the experiments were carried out in triplicates and the mean value taken. Percentage removal of the metal ions was estimated using the following equation:

$$\text{Removal efficiency} = Ci - C_f/C_i \times 100 \qquad (1)$$

where, Ci : Concentration of heavy metal ions before adsorption C_f : Concentration of heavy metal ions after adsorption The amount of metal ion adsorbed at time t (qt) was calculated using the formula:

$$qt=(Ci-C_f)v/m \qquad (2)$$

where, v: volume of aqueous solution used for adsorption m: mass of adsorbent used.

Kinetic and thermodynamic studies were carried out using spent tea leaves.

Results and Discussion: The effect of contact time on adsorption by spent tea leaves (STL) indicates that 30 minutes was required for the metal ions to achieve optimum adsorption. For Pb (II), it required 30 minutes to remove 95% of the ion from aqueous solution while it took the same time period to remove 97.5 % Zn (II) from aqueous solution. From the plot, it can be seen that metal ion uptake increases with contact time for the adsorbent, however, adsorption of both ions tends to decrease after 30 minutes, and no significant increase was observed even after 180 minutes contact period. It is clear that STL can adsorb an appreciable amount of these ions within a short period.

It is well known that the adsorption of metal ions by adsorbents is pH dependent. Metal ion adsorption on the surface of an adsorbent is described in terms of molecular mechanisms, which may probably include cation exchange in the interlayer and specific adsorption that results from surface complexation. Metal ion complexation is affected by hydrogen ions because of the affinity they have for the adsorption sites. The effect of initial pH on the adsorption of Pb and Zn ions by STL was studied and the result shown in Figure 2. From the figure, it is observed that there was an increase in the adsorption of the heavy metal ions with increase in pH from 1- 4, where maximum adsorption of 87% was recorded for Zn and 1-5 and with maximum adsorption of 96% for Zn (II) and Pb (II) respectively. STL contains functional groups that are favorably disposed to Pb (II) and Zn (II) ion. As the pH of the solution increased, these functional groups are exposed thereby favoring the attraction of the metal ions with positive charge, hence the increased adsorption. At this pH, the surface charge on the adsorbents increases, thereby enhancing the physical adsorption on the functional groups.

Heavy metal ions adsorption is also a function of the quantity of adsorbent available for adsorption. Figure 3 shows the effect of adsorbent dose on the percentage removal of Pb (II) and Zn (II) ion onto Spent Tea leaves. It is observed that percentage removal of metal ion increased with increase in adsorbent weight between 0.25 and 0.5 g for both metal ions. The optimal level of Pb and Zn ions removal by STL is thus established at 0.5 g. It was noted that a higher percentage of the Zn (II) was removed at this dosage than for Pb (II). The observed difference in the level of adsorption may be explained based on the difference in ionic radii of the two metals. Adsorption of heavy metals having smaller ionic radius has been reported to be superior. The kinetics and thermodynamic results are not shown in this report but subsequent one.

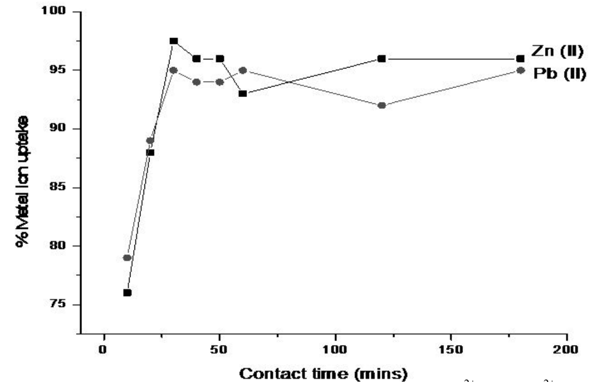
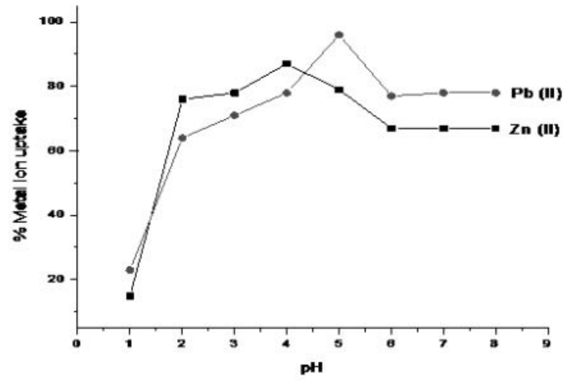


Figure 1. Change in contact time on the adsorption of Pb^{2+} and Zn^{2+} by STL



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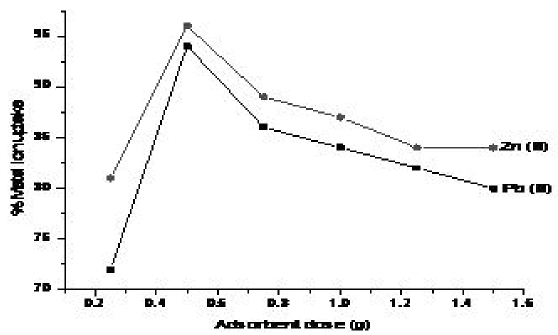

Figure 3. Changes in adsorbent dose on the uptake of Pb (II) and Zn (II) by STL

Conclusion and Recommendation: These results indicate that spent tea leaves can be used as a low-cost adsorbent in scavenging heavy metal ions such as Pb (II) and Zn (II) from solutions containing same. It will be recommended that large scale production of the adsorbent be produced and collaboration with industrial stakeholders be encouraged.

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Experimental Title: Comparative Study of Tea Marketing in Kano and Benue State of Nigeria

Investigators: Yahaya, A.T; Oluyole, K.A and Oladokun, Y.O.M

Introduction:

Tea has become the world's first most popular beverages after water, it is the cheapest beverage in the world and consumed by over 3 million people across religion and culture. It represents one of the major components of world's beverage market (IISD, 2019; UNCTAD, 2016, Anderson, 2014). It is a commodity of high value with extensive value addition capacity for economics of scale (IISD, 2019; Blueprint, 2017). Tea has contributed largely to the Gross Domestic Product (GDP) and Gross National product (GNP) of growing countries and has growing international market in health and food industries. The demand for tea is increasing and continued to increase across the world (Ethical Tea partnership, 2019; Solidaridad Network, 2014).

Global Tea sales (7.76 billon tons in 2018) recorded a good performance attributed largely to urban population growth (UNCOMTRADE, 2020). Tea sector is projected to experience continued and increasing growth due to increasing demand primarily from Asian and Pacific countries. Increase demand for tea is attributed to increasing income, growing clientele among young urban consumers, interest in the health benefit of drinking tea, expansion of new products and flavouring such as ready-to- drink /instant tea, premium tea, herbal and fruit fusion (Bolton, 2019, Kumar, 2019, FAO, 2018, Mordor, 2018 and Zion, 2018, Technavo, 2017).

Nigeria is one of Tea producing countries in the World; Nigeria, tea production was estimated at an average 82,234 tons per year (NBPC, 2011) and it increased to 167,324 metric tons in 2018, an average consumption level of 100kg/ person/ year (NBPC, 2019, Oluyole, *et al.,* 2017). Tea production in Nigeria is a significant economic activity; approximately 10,000 people depend on Tea as source of livelihoods. In Nigeria Tea is a source of raw materials for industry producing value added products in many parts of the country and is a vital part of beverages market in Nigeria (CRIN annual reports, Oluyole *et al*, 2018).

Consumption of tea is done across religion and culture in Nigeria but predominantly in the Northern part (CRIN annual reports, CRIN @ 50).

Objective

The study assessed marketing activities in tea across three LGA's each, in Kano and Benue states of Nigeria vis-a-vis: the market outlook and volume of tea trade in each region for comparative advantage and competitiveness of tea trade in Nigeria determine the opportunities for business relationship for small- holders' farmers and processors analyze the constraints to tea marketing in these region examine the various stages and actors in tea marketing in Nigeria provide a policy recommendation for tea crop as a good source of revenue for Nigerian economy.

Materials and Methods

The study was carried out in Otkupo, Gboko and Markudi LGA's, in Benue and Fagge LGA of Kano states respectively. Multistage sampling techniques was used to select Otkupo, Main and Nwukuru markets of Benue and Singa market of Kano State respectively. The second stage was selection of respondent for the study. The third stage was selection of 241 respondents from the selected markets. Information was collected with the use of structured questionnaire, which seeks information on cost incurred on inputs and output, volume of sales, prices of inputs and output, supply chain, sources of materials for sales, buyers, channel of marketing, levels paid to government at different levels, subsidy received from government, constraint to marketing among others. Data were analysed with the use of descriptive statistic and Policy Analysis Matrix (PAM). The indicator of competitiveness in PAM was employed.

Results and Discussion

The results of the social-economic characteristics of the respondents were presented in Table 1. The result showed that in Kano, 65.56% of the respondents are between 40-50 years. There is a positive correlation between age and efficiency. Youth are more meticulous in carrying out their activities and they easily embrace new technology. However, the result shows that in Benue, 67.22% of the respondents are between 40-50 years. This indicates that the marketers are in their active and productive age. It is also observed that in Kano, larger percentages (96.27%) of men are into tea marketing. Males are more involved in buying and selling, while their female counterparts are into managing family activities owing to religious reasons. On the other hand, more females (69.98%) are into tea marketing in Benue along sides their male counterpart (34.02%). This indicates that both male and female are actively involved in tea marketing in Benue. Results for Kano shows that majority of the respondent (70.54%) had no education at all whiles (23.65%) had only basic education. This informed their method of business dealings in the areas. Nevertheless, (85.89%) of the respondent in Benue had secondary school education and (5.81%) had primary education, while (8.30%) of them had no education at all. This informs efficiency in their business dealings in the areas.

Table 2 show the cost and returns of tea marketing in the study areas using the policy analysis (PAM). The estimated private budget for tea marketing in Kano and Benue states are presented respectively. Table 1 showed that in Kano state, the estimated total cost incurred was N 7,010 per ton. The component of the cost includes input cost of (Generator cost, building cost, Vehicle cost), factor cost (such as cost of rentage, transportation cost, electricity cost, cost of fueling, interest on loan) as well as labour cost. The estimated input cost was N 273,284. The value of factor cost was N383,488 while that of labour cost was N500,000 at private cost. The estimated revenue per ton was N185,588.88 per ton at private prices, hence, a net profit of N 178,578.88 per ton was derived at private prices.

Table 2 also showed that in Benue state, the estimated total cost incurred was N 5,295 per ton. The component of the cost includes input cost of (Generator cost, building cost, Vehicle cost), factor cost (such as cost of rentage, transportation cost, electricity cost, fueling cost, interest on loan) as well as labour cost. The estimated input cost was N 150,000. The value of factor cost was N220,000 while that of labour cost was N689,188 at private cost. The estimated revenue per ton was N 3,553,031 per ton at private prices, hence, a net profit of N 3,547,736 per ton was derived at private prices.

Table 3 shows the supply chain of tea in the study areas. It shows the sources of tea market open to traders dealing in tea in Kano and Benue states respectively. From the table, high percentages (85.89) of the marketer in Kano source their materials for sales from the packagers while (55.19) marketers in Benue source theirs from processors. It's however worthy of note that marketers in the study areas do not have access to business relationship with tea farmers.

Table 4 shows the buyers of tea from marketers in Kano and Benue state respectively. The table shows that in Kano majority (41.49) of tea marketers sell their goods to countries like Niger Republic, Chad and Cameroun. This is unique features of tea marketing in these areas. Also, the table also shows that 36.10 percent of marketers sell their products directly to the consumers. However, in Benue, majority of marketer sell to retailers while 37.34 are sold to consumer.

Table 5 shows the constraints to tea marketing in Kano and Benue states respectively. The table shows that major problems to tea sales in Kano and Benue states respectively are not getting sufficient tea for sales and insecurity in the land. The table shows that in Kano 65.98 percent marketers complain they do not have enough tea to sell while 20.75 percent claimed insecurity constitute another major problem to the marketing activities. Similarly, in Benue state, majority 37.34 also complain of lack of enough tea materials for sales. Tea marketing in Benue is also affected by insecurity as 29.46 percent of the marketer's complaint. This is an indication of marketing opportunities for small holders' farmers and processors in Mambilla, Taraba States who complains of lack of markets to sell to.

Table1. Social Economic Characteristic of the respondents

Variable	Kano		Benue	
Age	Freq.	percent	Freq.	Percent
≤ 40	13	5.39	57	23.62
40-50	158	65.56	162	67.22
51-60	68	28.22	19	7.88
>60	2	0.83	3	1.24
Total	241	100.00	241	100.00
Gender				
Male	232	96.27	82	34.02
Female	9	3.73	159	65.98
Total	241	100.00	241	100.00
Educational Status				
No Education	170	70.54	20	8.30
Primary Education	57	23.65	14	5.81
Secondary Education	14	5.81	207	85.89
Total	241	100.00	241	100.00

Source: Field Survey 2021

Table 2. Estimated Budgetfor Tea Marketing in Kano and Benue state

Variable	Kano price (₦)	Benue
Tradable inputs	273,284	150,000
Domestic factors	383,488	220,000
Labour	500,000	689,188
Total cost	1,156,772	1,059,188
Cost/ton	7,010	5,295
Revenue/ton	185,588.88	3,553,031
Profit/ton	178,578.88	3,547,736

Field Survey, 2022

Table 3. Source of material for sales

	Kano		Benue	
	Freq	Percentages	Freq	Percentages
Farmers	0	0	0	0
Processors	34	14.11	133	55.19
Packagers	207	85.89	108	44.81
Total	241	100	241	100

Field Survey, 2022

Table 4. Marketing and sales

	Kano		Benue	
	Freq	Percentages	Freq	Percentages
Consumers	87	36.10	90	37.34
Retailers	34	14.11	139	57.68
Distributors	20	8.30	12	4.98
Export	100	41.49	0	0
Total	241	100	241	100

Field Survey, 2022

Table 5. Constraint to Marketing

	Kano		Benue	
	Freq.	Percent	Freq.	Percent
High Tax	0	0	50	20.75
High Prices inputs	2	0.83	10	4.15
Non-Availability of Tea for sales	159	65.98	90	37.34
Proximity to source of raw materials	5	2.07	0	0
Storage Facilities	0	0	0	0
Credit Accessibility	25	10.37	20	8.30
No- support from Govt.	0	0	0	0
Non-Existence of Tea Policy	0	0	0	0
Insecurity	50	20.75	71	29.46
Total	241	100	241	100

Field Survey, 2022

Conclusion and Recommendations: Tea marketing is done majorly by youths in their active working years in the study areas. Tea sales were competitive given the net profit derived by marketers in the study areas. The supply chain of tea in the areas is such that tea are sourced from packagers and processors who sell to marketers who in turns sell to consumers, retailers or sell to neighboring countries. Major problems to marketing in the study areas are inability to get enough tea materials for sales and insecurity. This study thereby recommends a link between small- holders' farmers and cottage processors in Mambilla Taraba state who yearn for market to sell their produce to improve their livelihoods.

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KOLA PROGRAMME

Experimental Title: Effects of Drying Methods on the Proximate and Phytochemical Compositions of *Cola Nitida*

Investigators: Olorundare, B.O., Jayeola, C.O., Ogunsowo, A.O., Adesanya, A.K., Akinola, O.C., Aremu-Dele O. and Adebiyi, O.S.

Introduction

Kola nut, a major caffeine-containing nut belongs to the plant family Sterculiaceae with about 125 species of trees native to the tropical rainforests of Africa. However, the most common of these species in Nigeria are *Cola nitida* (gbanja) and *Cola acuminata* (abata) (Adebayo and Oladele, 2012). Aside the nut's high caffeine contents, *Cola nitida* is reportedly known to contain other useful constituents such as theobromine, sugars, essential oils, alkaloids, and many others (Asogwa *et al*., 2006). Over time, the bioactive constituents, phytochemicals, and antioxidant properties of the kola nuts have been of keen interest to researchers in food and pharmaceutical industries. This owes to the fact that such components and properties are actively responsible for their medicinal importance.

Actually, the bioactive and biochemical properties of food have been reportedly revealed to be altered by several food processing methods thus causing a desirable or non-desirable change (Hassan *et al*., 2007). Notably, drying, a food processing method remains one of the post-harvest processing methods of kola nuts.

Kola nuts can be consumed or used in fresh or dried form. Fresh kola nuts are often consumed as a masticatory (Lowor *et al*., 2010) while dried kola nuts are mostly used in the production of kola nut powder and beverages. Drying is a major unit operation in kola nut processing that aids handling and preservation of the nuts by reducing its moisture content hence preventing deterioration by microorganisms and enzymes activities (Akinoso *et al*., 2014). While drying plays an important role in kola nut post-harvest processing, it is pertinent to employ the best and safest drying method that will conserve its bioactive and phytochemical constituents thus preserving their medicinal, nutritional and pharmaceutical properties. Despite the fact that drying is a key post-harvest processing and handling method of kola nuts, however, there is scanty information in literatures on its effect on the bioactive constituents of the nuts. Hence, this study was designed to assess the effect of drying methods on the proximate compositions and phytochemical properties of *Cola nitida* and to identify the most effective drying method(s) for the conservation and preservation of these bioactive components.

Materials and methods

Sample collection and preparation

Fresh kola nuts (*Cola nitida*) samples were purchased from Oke Otin farm, Okuku village, Odo Otin LGA, Osun State, Nigeria. The *Cola nitida* samples were sorted and divided into four portions for drying.

Processing and drying of *Cola nitida*

Cola nitida seeds were dried to a constant weight by four different methods: air-drying at room temperature (AID), solar-drying (SOD), oven-drying (OVD) and sun-drying (SUD). Air-drying of *C. nitida* was done at room temperature in a dark and well-ventilated room for a period of two weeks. The solar-drying took place in a solar chamber for 7 days while oven-drying was conducted in a hot-air oven at 65°C for 48 hours, the sun-drying was carried out by exposing the nuts to sun light for three days. After drying, all the dried samples were milled into fine particles, put in air-tight bottles and stored at -4°C for subsequent analyses.

Proximate Analysis: The moisture and total ash contents were determined gravimetrically according to the methods ofAOAC 930.15 (2000) andAOAC 984.02 (2000) respectively. Crude protein content was determined by kjeldahl method whereby nitrogen content of the sample was digested using sulphuric acid in the presence of catalyst to covert sample nitrogen to ammonium sulphate. The acid solution was made alkaline with 40% sodium hydroxide solution. The ammonia was distilled and collected in excess of boric acid solution, followed by titration with sulphuric acid solution. The protein content was calculated using conversion factor of 6.25 (AOAC 984.13, 2000). Crude fat content was determined by the method of AOAC 920.39 (2000) while the evaluation of crude fiber was performed by filtration method (AOAC 978.10, 2000). Herein, the sample after defatting with acetone was sequentially boiled with 1.25% acid followed by 1.25% alkali after which the residue was then dried in the oven at 130°C for 2hrs.

Phytochemical Analysis

Total phenols: Total phenols were extracted using acidified methanol and quantified by the Folin-Ciocalteu reagent method. Using UV spectrophotometer, the absorbance was read at 765nm and expressed as tannic acid equivalents mgkg^{-1} (Singleton *et al*., 1999).

Total Tannins: Tannin content was determined spectrometrically by the method of Hargerman *et al*. (2012) using folin-coicalteu reagent. The sample's tannin content was calculated after measuring the absorbance at 725 nm against the blank solution and the result was express as g/100g (Hargerman *et al*., 2012).

Alkaloids: Alkaloids were quantitatively determined according to the methods of Harborne (1973) and Sheikh *et al*. (2013). The contents were extracted with 10% acetic acid. The extract was concentrated on a water bath to one-quarter of the original volume followed by addition of few drops of concentrated ammonium hydroxide until the precipitation was complete after filtration, the precipitates were washed with 20 cm^3 of 0.1 M of ammonium hydroxide and then filtered, the residue was dried in an oven and the percentage alkaloid was expressed mathematically.

Results and Discussion

The proximate compositions of *cola nitida* seeds after exposure to various drying methods are presented in Table 1. The moisture content of the samples significantly varied in respect to drying methods with solar-dried sample having the lowest moisture content of 7.00 % followed by sun-drying (8.30 %) then air-drying (8.85 %) while the oven-dried *cola nitida* has the highest moisture value of 9.15 %. The solar-dried sample which was with the lowest moisture content has the highest fiber content, followed by oven-dried, sun-dried and air-dried samples. A marked reduction in protein content was observed in oven-dried and air-dried samples when compared with that of solar and sun-dried *Cola nitida*. The decreased protein contents observed in oven-dried samples correlates with the report of Devi *et al*. (2019) and this could be ascribed to the ability of the oven to accumulate energy which could in turn cause some protein denaturation in dried samples (Hassan *et al*., 2007). However, the reduced protein content in air-dried samples could be due to enzymatic degradation resulting from increased period of drying at room temperature. Furthermore, the different drying methods except oven-drying have no significant effect on the ash contents of *Cola nitida* as there was no significant difference in their values which ranges from 2.82 to 2.90 % although, oven-dried *Cola nitida* has an ash content value of 2.61 %. Also, a remarkable difference was observed in the crude fat and carbohydrate (CHO) values on exposure to the drying methods with oven-drying and air-drying methods having the highest fat and CHO values respectively.

The results of proximate analysis obviously revealed that drying methods influenced the proximate compositions of *Cola nitida*.

In addition to the proximate analysis, the effects of these drying methods on phytochemical compositions of *C. nitida* were also evaluated. The results as presented in Table 2 revealed that the four drying methods used SOD, AID, SUD and OVD affected the phytochemicals, namely, alkaloids, tannins and total phenols in a similar manner, although with slight differences. These phytochemicals which are natural antioxidants are natural disease preventing, health promoting and anti-ageing substances (Ozyurt *et al*., 2004). Apparently from the result, *C. nitida* that underwent air-drying has the highest values of tannins and phenols followed by sun drying, oven drying and solar drying. In the same vein, the highest value of alkaloids was also observed in air-dried *C. nitida*, although, this was followed by SOD, SUD and OVD. Notably, this observation is in accordance with the report of Irondi *et al*. (2013) who observed that air-drying of *Carica papaya* seeds preserve the total phenols and tannins constituents better than sun drying and oven drying. The reduction in the levels of tannins and phenols by SUD and OVD could be attributed to oxidation of these bioactive compounds by high temperatures according to the reports of Yoshioka and co-authors (Yoshioka *et al*., 1990).

Conclusion

The different drying methods considered in this study influenced both the proximate and phytochemical compositions of *Cola nitida* seeds. General trend of results in proximate analysis showed that better nutrient retention was found in solar and sun-dried *C. nitida* than in air and oven-dried nuts. Hence, either solar drying or sun drying can be opted for as processing methods when proximate composition is under consideration. However, the analysis of phytochemicals apparently revealed that air-drying efficiently preserved the bioactive component that is phenols, tannins and alkaloids of *C. nitida* seedstherefore for effective preservation of these bioactive constituents, air-drying method of drying *Cola nitida* seeds may be most preferred however, the drying rate was slow.

Table 1: Effect of drying methods on Proximate Composition of *Cola nitida* seeds

	AID	SOD	SUD	OVD
Moisture (%)	8.85	7.00	8.30	9.15
Fat (%)	0.59	0.64	0.76	0.85
Protein (%)	8.00	8.81	9.68	8.69
Fiber (%)	1.81	3.63	2.11	2.36
Ash (%)	2.82	2.89	2.90	2.61
CHO (%)	77.93	77.03	76.25	76.34

•AID – Air drying SOD – Solar drying SUD – Sun drying OVD – Oven drying

Table 2: Effect of drying methods on the Phytochemical Composition of *Cola nitida* seeds

	AID	SOD	SUD	OVD
Alkaloids (%)	3.15	2.93	2.59	1.75
Tannins (gTAE/kg)	124.8537.42	101.21	62.25	
Phenols (g/kg)	151.1164.20	150.94	101.11	

AID – Air drying SOD – Solar drying SUD – Sun drying OVD – Oven drying

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Experimental Title: Participatory Diagnostic Survey of Constraints To Youth Involvement In Kolanut Production In Osun State

Investigators: Williams OA, Orisajo SB, Adebiyi S and Abdulkarim IF

Introduction

Kola nut is an important economic cash crop, to a significant proportion of Nigerian population who are involved in kola nut farming, trading, and industrial utilization. Kola nut has served for hundreds of years, as an important article of internal trade in Nigeria and other parts of Africa (Nzekwu, 1961). It has been an item of trade in West Africa and in the trans-Saharan trade routes for many centuries (Egbe and Sobamiwa, 1989). Nigeria accounts for about 70 percent of the total world production of kola nuts (Jacob, 1973).

Kola nut is used as a masticatory stimulant by Africans and has numerous uses in social, religious, and ceremonial functions by the natives in the forest region of Africa (Asogwa *et al*., 2006). It is used during ceremonies such as marriage, child naming, installation of Chiefs, funeral and sacrifices made to the various gods of African mythology (Opeke, 2005). There is also increasing demand for its usage in pharmaceutical industries and for production of soft drinks, wines, and candles (Beattie, 1970). Its uses have inevitably created a high demand more than its production (Oladokun, 1985). While the demand is rising, Nigerian kolanut sector production remains low because many of the trees in Nigeria are unfruitful or have very low yield due to self-and-cross incompatibility among trees, partial and total sterility, inefficient natural pollination, field and storage pests, diseases and old age (both trees and farmers) (Daramola, 1978).

Generally, agricultural production in Nigeria involves using physical strength, which declines with age. This has being observed as one of the major constraints to agricultural production in Nigeria (Okeowo *et al*., 1999). Youth constitute an important segment of the society and if given necessary support, their contributions cannot be undermined. Youth can be defined as a stage in life cycle before adult life begins. Onuekwusi and Effiong (2002) defined youth as the period, in an individual life, which runs between the end of childhood and entry into the world of work. Okwoche *et al*. (2012) posited that one of the major setbacks of agriculture development in Nigeria is attributed to inability of the Federal Government to integrate youth into the mainstream of the numerous programmes implemented over the years. NBS, (2005) opined that ageing farming population in Nigeria, with an average age of 47years and life expectancy at 47-50 years in 2008. While youth policy define youth as all young persons, of the age 18-35 years; and for the purpose of this study, the definition will be adopted. Nigeria economy depends on the young people more especially the rural youth, hence constraints militating against their participation in agricultural production deserve to be investigated. On this basis, the study will investigate the constraints hindering youth participation in kola production in OkukuOsun state.

Justification

Youth contribution to agricultural development is significant to national development. Nations that refuse to engage the youth in development despite their unassuming ability to transform situation if given the enabling environment, will continually dwell in abject poverty. Ugwoke *et al*. (2005) disclosed that, youth have been noted to play a vital role in agricultural production, especially in developing countries. Youth in developing nations of the world including Nigeria, are facing many constraints, which militate against their active involvement in agricultural development. Chikezie *et al*., (2012) suggested that, with the fewer youth into agriculture, the long-term future of the agricultural sector is in question. There is need to ascertain the contribution of the youth towards kola nut production and their constraints. The result of this study will enable scientists and government to focus on the needs of the kola nut youth farmers in order to strengthen the area of weakness for increase production,

Objectives

Broad objective

The broad objective is to investigate participatory diagnostic survey of youth involvement in kola nut production in Osun state Nigeria.

Specific objectives are to:

1. Describe the socio-economic characteristics of youth farmers.
2. Ascertain sources of information of youth farmers.
3. Determine the attitude of the youth farmers towards kola nut farming.
4. Identify constraints militating against youth involvement in kola production

Material and Methods

The study was carried out in Osun; Purposive and multistage random sampling were used to select 60 youth farmers. A well-structured questionnaire and focus group discussion (FDG) were used to elicit detailed information from youth farmers in the study areas.

Stage 1; Osun states was purposively selected for the project

Stage 2: The kola producing community was

purposively selected in Osun (Okuku). 60 kolanutyouth farmers was randomly selected.
Stage 3: The data was analysed with frequency and percentages for the descriptive statistics while chi-square will be used for the inferential statistical analysis

Result and Discussion

Among the most important socio - economic variables considered was the respondent's age, sex marital status, farm size and educational level.

The mean age of the respondents in the study areas was 32.32 ±3, this indicates that a higher proportion of sampled kola nut farmers were in their active and productive years. Majority, 95% were male farmer; this could be linked with the tedious nature of kola farming and land tenure system which is patriarchal. Muhammad-Lawal, (2008) opined that sex of an individual can influence the type and quality of work carried out. Majority (71.67%) of the respondents were married this showed that they have more hands-on farm work. The results of respondents' educational status reveal that majority (65.83%) of the respondents had both primary and secondary school education; the moderately high literacy level could be traced to the age categories of the respondents. Furthermore, 80.83% of the respondents were small scale farmers and (69.10%) of Yoruba tribe. From, the findings more than half of the population of the respondents inherited the land, this implies that most of the kola nut farms are old.

Table 1. Frequency distribution showing socio-economic characteristics of the respondents

Variable	Frequency	Percentage	Mean	Std. Dev
Age				
21-25	10	16.67	32.32	3.04
26-30	19	32.50		
31-40	31	50.83		
Sex				
Male	57	95.00		
Female	19	30.83		
Educational level				
None	18	29.17		
Primary	18	29.16		
Secondary	22	36.67		
Tertiary	3	5.00		
Ethnic group				
Yoruba	42	69.17		
Ibo	5	8.33		
Hausa	2	4.16		
Others	11	18.33		
Marital status				
Single	17	28.33		
Married	43	71.67		
Farm size (Hectare)				
1 – 5	49	80.83	2.26	1.47
5 – 10	12	19.17		
Land ownership				
Inherited	36	59.17		
Purchased	7	10.83		
Rent	9	14.17		
Cooperative	20	15.83		

Source: Field study 2022

Table 2 revealed that, more than half of the respondents had their sources of information from the village leaders 59.17% while Village extension agents and radio accounted for 45 percent and 50.83 percent respectively. The use of radio as information source is in the study area is in agreement with the study carried out by Nwachuckwu (2003) and Obuh (2007). Farmers group accounted for 48.33 %. Cocoa Research Institute of Nigeria accounted for 50.83% respondents as source of information. Respondents (28.33%) used newspaper as their information source. This revealed that, wide range of information sources is identified by the kola nut farmers but village leaders were widely used as source of information. The findings is in line with the study of Nabinta, (2003), who declared that interpersonal communication is the most frequent medium of dissemination of agricultural information.

Table 2: Respondents' Information Sources

Information Sources	Frequency	Percentage
Village leaders	36	59.17
Extension Agents	27	45.00
Radio	31	50.83
CRIN	31	50.83
Newspapers	14	22,50
Farmers group	29	48.33

Source: Field study 2022

The attitudinal scores of kola nut youth farmers in the study area, majority 61.67% have medium attitude. Only 9.17% have high attitude. This (medium attitude) may be due to the constraints being faced in kola nut production, this may contribute to their inability to have high attitude. This implies that youth farmers in the study area need to be encouraged to have high attitude.

Table 3: Attitude of youth farmers towards kola nut farming

Variables	Score	Frequency	Percentage
High	≥21.52	6	9.17
Medium	≤21.52≥15.44	36	61.67
Low	≤15.44	18	30.83

Field Study 2022

Table 4 described the respondents' identified constraints militating against their involvement in kola nut production in the study area. Inadequate basic amenities were ranked first, with weighted mean score of 2.85 and (97.50%) of the respondent. The next challenge faced by farmers was rigorous nature of kola nut 2.74 (90.0%). Youth interest and preference in riding commercial motorcycle popularly known as “okada” ranked 3rd as constraint in kola nut production, with weighted mean score of 2.71 (87.5%), likewise, more than half 2.44 (85.0%) respondent attested that low price of kola nut was also a constraint. Others include youth-urban migration, 2.18 (84.17%) while more than half of the population 2.10 (76.67%), indicated that they are being faced with inadequate access to land. Chemical adulteration was ranked 7th among the constraints 1.78 (57.60%) The findings was supported by Adekunle, *et al,* (2009) that there are economic, social and environmental factors reducing rural youth involvement in agricultural production in Nigeria.

Table 4. Distribution of respondents on identified constraints

Services	Very severe	severe	Not severe	Score	WMS	Rank
No basic amenities	57(97.50)	-	(3.330)	413	2.85	1st
Rigorous farming	54(90.00)	-	6(10.00)	393	2.74	2nd
Commercial motorcycle	53(87.50)	-	8(12.50)	387	2.71	3rd
Low price of kola nut	51(85.00)	6(9.20)	4(5.83)	339	2.44	4th
Youth migration	51(84.17)	5(8.30)	5(7.50)	293	2.18	5th
Inadequate land access	46(76.67)	21(17.50)	4(5.80)	220	2.10	6th
Chemical adulteration	35(57.60)	13(21.67)	13(20.83)	193	1.78	7th

Field s Study 2022

Conclusion

The youth farmers in the study area were small scale farmers, majority were males and of moderately high literacy level. Results from the study also revealed that their source of information on kola nut production was the village leaders. They have medium level of attitude towards kola nut farming due to lack of basic amenities as a major constraint debarring them. Also majority of youth farmers identified preferred commercial motorcycle business to farming in the study areas. It is recommended that more village extension agent should be recruited, trained and given appropriate package of good agricultural practices that will address youth farmers' needs in kola nut farming. Government should encourage youth farmers by providing basic amenities, opportunities and incentives to motivate and encourage youth into kola nut production in order to increase yield and returns to revamp the sector. In addition, youth kolanut farmers in the study area showed interest in the distributorship of CRIN kola products especially kolawine, they were advised to come for training in the institute in order to take up the technologies also youth farmers asked questions on kola hybrid and they were assured that research was on-going.

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Experimental Title: Gender Differentials in the Processing of Kolanuts for Marketing in the Southwest Nigeria

Investigators: Oluyole, K.A., Adebiyi, S. and Adesida, F.

Introduction

Kola grows as a tree form, and it is believed that kola trees are native to Ghana and Ivory Coast and their spread has brought about by humans (American Horticultural Society, 2002). There are over fifty species of kola. Of these, seven have edible nuts, but only two have been widely exploited, these are *cola nitida* and *cola acuminata.* These species have been important objects of trade for a long time. The most important is *cola nitida* because of its wide economic value (Oluyole *et al*, 2009). Kola is mostly produced in Africa and is cultivated to a large degree in Nigeria but also in Ghana, Ivory Coast, Brazil and the West Indian Islands (Oludemokun, 1983; Opeke, 1982). Annual production from these countries alone is in excess of 250,000 tons while the world production is about 300,000 tons (American Horticultural Society, 2002). According to Quarcoo (1969), Nigeria produces 88% of the world's kola production and 90% of this is consumed locally while the remaining 10% is exported. This finding was buttressed by Oluokun and Oladokun (1999) who claimed that Nigeria produces two million metric tons of kolanut annually which represented 70% of the world's kolanut production. Kolanut post-harvest processing starts by careful examination and sorting out pods infested with weevils, diseases and other deformities, from the healthy pods. The seed coat or testa of the nuts from these healthy pods are removed by soaking the nuts in clean water for 24 h to enhance rottening, after which the nuts are skinned and rinsed in fresh water. The rinsed nuts are collected in wide flat baskets through which excess water drains off before they are kept inside the room where they are maintained under ambient room temperature for a period of three days to cure. Defective/infested nuts are picked out during this curing process that usually involves considerable sweating to reduce the moisture content of the nuts. The nuts are then graded into sizes for proper preservation in big sized baskets (Asogua*et al, 2011).*

Kola is an important economic cash crop to a significant proportion of Nigerian population who are involved in kola farming, trading and industrial utilization. However, Nigeria accounts for about 70% of the total world production of kolanuts (Oluokun and Oladokun, 1999; Oluyole, *et al.*, 2009). The kolanut is used as a masticatory and stimulant in the tropics. It also has industrial usage in pharmaceuticals, production of soft drinks, wines and in confectionaries (Oguntuga, 1975). The kolanut pod husk, which is a byproduct from processing the nut, is widely used for animal feeding because of its high nutritive quality. According to Babatunde and Hamzat (2005), broilers fed with kolanut pod husk meal diets had an outstanding growth performance. Apart from this, kolanut is a very important farm produce which is used in extensive culturally and consumption. Culturally, kolanut is used to observe naming ceremony, wedding ceremony and for entertaining visitors. However, extensively, kolanut is consumed in Nigeria, especially in the Northern part of Nigeria. It is on record that the substantial proportion of the kolanut being produced in Nigeria is consumed domestically (Oluyole *et al*, 2009).

However, the shelf life and quality of this valuable farm produce is improved by processing. The processing activities are undertaken by both the male and female. Therefore, the main aim of this project is to determine the gender differentials in the post harvest processing of kolanut.

Methodology

The study was carried out in Ondo State of Nigeria. Two kolanut producing Local Government Areas (LGAs) were purposively selected from the State. Hence, Ife East and Ondo East were selected. From Ife East, Ifekola was selected while Bolorunduro community was selected in Ondo East. A total of 150 kolanut processors were randomly selected from the two communities. A structured questionnaire was used to collect information from the respondents. The data retrieved from the information collected were analysed using descriptive statistics.

Results and Discussion

Table 1 shows the demographic/socio-economic characteristics of the respondents (kolanut processors). The table shows that most (70.67%) of the respondents are 50 years and below while 29.33% of the respondents are above 50 years of age. This indicates that most of the kolanut processors are still active to participate in the business. This is a good indicator as this would improve the efficiency of the processors. Table 1 also shows that all (64.67%) of the marketers are females showing that female participate more in the business. This result is in consonance with Adamu *et al.* (2006), who stated that majority of rural women engaged in off-farm activities such as packing of farm produce, processing of farm produce, storage of crops among others while their male counterparts are involved in the production of tree crops. It could also be revealed from Table 1 that most (89.33%) of the processors are married while some (4.00%) are widow. This is an indication that there would be more availability of family labour that would assist in the run of the business. Table 1 also shows that 83.33% of the respondents are having formal education. It could be observed that majority of the processors are having formal education. This is likely to have a positive impact on the profit level of the business as education increases the efficiency. Education enables one to be able to read and interpret a new technology thus will enable him to be able to apply such a technology appropriately and hence increases his efficiency. Most (58.0%) of the respondents are well experienced in kola processing as they have been doing the work for more than 10 years. This is a good indicator as long years of kola processing experience tend to increase the efficiency of the processors. Table 1 also shows that majority of the processors (94.67%) deal with kola nitida. This shows that Kola nitida is more predominant in the study area.

Table 1. Socioeconomic Charracteristics of the Respondents

Variables	Frequency	Percentage
Sex		
Male	53	35.33
Female	97	64.67
Total	150	100.00
Age (Years)		
≤ 20	6	4.00
21-30	40	26.67
31-40	32	21.33
41-50	28	18.67
51-60	26	17.33
> 60	18	12.00
Total	150	100.00
Marital Status		
Married	134	89.33
Single	8	5.33
Divorced	2	1.34
Widowed	6	4.00
Total	150	100.00
Educational Levels		
No formal education	25	16.67
Primary education	58	38.67
Secondary education	51	34.00
Tertiary education	16	10.66
Total	150	100.00
Household size		
≤ 6	70	46.67
7-10	74	49.33
>10	6	4.00
Total	150	100.00
Years of experience (years)		
≤ 10	63	42.00
11-20	42	28.00
21-30	21	14.00
31-40	9	6.00
41-50	6	4.00
Total	150	100.00
Variety of kolanut dealing with		
Kola nitida	142	94.67
Kola acumulata	8	5.33
Total	150	100.00

Source: Field survey, 2022

Table 2 shows the gender that actually carries out a particular activity in kolanut processing. The table shows that all the activities are being carried out by more women than men. Hence, it can be said that kolanut processing is more of feminine job. Notwithstanding, few males still participate in all the activities under kolanut processing.

Table 2. Gender participation in kolanut processing

Activities	Adult male		Adult female	
	Freq	%	Freq	%
Soaking of kolanuts in preparation for peeling	15	10.00	137	91.33
Peeling of kolanuts	6	4.00	146	97.33
Washing of the peeled kolanuts	4	2.67	145	96.67
Preservation of the peeled kolanut	21	14.00	129	86.00
Parkaging of the peeled kolanuts	15	10.00	135	90.00
Transportation of the peeled kolanuts to the market	15	10	134	89.33

Source: Field survey, 2022

Table 3 shows the problems encountered during kolanut processing by the processors. The table shows that 46.00% of the processors agreed that fresh kolanut was always very difficult to get while 5.002% of the processors believed that it was not difficult to get fresh kolanut to buy. In a similar manner, 52,67% of the respondents agreed that preservative chemicals are not always available to buy while 45.33% did not agree. As regards the labour availability for peeling, 45.33% of the respondents are of the opinion that labours for peeling are always very difficult to get while 53.33% did not believe it. To some of the processors (32.67%), leaves for storing kolanut is always very difficult to get while most of the processors (63.33%) believed that one can get the leaves with ease. As regards the preservative chemicals, 52.67% of the processors believed that the chemicals are not always available and 52.00% believed that even if the chemicals are available, they are always very expensive to buy.

Table 3. Problems encountered in kolanut processing

Problems	Yes		No	
	Freq.	%	Freq.	%
Fresh kolanut is always very difficult to get buy	69	46.00	78	52.00
Labour is always very difficult to get for peeling	68	45.33	80	53.33
The leaf for storage is always very difficult to get	49	32.67	95	63.33
Preservative chemicals are not always available to buy	79	52.67	68	45.33
Preservative chemicals are always expensive	78	52.00	70	46.67
Problems of kolanut spoilage is very common during preservation	88	58.67	60	40.00

Source: Field survey, 2022

Conclusion

The study which was carried out on gender differentials in the processing of kolanuts reveals that more women are involved in all the activities involving kolanut processing than men. The study also revealed that most of the processors in the study area deal with Kola nitida showing that this is the variety of kolanut that is common in their area. Some of the problems confronting kolanut processing according to some processors in the study area include unavailability of kolanut to buy, difficulty in getting labour for peeling, difficulty in getting leaves for storing kolanuts, inavailability and expensiveness of the preservative chemicals. However, to some processors, they are not being faced by the mentioned problems.

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Experimental Title: Genetic Characterization of Nigeria Kola Germplasm

Investigators: Sobowale, I. O, Adenuga, O.O, Orisajo S. B, Adebiyi, S.

Introduction

Kola nut is an important commercial crop cultivated mostly in Africa (Dadzie *et al*., 2013). The seed of *C. nitida* fruit (pod) is referred to as kola nut and morphologically, it has three distinct colours including white, red and pink. Kola nuts are rich in essential chemical compounds including water, fat, ash, fibre, carbohydrates, and proteins. Kola nuts are known for their high caffeine content, between 1.84 and 2.56% (Nyamien *et al.,* 2014). Additionally, secondary metabolites, such as polyphenols, alkaloids, saponins and terpenoids, abound in kola nuts and they are produced when the plant is under stress (Pagare *et al*., 2015). In some West African countries including Ghana and Nigeria, the nuts are chewed mostly to suppress sleep and hunger (Adedayo *et al*., 2019; Olaniyan *et al.*, 2018). Moreover, it has several traditional, social and medicinal importance, such as treatment of asthma and whooping cough (Adedayo *et al.*, 2019; Dorathy *et al.*, 2014). In addition, the cola nut plays an important role in African society for cultural and customary rituals such as births and weddings (Durand *et al*., 2015).To improve the Nigerian kola, Cocoa Research Institute of Nigeria (CRIN) has embarked on a number of projects including the collection of kola accessions from different farmer's field in Nigeria, although with no distinguishing features. These are maintained as field gene banks with the view to effectively incorporate them in breeding programmes. Molecular characterization, which highlights the amount of genetic diversity and relationship among various groups of different accessions, is required for a direct and more reliable selection in kola genotypes.

Objectives:

To assess and characterize Nigeria kola germplasm from CRIN collections using molecular methods for further breeding improvement.

Materials and Methods

Fresh young leaves samples of each of the selected twenty accessions of kola material were harvested, well labeled, and tightly covered in sample bags. The samples were placed on ice pack and immediately convey to biotechnology laboratory for DNA extraction and genetic profiling usingInter Simple Sequence Repeat Marker (ISSR) procedure.

Results and Discussion

Extracted DNA obtained across the twenty kola accessions showed sharp and clear bands. DNA bands did not indicate smearing (degraded DNA) as seen from the agarose gel electrophoresis picture and the genomic DNA was a satisfactory PCR template (Plate1). Figure 1 is a dendrogram showing genetic similarity among the 20 accessions of kola as revealed based on ISSR markers. At similarity level of 0.70, all the accessions formed a single cluster. The dendrogram also showed that the first linkage was formed between IBDLS04 and IBD01 at 1.00 similarity level. At 0.83 similarity level, the dendrogram revealed five distinct groupings. Group II and V had one accession each, group I had 2 accessions, group IV had 3accessions and group III had 13 accessions, the highest number of accessions (Figure 1)**.** The grouping of the ISSR dendrogram has demonstrated polymorphic nature and wide genetic base of 20 kola accessions investigated.

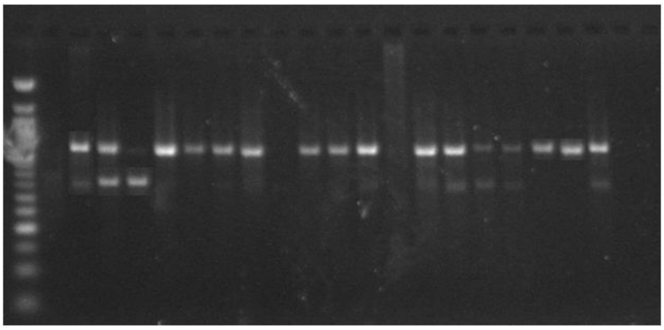

Plate 1: DNA of 20 accessions of kola visualized on Agarose gel electrophoresis

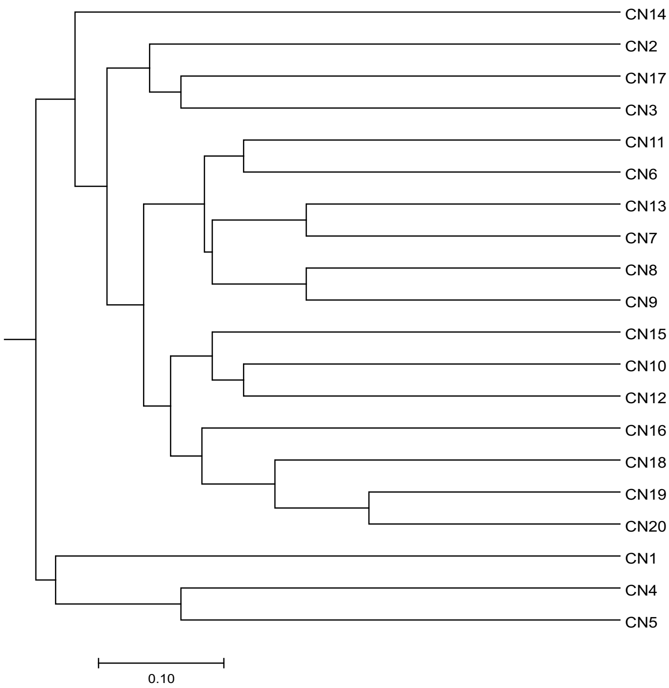

Figure 1: Molecular Dendrogram showing genetic similarity among the twenty accessions of kola based on ISSR markers

Conclusion and Recommendation

The results of this study indicated that ISSR analyses provide an effective tool for the analyses of genetic diversity in *Cola* species. The ISSR method developed need to be adopted and optimized to establish a sound database of genetic diversity in *Cola*.

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Experimental Title: Determination of Kolanuts Production volume in Nigeria

Investigators: Adebiyi S, Adenuga, O.O Yahaya A.T. Oduwole O.O Ibiremo, O.S and Ogunlade M.O

Introduction

Kola is a family of starculiceae and was first introduced in Nigeria in 1556 by a man called Johnannas Leo Africanus. The occurrence was traced to Congo in 1591 by a Portuguese called Odorado Lapez. It is believed that Kola trees are native to West African countries these are Ghana, Nigeria, Republic of Benin Ivory coast (Cote D'ivoire) and their spread has brought about by humans (American Horticultural Society, 2002).

There are over Fifty species of Kola of these, seven are edible nuts while only two have been widely exploited these are cola nitida and cola acuminata. Out of these two species, cola nitida is being traded internationally, while the consumption of cola acuminata is confined to Southern Nigeria (Opeke 2007) Kolanuts which is widely consumed by virtually all category of people is found useful in the production of beverage, flavouring materials, alkaloids, caffeine, theobromine laxatives, heart stimulants and sedatives (Hamzat and Olubamiwa 2003).

These potentials attracted many people to consume Kolanuts, most especially people from Northern Nigeria consumes cola nitida, while people in Western Nigeria uses cola acuminata in consulting gods and worship by the Easterner as the case may be (Adebiyi *et al*., 2009).

The two important varieties are of economic, social and scientific importance. However, the actual production figure of this commodity became an issue in social research as the actual figure cannot be ascertained. Though, National bureau of statistic in its National survey of Exportable Agricultural commodities recorded 174,230,000 metric tons asKolanuts production volume. Nevertheless, due to the chains of supply and demand in kolanut industry, it is always difficult to measure what farmers produce from their farms or collates what was produced from community to community.

Nevertheless, the activities of middlemen in all the trading stages bring complication in the determinants of the actual kolanuts produced at a particular production period.

In the survey conducted by National bureau statistic, the total production figure of Kolanuts is 174,230,000 tons out of which the five states in the Westerns Nigeria including Lagos produces 158,067,000 tons while the remaining 13 states contributed just about 15,006,000 tons of the total volume produced in the country National bureau of statistic (2012). In the same vein, Quarco (1969) revealed that Nigeria produces 88% of the world's Kola production and 90% of this is consumed locally while; the remaining 10% is exported. Akinbode (1982) revealed that Kolanuts are produced mainly in the Southern part of Nigeria and largely marketed and consumed in the Northern part. Many villages in Yoruba land are occupied by Hausa trader of which Kolanut is the main commodity crop. These Hausa traders engaged in buying Kolanuts from Kolanut wholesalers, Packing and sending them to the Northern Nigeria (Tachie – Obeng and Brown 2006).

The Yoruba communities in the Southern Nigeria equally engaged in kolanuts trading thereby organized themselves into groups and create a platform of kolanut movement from Yoruba communities to different states and communities in Northern Nigeria.

Objectives of the study

1. Identify groups and organization available in the study area.
2. Ascertain different community and collation centers used for kolanut movement.
3. Determine volume of kolanuts moved in all identified communities.
4. Determine kolanutouput in Nigeria.

Methodology

Multistage sampling procedure was used to select kolanut movement centers.

The first stage was purposive selection of five (5) states known for movement of kolanuts to Northern Nigeria and other neighbouring West African countries.

The second stage involved purposive selection of communities where kolanuts are packed and moved to different places in Northern Nigeria and other countries.

The third stage involved purposive selection of communities and centers where kolanuts are collated and moved to the areas where they are needed.

Kolanut marketers were identified with the help of kolanut groups available in the study area. Record booklets were given to all stakeholders of each center who takes record of all kolanuts moved out of their centers. Record booklets were left with one literate individual to complete and collated in all identified communities and centers. Data obtained from the record of movement of kolanuts was analysed using descriptive statistics.

Result and Discussions

Table 1 revealed that Osun state (62.3%) is the highest in terms of community involved in kolanut movement. This was followed by Ondo state (14.8%) and Ekiti state (12.7%). The finding revealed that, there were more collation communities and centres in Osun State. The reason could be that Osun state is the third lagest producer of kolanuts and shared boundary with all major producing states these are Ogun, Ondo, Oyo and Ekiti states (National bureau of statistics 2012). The smallest in terms of collation center which is Lagos state (0.89%) could be of a result of urbanization which has reduced Kolanuthectrage in the state.

Table: 2 revealed that 61.8% of the ownership of collation centers was female from Osun state while 37.8 were male from Osun state. The finding revealed that 24.4% and 10.5% of the respondents were female marketers from Ondo and Ekiti states respectively. Also, male respondents out-number female respondent in Ogun (24.0%) and Lagos state (2.1%).

Table: 3 revealed that 52.6% of the respondents belonged to kolanut producers and marketers association of Nigeria, While, 37.6% belonged to OmoOduakolanuts growers and sellers association of Nigeria. Nevertheless, few members (9.8%) were not in any group or association. Majority (90.2%) of the sampled participants belonged to group association. This is an indication that kola marketers have opportunities for skill acquisition, social and economic opportunities as a group with more responsibilities and enlightens to improve in their trading methods. Social group serves as morale booster, linkage to source of credit and medium of information dissemination. This was supported by (Adeleke- Bello and Ashinmolowo 2015) that group membership helps member to become better informed about the world and change the situation around them.

Table 4 revealed communities where kolanuts were collated from Osun state to Northern Nigeria and some neighbouring countries. Data collated from booklet revealed that; the total of 70,090 tons was recorded; Garage Olode (15.3%), Owena-Ijesha (15.2%) and Ifon-Osun (14.8) recorded more tons than any other communities in the state. These may be as a result of large population of Hausa tribe who always traded on kolanuts as a commodity crop.

Table 5 revealed communities in Ekiti State. The total of 6,382 tons was recorded of which AjegunleIseEkiti (21.820) and IjanEkiti (18.0%) had highest production figure.

Table 6 revealed few communities noted for movement of kolanuts in Ogun state, it was revealed that Shagamu (97.7%) was the major center for movement of kolanut. Other communities such of Owode –Egba ((0.8%) Owode – Idi Iroko (0.70) and Ogunmakin (0.5%) recorded very small volume.

Table 7 revealed movement volume in Ondo state. Ore (67.0%) had the highest figure; this was followed by Ondo (21.1%) and Ikare – Akoko (11.98). These three communities were the major centers, in which Ore was the center market for kolanuts coming Edo state which has available land and potential for increased kolanuts production.

Table 8 revealed that Agege (85.5%) a community in Lagos state still retain the history of kolanut in Nigeria. The Hausa traders still sustain their trading activities with kolanuts. Kolanuts from Ghana moved to Agege where it is moved to the Northern Nigeria.

Table 9 revealed the total sum of 189,943 tons of kolanuts was collated from Osun state (70,090 tons), Ekiti state (6,332 tons), Ogun state (24,194 tons), Ondo state (67,927 tons) and Lagos state (21,400 tons).

Conclusion

Collation center creates platform through which data for the study was gathered. Record on the volume of kolanuts leaving various communities was collated in each of the center identified. There were more communities engaged in kolanut movement in Osun state (62.3%) than any other state. Kolanut trading was dominated by female in Osun, Ondo and Ekiti state while male dominated kolanut trading in Ogun and Lagos State.

Majority (90.2%) belonged to group organization while few (9.8%) were not. The study revealed the total sum of 189,943 tons as volume of kolanuts leaving all identified collation centers, out of which Osun state recorded (36.9%), Ondo state (35.8%), Ogun state (12.7%), Lagos state (11.3%) and Ekiti state (3.3%). The study concluded that, kolanut is an important commodity crop which creates business activities for both male and female in the study area. It is also a commodity crop that is traded between south and northern Nigeria, thereby brings unity and understanding which made them to co-exist.

Recommendation

Kolanuts produced in Southern Nigeria are moved to

Northern Nigeria, thus brings unity and mutual understanding between tribes. This is germane in addressing incessant insecurity challenges facing the country. In an approach to sustain production and prevent extinction, government, non-governmental organizations and farmers' organization should come together to address production and marketing problems face kola industry in Nigeria.

Table 1. Distribution according to collation center

State	Frequency	Percentage
Osun	535	62.3
Ondo	127	14.8
Ogun	79	9.2
Ekiti	109	12.7
Lagos	7	0.8
Total	857	100.0

Table 2 Distribution according to Gender of ownership of collation center

State	Male		Female	
	Freq.	Percentage	Freq.	Percentage
Osun	109	37.8	426	61.8
Ondo	69	2.4	168	24.4
Ogun	68	24.0	21	3.0
Ekiti	36	12.5	73	10.5
Lagos	6	2.1	01	90.1
Total	288	100.0	689	100.0

Table 3 Distribution according to group/organization of respondents

Group/ Association	Freq.	Percentage
Kolanut producers& marketers association of Nigeria	451	52.6
OmoOduakolanuts growers &sellers association of Nigeria	322	37.6
Non- Membership of group	84	9.8
Total	857	100.0

Table 4. Distribution according to volume collated per community in Osun State

Community	Volume (ton).	Percentage	Community	Volume (ton)	Percentage
Osogbo	980	1.4	Iwo	2,680	3.8
Ifon- Osun	10,340	14.8	Ile-Ogbo	439	0.6
Ipetu-Ijesha	420	0.6	Oluponna	986	1.2
Owena-Ijesha	10,680	15.2	Gbongan	624	0.9
Okuku	375	0.5	Orile-Owu	164	0.2
Irele	165	0.2	Ode-Omu	260	0.4
Garage- Olode	10,700	15.3	Ikeji-Arakeji	152	0.2
Ile- Ife	664	0.9	Ilesha	3,422	4.9
Araromi	227	0.3	Ogbagba	327	0.5
Oore	327	0.5	Ikeji-Ile	115	0.2
Okinni	340	0.5	Ire	608	0.9
Ilobu	6,220	8.9	Ila-Orangun	6,690	9.4
Erin-Osun	480	0.7	Ilare-Ijesha	225	0.3
Iragbiji	767	1.0	Ora	206	0.2
Ikirun	6,690	10	Oyan	231	0.3
Ede	3,222	4.6	Iresi	303	0.4
Total				70,090	100.0

Table 5. Distribution according to volume collated per community in Ekiti State

Community	Volume (ton).	Percentage
Ajegunle- Ise	1380	21.8
Aramako	464	7.3
Ijan	1140	18.0
Kajola	476	7.5
Temidire	349	5.5
Afolu	668	10.5
Ogbese	384	6.1
Odole	454	7.2
Aba-Obasa	336	5.3
Aba-Osogbo	240	3.8
Osan	181	2.9
Otun	260	4.1
Total	6,332	100

Table 6. Distribution according to volume collated per community in Ogun State

Community	Volume (ton).	Percentage
Ogunmakin	120	0.5
Shagamu	23,200	97.7
Owode Idi-Iroko	180	0.7
Owode –Egba	193	0.8
Total	24,194	100

Table 7. Distribution according to volume collated per community in Ondo State

Community	Volume (ton).	Percentage
IkareAkoko	8,080	11.9
Ore	45,532	67.0
Ondo	14,315	21.1
Total	67,927	100

Table 8. Distribution according to volume collated per community in Lagos State

Community	Volume (ton).	Percentage
Agege	18,300	85.5
Imota	3,100	14.5
Total	21,400	100

Table 9. Distribution according to volume collated in the sampled State

State	Volume (ton)	Percentage
Osun	70,090	36.9
Ekiti	6,332	3.3
Ogun	24,194	12.7
Ondo	67,927	35.8
Lagos	21,400	11,3
Total	189,943	100.0

Some members of kolanut Producers & Marketers Association of Nigeria Posed with Mr. Zachary, a Foreign investor in Kola Industry

Truck loaded with 3000 packs of kolanut leaving collation center in Ondo to Northern Nigeria.

A Visit to Kola Farm in Okuku, Osun State

2nd from Rt. Mr. Zachary, Mr. Abu (Farmer), Dr. Ibiremo, Mr. Oladele (Farmer) and Dr. Adebiyi

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Experimental Title: Evaluation Of The Potential Use Of Human Urine Amended With Cocoa Pod Husk Ash As Nutrient Sources For Growth Performance of Kola(Cola *Nitida*) In South Westhern, Nigeria.

Investigator: Adejobi, Kayode Babatunde

Introduction

Kola nut is caffeine –containing nut of evergreen trees of the genus cola, primarily the species cola acuminata and cola nitida (Burdock *et al*., 2009). The cola nut has a bitter flavour and contains caffeine. It is chewed in many West Africa cultures, individually or in a group setting .It is often used ceremonially, presented ton chiefs or presented to guests. Kolanut (cola nitida) are also source of essential oils and alkaloids which have utilization in the preparation of beverages and pharmaceutical products and for flavouring in confectionary industry. It is also used as masticatory for stimulating effect. Because of its economic importance, the young plant should be raised in nurseries using fertile top soil rich in organic matter. However, it is often difficult to obtain adequate suitable top soil due to deforestation. Egbe *et al*. (1989) observed that kola soils in Nigeria had low exchangeable K, N and P. widespread deficiency of B and Cu was also reported. The use of animal and crop waste in the form of farmyard manure (FYM) or compost in common practice in majority of the farm community in Nigeria. But the importance of the plant nutrients content in human waste has never been realized as an alternative source of fertilizer for crop production. Out of the human excreta i.e. faeces and urine, urine has high nitrogenous fertilizer value than faeces. Urine contains up to 0.9:0.12:0.26% of N, P and K respectively (vnneras *et al*., 2004). Urine is quick acting fertilizer rich in nitrogen can be applied directly to the soil as it is entirely sterile product and the health risk from the use of urine has been found to be negligible (Hoglund *et al*., 2000). Cocoa pod husk is an organic source of fertilizer in Nigeria with about 800,000 tonnes generated annually and is often wasted. It is advised that the husk be burnt into ash as a method of farm sanitation and can be applied to soil as an organic fertilizer. Cocoa pod husk ash acts slowly and contain organic matter, high K and P but low in N. both human urine and CPHA materials well supplement each other to match the needs of crops.

Nigeria soils are very deficient in nitrogen content low in phosphorous and potassium content (Ojeniyi *et al*., 2009). Hence nitrogenous fertilizer is the necessary supplement on soil in order to increase the productivity of the country and about 1,927,971 tonnes of chemical fertilizer (mostly urea) is imported into Nigeria in a fiscal years 2005-2010 (IFDC, 2012). It is estimated that an adult excrete about 550 litres of urine per year (Esrey *et al.*, 1998). 550 liters of urine is calculated ton have 4.0kg of nitrogen, 365g of phosphorous and 1kg of potash (vinneras and Jonson 2002). Nigeria total population in year 2006 was about 150,000,000. If only about 50% of total population of Nigeria starts to collect urine, it is required to about 666:60:126 thousand tonnes urea, triple super phosphate and muriate of potash respectively which can totally fulfill the demand of chemical fertilizer in Nigeria and can also save the foreign currency needed to import these fertilizers.

Experiments in other countries have proved that nutrients in urine are easily accessible to plant and effective as chemical fertilizers. In Nigeria very little research has been carried out on the use of human urine amended with cocoa pod husk ash as nutrient sources for growth performance of kola seedlings. (Egbe and Olaniran, 1980). However, the use of chemical fertilizers on kola production is hindered by its scarcity, high cost, incomplete nutrient supply and possible enhancement of soil acidity in case of N fertilizers (Egbe *et al*., 1989). There is need to study cheap, locally sourced human and agricultural waste that could enhance balance crop nutrition.

Therefore, the objective of this study was to evaluate the potential use of human urine amended with cocoa pod husk ash as nutrient sources for growth performance of kola

Materials and Methods

The experiment took place at the research farm cocoa research institute of Nigeria Ibadan (07^0 10, 03^0 52^0E) in the rainforest zone of Nigeria between 2010 and 2011. The annual rainfall is between 1200-1500mm per annum while the average temperature is 30.1^0C. The soil is texturally sandy loam belonging to Onigambari series and an alfisols (soil survey staff, 1999).

Soil Sampling and Analysis before Planting

Soil samples (sand loam) used in the experiment were randomly collected from 0-15cm depth, mixed thoroughly and the bulked sample was taken to the laboratory, air dried and sieved to pass through 2mm screen for analysis. The soil PH (1:1 soil/water) was read on the PH meter. Organic matter was determined by wet oxidation method (A.O.A.C. 1970). Soil p was extracted by the Bray P1 extraction and measured by the murphy blue coloration and determined on a spectronic 20 at 882 um (Jackson 1965). Soil k, Ca and Mg were extracted with 1m NH4 DAC, PH7 were determined with flame photometer; Mg was determined with atomic spectrophotometer. The total nitrogen was determined by the microkjedahl method in which the distillate is filtrated against the boric acid (AOAC, 1990).

Sources and Preparation of Organic Fertilizer

The cocoa pod husk (CPH) used for the experiment was obtained from the crop processing unit of cocoa research institute of Nigeria, Ibadan. The CPH was dried for 3 weeks and then burnt to ashes. After cooling the ash collected was bagged and kept in dry place.

Two (2) grammes of CPHA were analyzed. The nitrogen content was determined by kjedahi method (Jackson 1965), while the determination of other nutrients such as P,K,Ca,Mg and Na were done using the wet digestion method based on 25-5-5ml of HNO_3- H_2SO_4-$HCLO_4$ acid. The K and Ca nutrient were read on the flame photometer while Mg,Fe, cu, Zn and Mn were read on the atomic absorption spectrometer. The P content was developed in yellow coloration with vanado molybdate solution and read on a spectronic 20 at 442um. The organic carbon (%) was determined by wet oxidation method through chronic digestion (walkey and black, 1934).

Human urine was also collected from a household in CRIN, Ibadan. The collected urine solution was transported 3 km to the nursery where it was stored for two weeks and later applied to the soil. Twenty-five (25ml) milliliter of urine solution was analyzed using the aforementioned methods.

Pre-Nursery and Nursery Establishment

Matured fruits of kolanut were collected from the kola plantation in CRIN, Ibadan. The seeds were obtained after extraction of the fruits, its mucilage washed and air dried for 72 hours at room temperature to remove moisture. Two seed boxes of (90 X 60 X30 cm) size were filled with saw dust and the mature seeds of kolanut were planted. Cultural practices such as weeding and watering were carried out as necessary. The planted kolanut seeds germinated after between 25 -35 days and were transplanted to the nursery. The bulk soil samples taken (0-15cm) was sieved to remove stones and planted debris and 2.5 kg of the sieved soil was placed into the polyethene bag. (25 cm X 13 cm).

There were 8 treatments in all, and the rates of application were:

800ml of human urine (HU), 700ml of human urine + 5t/ha of cocoa pod husk ash (CPHA), 600ml of human urine + 5t/ha cocoa pod husk ash, 500ml of human urine + 5t/ha cocoa pod husk ash, 400ml of human urine +5t/ha cocoa pod husk ash, 300ml of human urine + 5t/ha cocoa pod husk ash, 200ml of human urine + 5t/ha cocoa pod husk ash and control (no fertilizer).

The organic manure was added to the soil two weeks after the germination, kolanut seeds were sown each treatment was replicated three times and arranged in a completely randomized design. (CRD). Growth parameters such as plant height , number of leaves , leaf area , stem girth and number of branches were recorded from 4 weeks after planting (WAP) and later monthly until 24 weeks after planting. Hand weeding was done at 3 weeks after planting and repeated at interval of 3 weeks.

At the termination of the experiment (24 WAP) in the nursery, the seedlings were carefully removed from the polythene bags for the measurement of fresh root and shoot weights, roots and shoot lengths.

They were oven dried and there after dried root and shoot weights were taken before finally analyzed for N, P, K, Na,Mg and Ca contents. Post planting soil samples were also taken from each treatment, at the termination of the experiment air dried and sieved for analysis of soil N,P,K,Ca,Mg,PH and O.M.

Statistical Analysis
The growth data collected were analyzed using ANOVA. The treatment means were compared using the Duncan's multiple range test ($p<0.05$).

Table 1: Pre- planting physiochemical properties of the soil

Soil properties	value
Physical properties	660.70g/kg
Sand	192.36g/kg
Silt	146.94g/kg
Textural cross	sand loam
Chemical properties	
pH (h2o) 1:1	5.20
organic carbon	1.30g/kg
organic matter	0.52%
Total nitrogen	0.12%
Available phosphorus	3.01mg/kg
Exchangeable bases	0.50cmol/kg
K+	0.45coml/kg
Ca+	0.45cmol/kg
Mg+	2.39cmol /kg
Mn+	0.89cmol/kg
Exchangeable acidity	
Al++	0.24cmol/kg
H+	0.12coml/kg
ECEC	4.67CMOL/KG

Table 2: Chemical analysis of Human urine and cocoa pod ash used as organicfertilizers.

Treatments	pH	C/N	OM	N	P	K	ca	mg	na
	H2o(1:1	ratio	%		%	mg/kg	cmol/kg	cmol/ kg	cmol/kg
Human urine(HU)	6.8			6.92	21.37	7.88	7.50	2.50	5.83
Cocoa pod husk ash (CPHA)	7.21	5.9	-	1.02	40.26	5.01	3.60	1.80	3.06

Table 3: effect of different leaves of HUI and CPHA on growth parameters of kola seeding in the nursery

Treatments	Plant height	No of leaves	Stem girth cm	Number of branches	Lent and area	Root length cm	Shoot length
800ml HU	32.16ab	12.17b	0.59ab	4.93b	22.71b	29.23a	41.83a
700mlHU+ 5t /ha CPHA	29.20ab	13.08b	0.59ab	4.25b	34.13a	29.10a	29.37b
600ml/HU+5t/ha CPHA	35.81a	11.80b	0.58ab	4.13b	23.92b	25.35ab	39.40ab
500ml/HU+5t/ha CPHA	28.61a	10.52b	0.58ab	12.14a	35.85a	22.73b	22.67ab
400ml/HU+haCPHA	36.52a	17.22a	0.64ab	5.16b	36.00a	29.36a	43.93a
300ml/HU+5t/haCPHA	22.35b	12.21ab	0.64b	4.50b	23.31	32.33a	3043ab
200ml/HU+5t/haCPHA	26.77b	15.32ab	0.54a	5.25b	27.40b	28.4ab	33.17ab
CONTROL	21.81c	8.17c	0.41c	2.97c	20.64c	16.73b	20.37c

Table 4 : The yield parameters of kola seeding 24 weeks after planting under different levels of fertilizer

Treatments	fresh root Weight (g)	dry root weight(g)	fresh shoot Weight(g)	dry shoot Weight (g)
800ml/HU	11.19b	4.16b	21.15a	8.69ab
700ml/HU+5ta/haCPHA	15.60	6.11a	21.66a	10.46a
600mlHU+5t/haCPHA	9.41b	3.68b	18.42b	8.12ab
500ml/HU+5t/haCPHA	9.71b	4.58b	12.01c	4.65b
400ml/HU+5t/haCPHA	11.66b	4.19b	21.46a	8.74ab
300ml/HU+5t/haCPHA	10.63	3.40b	14.66b	5.49b
200ml/HU+5t/haCPHA	10.12ab	3.58b	14.95b	5.68b
Control	7.71c	2.81c	8.90d	3.69c

Table 5. Post planting physicochemical properties of the soil

Treatments	soilpH	O	C	O	M	N	P	K	Ca
Mg	Na(h2o)	1:1g/kg	%	%	mg/kg	cmol/kg	cmol/kg	cmol/kg	cmol/kg
800ml HU	6.23d	1.42c	2.43de	1.156de	18.76b	0.79ab	4.90a	2.18a	0.41bc
700mlHU+5t/haCPHA	7.12c	2.71a	4.19a	2.36a	23.82a	1.10a	3.67b	1.99a	0.36bcd
600mlHU+5t/haCPHA	7.33b	2.21b	3.43b	2.02b	15.17bc	0.45bcd	4.60a	1.37b	0.51a
500mlHU+5t/haCPHA	7.41ab	1.67c	3.77b	1.56c	11.91cd	0.56bed	4.55a	1.31b	0.61a
400mlHU+5t/haCPHA	7.46ab	2.14b	3.11c	1.35cde	10.36d	0.78abc	3.66b	1.44b	0.35bcd
300mlHU+5t/haCPHA	7.57a	2.15b	2.64d	1.41cd	8.29d	0.14d	2.92	1.35b	0.13e
200mlhu+5t/haCPHA	7.60a	2.54ab	2.41d	1.03e	10.18d	0.31cd	4.27ab	1.28b	0.28cde
Control	5.70e	0.83d	1.23c	0.10f	2.93e	0.11e	1.94d	0.89c	0.19fc

Table 6 : leaf chemical composition after 24 weeks of treatment application

Treatments	N	P	K	Mg	Ca	Na
	%	Mg/kg	cmol/kg	cmol/kg	cmol/kg	cmol/kg
800 HU	2.42b	13.48c	5.66c	30.30	35.16g	2.34b
700ml/HU+5t/haCPHA	2.06ef	7.61h	4.00d	16.95d	40.15f	1.76b
600mlHU+5t/haCPHA	2.00f	9.75g	7.25b	13.35d	34.17h	3.13b
500mlHU+5t/haCPHA	2.59a	26.32a	12.00a	15.02d	49.36b	11.86a
400mlHU+5t/haCPHA	2.18cd	10.31f	6.55bc	19.33bcd	46.34c	2.35b
300mlHU+5t/haCPHA	2.21c	12.85e	3.58de	22.94bc	62.14a	2.64b
200mlHU+5t/haCPHA	2.57a	12.85d	2.54e	16.33ed	41.32e	1.67b
Control	1.00g	5.20i	1.76f	4.32i	5.02g	0.27c

Results and Discussion

The physical and chemical properties of the soils used for raising kola seedlings in the nursery are presented in Table1. Based on the established critical levels for the soils in the southwestern Nigeria, the soils are acidic (5.20) and low in organic matter (0.52%) when compared with 3% critical level (Agboola and Corey, 1973). The total % nitrogen (0.12%) was found to be less than 0.15%N, which is considered as the optimum for crop (Sobulo and Osiname (1981). The available P (3.01 mg/kg) was less than 10mg/kg that is considered as adequate for crop production in this region (Agboola, (1982). Also, the exchangeable K and Mg (0.50cmol/kg and 2.39 cmol/kg) were higher than the critical level of 0.2 cmol/kg and 0.9 cmol/kg which are considered optimal for most crops (Agboola and Corey, 1976).

Between the organic manures used, cocoa pod husk ash (CPHA) had the highest PH and P, this was an indication that it could be effective as a liming material. While human urine (HU) had the highest N, K, Ca, Mg and Na. The result agreed with the work of HK Upreti et al (2011), who found out that human urine could act as effective as NPK fertilizer which can be used as an effective source of plant nutrients and any crops can be grown using urine as a fertilizer without significant reduction in the yield if nutrient losses during handling could be minimized.

The plant height, number of leaves, stem girth, number of branches, leaf area, root and shoot lengths fresh and dry root weights of kola seedlings under different levels of human urine amended with cocoa pod husk ash treatment are presented in table 3 and 4.

The application of different levels of human urine amended with cocoa pod husk ash increased significantly ($p<0.05$>) on growth and yield parameters of kola seedling compared to the control treatment (table 3 and 4). This study showed that HU and CPHA seemingly waste products of man and cocoa should be used to reduce soil acidity and increase availability of N, P, K, Ca, Mg, and Na in the soil and their uptake by kola plants thereby leading to enhanced growth performance of kola. Poor growth of kola seedlings because of low nutrient status of soil and N, P, K, Ca, Mg, soil PH, Na and OM were generally observed in no treatment plot. This observation agrees with the work of Moyin–Jesu, (2008). Which identified deficiency symptoms of yellow coloration, purple coloration and marginal burning of leaves signifying N, P, K deficiencies of tropical Africa soils. Human urine blended with cocoa pod husk ash at 400ml Hu +5t/ha CPHA increased the plant height, number of leaves, stem girth, leave area, rot length and shoot length of kola seedling by 12%, 29.3%, 7.8%,37%, 10% and 5% respectively compared to single application of 800ml HU. When compared with 700ml Hu+5t/ha CPHA, it also increased the plant height, number of leaves, stem girth , leave area, root length and shoot length of kola seedling by 20% , 24%, 9%, 18%, 5%,1% and 33%. Also, human urine amended with CPHA increased significantly ($p<0.05$) the soil N, P, K, Ca, Mg, PH, Na, OC and OM compared to the control treatment (Table 5). This observation did not deviate from the works of Ojeniyi and Adejobi (2002). Swift and Anderson (1993) reported that organic manures increased soil N, OM, P, K and PH and micronutrients which are absent in conventional NPK 15:15:15 fertilizers. Increase in soil PH using combined application of HU and CPHA compared to the single application of HU and the control could be traced to the synergistic effect of the two organic fertilizers which produced high K and more especially Ca contents and could be effective as liming materials unlike Urea and NPK fertilizers when applied continuously to soil, decreases soil PH and OM. The soil PH has been reported to influence nutrient uptake and availability to crops for optimum growth (Gordon, 1988). The control treatment had least value of soil, leaf and growth parameters of kola seedlings compared to combined and single application of the organic manure (table 5 and 6). The significant increase in growth parameters, soil nutrient composition and leaf nutrient uptake of kola seedlings by the different levels of HU and were due to their high nutrient contents (N, P, K, Ca and Mg) which encouraged vegetable growth. Nitrogen is known to be responsible for plant growth and protein synthesis (Ojeniyi, 1984). While P and K were essential for promotion of meristematic tissue and carbohydrates formation (Tisdale and Nelson, 1966). 400ml HU + 5t/ha CPHA, 700ml HU + 5t/ha CPHA and 500ml HU + 5t/ha CPHA applications were most beneficial for the kola seedlings than other treatments because generally both ash and urine are easily mineralized due to their lower C/N ratios (Folorunso, 1999and Hoglung *et al*., 2000).

Conclusion

The results indicated that 400ml HU +5t/ha CPHA, 700ml HU+ 5t/ha and 500ml HU + 5t/ha CPHA applications increased the soil, leaf N, P, K, Ca, Mg, soil PH, OM and also both growth and yield parameters of kola seedlings. It is concluded that human urine amended with CPHA could serve as a good fertilizer for the kola seedling as shown in the experiment. Human urine amended with cocoa pod husk ash applied at 400ml HU +5t/ha CPHA being the most effective treatment improved kola growth, yield parameters and soil chemical properties is therefore recommended for optimum growth of kola seedlings in the nursery.

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Experimental Title: Synergistic Effects of Organic and Inorganic Based Fertilizers On Soil, Leaf Chemical Properties And Growth Performance of Kola (*Cola nitida*)

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Introduction.

Kola is a tree of tropical rain forest and a member of the family sterculiaceae (Opeke, 2005) about 40 kola species have been described in West Africa, however, the kola species of economic importance in Nigeria are *Cola nitida* and *Cola acuminata* (Daramola, 1978) . The use of the kola nut like the coffee berry and tea leaf, appears to have ancient origins, it is chewed in many West African cultures, individually or in social setting, to restore vitality and ease hunger pains. Kola nuts are an important part of the traditional spiritual practice of the culture and religion in West Africa, particularly in Niger and Nigeria (Aina, 2004). Kola nuts are used as a religious object and sacred offering during prayers, ancestor's veneration and significant life events, such as naming ceremonies, weddings and funerals. They are also used in traditions divination system called obi divination (Epaga, 2003)

Nigeria is the leading world producer of kolanut. It is estimated that Nigeria currently produces 70% of the world kola nuts with annual production of 200,000 metric tonnes of fresh nuts (Asogwa, 2012), although only 10% of this amount is exported the rest is consumed locally. Inspite of the immense benefits of kola, many factors have been limiting its production in Nigeria. Among these factors are poor agronomic practices, ageing kola farms (Adebiyi *et al*.,2011) partial and total sterility, inefficient natural pollination, field and storage pest and diseases (Daramola, 1978) and poor soil fertility (Asogwa, 2011). William et al. (1991) reported that because of the high rainfall, soil of humid tropics are usually leached to the extent that they contain lower level of plant nutrient that those from dryer regions and because alkaline substances (Ca, Mg, K and Na) are leached out , tends to be acidic in nature . it has also been reported that Nigeria soils are largely deficient in major essential soil nutrients, hence multiple nutritional deficiencies and lower yield are common occurrence (Agboola and Sobulo, 1981)

Effort to increase the soil nutrient status with chemical fertilizers by farmers is rather limited due to high cost of fertilizers and /or their poor availability to farmers locally. Thus there is need to identify locally available organic fertilizers which can be used to improve the fertility of the soil used in raising kola seedling in the nursery which usually takes about 8 to 12 months (pre- nursery and nursery proper). Recent research on fertilizer has reviewed the potentials of some organic fertilizers as cheap, readily available, affordable, and adoptable. The use of animal and crop wastes in form of farmyard manure (FYM) or compost is common practices in majority of the farm communities. Several studies have shown that ash derived from cocoa pod husk, saw dust and oil palm bunch waste increased availability of nutrients in the soil and consequently enhanced growth performance of the crops such as coffee, maize , cassava and vegetable (Ojeniyi *et al*., 2010; Adejobi *et al*., 2011). Also, the importance of plant nutrients content in human waste such as urine has never been realized as an alternative source of fertilizer for raising kola seedling in the nursery. However, there is paucity of information on the combine use of different levels of human urine (HU), goat dung (GD) and kola pod husk ash on growth performance of kola seedlings and chemical properties of kola soil. The use of these wastes will assist in environmental sanitation and nutrient recycling in both farms and urban communities.

The objective of this study therefore was to evaluate the combine effects of human urine, Goat dung and kola pod husk ash on the chemical properties of soil and growth performance of young kola seedlings in the nursery.

Materials and Methods

Experimental location

The trial was conducted at the experimental plot of Cocoa Research Institute of Nigeria (CRIN), Ibadan, on latitude 07^0 10^0E and longitude 03^0 52^0E in the humid tropical and rainforest zone of Nigeria. The rainfall is between 1200mm -1500mm per annum and a daily average temperature of 30.1^0c.

Pre-planting, soil sampling and analysis

The top soil to be used for this trial was collected from 0-15cm depth on the site and mixed thoroughly. The representative samples were taken to the laboratory, air dried and sieved with 2mm sieve and ready for routine analysis. The soil pH (1:1 soil/water) was read on the pH meter. Organic matter was determined using wet oxidization method through Chromic Acid Digestion (walkey and black ,1934) soil P was extracted by Bray P, extractant and the extract was developed into murphy Blue Coloration and determined on a spectronic 20 at 882 ums (Murphy and Riley,1962). The soil k, Ca, Mg and Na were extracted with 1M NH_4, OA PH7 and the contents of K, Ca and Na were read on the flame photometer (Jenway clinical PFP7, designed and manufactured by Jenway Ltd. Felsted Dunmow, Essex CM6 3LB, United Kingdom) while the Mg content was determine on the Atomic Absorption Spectrophotometer (Movaspec 11 visible spectrophotometer, manufactured by Pharmacia Biotech (Biochron Ltd) Cambridge, England). Meanwhile, the %N was determined using the Microkjedahi method (Jackson, 1964).

Collection, processing and chemical analysis of kola testa (KT)

Kola pod husk was obtained from kola processing unit of CRIN, Ibadan. It was sun dried for a week and then burnt to ashes. After cooling the ash collected was bagged and kept in dry place before application. The goat dung was obtained from nearby pen in Akure, Ondo State.
The % nitrogen was determined by weighing 2g of each organic material into a digester flask and 5ml of H_2so_4, with selenium and copper sulphate tablets were added. After 5ml of NaH was added, the distillate was collected

and boric acid was added with an indicator before it was filtrated with O.I.M Hcl .

Furthermore, two grams of each organic material was weighed into a clean dry tecator digestion tubes to determine the P, K , Ca and Mg contents . 25ml of HNO_3 was added down the neck of the flask and swirled to ensure that the organic material was thoroughly wetted. 5ml of H_2SO_4 and 5ml of perchloric acid ($HCL0_4$) were added and the mixture was swirled again. This was then placed at the digestion block and heated carefully by ensuring that the samples did not froth. Digestion was continued until the samples were clear and acids were completely volatized. The samples were allowed to cool and 10ml of distilled water was added; filtration into 100ml volumetric flask was done and the filtrate was left to cool before it was filled to the mark with distilled water. For phosphorus (P) 20ml of phosphorus vanado molybdate solution was added and allowed to stand for at least 2 hours. The colour absorbance was measured on spectronic 20 at 442um. Meanwhile, the % k ,Ca and Na contents, an aliquot was measured into 100ml flask and diluted to mark. 1ml of the sample solution was taken, and the flame photometer was adjusted, this was followed by the aspiration on the diluted sample solution. The solution was read and later converted to mg/kg. The mg content was determined using the atomic absorption spectrophotometer.

Human urine was also collected from a house hold in CRIN, Ibadan. The collected urine solution was transported 3km to the nursery where it was stored for 2 weeks and later applied to the soil. Twenty five (25ml) milliliter of urine solution was analyzed using the aforementioned methods.

Experimental hypothesis

Three hypotheses were tested using independent variable (X1) and dependent variables Y1 for kola seedlings. The independent variables (X1) were defined as organic materials such as Human Urine / Kola Pod Husk Ash mix, Human Urine / Goat Dung Manure mix, Human Urine/ Kola Pod Husk Ash/ Goat Dung Manure mix.

The dependent variable (Y1) were defined as comprising plant height , number of leaves , leave area , stem girth , number of branches, root length and shoot length and soil and leaf N, P, K, Ca and Mg, soil pH and O.M.

Each null hypothesis (H0=U) was tested to determine whether significant statistical relationship existed between each dependent and the observed independent variables.

The three hypotheses tested were as follows:

1. There is no significant relationship between the organic materials and the plant height, number of leaves, stem girth, number of branches, leaf area, root length and shoot length of kola seedlings.
2. There is no significant relationship between the organic materials and soil N, P, K, Ca, Mg, PH and O.M compositions.
3. There is no significant relationship between the organic materials and leaf N,P, K, Ca and Mg of the Kola seedlings

Pre-nursery and Nursery Establishments

In July 2010, disease free kola nuts (*C.nitida*) were obtained from Kola Processing Unit, CRIN, Ibadan. The nuts were planted in wooden box filled with sawdust and watered. The nuts germinated and allowed to grow in the pre-nursery for 8 months. During this period, the germinated seedlings were watered and weeds were controlled manually. The bulk soil samples (0-15cm depth) were sorted to remove stones and plant debris and 2.5kg of the soil was placed into the poly bag (25cm X 13cm). There were eight treatments in all and the rates of application were 400ml Hu + 5t/ha KPHA, 400ml Hu +20t/ha GD, 400 ml Hu+ 5t/ha KPHA + 5t/ha GD, 400ml Hu +5t/KPHA + 10t/ha GD, 400ml Hu + 5t/ha KPHA + 15t/ha GD, 400ml Hu + 5t/ha KPHA +20t/ha GD, 400kg/ha Urea and the control (no fertilizer; no manure). All the treatments were replicated three times and arranged in a completely randomized design (CRD). The treatments were applied at the time the pre-germinated kola nut seed was planted into each poly bag. After four weeks of planting in the nursery, plant height, number of leaves, stem girth, number of branches and leaf area of kola nut seedlings were measured. These growth parameters were measured at every four weeks interval up to 24 weeks after planting.

Weeding of site was started at 3 weeks after planting and repeated at 6, 9 and 15 weeks after planting. At the termination of the experiment (24 WAP) in the nursery, the seedlings were carefully removed from the poly bags for the measurement of fresh root and shoot weights, root and shoot lengths. They were oven dried and thereafter dried root and shoot weights were taken before finally analyzed for N, P, K, Na, Ca and Mg contents. Post planting soil sample were also taken from each treatment, at the termination of the experiment, air dried and sieved for analysis of soil N, P, K, Ca, Mg pH, and O.M .

Statistical Analysis

The growth data collected were analyzed using ANOVA. The treatment means were compared using the Duncan's multiple Range Test ($p<0.05$)

Results and Discussion

Both the physical and chemical properties of the soils used for raising of kola seedlings in the nursery are presented in table 1. According to the results of the particle size analysis, the soil was texturally sandy loam belonging to Onigambari series and alfisol (soil survey staff, 1999). Based on the established critical levels for soils in south western Nigeria, the soil was acidic with pH of 5.24 and low in organic matter (0.54%) compared to the findings of critical level of 3% organic matter (Agboola and Corey, 1976). In addition, the total % nitrogen (0.13%) was found to be less than 0.15% N, which is considered as the optimum for most crops including kola (Sobulo and Osiname, 1981). While the available P (2.02mg/kg) was less than 10mg/kg P, which is considered as adequate to produce crops (Agboola, 1982). The exchangeable K and Mg (0.52cmol/kg and 2.39cmol/kg) were higher than the critical levels of 0.2cmol/kg and 0.9cmol/kg which were considered optimal for most crops (Agboola, and Corey, 1976). Among the organic residues used, kola pod husk ash (KPHA) had the highest pH (8.21) and P (32.62) followed by human urine (6.80) while goat dung had the lowest pH and P of (6.38) and (16.36) respectively (Table 2). In particular human urine had the highest N, K, Ca, and Na concentrations and this was followed by kola pod husk ash. The goat dung was indicated to be fairly high in NPK and Ca (Table 2). Relative higher N obtained from kola pod husk ash could be attributed to the fact that kola pod husk could be a good N source to that extent that volatilization of N during burning could not reduce it N content to a critical level of 0.15% required for most crops.

The plant height, number of leaves, stem girth, number of branches, leaf area, root and shoot, weight of kola seedlings under different organic fertilizers are presented in tables 3 and 4. The results showed that combined application of 400ml HU + 20t/ha GD increased significantly ($p<0.05$|) the plant height, number of leaves, number of branches, shoot length, and fresh shoot weight of kola seedlings relative to urea treatment and the control. While combined application of 400ml HU +5t/ha KPHA + 15t/ha GD gave significant higher stem girth, leaf area, and dry root weight relative to the urea fertilizer treatment and the control. This study showed that human urine, goat dung and kola pod husk ash , seemingly waste products of man ,animal and plant respectively could be used as fertilizers to increase availability of N,P,K, Ca, and Mg in the soil and their uptake by kola plants thereby leading to enhanced growth performance of kola. This result attests to the synergistic relationship that exists among the amended organic manures and their resultant complimentary effect in enhancing vegetative growth of kola seedlings. The current result is consistent with the findings of Ayeni (2010) who reported that cocoa pod ash combined with NPK 15:15:15 fertilizers significantly ($p<0.05$) gave the highest fruit yield of tomato. Similarly, Makinde (2010) found out that vegetative growth of crops was engendered by organic manure especially kola pod husk, cocoa pod husk and NPK fertilizer. Also, Upreti (2011) observed that the crops yield (potato, rice, radish onion and wheat) increases when urine is applied in split, and efficacy of urine increases with the supplement dose of phosphorus (p) and potash (k) from chemical fertilizers to increase yield of different crops as compared to urine applied in single dose at the time of planting. The poor growth of the kola seedlings in the nursery under the control treatment was consistent with the low nutrient status of soil N, P, Mg, OM and pH, this fact is supported by Agboola (1982) who had identified poor soil fertility as the moving factor in reducing crop yields. This observation was also corroborated with the work of Moyin-Jesu, (2008) which identified deficiency symptoms of yellow coloration, purple coloration and marginal burning of leaves signifying N, P, K deficiencies in tropical Africa soils.

Table 1: Pre-planting physiochemical properties of the soil.

Soil properties	value
Physical properties	
Sand	6569g/kg
Silt	189.78g/kg
Clay	153.53g/kg
Textural class	sand loam
Chemical properties	
pH (H_20) 1:1	5.24
Organic Carbon	1.32g/kg
Organic Matter	0.54%
Total Nitrogen	0.13g/kg
Available Phosphorous	2.02mg/kg
Exchangeable bases	
K^+0.51cmol/kg	
Ca^{++}	0.48cmol/kg
Mg^{++}	2.39cmol/kg
Na^+	0.89cmol/kg
Mn^{++}	0.04cmol/kg
Exchangeable acidity	
Al^{+++}	0.24cm/kg
H^+	0.12cmol/kg
ECEC	4.27cmol/kg

Table 2: chemical analysis of human urine (HU), kola pod husk ash (KPHA) and goat dung (GD) used as organic fertilizers

Treatments	pH	C/N	OM	N	P	K	Ca	Mg	Na
	H_2O	(1:1)	%	%	mg/kg	Cmol/kg	Cmol/kg	Cmol/kg	Cmol/kg
Human urine	6.8	-	-	6.92	21.37	7.88	7.50	2.50	5.83
kola Pod Husk Ash (KPHA)	8.21	10.0	2.8	3.26	32.62	3.93	6.90	3.80	2.19
Goat Dung(GD)	6.38	6.2	4.8	1.26	16.36	2.29	3.40	1.90	1.62

Table 3: Effects of different levels of HU and KPHA on growth parameters of kola seedlings in the nursery

Treatments	Plant height (cm)	Number of Leaves (cm)	Stem Girth (cm)	Number of Branches	Leaf Area (cm)	Root Length (cm)	Shoot Length (cm)
400mlHU+5t/ha KPHA	32.74ab	15.16bdc	0.97ab	3.58ab	42.66b	28.50ab	39.16ab
400mlHU+20t/ha GD	38.27a	21.44ab	0.94ab	4.35a	41.01b	19.93b	45.90a
400mlHU+5thaKPHA+5t/ha GD	34.79ab	13.83dce	0.87ab	3.14ab	39.31b	30.83a	39.33ab
400mlHU+5t/haKPHA+10t/ ha GD	33.65ab	8.29e	0.83ab	2.72ab	55.32ab	19.43b	29.00b
400mlHU+5t/haKPHA+15t/ ha GD	35.70ab	17.77abc	1.03a	3.76a	64.22a	29.80a	39.73ab
400mlHU+5t/haKPHA+20t/ha GD	35.88ab	21.66a	1.01a	3.70a	58.19ab	28.90ab	40.83ab
400kg/ha urea	28.56b	9.73de	0.76b	1.89b	44.51b	30.04ab	34.47b
Control	28.09b	13.66de	0.80b	2.00b	40.05	19.33b	29.77b

Treatments means within each column followed by the same letters are not significantly different from each other

Table 4: the yield parameters of kola seedlings 24 weeks after planting under different levels of fertilizers

Treatments	fresh root Weights(g)	dry root weights(g)	fresh shoot weights(g)	dry shoot weights(g)
400mlHU+5t/haKPHA	12.76ab	4.64b	20.28ab	8.20abc
400mlHU+20t/haGD	9.58b	4.91b	32.13a	11.55ab
400mlHU+5t/haKPHA+5t/haGD	12.17ab	4.55b	15.15bc	6.79be
400mlHU+5t/haKPHA+10t/haGD	6.56b	5.76b	7.27b	3.45b
400mlHU+5t/haKPHA+15t/haGD	14.43ab	8.10a	23.32b	10.10abc
400mlHU+5t/haKPHA+20t/haGd	21.53a	5.81b	27.64ab	13.86a
400kg/ha urea	22.83a	5.49b	21.90b	6.74bc
Control	16.43ab	7.05b	24.46b	10.67ab

Treatments means within each column followed by the same letters are not significantly different from each other

Table5: post-planting physiochemical properties of the soil

Treatments	Soil pH (H_20) 1:1	OC g/kg	OM %	N %	P mg/kg	K cmol/kg	Ca Cmol/kg	Mg Cmol/kg	Na Cmol/kg
400mlHU+5t/ha KPHA	6.93c	1.40b	2.41b	1.12b	17.05a	0.59b	4.31ab	1.50ab	0.40ab
400mlHU+20/ha GD	7.12b	2.04ab	3.50a	2.18a	8.65f	0.88a	3.50d	1.20c	0.37b
400mlHU+5t/haKPHA+5t/ha GD	7.13b	2.01ab	3.47a	1.17b	10.29d	0.41c	4.60a	1.40ab	0.45ab
400mlHU+5t/haKPHA+10t/ha GD	6.53d	3.27a	2.77b	1.14b	10.33d	0.42c	4.00bc	1.50ab	0.65a
400mlHU+5t/haKPHA+10t/ha GD	6.55d	1.97ab	3.40a	2.17a	13.41c	0.46c	3.90c	1.80a	0.39b
400mlHU+5t/haKPHA+20t/ha GD	7.36a	2.05ab	3.53a	2.18a	4.12g	0.11e	2.90e	1.30bc	0.13d
400kg/ha Urea	6.01e	2.53ab	1.36c	2.22a	13.69b	0.32d	4.30ab	1.60ab	0.33c
Control	5.96f	2.78ab	0.51d	0.89c	9.57e	0.30d	3.80cd	1.00c	0.27cd

Treatments means within each column followed by the same letters are not significantly different from each other

Table 6: Leaf chemical composition after 24 weeks of treatment application.

Treatments	N %	P Mg/kg	K Cmol/kg	Mg Cmo;/kg	Ca Cmol/kg	Na Cmol/kg
400mlHU+5t/ha KPHA	2.25bc	46.13a	4.86c	32.00a	36.00dc	1.59b
400mlHU+20t/ha GD	2.88a	29.99bc	8.64a	18.59c	68.88a	0.49d
400mlHU+5t/haKPHA+5t/ha GD	2.60a	19.21d	5.54b	14.04	33.31e	1.74a
400mlHU+5t/haKPHA+10t/ha GD	2.74a	19.29d	7.77a	25.00b	57.56a	0.55c
400mlHU+5t/haKPHA+10t/ha GD	2.39b	18.12d	7.45a	18.81c	45.26b	0.40f
400mlHU+5t/haKPHA+20t/ha GD	2.78a	21.05cd	4.82c	32.00a	60.00a	0.50d
400kg/ha Urea	2.15bc	19.47d	4.04d	33.33a	40.71c	0.41ef
Control	0.04d	7.17e	2.67e	7.25d	3.36e	0.21g

Treatments means within each column followed by the same letters are not significantly different from each other.

Effects of both organic and inorganic fertilizers applied on post –planting physiochemical properties of the soil are presented in table 5. Different organic fertlizers applied increased significantly ($P<0.06$). The soil pH, OM, N, P, Mg compared to the control (table 5). This observation did not deviate from the works of Ojeniyi and Adejobi (2002). Swift and Anderson (1993) reported that organic manure increased soil N,OM,P,K and PH and also micronutrients which are absent in conventional N,P,K 15:15:15 fertilizer. The significant increase in soil pH by the use of 400ml Hu + 5t/ha KPHA and 20t/ha GD compared to other treatments was traced to its high K and Ca as a result of the synergy among the amended organic manure and could be effective as liming materials. The soil PH had been reported to influence nutrient uptake and available to crops for optimum growth (Gordon, 1988). Meanwhile the NPK fertilizer gave the best value of soil N as compared to other treatments and control. The leaf analysis of the kola seedlings for different organic fertilizer sources is presented in table 6. The results showed that there were significant increases ($P<0.05$) discovered in the leaf N,P,K, Ca, Mg contents as compared to the control. 400 ml HU+ 20t/ha GD increased the kola leaf N,K and Ca contents compared to the NPK fertilizer and the control; however , 400 ml Hu + 5t/ha KPHA was found to increase the leaf P more than other treatments and the control.

Recommendation and Conclusion

Some selected organic manures and NPK fertilizers were studied in terms of their effects on soil, leaf chemical properties and growth performance of kola in the nursery. It was proved that amended form of goat dung and human urine with kola pod husk ash or without, increased the soil, leaf and growth performance of the kola seedlings in the nursery. For this reason, farmers are encosuraged to adopt their use especially 400ml Hu + 20t/ha GD. Combination of more than two organic sources might not be necessary.

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ECONOMICS AND EXTENSION

Experimental Title: Cocoa Data Bank in Delta State, Nigeria

Investigators: Oduwole, O.O., Oluyole, K.A., Akinpelu, A.O., and Orisasona, T.M.

Introduction

Nigeria is the World's fourth largest cocoa producer after Ivory Coast, Ghana and Indonesia, producing about 12 percent of the total world production. In Africa, Nigeria is the third producer (World Cocoa Foundation, 2014). Cote d'voire which was placed at a distant third position in Africa with 143,000 tonnes behind Nigeria's 196,000 tonnes in 1970 is now the largest producer of cocoa in the whole world with 12, 824, 717 tonnes while Nigeria with 298,029 tonnes is currently the fourth largest producer (FAO, 2019; ICCO, 2015). Nwachukwu *et al*. (2012) stated that cocoa is the most prominent export crop in Nigeria in terms of production and export capabilities. According to Adebile and Amusan (2011) cocoa contributes about 15 percent to the total Nigerian export in 1970 and also contributes \$900 million to Nigeria's economy in 2012 (*The Sun*, 2013). Nigeria's cocoa production in 2011/12 was put at 300,000 MT, up from 280,000 MT in 2011. The increase is based on a favourable weather condition in addition to considerably higher grower prices, which encouraged farmers to increase their farm holdings (David and Nzeka, 2011). Cocoa and its products exported from Nigeria include cocoa beans (whole or broken, raw or roasted), chocolate and other food preparations containing cocoa, cocoa paste (whether or not defatted) cocoa powder and cake and cocoa butter (World Cocoa Foundation, 2014). United States of America, Spain, France, Germany, and Netherlands are the main importers of Nigerian cocoa. It was reported that Nigerian cocoa output declined from 399, 200 tonnes in 2010 to about 298, 029 tonnes in 2016 with a growth rate declining from 16.2% to about 12.2% during the period (FAO, 2019).

Objectives

The specific objectives of the study were to:

I. profile the socio economic characteristics of the farmers in the study area
ii. identify cropping patterns and agronomic practices among the farmers
iii. identify marketing channels in the study area
iv. identify constraints in cocoa production in the study area

Methodology

The study was carried out in Delta State, Nigeria in 2021. The study employed a multistage random sampling technique to select cocoa farmers. The first stage was a purposive selection of the state. This is because of the volume of cocoa production in the recorded in the state even though the production is marginal. The second stage was a random selection of two Local Government Areas within the state. These LGAs were randomly selected. The LGAs sampled for the study were Aniocha North Local Government Area and Ika North East Local Government Area. The third stage was a random selection of 30 farmers each in Issele-Uku and Umunede communities, respectively. A total of sixty cocoa farmers within the two randomly selected LGAs were used formed the sample size for the study. Primary and secondary data were used for the study. Well structured questionnaire was used for the primary data. Data were collected on age of the farmers, marital status of farmers, household size, farming experience, educational level, and membership of farmers' association. Data was analyzed using simple descriptive statistics (means, frequencies, percentages).

Results and Discussion

Table 1 shows the socio-economic characteristics of cocoa farmers in Delta State. The table reveals that majority (86.67%) of the farmers were male. The implication of this is that cocoa farming in the study area is largely dominated by male gender. Girei *et al* (2013) reported that in Africa, men are more in a crop that is perceived to have commercial value. In addition, the result conforms to the findings by Taiwo *et al* (2015) who reported that about 68.7% of farmers that practiced cocoa rehabilitation techniques (CRTs) in Southwest and South-South agro-ecological zones of Nigeria are male. Similarly, the table reveals that majority (91.67%) of the farmers were married. Moreover, the mean age of the farmers is about 48 years with a Standard Deviation (SD) of ± 10.6. The implication of this is that cocoa farmers in the LGA are at the peak of their productive years and thus cocoa production in the study area is expected to be on the increasing trend. However, this is in not in consonance with the findings by Adeogun *et al* (2010) and Adebiyi and Okunlola (2013) who reported that cocoa farmers in selected states of Nigeria were old. Similarly, the table reveals that 45.00 percent of the farmers had access to primary education. The implication of this is that the farmers may perhaps have access to information on good agricultural practices (GAP) with respect to cocoa production. However, they may not be able to put thos GAP into use based on their level of education. Furthermore, the table reveals an average household size of 7 persons with 3.3 as SD. This implies that the farmers may perhaps utilize members of the household as labour for some operations relating to cocoa production. This may reduce some production and transaction costs expected to be incurred on the crop. Furthermore, the table shows that majority 88.35% of the cocoa farmers had between 1-5 hectares of cocoa farms. This implies that cocoa production in the study area is still in the hands of smallholder farmers who probably may not have access to farm inputs to enhance their productivity.

Table 2 below shows the distribution of the farmers according to cropping patterns, varieties of cocoa grown and sources of planting materials. The table reveals that majority of the farmers (91.67%) were involved in sole cocoa cultivation; about 68.33 percent of the farmers cultivated cocoa/arable crops combination. The implication of this is that sole cocoa cultivation is the most predominant cropping pattern in the study area. However, the result of cocoa/arable combination implies that the farmers maximized the use of available land intensification and crop diversification to guide against food insecurity. This conforms to a priori expectation. In addition, less than half (48.33%) of the farmers planted F3 Amazon variety of cocoa while 63.33 percent, 10.00 percent planted Amelonado and Hybrid (CRIN) varieties, respectively. This implies that distribution of CRIN varieties of cocoa has not spread enough to the farmers, hence the cultivation of the old and low yielding varieties. Furthermore, it was revealed that 31.67 percent, 30.00 percent 28.00 percent and 11.00 percent of the farmers got their planting materials from own farms, inherited, Ministry of Agriculture and friends, respectively. This implies that the old habit of getting planting materials from neighbours by cocoa farmers is still in existence and common in the study area. This may perhaps lead to recycling of pests and diseases on the farms.

Moreover, the table revealed that majority of the farmers (75.00%) carried out clearing operation on the farms while planting, weeding and spraying were carried out by 71.67, percent, 73.33 percent and 78.33 percent, respectively. Similarly, prunning and harvesting were carried out by 66.67 percent of the farmers. The implication of these results is that the farmers are knowledgeable in all these cocoa agronomic practices.

Table 3 below shows distribution according to the marketing channels among the farmers. The result shows that 91.53 percent of the farmers chose local buying agents as channels through which their product gets into the market while about 8.47 percent sell to licensed buying agents. The implication of this is that majority of the farmers are smallholders who see the local buying agents as a faster means of getting cash from the sale of their produce. In addition, it was revealed that about 41.66 percent of the farmers produced between less than 500kg/ha of cocoa from their farms while 28.35 percent produced above 1000kg/ha. This justifies that the farmers farm on small hectarage of land. Furthermore, majority (96.70%) of the farmers in the study area sold their cocoa beans between 500-1000 naira/kg. The implication of this is that all the farmers had information on the prevailing market prices for their produce and may probably sell as the needs for money arose. Moreover, about 75.00 percent of the farmers agreed they pay taxes to the government while 55.00 per cent taxes paid taxes that are above 500 naira per annum. This implies that farmers are conscious of government revenue from taxes.

Table 4 below reveals the distribution of the farmers according to common insect pests and diseases on cocoa farms in the study area. The result shows that termite was seen as most common insect pest by about 76.67 percent of the farmers while about 3.33 percent of the farmers reported black ant common insect pest of cocoa. This implies that the termite infestation of cocoa farms is a serious problem among the farmers in the study area. Similarly, black pod disease and cherelle wilt were seen as the most common diseases by about 70.00 percent and about 28.33 percent of the farmers respectively. This implies that black pod disease still remains a disease of cocoa in the humid region of Nigeria.

Table 5 below shows the distribution of farmers according to constraints and intention to increase cocoa production. It was revealed that about 80.00 percent of the farmers identified non-availability of improved varieties of cocoa as a constraint. Similarly, credit accessibility, high cost of agrochemicals and inadequate marketing channels were seen as constraints to cocoa production by 88.33 percent, 90.00 percent and 88.33 percent, respectively. However, contrary to a priori expectations based on the above results of constraints in cocoa production, majority of the farmers (80.00%) in the study area had intentions to increase their production.

Conclusion and Recommendations

The study was carried out to have a data bank of the operations of cocoa farmers in the study area. The study showed that majority of the farmers still produce on a small scale. Farmers should be encouraged to increase their farm holdings through the provision of enabling policies such as liberalization of cocoa markets, accessibility of improved varieties of cocoa and the removal or mitigation of identified constraints to cocoa production in the study area.

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Table 1: Socio economic characteristics of Cocoa Farmers in Edo State

Variables	Frequency	Percentage (%)	Mean	Std. Deviation
Gender				
Male	52	86.67		
Female	8	13.33		
Age (Years)			48.6	10.6
21-30	7	11.67		
31-40	5	8.33		
41-50	19	45.00		
Above 50	29	46.68		
Marital Status				
Married	55	91.67		
Single	5	8.33		
Educational Level			2.13	0.89
No Formal Education	15	25.00		
Primary	27	45.00		
Secondary	13	21.67		
Tertiary	5	8.33		
Membership of Farmers' Group				
Yes	23	38.33		
No	37	61.67		
Household Size			7.8	3.34
1-5	16	26.67		
6-10	31	51.66		
Above 10	13	21.66		
Farm Size (Hectares)			2.7	1.8
< 1	2	3.33		
1-5	53	88.35		
6-10	5	8.33		

Source: Field Survey, 2021 Std. Dev: Standard Deviation

Table 2: Cropping Patterns, Varieties of Cocoa Grown and Sources of Planting materials by the Farmers

Variable	Frequency	Percentage
Sole Cocoa		
Yes	55	91.67
No	5	8.33
Cocoa-Arable		
Yes	41	68.33
No	19	31.67
Cocoa/Tree Crops		
Yes	29	48.33
No	31	51.67
Amelonado		
Yes	38	63.33
No	22	36.67
F3 Amazon		
Yes	29	48.33
No	31	51.67
Hybrid (CRIN Varieties)		
Yes	6	10.00
No	54	90.00
Source of Planting Material		
Self/Own Farm	19	31.67
Inherited	18	30.00
Friends	6	11.00
CRIN	0	0.00
Ministry of Agriculture	17	28.00
Clearing		
Yes	45	75.00
No	15	25.00
Planting		
Yes	43	71.67
No	17	28.33
Weeding		
Yes	44	73.33
No	16	26.67
Spraying		
Yes	47	78.33
No	13	21.67
Prunning		
Yes	40	66.67
No	20	33.33
Harvesting		
Yes	40	66.67
No	20	33.33

Source: Field Survey, 2021

Table 3: Distribution according to the Marketing Channels among the farmers

Variable	Frequency	Percentage
Quantity Produced (Kg/ha)		
<500	25	41.66
500-1000	19	31.68
Above1000	16	28.35
Price of Cocoa beans (₦/Kg)		
500-1000	58	96.70
>1000	2	3.30
Tax/Levy		
Yes	45	75.00
No	15	25.00
Amount of Tax (₦/Yr)		
<500	27	45.00
500 Above	33	55.00

Source: Field Survey, 2021

Table 4: Common insect pests and diseases on cocoa farms

Insects	Frequency	Percentage
Termite	46	76.67
Caterpillar	12	20.00
Black ant	2	3.33
Diseases		
Blackpod Disease	42	70.00
Cherelle Wilt	17	28.33
Green carpet	1	1.67

Source: Field Survey, 2021

Table 5: Distribution according to constraints and intention to increasecocoa production

Variable	Frequency	Percentage
Improved Cocoa Varieties		
Yes	48	80.00
No	12	20.00
Land Availability		
Yes	32	53.33
No	28	46.67
Credit Accessibility		
Yes	53	88.33
No	7	11.67
High Cost of Agrochemicals		
Yes	54	90.00
No	6	10.00
Inadequate Marketing Channels		
Yes	53	88.33
No	7	11.67
Storage Facilities		
Yes	15	25.00
No	45	75.00
Labour Shortage		
Yes	17	28.33
No	43	40.68
Fire Incidents		
Yes	31	51.67
No	29	48.33
Weather Impact		
Yes	51	85.00
No	9	15.00
Intention to increase production		
Yes	48	80.00
No	7	11.67
Indifference	5	8.33

Experimental Title: Report of Cashew Survey Data Bank in Abia State

Investigators: Oduwole, O.O., Lawal, J.O., Obatolu, B.O., Taiwo, O and A.T. Yahaya

Introduction

The dearth of data on Cashew as it relates to production and the farming households has affected planning and policy decisions at different levels. Many quarters have proved that CRIN should be the base for the collection of data on all its mandate crops. Data bank system involves a lot of information collection, generation and modeling to meet the need of various users of information such as farmers, industrialists and other stakeholders. It requires careful data collection and management for the needs of the various users of information. There is no existing reliable data platform for CRIN mandate crops and the available ones are not adequate and not reliable and timely, hence, there is a need to complement it to make it more robust. Various agencies and private sectors have different information on cashew and the available ones are limited to just production and price. However, there is need for information on socio-cultural variables, biological variables, soil and spatial information (GIS).

Objectives

1. Collection and management of baseline information on cashew.
2. To provide the network with other local and international bodies.

Methodology: This will involve desk research, field survey and interactions with various stakeholders and scientists. Data bank is a continuous and dynamic process involving modeling techniques for the management of information. It involves a lot of rules for the coding system. Personal interviews and the use of questionnaires to collect data and the data set requirement will include the following:

- Socio-economic and physiological data, Weather data, Soil nutrients and water balances, - Phenolic and growth data (variety, acceptability, cultural);- Agronomic data
- Disease and pest data- level of infection and damage;
- Pesticides and their products
- Risk or uncertainty data; production, processing and consumption patterns

The cashew data bank survey in Abia State was carried out in three local government area of the state namely: Umumeneochi, Isikuwato and Abia North local government area.

This report is subdivided into the following major heading:

I Socio- economic characteristics of the cashew farmers
II Planting history of the cashew farmers
III Cashew agricultural practices and rehabilitation methods
IV. Major constraints faced by farmers
V. Awareness of cashew production factors
VI. Proffered solutions by the farmers

The Socio-Economic Characteristics of Cashew Farmers

The socioeconomics of the cashew farmers is an important aspect of the cashew data bank as it contributes positively or negatively to the production of the cashew in the study area. Such demographic characteristics like age, gender, educational levels, membership of associations, mode of land acquisition, sizes of farm among others were considered and analyzed.

Results of analysis from the survey carried out shows that most of the farmers are male (68.3%) and are primarily farmers (58.7%) though some are traders (27%) while very few are found to be civil servant. The analysis further shows that majority of the farmers (28.6%) have over twenty years of cashew farming experience, while 7.9% has 40years of experience this shows that the farmers have a good number of years of experience in cashew farming. The analysis further shows that majority (52.4%) have secondary school education while 19% have tertiary education thus indicating that the cashew farmers had good level of education and therefore are capable of adopting good agricultural practices in cashew production.

Further analysis shows that the farmers' average age is 50 years with an average household size of 7-8 members constituting 15.7% of the respondents. Also an average of 5 members of the household assists the farmers in cashew farm work and other operation. This indicates that an average farmer in the area is young and agile to face cashew farm work thereby boosting cashew production more so that there is evidence of large household size and members' assistance in farm operation. The analysis also shows that 81% of the farmers belong to one association or the other of which 19% belong to Abia farmers' multipurpose cooperatives. Indicating a good medium for farmers to market their cashew products for better price and get better information on cashew operations.

Twenty percent of the respondents have an average of 2ha of land for their cashew farm of which most of them (75%) were acquired through inheritance. This indicates that most of them operate on small/medium scale of cashew production and the cashew farms are passed from one generation to the other.

Planting History

The survey revealed that majority of the farmers have 200 cashew trees that is below the age of 5 years, about 300 trees between the age of between ages 10-15 years,400 trees planted between the ages 15-20years. And 80 trees between the ages 20 -25 years. The farmers mostly planted small and medium variety of cashew seeds with very little number cultivating jumbo variety. This is so because it is believed that the small and medium cashew varieties produce more seeds which is the commercial product. It was also found that there was over 70% survival rate of the cashew seeds when propagated at stake.

An average of 75 and 58 bags of cashew nuts were produced for the main and light season respectively for the year 2017/ 2018 production year while an average of 84.20 and 78.13 bags were produced during the main and light season of 2019/2020 thus showing that there is progress in production. The survey analysis also revealed that most of the cashew farmers weed their cashew farms once a year and none of them apply fertilizer on their cashew farm nor carried out any soil test before planting. Almost all the farmers indicated that the most important part of the cashew harvested is the seed while the fruits aspect is being neglected to rot away or eaten by people however, only few sell out the fruit part.

Cost of cashew fruits were found to be N322, 475.11, and N628.67 on the average for the year 2018, 2019 and 2020 respectively thus showing a progressive increase in price for those years. The costs of cashew nuts were found to be between 650- 1200 naira per kilogram between the 2018-2020 production years. The price however, is not stable depending on the time of the season and market demand and supply for cashew nuts.

Project Results and Discussion 2

This research was conducted in Abia State to identify the constraints to cashew production and how important they are, it examines the level of awareness in cashew production providing some important parameters and points out certain suggested solutions for cashew farming to decide how relevant they are to improving its production in the state.

Table 1.0: Constraints to the Production and Marketing of Cashew

Perceived Constraints	Highly important (%)	Less important (%)
Inadequate information on cashew production	22%	27%
High taxes and unfavourable government policy toward cashew	27%	18%
Climate change affects cashew Production	24%	21%
Inability to access government assistance on production	22%	40%
Inability to access government assistance in marketing	46%	13%
High risks and uncertainty in Agric	46%	11%
Poor access to inputs and chemicals	25%	16%
No access to improved planting materials	33%	19%
Need of training on post-harvest handling	40%	8%
Incidence of pest and diseases	48%	10%
Poor access roads to cashew plots	19%	30%
Poor access to credit facility	44%	18%

Source: Field Survey, 2021

The result in table 1.0 shows that incidence of pest and diseases, high risk and uncertainty in Agriculture, inability to access government assistance in marketing, poor access to credit facility and need of training on post-harvest handling are the most important constraints to the production and marketing of cashew in Abia state. It also shows that inadequate information on cashew production, inability to access government assistance on production and poor access to roads leading to cashew plots are of least importance and therefore have a very low impact on the production and marketing of cashew in the research area.

Table 2.0 Level of Awareness in Cashew production

Variabl es	Very much aware (%)	Not aware(%)
Use of agrochemicals	25%	13%
Cashew farm sanitation practice	16%	11%
Varieties of Cashew	14%	13%
Planting population	10%	21%
Research advances in cashew production	11%	24%
Marketing channels	8%	16%
Processing problem	11%	11%
Stakeholders in the value chain	16%	8%
Good agricultural practices	18%	6%
Mitigation/adaption to climate change	13%	18%

Source: Field Survey, 2021

Table 2.0 shows the level of awareness of the respondents in cashew production concluding that they were very much aware of the use of agrochemicals, cashew farm sanitation, varieties of cashew, stakeholders in the value chain, and good agricultural practices but were not aware of practices like; planting population, research advances in cashew production, marketing channels, and mitigation/adaption to climate change.

Table 3. Suggested solutions for cashew farming and their relevance

Variables	yes (%)	no (%)
Information on improved cashew production technology	71%	27%
Better government policy towards farm practices	67%	32%
Information on mitigating climate change to farmers	54%	44%
Training on how to access government assistance in marketing especially taxes and tariffs	71%	27%
Improved government assistance in marketing especially taxes and tariffs	51%	48%
Set up marketing boards to control prices and trade	68%	30%
Provision of good infrastructure like roads to farmers plot	64%	35%
Assistance on accessing credit facility from banks at low interest	67%	32%

Source: Field Survey, 2021

The cashew farmers were asked to identify how relevant some of the suggested solutions are to cashew farming and the result of the analysis shows that all of the implied solutions are relevant to the marketing and production of cashew. Some of them are; information on improved cashew production technology, Better government policy towards farm practices, Information on mitigating climate change to farmers, Training on how to access government assistance on production, Improved government assistance in marketing especially taxes and tariffs, Set up a board to control prices and marketing of cashew nuts.

Conclusion /Recommendations

The survey carried out shows that the majority of the farmers are male farmers, educated but are not familiar with good agricultural practices for cashew production. They operate on small-medium scale cashew production. It was also observed that there are no organized market(s) for cashew in Abia state as farmers are at the mercy of the buying agents. Most of them do not adhere to good agricultural practices of cashew production.

This study hereby recommends that cashew farmers in the State be assisted and trained on the reduction of the incidences of pests and diseases, adaptation and mitigation of climate change effects on cashew to help reduce the risks and uncertainties in production and linking them to markets.

In the same vein, there is the need for these farmers to be formed into viable groups through which they can benefit on credit access, marketing and post-harvest management trainings. Also, there is the need for the farmers in Abia state to be trained on the basics of cashew plant population and the need for the recent advances in cashew research and viable marketing channels for their products disseminated to them.

Experimental Title: Dissemination of CRIN Developed Technologies among End-Users in Ondo State

Investigators: AgbongiarhuoyiA.E.., Orimogunje, O.A., Adebiyi, S., Abdulkarim, I. F, Williams, O. A., Oduwole, O.O. and Igbinadolor, R.O.

Introduction

One of the major objectives of Cocoa Research Institute of Nigeria (CRIN) is to investigate the effective utilization of the crops, by-products and the feasibility of small- scale production of such end-use product. Based on this objective, agricultural development in the country depends on the successful dissemination and implementation of agricultural research information to farmers, processors, marketers, consumers and other stakeholders by qualified extension experts. The Cocoa Research Institute of Nigeria (CRIN), over the years developed a lot of technologies and some were extended to end-users in the southwest and other parts of Nigeria through Farmers' field day, exhibition, training, demonstration, radio and excursion visits to CRIN and to farmers' farms. Examples of some of these technologies include cocoa bread, cocoa powder, liquid soap, cashew kernel, kola wine, coffee wine and green tea. A critical assessment of the extent of utilization these technologies will help ensure improvements where necessary, income generation, job creation, food and nutrition security of the country and bring feedback from end-users to researchers.

Objective of the study

The general objective of this study was to assess the utilization of selected CRIN developed technologies in Ondo State.

The specific objectives were to:

- describe end-users' socioeconomic characteristics in the study area;
- create awareness of selected CRIN developed technologies and examine its utilization;
- ascertain the availability and utilization of selected CRIN developed technologies;
- identify the sources of information on utilization of CRIN developed technologies and
- examine the constraints encountered by end-users in utilization of CRIN developed technologies.

Methodology

The study was carried out in Ondo State of Nigeria. A multistage sampling procedure was used for the study. Firstly, Ondo state was purposively selected because CRIN technologies had earlier been introduced to the farmers, consumers and Extension agents and also due to the fact that Ondo is the highest producer of cocoa in Nigeria. Secondly, two Local Government Areas (LGAs) markets were purposively selected due to the nearness of CRIN substation and the commercial nature of the locations Akure South (Isikan market) and Idanre (Owena market).100 persons (buyers and sellers) were selected using simple random sampling in Isikan market because it is a big market which holds on a daily basis while 50 respondents were also selected using simple random sampling in Owena market which is a peri-urban market and marketing activity is once in every five days.Participants were selected among the registered traders in Isikan and Owena markets through the *Iyaloja* and *Babaloja.* Buyers were also asked to join the event by the leaders of the market chosen. Representative of ADP Extension agents were also involved in order to further disseminate the information to farmers. The total sample size was 80 respondents. The selected CRIN developed technologies that was exhibited during study were Cocoa bread, Cocoa powder, Cocoa wine, Liquid soap, edible cashew nuts, kola wine, coffee wine and green tea. At the end of the programme, 130 Questionnaire were administered to participants in order to get their feedback on disseminated products.

Plate 1: Director E&E and other researchers at Isinkan market

Plate 2: Director E&E introducing CRIN products to consumers at Isinkan market

Plate 3: Display of CRIN products by researchers at Isinkan market

Plate 4: Display of CRIN developed products by researchers at Owena market

Results and Discussion

Brief opening ceremony and introduction of CRIN Developed Technologies to the public

The CRIN dissemination event was held on the 16th of December, 2021 at Isinkan and Owena markets in Ondo State. There was a brief opening ceremony coordinated by the Director, Economics and Extension CRIN, Dr Oduwole, O.O. He welcomed all participants to the event on behalf of the Executive Director Dr Patrick Adebola. Dr Oduwole introduced the CRIN products to everyone and urged them to use the products to create job opportunities, provide income, improve their health and food security. The head of Extension Mr. Agbongiarhuoyi E. Anthony told all interested and willing businessmen and women that the uptake process in any of the technologies is simple. They were encouraged to visit CRIN and they will be well attended to. The *Iyaoloja* of *Isinkan* market appreciated CRIN for exposing the products to them at their market. She said the products were nice and CRIN should make it available and affordable for their traders.

The developed products brought by CRIN were introduced to the participants by Dr Adebiyi, S. and Abdul-karim, I.F. in order to create much awareness and encourage uptake by interested up-takers. The products include were Cocoa bread, Cocoa powder, Chocolate, Cocoa wine, Liquid soap, cashew kernel, kola wine, coffee wine and green tea.

Testing of CRIN Products

cocoa bread was cut into smaller sizes and distributed to all the participants, wines from all our mandate crops was served as well. Pure cocoa powdered beverage without milk and sugar was served. Also, cocoa powdered beverage with sugar was prepared. The participants tested all our products. They told us what they observed:

Immediate feedback:

Most of the respondents commended CRIN for the awareness created on the developed products. The following feedback how the products can be improved are stated as follows:

Availability of the product: Most respondents pleaded with CRIN to make products more available most especially Cocoa powder because of its health benefits. Also, Cocoa bread, cashew kernel, cocoa butter cream and all the wines should be made available to the public.

Price: The price of the products should be reviewed downward, so that more consumers can afford it.

Packaging: It suggested that CRIN should improve on packaging of the developed products in order to be more attractive.

The youths in Owena community who visited the exhibition stand of CRIN in the market liked the products and wants CRIN to trained them on soap and bread making in order to empower them.

Media coverage: The dissemination event was covered by an online New Telegraph Newspaper. The link is enclosed for your perusal.

It was also reported in Ondo State Broadcasting (OSBC) news both Radio and Television.

Data Analysis of feedback from interview schedule administered is on-going.

Conclusion and Recommendation

CRIN developed technologies were successfully disseminated at both *Isinkan* and *Owena* markets. Consumers, businessmen and women welcomed the idea of bringing the products to their locations. They expressed willingness to use the products especially cocoa powder, cocoa bread, cocoa butter cream, chocolate, cocoa wine and kola wine. They advised CRIN to make the products available and accessible to the general public for optimum utilization.

Experimental Title: Dissemination of CRIN Developed Technologies among end-users in Lagos State

Investigators: Agbongiarhuoyi. A, E, Awodumila, D.J. Mokwuye, F.C., Agbebaku. E. E. O., Oha, K.F., Rahman., S., Dinne, C.E., F.B. and Mustopha, F.B.

Introduction

The Cocoa Research Institute of Nigeria (CRIN), over the years developed a lot of technologies from her mandate crops. Some of these technologies are on shelf and needs to be extended to end-users in Nigeria through exhibition, training, demonstration, radio, television and workshop. Agricultural research technologies are essential inputs in agricultural education, research, development and extension services. To a great extent, agricultural development depends on the successful implementation of disseminated agricultural research information to farmers, processors, marketers, consumers and the general public Mubofu (2017). A critical assessment of the extent of utilization of these technologies will help ensure improvements where necessary. CRIN technologies help to provide income, job creation, food and nutrition security of the country. This is very much in line with the diversification agenda of the Federal Government from the oil to non-oil sector in Nigeria. It was a one-day event which was held on 23 March, 2022 at Jara Mall Ikeja, Lagos.

Objective

The major objective was to extend some CRIN developed technologies to end users in Lagos State. The specific objectives were to exhibit and promote CRIN developed technologies to end-users.

Methodology

The project was carried out in Jara Mall Ikeja, Lagos State of Nigeria. Lagos State was purposively selected because of its commercial nature and CRIN technologies had earlier been introduced tosome traders and Extension agents. Participants were selected from traders within and outside Jara Mall premises with the help of the manager of the organization. Representative of ADP Extension agents were also involved in order to further disseminate the information to farmers. Also, Lagos Agricultural Development Authority (ADA), Agribusiness, business men and women and the commissioner for Agriculture who was ably represented by the Director of Agribusiness were invited to be part of the event.

The CRIN developed technologies that were exhibited during the programme were Cocoa bread, Cocoa powder, Liquid soap, cashew kernel, Chocolate, Cocoa wine, Kola wine, Coffee wine, Cashew wine and Tea wine.

Results and Discussion

Activities of the programme

Introduction of guests and media practitioners

The programme was attended by many dignitaries including commissioner for agriculture, Lagos State who was represented by the State Director of Agric business, Mrs Aramide Dansalu, an Extensionist from Nigeria Institute of Oceanography and Marine Research (NIOMR), Dr Gloria Ikeyoweto Omogho, Acting Director of extension service, Lagos State Ministry of Agriculture and Rural Development, Mrs Ebota Olusola official of radio Nigeria Lagos branch, News agency of Nigeria among others.

Opening remarks by CRIN

The Executive Director, CRIN, Dr. Patrick Adebola in a remark stressed on the importance of the products, saying their health benefits ranged from reducing hypertension, curing diabetes as well as serving as antidote to malaria symptoms and boosting the brain function. ED charged investors to take up the responsibility of mass production to further increase the volume of the nation's agro products for export and for local consumption thereby enhancing the economy. He said “The Cocoa Research Institute of Nigeria (CRIN) was established in 1964 to carry out research and development on five major crops which are cocoa, kola, coffee, cashew and Tea. He emphasized the reasons for displaying products from CRIN mandate crops. The intention is to disseminate this to the community and to Nigerians in general to see if there are investors that will be interested in coming to take up these technologies that have been in our shelves

Brief speech from the Hon. Commissioner for Agriculture, Lagos State

The Lagos state Hon. Commissioner for Agriculture, Mrs Abisola Olusanya who was represented by Director of Agric Business, Mrs Aramide Dansalu explained that the value addition on the affected crops would bring about increased job and wealth creation for Nigerians, in addition to addressing nutritional deficiencies among both children and adult citizens .She added that, “the expansion of the value chain is good as it will bring about value addition to what we produce and that the research products , particularly those from CRIN would go a long way in bringing the commodity to consumers while promising that she will visit CRIN and make sure they take these products to farmers . She appreciated CRIN for bringing such programme to Lagos and that Lagos State is ready to partner with CRIN.

Introduction of CRIN Developed Technologies/ Products to the public.

The Head of Extension Section CRIN, Mr Anthony Agbongiarhuoyi stated the institute was given five mandate crops by the Federal Government these crops are Cocoa, Kola, Coffee, Cashew, and Tea. He stressedthe products from the mandate crops which are Cocoa bread, Cocoa wine, Coffee wine, Tea wine, Cashew wine, Cocoa powdered, Liquid soap, milk chocolate among others. He called on the Lagos State government to adopt some of the products for its school feeding programme, explaining that a particular product from cocoa contains the needed nutrients that boost brain power and that if used in feeding school children could enhance their ability to learn.

Testing of CRIN Products

Cocoa bread was cut into smaller sizes and distributed to all the participants, wines from all our mandate crops was served as well. Cocoa powdered beverages with milk and sugar was served. Also, raw cocoa powdered beverage was prepared. The participants tested all our products. They later told us about what they observed.

Feedback from the participants

The participants commented that the wax in the body cream and balm must be increased to prevent it from being melting easily.
They said the level of alcohol in tea wine was too high.
They cocoa powered beverage was too bitter
CRIN should improve on the packaging of our products.

Media coverage: The event was adequately covered by Federal Radio Corporation of Nigeria (FRCN) Lagos, Punch Newspaper, KAFTAN online Television and Lagos City News. The links are enclosed for your listening and viewing.

https://punchng.com/nigeria-should-not-rely-on-exporting-cocoa-alone-says-crin-ed/

www.kaftan.tvhttps://youtu.be/C-JwwLVrs_Y

Photo speaks

Products' Banner Representative of the Hon Commissioner, Lagos State

CRIN products displayed.
Cross section of Participants and invited guests at the event

Closing Remarks: The head of Extension appreciated the participants and invited guests for honoring the invitation to attend the programme. The event came to an end around 4:30 pm.

Conclusion and Recommendation

The event was successful and created lagosians the opportunity to be aware and use CRIN developed products. This was the first of its kind in Lagos State. Participants expressed willingness and interest in up taking some of the products. The Lagos State Government was particularly interested in taking the cocoa powder consumption for school feeding programme due to its health benefits. The representative of the honorable commissioner for agriculture told reporters that Lagos State government was ready to partner with CRIN in utilizing CRIN products which could enhance local processing, create job opportunities, provide income and improve food and nutrition security. The participants appealed to CRIN to make the products available in the market so that people can have access to them.

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Experimental Title: Structure and Use Pattern of Labour among Cocoa farmers in Nigeria

Investigators: Oluyole, K.A., Akinpelu, A.O. and Yahaya, A.T.

Introduction

Nigerian agricultural sector is dominated by small-scale farmers whose farms vary between 0.10 and 5.99 hectares in size and constitute about 80.35% of all the 29,800 million farm holdings in Nigeria (Ayanwale, 2002). Their farmers used traditional technologies called hoe-cutlass culture and their capital structure is in form of small tools and predominant usage of family labour (Oluyole *et al*., 2009). Human labour is about the only main source of labour available to smallholder farmers in Nigeria. Smallholder farmers contribute over 85% of domestic agricultural output in Nigeria, hence, human labour accounts for domestic food supply in Nigeria. Therefore, the needs to continue supplying food the ever-growing Nigerian population anchors on human labour productivity. In Nigerian agriculture, hired labour is predominantly used. In fact, it carries 88% of the total labour used on farms (Okuneye, 2000). Apart from hired labour, the other types of labour that could be employed are family labour and cooperative labour. The availability of labour has been found to have impact on planting precision, better weed control, timely harvesting and crop processing (Oluyole, et al, 2007). Therefore, labour is a major constraint in peasant production especially during planting, weeding and harvesting (Gocowski and Oduwole, 2003). According to Lele and Stone (1989), rapid growth in population which increases farm labour supply exerts so much pressure on land and reduces farm size per hectare. Empirical evidence has shown that available labour force comprised mostly of old people to the exclusion of young men and women within the active working age thus having a negative impact on agricultural productivity. This is because the role of youths in agricultural production cannot be over-emphasized.

With the foregoing, it could be observed that human labour plays a very significant role in agricultural development especially in the developing countries in which the level of technological development is still very low. In view of the importance of labour in agricultural production, this study was designed to investigate the structure and use pattern of farm labour in the study area.

Methodology

The project was carried out among cocoa farmers in Ondo State. Ondo East Local Government Area (LGA) was purposively selected from the State and from the LGA, Laagba community was also purposively selected because cocoa farmers are mostly concentrated in the community. Simple random sampling technique was used to collect data from a total of 144 farmers randomly selected from the community. Data were collected from the respondents with the aid of structured questionnaire and the data obtained from the questionnaire were analysed using Descriptive analysis. Descriptive Statistics was used to describe the socio-economic characteristics of the farmers as well as the structure and use of labour pattern in the study area.

Results and Discussion

The result of the socio-economic characteristics of the farmers is shown in Table 1. The table shows that 74.99% of the total respondents are above 50 years of age indicating that the proportion of old people among the respondents is very high. Meanwhile, only 25.01% of the total respondents were 50 years and below. The lowness in the proportion of the youths is a bad pointer to cocoa production efficiency as younger farmers are more active on farm work than the aged ones. Table 1 also shows that 79.17% of the respondents were males. This is quite obvious in that farm work is a tedious work and is only men that could cope effectively with it. Apart from this, most of the farms were inherited and some traditional cultures permit only the male children to inherit farms. As regards the educational level of the respondents, the result of the analysis shows that 75.07% of the respondents were having formal education. This would improve the efficiency of the farmers in as much that literate farmers would find it easier to adopt new technologies on cocoa than the illiterate ones. The analysis on farm size shows that 66.67% of the respondents had farm size of 5 hectares andbelow which shows that most of the farmers are small scale farmers. Table 1 also shows that 50.0% of the farmers had the age of their farms greater than 30 years showing that most of the farms are old and hence the farm's productivity would reduce, therefore such farms needs to be rehabilitated. This is a good pointer to an increased productivity. Table 1 also revealed that majority (75.00%) of the farmers had purchased farms while just 12.5% inherited their farms.

Table 1: Socioeconomic Characteristics of Farmers

Variables	Frequency	Percentage
Age of farmers (years)		
≤ 30	6	4.17
31-40	6	4.17
41-50	24	16.67
51-60	48	33.33
>60	60	41.66
Total	144	100.00
Sex of farmers		
Male	114	79.17
Female	30	20.83
Total	144	100.00
Educational Status		
No formal education	36	25.00
Primary education	36	25.00
Secondary education	54	37.50
Tertiary education	18	12.50
Total	144	100.00
Marital Status		
Single	0	0.00
Married	126	87.50
Widow/widower	12	8.33
Divorced	6	4.17
Total	144	100.00
Farm size (Ha)		
≤ 5	96	66.67
6-10	30	20.83
11-15	18	12.50
Total	144	100.00
Age of farm (years)		
≤ 10	6	4.17
11-20	24	16.66
21-30	42	29.17
31-40	36	25.00
41-50	18	12.50
>50	18	12.50
Total	144	100.00
Nature of ownership		
Inherited	18	12.50
Purchased	108	75.00
Rented	12	8.33
Sharecropping	6	4.17
Total	144	100.00

Source: Field survey, 2021

Table 2 shows the structure of labour according to the different types of labour used for different activities in cocoa farming. The table shows that contract type of labour is majorly used for most activities in cocoa farming. However, cooperative labour was seldom used for any activity showing that cooperative labour is no more utilized in cocoa farming in the study area. Family labour is also utilized for all activities but at different magnitude. Activities such as land clearing, planting, weeding, application of chemicals, removal of mistotoes, harvesting of cocoa pods, conveyance of cocoa pods to the pod breaking point, breaking of cocoa pods and conveyance of cocoa beans to the point of fermentation were majorly carried out by contract labour. This is because 75.0%, 83.32%, 95.83%, 91.67%, 87.50%, 87.50%, 95.83%, 100.0% and 88.33% of the farmers respectively indicated that they utilized contract labour for such activities. However, activities such as drying of cocoa beans, parking of dried cocoa beans and preservation of cocoa beans were majorly carried out with family labour

Table 2: Distribution of labour by types of labour used for different activities in cocoafarming

Activities	Types of Labour					
	Family		Contract		Cooperative	
	Freq	%	Freq	%	Freq	%
Land clearing	36	25.00	108	75.00	0	0.00
Planting	18	12.5	120	83.33	0	0.00
Weeding	6	4.17	138	95.83	0	0.00
Application of chemicals	24	16.67	132	91.67	0	0.00
Application of fertilizer	12	8.33	108	75.00	0	0.00
Removal of mistotoes	6	4.17	126	87.50	0	0.00
Harvesting of cocoa pods	30	20.83	126	87.50	0	0.00
Conveyance of cocoa pods to the point of pod breaking	24	16.67	138	95.83	0	0.00
Breaking of cocoa pods	42	29.17	144	100.00	0	0.00
Conveyance of cocoa beans to fermentation spot	42	29.17	120	88.33	0	0.00
Fermentation of cocoa beans	42	29.17	96	66.67	0	0.00
Conveyance of cocoa beans from the fermentation spot to the drying spot	38	25.00	108	75.00	0	0.00
Drying of cocoa beans	144	100.00	12	8.30	0	0.00
Parking of dried cocoa beans	144	100.00	6	4.17	0	0.00
Preservation of cocoa beans	144	100.00	0	0.00	0	0.00

Source: Field survey, 2021

Table 3 shows the distribution of the labour used for cocoa farm activities based on the gender of the labour. The table shows that male labours were mostly utilized for all the activities as indicated by most respondents. On the other hand, female labour were sparingly utilized for some activities such as land clearing, planting, application of chemicals (spraying of chemicals), removal of mistotoes and harvesting of cocoa pods as only 8.33%, 0%, 8.33%, 4.17%, 0% and 12.5% of the farmers respectively indicated that they use female labour for the respective farm activities. However, female labour were mostly used for conveyance of cocoa pods to the point of pod breaking, breaking of cocoa pods, conveyance of cocoa beans to the spot for fermentation and drying of cocoa beans.

Table 3: Distribution of labour by the gender of labour used for different activities in cocoa farming

Activities	Gender of labour			
	Male		Female	
	Freq	%	Freq	%
Land clearing	144	100.00	12	8.33
Planting	144	100.00	0	0.00
Weeding	126	87.50	12	8.33
Application of chemicals	126	87.50	6	4.17
Application of fertilizer	114	79.17	24	16.67
Removal of mistotoes	126	87.50	0	0.00
Harvesting of cocoa pods	114	79.17	18	12.50
Conveyance of cocoa pods to the point of pod breaking	120	83.33	126	87.50
Breaking of cocoa pods	126	87.50	132	91.67
Conveyance of cocoa beans to fermentation spot	144	100.00	138	95.83
Fermentation of cocoa beans	120	83.33	12	8.30
Conveyance of cocoa beans from the fermentation spot to the drying spot	120	83.33	132	91.67
Drying of cocoa beans	138	95.83	120	83.3
Parking of dried cocoa beans	126	87.50	30	20.83
Preservation of cocoa beans	132	91.67	24	16.67

Source: Field survey, 2021

Conclusion

The study was carried out on the structure and use pattern of labour among cocoa farmers. The study found out that labour could be structured according to the types of labour (family labour, contract/hired labour and cooperative labour) and according to the gender of the labour. The study further revealed that contract labour is mostly used for activities such as land clearing, planting, weeding, application of chemicals, removal of mistotoes, harvesting of cocoa pods, conveyance of cocoa pods to the pod breaking point, breaking of cocoa pods and conveyance of cocoa beans to the point of fermentation while family labour is mostly used for drying of cocoa beans, parking of dried cocoa beans and preservation of cocoa beans. However, cooperative labour is no more used as a form of labour in the study area. It was found out from the study that

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FARMING SYSTEM RESEARCH

Experimental Title: Growth and Establishment of Cacao Seedlings Under Intercrop with Plantain at Different Transplanting Positions

Investigators: Adejobi, K.B., Famaye, A.O., Adeosun S.A, Ayegboyin, K.O, Edibo, G O.

Introduction

Cocoa (*Theobroma cacao* L.) is a tropical woody species which belong to the family Malvaceace (Alverson *et al*., 1999). Under natural condition, the tree can attain a height of 20 -25 m (Lachenaud *et al*., 1997), whereas under cultivation, plant height varies from 3 to 5 m. The geographical origin of cacao is South America (Oluwalade, 2018). It is considered as one of the most important perennial crops with an estimated world output of 4.2 million tonnes in 2018 (ICCO, 2007), while FAO (2011) reported an estimated annual yield of 3.2 million tonnes in 2009. It is cultivated in the Humid tropics of the world (Yanelis *et al.,* 2012) with more than 70% production coming from Africa as source of income for producing countries (Simo *et al*., 2018).Cocoa production is dominated by small-scale farmers who live and work in the cocoa belt providing them employment and income (Minimol *et al*., 2015; Ngoh *et al.,* 2015) Cocoa is the most prominent export crop in Nigeria in terms of its production and export capacities.

Traditionally, cacao farmers in Nigeria established their farms with plantains or other food crops, either sown directly at stake or seedlings are transplanted from the nursery in to the field (La Anyane, 1963; Benneh, 1987; Opeke, 2005). Conventionally, cacao seedlings are planted or transplanted in between the plantain suckers (Owusu-Benpah, 1988). The temporary shade provided by plantain provides direct shade to the cacao seedlings for 2 to 3 years after transplanting. Moreover, despite the provision of shade by plantain for transplanted young cacao seedlings, it is a known fact that the highest percentage of these seedlings die between the first and second dry seasons as a result of soil moisture deficit during the peak of dry seasons (Babadele, 2018). It is also established that plantains that are planted to provide shade during the dry period do shed most of their leaves as a result of limited soil moisture in order to survive (Babadele, 2018). In Nigeria, cocoa production is limited to the rainforest and savanna transition zones. Presently, the level of cocoa production stands at 350,000 tonnes per annum (ICCO, 2015), in spite of the fact that Nigeria is endowed with vast land areas suitable for its cultivation. Adoption of good management practices can bring about increased bean production of up to 100-300% (Famuagun, 2016). According to Famuagun and Agele (2010), the major reason attributed to low productivity despite the huge effort of the government were limited access to modern production technology, limited access to input and credit facilities, low percentage of survival (less than 35%) of transplanted seedlings at the end of the second dry season due to soil moisture stress and poor field management. There are also concerns that the projected global temperature rise and subsequent increase in potential evapo-transpiration and demand for plant water may lead to further drought stress during the dry season and deterioration of cocoa climate condition (Laderach *et al*, 2013; Schroch *et al.,* 2016). To solve the above mentioned problems, more robust farm management strategies are therefore needed.

Effective management of cacao seedlings on the field using agronomic practices like dry season irrigation and optimum shading regime to enhance root development could improve plantation establishment and cacao productivity. However, research efforts that would ensure cocoa sustainable production at the early stage of establishment are seen as steps in the right direction which remains sacrosanct for the survival of young cocoa in the field and the improvement of farmers' income (Agbongiarhuoyi *et al.,* 2016). Moreover, it is a known fact that cacao cultivation in Nigeria is predominantly in the hand of peasant farmers who cannot afford irrigation facilities. Due to climate change, rainfall and humidity have been on a decline progressively since mid-1970s (Omotosho *et al.*, 2000), while global warming has been on steady increase. Given the increasing global demand for cocoa and quest for obtaining sustainable production systems, it is imperative to understand the effects of some agronomic practices on the responses of cacao seedlings to dry season environmental conditions especially the hydrothermal stresses (Daymond and Hardley, 2004). Improved insights would be valuable towards the attainment of optimum seedlings establishment and vigor on the field (Famuagun and Agele, 2019). Much of success of intercrops in cacao establishment depends on understanding the role each component plays in the system: cacao/plantain farming system has been recommended (Manu and Tettel, 1988) but the transplanting arrangement in the face of global warming and climate change is a gap in research.

Objective of the study: To evaluate effect of different planting positions of cacao and plantain on survival and morphological growth of cacao on the field.

Materials and Methods

Study Area

Field experiment was carried out at the experimental farm of Cocoa Research Institute of Nigeria (CRIN), Uhonmora Station in Edo State between 2018 and 2020 covering two consecutive rainy seasons and two dry seasons. The location, a derived savanna zone of Nigeria, lies on latitude 6'5N and longitude 5'50'E. The rain fall is between 1000 – 1500 mm per annum. The maximum temperature ranges between 26 to 35 ^{0}C with an average of about 30 ^{0}C while minimum temperature ranges from 15 to 25^{0}C with an average of 20 ^{0}C. Relative humidity is high during the raining season, ranges from 50 to 85 % with an average of 75%. There are seasonal variations in the values of relative humidity, which varies from 65 to 89% during the rainy season and 46 – 70 % during the dry season. The rainy season which runs from April to October is characterized by heavy rains, low ambient temperature and high humidity; while the dry season runs from November to March and is characterized by little or no rain, high ambient temperature and very low humidity.

Acquisition and preparation of experimental materials

Seedlings of hybrid CRIN TC genotype were collected from CRIN, Uhonmora nursery, while plantain suckers were collected from experimental plots in the station. Experimental plot of 50 by 30 m was mapped out and the experiment was laid out in rows of 3 x 3 m.

Treatments and Experimental Design.

The field experiment comprised four treatments (four different transplanting positions of cacao seedlings and plantain suckers): Plantain suckers on top of cacao seedlings at transplanting (PTCT), Cacao seedlings on top of plantain suckers at transplanting (CTPT), and Cacao seedlings transplanted 30 cm (between 2 plantain stands) apart from plantain suckers at transplanting (CT30cmP) and Cacao seedlings transplanted 150 cm (between 2 plantain stands) apart from plantain suckers at transplanting (CT150cmP) as control. The experimentwas laid in Randomized Complete Block Design (RCBD) with three replications. Layout of the experimental site (Measurement, pegging, and holing) was carried out. One hundred and forty-four (144) plantain suckers were planted at 3 x 3m spacing as shade crop. The same number of five months old cacao seedlings (Hybrid) of average height of 50 cm (raised in the nursery) was transplanted on treatment basis. The experiment was monitored for 22 months after transplanting (MAT).

Data collection

Data collected included growth parameters of cacao seedlings (Plant height, Number of leaves, Stem diameter, Leaf area, Number of branches) and their Survival counts. The growth parameters were taken on monthly basis for 22 months commencing from 3 months after transplanting (3MAT). Plant height (cm)was measured using a meter rule from the ground surface to the tip of the main stem. Stem diameter (cm) was measured with Vernier Caliper 30 cm above the ground level. Number of leaves, Number of branches and Survival count were determined by visual count. Leaf area was also measured. The growth parameters were taken monthly for 22 months commencing from 3 MAT. Survival counts were carried out at 10 and 22 MAT

Data collected were subjected to statistical analysis using analysis of variance (ANOVA) as well as descriptive statistics, and significant means were separated by Duncan Multiple Range Test (DMRT) (P<0.05)

Results and Discussion

Effects of transplanting positions of cacao seedlings on survival count are represented in Figure 1.Cacao seedlings on top of plantain suckers at transplanting (CTPT) and Plantain suckers on top of cacao seedlings at transplanting (PTCT) significantly (P<0.05) enhanced the survival count of cacao seedlings relative to other treatments at 10 and 22 MAT, while cacao seedlings on top of plantain at transplanting gave the highest survival count in both 10 and 22 MAT (Figure 1). The highest seedlings survival count recorded in 10 and 22 MAT under Cacao seedlings on top of plantain suckers at transplanting (CTPT) could be as a result of commensalism relationship between the transplanted cacao seedlings on top of the plantain suckers in which both shared the same environment and the cacao benefitted from the water and cooler weather around the biosphere especially during the dry season, yet the plantain was not adversely affected. The relationship is called table fellowship. This result also confirmed that the survival of transplanted cacao seedlings did not depend on the spacing adopted but the arrangement of cacao with the plantain. This result was corroborated by Ayegboyin *et al*. (2020), Famuagun and Agele (2019) who reported that the reduction in stand mortality under moderate and dense shaded plots was traced to improved microclimate conditions occasioned by shade plants that aided reduced air and soil temperature, reduced moisture loss through evaporation and increased activities of microbial organism under shaded microclimate. It was also observed that the same CTPT treatment had the lowest percentage mortality rate of 18% after the end of the first dry season; this was closely followed by PTCT (19%) (Figure 1).

Effect of transplanting position of cacao seedlings on growth parameters of cacao seedlings is presented in tables 1 -5. The CTPT also gave the highest plant height, number of leaves, stem diameter, number of branches and leaf area at 4 MAT, at 15 MAT, at 13, 14, 15 MAT, at 15 MAT and 15 MAT, respectively. When compared with the conventional transplanting of cacao seedlings in between the plantains (CT150cmP), CTPT increased the plant height, number of leaves, stem diameter, number of branches and leaf area at 4 MAT, at15 MAT, at 3, 13, 14, 15 MAT, at 3, 15 MAT and at 13, 14,15 MAT respectively by 1%, 10%, 61%, 2%, 3%, 8%,46%, 11%, 5%, 3% and 13% respectively; while CT150cmP treatment significantly enhanced cacao seedlings, number of leaves, number of branches and leaf area at 4 MAT, 4 and 13 MAT, 3, 4,5 MAT, respectively, when compared with the other treatments. This finding could be due to the fact that the cacao seedlings which could have been suppressed by plantain shade were not directly positioned under the plantain suckers but in between which is 150cm apart. This discovery is in agreement with the reports of Famaye *et al*. (2003) that, due to the competition that exists among them, closely spaced cacao seedlings produced smaller morphological parameters than well-spaced ones. Shipat (2001) as well as Famuagun and Agele (2016) also established that the leaves and circumference of plants are among the main factors that determine the vigour needed for the growth of cacao seedlings after transplanting.

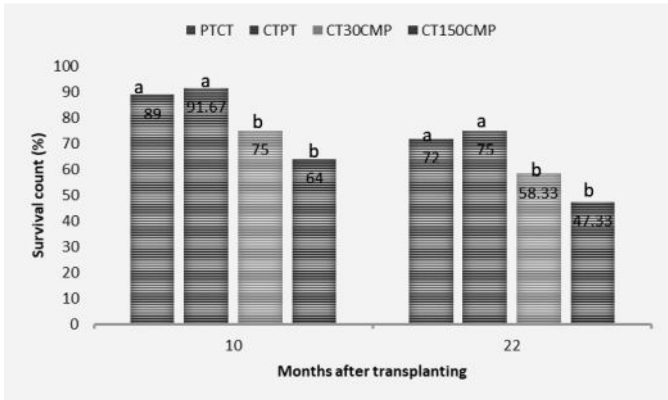

Figure 1: Effect of transplanting positions on survival count (%) of cocoa seedlings

Means followed by the same letters in each composite bars are not significantly different by DMRT (P<0.05)
PTCT: Plantain on top of cacao seedlings at transplanting; CTPT: Cacao on top of plantain at transplanting; CT30cmP: Cacao transplanted 30 cm apart from plantain; CT150cmP; Cacao transplanted 150 cm apart from plantain

Table 1: Effect of transplanting positions on plant height (cm) of cocoa seedlings

Treatments	3 MAT	4 MAT	5 MAT	12 MAT	13 MAT	14 MAT	15 MAT
PTCT	74.33b	98.33c	124.00c	175.67a	179.67a	182.67a	187.00a
CTPT	94.33ab	147.00a	157.67ab	159.33a	173.00a	178.67a	195.33a
CT30cmP	92.00ab	134.00b	146.33b	162.33a	169.67a	182.00a	191.33a
CT150cmP	112.67a	145.67a	164.67a	177.00a	179.67a	186.67a	200.67a
Mean	93.33	131.25	148.17	168.58	175.50	182.50	193.58

Means followed by the same letters along each column are not significantly different by DMRT (P<0.05)
PTCT: Plantain on top of cacao seedlings at transplanting; CTPT: Cacao on top of plantain at transplanting; CT30cmP: Cacao transplanted 30 cm apart from plantain; CT150cmP; Cacao transplanted 150 cm apart from plantain

Table 2: Effect of transplanting positions on number of leavesof cocoa seedlings

Treatments	3 MAT	4 MAT	5 MAT	12 MAT	13 MAT	14 MAT	15 MAT
PTCT	23.00a	45.67b	64.33ab	92.33a	111.00a	114.33a	132.33a
CTPT	9.00c	48.00b	83.33a	91.33a	110.67a	112.67a	137.67a
CT30cmP	13.33b	31.00c	55.67b	90.00a	109.00a	109.00a	121.33a
CT150cmP	11.33bc	87.33a	87.33a	92.33a	127.00a	116.00a	123.67a
Mean	14.17	53.00	72.67	92.00	114.42	113.00	128.75

Means followed by the same letters along each column are not significantly different by DMRT (P<0.05)
PTCT: Plantain on top of cacao seedlings at transplanting; CTPT: Cacao on top of plantain at transplanting; CT30cmP: Cacao transplanted 30 cm apart from plantain; CT150cmP; Cacao transplanted 150 cm apart from plantain

Table 3: Effect of transplanting positions on stem diameter(cm) of cocoa seedlings

Treatments	3 MAT	4 MAT	5 MAT	12 MAT	13 MAT	14 MAT	15 MAT
PTCT	0.63a	1.57ab	1.83b	3.27a	3.33a	3.70a	3.67b
CTPT	0.43ab	1.60ab	2.23ab	3.03a	3.73a	3.83a	4.07a
CT30cmP	0.73a	1.20b	2.30ab	3.20a	3.47a	3.43a	3.77ab
CT150cmP	0.17b	1.83a	2.67a	3.37a	3.67a	3.73a	3.73b
Mean	0.49	1.55	2.26	3.22	3.55	3.81	3.68

Means followed by the same letters along each column are not significantly different by DMRT (P<0.05)
PTCT: Plantain on top of cacao seedlings at transplanting; CTPT: Cacao on top of plantain at transplanting; CT30cmP: Cacao transplanted 30 cm apart from plantain; CT150cmP; Cacao transplanted 150 cm apart from plantain

Table 4: Effect of transplanting positions on number of branches of cocoa seedlings

Treatments	3 MAT	4 MAT	5 MAT	12 MAT	13 MAT	14 MAT	15 MAT
PTCT	0.47a	2.00b	5.67ab	3.50b	4.17b	5.67ab	5.33a
CTPT	0.37a	3.33b	5.00bc	3.60ab	4.20b	5.00bc	6.00a
CT30cmP	0.57a	1.33b	4.00c	4.37a	4.17b	4.00c	4.33b
CT150cmP	0.20b	6.67a	6.67a	4.00ab	6.67a	6.67a	5.33a
Mean	0.40	3.33	5.33	3.89	4.80	5.33	5.25

Means followed by the same letters along each column are not significantly different by DMRT (P<0.05)
PTCT: Plantain on top of cacao seedlings at transplanting; CTPT: Cacao on top of plantain at transplanting; CT30cmP: Cacao transplanted 30 cm apart from plantain; CT150cmP; Cacao transplanted 150 cm apart from plantain

Table 5: Effect of transplanting positions on leaf area (cm^2)of cocoa seedlings

Treatments	3 MAT	4 MAT	5 MAT	12 MAT	13 MAT	14 MAT	15 MAT
PTCT	70.33bc	84.00b	95.33b	308.33a	306.33a	308.67a	327.00b
CTPT	76.33c	74.33c	86.67b	164.67b	292.33a	302.67a	362.67a
CT30cmP	77.33b	82.00b	93.00b	153.33b	165.00b	206.33b	232.00a
CT150cmP	101.33a	110.33a	119.67a	241.33a	279.00a	292.67a	316.67b
Mean	79.08	87.67	98.67	215.12	260.27	277.58	309.58

Means followed by the same letters along each column are not significantly different by DMRT (P<0.05)
PTCT: Plantain on top of cacao seedlings at transplanting; CTPT: Cacao on top of plantain at transplanting; CT30cmP: Cacao transplanted 30 cm apart from plantain; CT150cmP; Cacao transplanted 150 cm apart from plantain

Conclusion and Recommendation

Much success of intercrops in cacao establishment depends on understanding the role each component plays in the system, cacao/plantain farming system has been recommended, but the transplanting arrangement in the face of global warming and climate change is a gap in research which this work has filled. Furthermore, the long dry season and the wind – storms early March to April in the study area usually devastate the plantains such that effective shade is not actually provided for the cacao in the later part of the dry season when the shade is needed most. According to this work, Cacao transplanting on top of plantain (CTPT) enhanced the best performance of cacao seedlings when compared to other treatments because cacao seedlings would have benefited from the soil moisture available at the base of plantain for survival and morphological growth.

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TRAINING DEPARTMENT

(Head of Department: Dr. Agbeniyi S.O.)

Introduction

Training Department is one of the Technical Departments in the Institute that recommends staff for various training like degree programme, postgraduate programme, capacity building, In-house performance improvement and Conferences/Workshops, both local and international.

The Department approves the engagement of students from various institutions in Nigeria for their Industrial Training and National Youth Service.

Staff strength

The Training Department consists of 6 staff headed by Dr S.O. Agbeniyi, Director (Training); Dr S.B. Orisajo, Director; Dr B.S. Famuyiwa, Chief Research Officer; Mrs M.O. Adejoro, AD/Desk Officer; Mrs O. A. Adepoju, Assistant Chief Confidential Secretary and Mrs A.O. Rafiu, Higher Executive Officer.

Vision

To ensure staff and farmers are regularly and well trained to improve their skills for optimal performance.

Achievement

In the year 2021, the Training Department took a giant step by recommending a large number of staff for training in and out of the Institute. Year 2021 Training cut across all levels of staff in the Institute which includes Researchers, Senior and Junior staff.

Four amongst scientists that are on PhD programme, have been awarded while many are about rounding up their programme.

Farmers training on Knowledge transfer on grafting, Proper Handling of Solar Collapsible Cocoa Dryer for Cocoa Farmers, Skill Acquisition On Agrochemicals Application and Safe Handling for Cashew Farmers, Nursery management for cocoa entrepreneur.

Three hundred and eighty thousand (380) students from various institutions in Nigeria were approved to undergo their students industrial work experience scheme (SIWES) in the Institute while 13 Corp members were also accepted in the Institute for their service year.

The table below shows the list of capacity building workshop recommended and sponsore d for staff in Year 2021

S/N	Course/ Workshop	No. of Staff	Location
1	Leadership and Change Management	22	ABNIF, Ogun state
2	Work Ethics and Productive Improvement	10	CMD, Lagos State
3	Leadership skill acquisition	7	OAU, Osun State
4	Collective bargaining and Industrial workshop		OAU, Osun State
5	Administrative Communication Skills	4	ASCON, Badagry
6	Productivity Improvement	27	HEROVIC, Ogun State
7	Survey of Scientists and Engineers In Nigerian Research Institutes	2	CMD, Lagos

Photo speaks

Cross section of cocoa farmers at the nursery

A cross section of cocoa farmers with the Executive Director CRIN at the Events Centre, CRIN

A cross section of cashew farmers with the ED, CRIN at the Events Centre, CRIN

Two CRIN Scientists at CMD

A cross section of CAFO at McPherson University

Management Staff at Leadership and change Retreat

Nursery management

Challenges

The Department did not receive regular monthly imprest to run its activities for the year.

There was shortage of fund to organize in-house training and to sponsor as many staff as possible for both local and international conferences.

Long Term Goals

The Department appreciates the Executive Director for his support but also crave his continuous support in the following areas;

1. Allocation of adequate funds for training department to organize more training sessions for all cadre of staff.
2. Provision of Training materials to facilitate work in the Department.
3. More accommodation quarters for Corp members and IT students.
4. Regular monthly imprest for the smooth running of the department.

LIBRARY, INFORMATION AND DOCUMENTATION DEPARTMENT (HOD: Dr Taiwo E Ogunjobi)

Library Division (Aboderin A.K – Acting Head, Library Division)

The library division is saddled with the responsibility of providing information resources and services to its users through print and electronic formats. In 2021, relevant information resources as it relates to the institute mandate crops were provided to Research scientists and other supportive staff. Outsiders such as members of the host community, youth corps members as well as IT students posted to the institute, also benefited from the services rendered during this reported year.

Acquisition: Acquisition of few books and journals were done through purchase and gift. Two newspapers were purchased on a daily basis. Compilation of research work that had been done by CRIN scientists is on-going to check plagiarizing and duplication of same research work. The library division attended to users' query both print and electronic forms. New Researchers were also profiled to assert their needed information resources. 1,281 users visited the library, while 1967 books, 1431 journal titles and 660 newspapers were consulted.

Documentation Division (Babafemi, Ibitope B. – Asst. Chief Program Analyst)

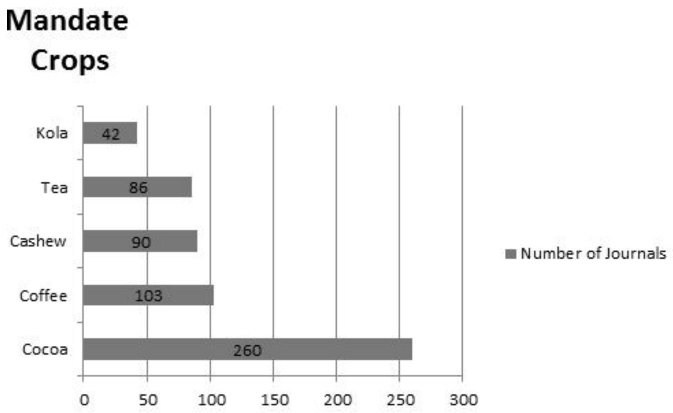
The Documentation Division is comprised of three (3) sections: Library Automation System, CRIN ID Card Production and Annual Report Compilation.

Library Automation Systems

Activities and Achievement

In the year 2021, a total number of 581 CRIN mandate crops (Cocoa, Coffee, Cashew, Kola and Tea) research journals were downloaded via the internet. This aimed at making up-to-date relevant CRIN mandate crops available to scientists in a digitalized format for their research works.

Below is the breakdown of the downloaded research journals:



CRIN ID Card Production

Activities and Achievement

- New customized CRIN Staff Identity cards were used for ID card printing
- 232 Staff Identity cards were collated, designed and printed on request as approved
- In-house training was conducted to the ad-hoc staff that are in charge of the ID card production

Annual Reports Compilation

In the year 2021, Annual Reports of various Departments were compiled for formating.

ICT DIVISION

Internet

The Institute is connected to the Internet through Globacom fibre link which was terminated in the server rooms. The bandwidth of connectivity was 4Mbps but it was graciously upgraded to 100Mbps by the Executive Director, Dr. Patrick Adebola on November 6, 2021. There is a point-to-point wireless connection from SPN, LID and ERLS Departments to the fibre link. With the exception of Account Department and office of some Directors, all staff in the Institute are connected wirelessly to the Internet. The Engineering Department as well as PEM are not connected to the Internet at the moment. However, plans are on going to connect these locations as well as the event centre, the multi-purpose hall and the ultramodern labouratory presently under construction to Inernet through direct fibre link to the buildings.

The Internet link has been grossly hampered by power failures both in the server room and the ERLS as well as SPN Departments; the Inverter located at these locations has suffered defects. The Internet equipment at ERLS was grounded by the inability of the Department to reconnect the equipment to the newly deployed inverter after the old inverter suffered defect.

In-House Training on Internet Network Management

The training commenced on December 15, 2021 and ended on the 23rd day of December, 2021. The facilitator was Mr. Felix Fapohunda, the CEO of ROUTEL Solutions and Consults Limited. The training was geared towards arming the staff of the Information and Communication Technology (ICT) Division with the practical exposures needed to properly manage the100Mbps bandwidth from Globacom. The training was hands on and was centered on the existing network infrastructure and future expansion. The following staff were trained:

1	Ibe Osita	Ag. Head, ICT Division
2	Ibitope Babafemi	Assistant Chief Programme Analyst
3	Tunji Adeyemo	Library Officer
4	Gbenga Oyeditun	Chief Printer

The Course deliverables

The trainee were trained on the following areas of network management that relates to the core equipment used in the Institute:

1 Introduction to networking
2 IP addressing and subnetting
3 Basic configuration for Internet setup on Mikrotik
4 IP addressing
5 Bridging
6 Firewall and NAT
7 DNS
8 Wireless configuration
9 Bandwidth management and QoS
10 Hotspot, Radius and user manager configuration
11 Basic Network Troubleshooting

Current Network Structure and Expansion

There are currently 9 pcs of indoor radio and one outdoor radio for wireless network access in the Institute. The table below gives the breakdown of the distribution:

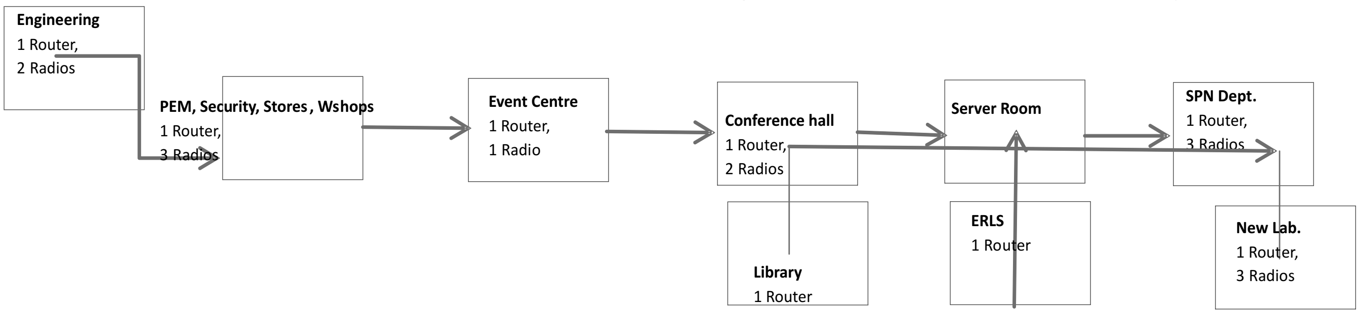
Table 1: Available and outstanding radio distributions

S/N	Location	Radio Available	Outstanding
1	Directorate	1	2
2	Account	1	1
3	Conference hall	1	-
4	FSR	1	2
5	Plant breeding	1	3
6	ERLS	2	1
7	LID	1	2
8	SPN	2	-
Total outstanding radios			11

As shown from the table, a total of 11 radios would be required to the reach of the current network structure.

Network Extension and Enhancement

At the moment, Engineering, Plantation Management (PEM), event centre, multipurpose hall and the ultramodern lab is yet to be connected to the network. The Library, Information and Documentation (LID) Department, Economics and Extension as well as the Soil and Plant Nutrition (SPN) Department are bound to suffer signal loss and network failure with time owing to the location with respect to the central Access point and Line-Of-Sight connectivity. This can be facilitated by extending the fibre link directly to these locations. The links will be terminated in the Internet Server Room for proper network management. Below is the schematic diagram of the proposed fibre connectivity.



The Fibre connectivity will be handled by Globacom and router boards with SFP modules, switches, radios and racks will be required at each node, with the exception of ERLS. On the whole, 8 routers, 14 radios and 7 racks that would be needed for the network expansion. Additionally, a Cloud Core Router is needed in the Internet server room for proper management of the 100Mbps bandwidth. Table 2 shows the breakdown of the fibre link requirements.

Table 1: Fibre link requirements

S/N	Description
1	Excavation, laying and backfilling (Normal soil, 1.2m depth)
2	Concrete breaking
3	Thrustboring
4	MH construction
5	Supply of 12 Fibre cable
6	Supply of 1-way duct
7	Supply of 12 port patch panel
8	Patch cord
9	Termination of fibre cable

Website

The Institute website domain is www.crin.gov.ng. This is the platform for the global visibility of the Institute. The website was originally designed in-house but a contract for a redesign was awarded to The MAXMACT Technologies solution, and the site was uploaded in October 22, 2021. Figure 1 is the schematic diagram of the new website

ENGINEERING DEPARTMENT

Introduction

During the year 2021, the Engineering Works and services Department was reorganized into three technical sections and fourteen operational units. This became imperative in order to effectively utilize the available manpower in all fronts of the official responsibility of the Division.

Sections

The three technical sections are arranged below:

(1) Civil Engineering
(2) Electrical Engineering
(3) Mechanical Engineering

Units

We have fourteen operational units, which are herein listed:

Civil

- ❖ Carpentry
- ❖ Mansory and Bricklaying
- ❖ Roads

Electrical

- ❖ Generation & Protection
- ❖ Networks & Installations
- ❖ Billing & Metering

Mechanical

- ❖ Agricultural & Equipment
- ❖ Fabrication & Welding
- ❖ Plumbing & Water supply
- ❖ Generator, Refrigerator & Air-conditioning
- ❖ Machine shop
- ❖ Motor vehicles
- ❖ Special Duties (Maintenances Planning & Monitoring)
- ❖ Transport

Functions and Responsibilities of Engineering Division

(1) Initialize and development a process plan to service the Research mandate goal.
(2) To design, construct, install and maintain any Engineering related equipment to support the Research mandate goal.
(3) Daily Maintenance of vehicles fleets, building, machinery, and equipment that drives the Research mandate goals.
(4) Prepare tender document of facilitate execution of capital projects.
(5) To advice the Executive Director and CRIN management on the tenets of the ethics of the Engineering Profession.
(6) Deployments of Drivers for Vehicle movement.

Challenges

One of the major Challenges faced by the division is the lack of an upgrade of equipment and tools in commensurate with available manpower. Also, insufficient training of staff to meet up with the global trends in maintenance techniques.

Scope for future/Recommendation

(1) Provision of upgrade equipment/tools for the day to day running of the division
(2) Training of staff to meet with the recent global technology
(3) Provision of daily needed maintenance items in the inventory store to eradicate delays in the execution of maintenance plans.
(4) Renovation of entire workshop.

Internal Audit

The Internal Audit Division is saddled with the responsibility of monitoring and evaluating the internal control system put in place by the management; and ascertains the strength of these control measures. We provide complete and continuous audit of the accounts and records of revenue and expenditure, assets, allocated and unallocated stores (FR 1701). Where the need arises, we investigate suspected cases of fraud in the Institute. We are also abreast of the ongoing government financial reforms to the level of access granted. The division is directly responsible to the Executive Director.

Divisional Staff Strength

Our staffs are professionally qualified and are very diligent in the discharge of their duties. As at 31st of December 2020, the division had thirteen (13) staff. Five (5) of these are in the accountant's cadre; Six (6) are in the Executive officer's cadre; and two (2) are secretarial officers. One of the executive officers was on study leave.

Duties

As part of our responsibilities as stipulated in the Financial Regulation (FR 1701), the division ensures that:

- Ensure that transactions and events pertaining to the institute are recorded as they occurred
- Ensure that transactions and activities that should have been recorded have been appropriately recorded.
- Amount disclosed in the records are appropriately recorded so as to avoid errors or fraud.
- We ensure that transactions and events were recorded to the correct accounting time and period.
- Transactions and events were properly presented.
- Assets and liabilities exist in the name of the institute and that the institute has total control of it.

Achievements

In the year under review, the division has been able to achieve the following feats:

- Ensure compliance with government rules and regulations, other official gazettes and circulars.
- Cost reduction and controls have improved drastically, as we have been able to manage these by ensuring the best quality of items or material is bought for the institutes use.
- Increase in the level of compliance with the different

control measures (preventive, detective, corrective, directive and compensating) put in place.

- The rate of retirement of advances by staff have improved compared with the previous years as the rule of no retirement of previous advances before getting another one was strictly enforced.
- Proper monitoring and evaluation of the internal control mechanisms put in place by the management of the Institute.
- No extra budgetary spending; expenditures were wholly, reasonably, exclusively, and necessarily incurred.
- On a regular basis, physical inspection of the Institutes assets was carried out for update on existence, current value, completeness, rights & obligations and allocation of these assets.

Challenges

Funding is a major challenge facing the division. Audit is continuous and it is evidenced based. Getting sufficient, appropriate, relevant, and reliable evidence to back up our opinion on a particular phenomenon require funds. Another challenge of the division is the perspective of staff as to what audit stands for. Many see our job as a witch hunt exercise rather than for the good of the institute; there is need for reorientation.

Conclusion

Our role is to add credence and value to the realization of the institutes mandate by ensuring that resources are allocated and used economically, efficiently, and effectively. We therefore enjoin you to join in the crusade of value addition so as to take the institute to greater height.

PRODUCTION AND SUBSTATIONS DEPARTMENT (Head of Department: Dr Ogunlade M.O.)

Plantation and Estate Management (Plantation Manager: Mrs Adeyemo)

The detailed analyses of the activities of the year under review are itemized below:

Staff Strenght / Disposition

S/N	Unit	Effective Hectare	No. of Staff	No of PCW
1	PEM	-	4	
2	Zone 1	34.79	18	
3	Zone 2	15.14	13	
4	Zone 3 & 4	15.19	10	
5	Zone 5	27. 63	16	
6	Zone 6	26.00	16	10
7	Zone 7	23.85	11	
8	Zone 8	41. 05	17	
9	Zone 9	22.89	10	
10	BCOO	6.00	2	
11	Fermentary	-	10	
12	Ground Maintenance	-	33	2
13	CFC/HPU	-	22	
14	Total	-	176	

Achievements

Plantation Activities: The plantation activities were effectively carried out in all the existing zones

During the year under review, the covid- 19 pandemic and Industrial strike action affected our normal cultural farm practices. Nevertheless, skeletal activities which include harvesting of cocoa pods and clearing of CRIN frontage, were carried out. After resumption, all farm activities such as harvesting, and processing of cocoa, and oil palm, weeding, pruning of old plots, clearing of access roads, removal of mistletoes, and chupons were carried out.

Detailed analysis of the harvested farm produce within the year under review is itemized below:

Zones	Cocoa	Kola	Cashew	Banana	Plantain	Remarks
1	6,969	-	16.7kg	163	4	
2	2,673	-	-	-	-	
3 & 4	1,106	48.8kg				
5	7,313	-	-	-	-	
6	3,011	-	-	-	-	
7	-	349	-	5	-	
8	14,081	-	-	-	-	
9	2,938	-	-	-	-	
CFC	985	-	-	-	-	Due to fire outbreak at CFC the output of the unit witnesses a setback because some percentage of the plots were wiped out
TOTAL	**39,074**	**397.8kg**	**16.7kg**	**168**	**4**	

Challenges and Constraints

- Shortage / inadequate supply of manpower greatly affected our production and maintenance activities.
- There is the need to revisit old and abandoned cocoa plots the way it was done the previous year.
- Porosity of zonal / unit office complex gives room for pilfering of farm produce.
- Delay in release of fund for the running of PEM.
- Late and inadequate supply of agro- chemicals allow over growing of weeds which compete with crops.
- Inadequate supply of farm tools and protective clothing materials.
- Monitoring / supervising exercise was difficult because of unavailability of functional motorcycle or utility vehicle.
- All the Bazuki's tricycles attached to PEM are grounded.
- The zonal and unit leaders have no personal and conducive office to retire to after each day work from the farm.
- Lack of utility vehicle for easy movement of the Plantation Manager supervision and ease of evacuation of harvested farm produces.

Conclusion

We thank God for being merciful to us and for His protection throughout the COVID -19 pandemic period. Also, we deeply appreciate the Executive Director and the entire management for their support and encouragement from time to time.

Nursery Development and Management Section

Babalola E. A. (NDM)

The Nursery section comprises of two units, Sexual propagation unit and Vegetative propagation unit. The activities of each unit in the year reported upon are as follows:

Sexual propagation unit (SPU): The following activities were carried out in this unit:

- Propagation of all mandate crops through sexual means
- Maintenance of seedlings of all mandate crops
- Maintenance of plantain orchard
- Supply of seedlings all mandate crops to farmers for commercial and research purposes
- Training of Students on industrial attachment, farmers on field trips, Students on excursion and other visitors
- General cleaning of Nursery and its environment
- Maintenance of WCF plot.

Vegetative propagation unit (VPU): The activities performed by this unit are as listed below:

- Vegetative propagation of all mandate crops through grafting, budding and stem cutting.
- Maintenance of all bud wood gardens.
- Maintenance of old cocoa clonal and seed gardens
- Establishment of new cocoa clonal garden for bud wood collection and seed collection purposes
- Supply of budded and grafted cocoa, cashew and kola to farmers and CRIN garden
- Training of visitors, students and farmers
- General maintenance of Nursery

Other activities carried out include:

- Rehabilitation of one shade net by the Management
- Successful vegetative propagation of kola and coffee stem cuttings for research purposes
- Successful grafting of cashew for field research purpose by cashew programme
- Provision of technical assistance on research activities as demanded by Research Scientists

Tools and Equipment: The following tools and equipment were given to the section for effective service delivery:

a. Chemicals: 1. Herbicide (clear weed and weed crusher) 2. Insecticides (termex)
b. Spraying pump
c. Spraying coat
d. Nose mask
e. Hand gloves
f. Wheelbarrow

Training: All Nursery staff were trained except those who were not regular during the period

Staff strength: The staff strength of the section is 32 (5 supervisors and 28 nursery Staff)

Achievement: The following achievements were recorded within the period reported upon:

- Sales of 182,402 hybrid cocoa seedlings to farmers
- Sales of 1,680 cashew seedlings
- Sales 3,628 of Kola seedlings

Challenges: The nursery section is faced with some challenges in spite of the aforementioned achievements, these include:

- Dilapidation of some shade nets
- Irregular transportation of staff to and fro Nursery
- Lack of security personnel
- Lack of office equipment/facilities and sufficient farm tools and equipment

Recommendation: More attention should be given to Nursery section in order to improve the production of healthy seedlings and clones.

SUBSTATIONS

AJASSOR

Ajassor substation, was founded in the year 1965 as a Research Substation and Extension Centre to CRIN, Ibadan. CRIN Ajassor is located along Ikom –Ajassor Border Road near Cameroun Border in Etung Local Government Area of Cross River State of Nigeria. It is bounded in the West by Ikom township, South by Effraya town, North by Ajassor plantations (Etigefe) and East by Ajassor Mission town. CRIN Ajassor substation is predominantly cultivate Cocoa but because of its soil fertility and ability to sustain most tree crops. Plantations of all the five mandate crops of CRIN- Cashew, Kola, Coffee and Tea are grown on CRIN Ajasso station.

CRIN Ajassor substation is the largest Substation with a landmark of about 768 hectares. This total land area which has been reported over the years is currently not certain due to mass encroachment of the border forest and plantations by the local native occupants/ communities.

In addition to the main substation in Ajassor, there are two other experimental outposts in Assena-sen community formerly referred to as (Okundi) located at Ikom-Okundi-Etome Road and predominantly cultivated with Cocoa and Coffee while Kalime outpost is located along Ikom –Ajassor Border Road mainly cultivated with T.38 clone of Cocoa.

Table 1: Updated List of Ajassor Sub-Station Staff In Order Of Seniority As At 31st December, 2021

S/N	Name	PF No.	CONRAISS and step as at 31/12/2021	Designation	Date of 1st appointment
1.	Dr. Eghosa Osas Uwagboe	251	13/03	Chief Research Officer (Head of Station)	11/12/2001
2.	Mr. Samson O. Odedele	314	12/02	Asst. Chief Agric Superintendent	08/04/2008
3.	Mr Ajayi Oluwaseun	375	11/03	Principal Agric. Superintendent II	2/2/2009
4.	Mrs. Joy Awunghe Takim	390	09/03	Principal Nursing Sister I	01/04/2010
5.	Mr. Nmeregini Uwadiaru	1206	08/03	Accountant II	17/07/1995
6.	Mrs. Esther Ntomo Echi	1293	07/03	Chief Health Asst.	01/12/1997
7.	Mrs. Maureen Duruaku	1897	07/01	Acct. II	05/12/2011
8.	Ms. Pauline Ukpeukiema Ugi	1566	07/01	Senior Secretariat Asst. I	23/12/2008
9.	Mrs. Blessing Ekama Isong	1288	06/11	Chief Clerical Officer	01/12/1997
10.	Mr. Ezekiel Asuquo Effiong	1289	06/04	Chief Agric Overseer	01/12/1997
11.	Mr. Edet Akpan Robson	1541	06/04	Chief Agric. Overseer	02/06/2003
12.	Mr. James Ibiang Okoi	1543	06/04	Snr Foreman	10/06/2003
13.	Mr. Okpokam Ozong Edim	1556	06/04	Chief Storekeeper	10/04/2008
14.	Miss Precious Magagi	1820	06/02	Chief Clerical Officer	06/07/2011
15.	Mr. Sunday Nkanta Ekereobong	1700	06/01	Chief Field Overseer (Security)	02/01/2009
16.	Mr. Abraham Samuel Inyang	1701	06/01	Chief Field Overseer	02/01/2009
17.	Mr. Samuel James Udoh	1702	06/01	Chief Field Overseer	02/01/2009
18	Mr. Idagu Godwin Echa	1703	06/01	Chief Field Overseer	02/01/2009
19.	Mr. Onah Peter Ogar	1704	06/01	Chief Field Overseer	02/01/2009
20.	Mr. Iwara Eteng Okoi	1706	06/01	Chief Field Overseer	02/01/2009
21.	Mr. Sunday Ime Asua	1705	05/02	Asst. Chief Agric Field Overseer	02/01/2009
22.	Mr. Azogor Isong Echeng	1707	05/02	Asst. Chief Agric Field Overseer	02/01/2009
23.	Mr Augustine Eteng Ubi	1698	05/02	Asst. Chief Agric Field Overseer	02/01/2009
24.	Mr. Emeng Ele Eleng	1708	05/02	Asst. Chief Agric Field Overseer (Security)	02/01/2009
25.	Ms. Mercy Umontia	1814	05/02	Asst. Chief Agric Field Overseer	29/04/2011
26.	Mr. Peter Godwin	1815	05/02	Asst. Chief Agric Field Overseer (Security)	29/04/2011
27.	Mr. Idorenyin Okpo	1950	04/05	Senior Agric Field Overseer	26/04/2012
28.	Mr. Anthony David	1816	03/09	Agric Field Attendant 1	29/04/2011
29.	Mr Monday Echi Enya	1974	02/02	Driver/Mechanic II	5/3/2020
30.	Miss Patience Takon Ayiba	1978	01/02	Agric. Field Attendant III	5/3/2020
31.	Mr Emmanuel Takon Ayiba	1979	01/02	Agric. Field Attendant III	5/3/2020

Staff Disposition

As at 31 December 2021 the staff strength across different sections were 31 including the Head of Station who is a Research Officer, 2 Agricultural Superintendents, 2 Chief Clerical Officers (Administration), 2 Accountants II, 1 Store Keeper, 1 Principal Nursing Sister I, 1 Health Asst, 1 Senior Secretariat Asst. I, 1 Foreman, 3 Security men, 15 Field officers, 1 Mechanic/Driver. It is pertinent to inform CRIN Management that most staff of CRIN Ajassor, especially those on the field and in the Security, Section are very few and old. There is an urgent need to recruit more young and vibrant persons into the system.

Table 2: Staff who left CRIN Ajassor Sub-station in 2021

S/N	Name	Designation	Date of Exit	Cause of Exit
1.	Mrs. Eunice O. Ojua.	Senior Executive Officer (Acct.)	16/7/2021	Retirement
2	Mr. Effiong Nathaniel Udoh .	Senior Foreman	16/7/2021	Retirement
3	Mr. Udoh Akpan Johnny	Senior Agric Field Overseer (Security)	22/12/2021	Death

Cocoa Research Plots	Hectares	Status
Cocoa plots		
1967 Trinidad	2.9	Abadoned
1975 F_3 Amazon	1.6	Abandoned
CRIN/NIFOR 1	6.0	Abandoned
CRIN Elite Seed Multiplication	2.2	Maintained
T38 Kalime	2.8	Maintained
Commercial 1	2.0	Abandoned
Cocoa Cuttings	1.0	Maintained
15 Acres Extension	2.0	Abandoned
Amelonado	2.0	Maintained
1973 F Amazon	2.0	Abandoned
Seed Garden Multiplication	2.2	Maintained
Okondi	10.69	Maintained
Planting at stake	1.6	Maintained
Farming System Experiment	2.0	Maintained
Adaptability/Tolerant Trial	2.1	Maintained
65 Lines Experiments	1.0	Abandoned
CRIN Elite Seed Multiplication	2.2	Maintained
Cocoa Research Plot	1.32	Maintained
Ornamental Cocoa Plot	0.5	Maintained
Okundi (Cocoa) Plot	0.4	Maintained
Kola Research Plots		
Kola Progeny	1.6	Moribund
Kola Cuttings	0.65	Maintained
Kola Germplasm	2.92	Maintained
Kola Fertilizer Trials	2.0	Abandoned
Coffee Research Plots		
Okundi	1.46	Moribund
1989 Ajassor	1.57	Moribund
Tea Research Plots		
Tea Ajassor	0.28	Abandoned

Table 3: Research experimental work on-going at Ajassor Sub-station in 2021.
Table 5: Plantations/ Research plots with their hectares and maintenance status in Ajassor as at 31 December 2021

Plantation Management

There were various challenges such as inadequate labour force (field workers) as well as unavailability of enough agro-chemicals for field and ground maintenance. Inadequate cultural maintenance of all the Cocoa, Coffee, Kola, and Tea plots under CRIN Ajassor were done throughout the period under review due to the covid-19 pandemic and National Trade Union dispute which made workers to be on strike.

Remark: The effective hectarage for the crops is not certain as proper survey has not been carried out. Some of the abandoned cocoa plots were put under sharecropping to enhance increase in revenue and prevent spread of pests

Research Experiments

A pocket of research experiments was on-going at CRIN Ajassor Substation as at 31 December, 2021 as indicated in Table 5 below

Infrastructure/Capital Projects

CRIN Ajassor didn't receive any capital fund for project in the period (2021) under review. The slab and tarpaulin are obsolete and non-presentable. We recommend their replacement with more recent and highly acceptable raised platforms and durable tarpaulin. The 3 shade nets for raising seedlings need urgent replacement as they are in a very bad condition. The roofing of the administrative block is leaking, and the ceilings are collapsing.

Environmental Sanitation

At CRIN Ajassor, we know that 'health is wealth' and so we placed a high premium on the cleanliness of our offices and the residential quarters. Against this backdrop, a Monthly Environmental Sanitation was carried out on every last Saturday of the month throughout the year under review. We also implore CRIN management to provide more public toilets for the staff in their residential quarters in 2022.

List of the vehicles/motorcycles/generators/other equipment and their present conditions:

1. Toyota Hilux Van with registration number FG 09 V03 (Not functioning. Recommended for auction).
2. 404 Pick-Up with registration number FG 2326 B034 (not functioning; recommended for auction).
3. Mercedes 911 Water Tanker with registration number FG 237 B02 (functioning but below optimal level; should be overhauled as soon as possible).
4. The Eicher Truck with registration number FG 740 B03 (Not functioning. Recommended for auction).
5. Mitsubishi L200 Van with registration number FG 741 B03 (not functioning but could be repaired for the use of CRIN Ajassor Substation).
6. Bedford with registration number FG 238 BO3 (already a scrap; recommended for auction)
7. Tractor 1 (serviceable) with registration number FG 239 B03 MF 265 (functioning but the tyres and few parts needed replacement).
8. Tractor 2 (unserviceable) already scrap; recommended for auction.
9. Motorcycles 3: We have 1 Daylong Wolf 150 it's not functioning due to accident while on official assignment but the 2 Suzuki 185 motor bikes with registration numbers FG 334 B03 and FG 335 B03 are old and not functioning, and are recommended for auction
10. 1 Tricycle Bazuki 200 TRC (functioning. Needs servicing)
11. Generators: 50 KVA Generator plant 1 (functioning but some of its parts needed replacement), 1 Elepaq 10KVA Petrol generator functional, 1 Tiger 2700 (functioning), 1 Sumec SPG 2500 (functioning) and 1 Tiger T 950 (functioning)
12. Farm/Field equipment: 1 Hand driven mower, 1 Hand mower, 1 Water pump, 1 Harrow, 1 Plough, 1 Ridger
13. Visual equipment: 1 Overhead projector DLP LG,
14. Laboratory Equipment: 1 Autoclave, 1 Micrscope
15. Electronic machines: 1 HP Scanner G4010 (functioning), 1 HP Printer P1006 (Faulty), 2 HP Laptops, 3 HP Laserjet printer (2 faulty, 1 functioning), 1 Desktop computer (Samsung) (Faulty)

Visitors to the Substation

More than 150 visitors came to CRIN Ajassor sub-station in 2021 but only 20 of them were sampled for this report. The names, addresses and purpose of visit of the sampled visitors are reflected in Table

Table 6: Name, address and purpose of visitation of some sampled visitors to CRIN Ajassor sub-station in 2021

S/N	Date	Names	Address	Purpose
1.	9/1/2020	Maria Eju	Ajassor	Official
2.	12/01/2020	Odo Joshua	Ikom	Official
3.	15/2/2020	Gertrude Osadim	PHC	Official
4.	21/2/2020	Olouyole, K. A.	CRIN hqtrs, Ibadan	Official
5.	16/3/2020	Taiwo, O. A.	,,	Official
6.	26/3/2020	Borjor Obi	Ekimaya	Cocoa pods
7.	24/4/2020	Loe Ati	Ikom	Cocoa pods
8.	28/4/2020	Ogar Oscar	Ikom	Cocoa pods
9.	10/5/2020	Osang Lawrence	WCS	Cocoa seedlings
10.	18/5/2020	Patrick Isong	Waterfalls	Cocoa pods
11.	18/6/2020	Sunday Ova	WCS	Cocoa seedlings
12.	23/6/2020	Abua Jonas	Police Etung	Official
13.	27/6/2020	Okozi Jude	Boki	Test
14.	02/7/2020	Joseph K	Hqtrs	Official
15.	17/7/202	Accoyin K. N	Nde Ikom	Personal
16.	14/8/2020	Sunday Okpikan	Ikom	Cocoa seedlings
17.	18/8/2020	Mbang **Oboyi**	Obubura	Cocoa seedlings
18.	6/9/2020	Faith Echeng	Ikom	Personal
19.	25/9/2020	John Ojang Agbor	Bashua	Personal
20.	13/10/2020	Sam Eko	Ekori	Cocoa seedlings
21.	13/10/2020	OK Nyam	Yala	Cocoa pods
22.	7/11/2020	George Arrume	Edor	Cocoa pods
23.	20/11/2020	Agbor Edotri	Mfum border	Cocoa pods
24.	2/12/2020	Dr. Adebiyi S	CRIN Hqtrs	Official
25.	4/12/2020	Dr. Abua K. B.	Calabar	Official
26.	18/12/2020	Mr Etuk Ntim	Ikom	Cocoa pods

Internally Generated Revenue for 2021

S/N	Items	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1.	Cocoa pods				200,000								635,100	835,100
2.	Processed Cocoa dry beans							51,200					60,000	111,200
3.	Cocoa seedlings											100,000		100,000
4.	Kola nuts				5,000									5,000
	Non-produce													
5.	Rents								70,000					70,000
	Total													**N1,121,300**

A total amount of One Million, One Hundred and Twenty-One Thousand and Three Hundred Naira (N1, 121,300) only was generated by CRIN Ajassor Sub-station in 2021. The breakdown of the revenue generated is presented in Table 7 below:
Table 7: Internally Generated Revenue (N) Analysis for 2021 (January-December)

Challenges and Prospects
Some of the challenges and prospects in CRIN Ajassor Substation are as follows:

Internally Generated Revenue (IGR): It was observed that revenue reduced this period (2021) due to Covid-19 pandemic, workers strike, inadequate field workers, intensive heat resulting from climate change. Hired labour was used to open some of the abandoned plots for share cropping in late 2021 to increase IGR for the station in subsequent years.

Inadequate workforce: We are the largest substation in CRIN yet with only 15 Field staff. We need more staff to adequately maintain all our plots. The substation has the capacity for expansion and increased productivity if more staff is engaged. This problem has resulted into the situation where most of our productive plantations are abandoned which, of course, gives room for pilfering of our farm produce, more encroachment and much lower productivity. We urgently need to salvage the situation and produce at our optimal level. To this end, CRIN Ajassor requires nothing less than 60 field staff to cope with the weeding, spraying, harvesting, pruning and other cultural practices on our cocoa, kola, coffee, and tea plots. There is also needed to employ additional 45 Field Attendants to complement the existing 15 Field Staff.
Besides, in order to effectively secure lives, properties and forestall against theft of our farm produce, we need additional 20 security men to complement our 4 current Watchmen at the moment.

Funds: There was no capital fund released to the station in 2021. We use this medium to appeal for Overheads and Capital Votes to CRIN Ajassor Sub-Station as soon as possible. It is extremely difficult to run a Substation with 31 Staff without overheads. We need to repair and fuel our Toyota Hilux, Tractor, Water Tanker as well as Bazuki, machines, equipment and generators especially as we mobilize our field men to go into our 3 outposts at Assena-sen (Okundi). Rantimankonor near Kalime and NIFOR. We are already struggling to meet our target of higher revenue next year, but it is already becoming extremely difficult without enough funds, Union trade dispute and the Covid-19 pandemic.

Training/Workshop: A training/Workshop was organized for Cocoa farmers on creation of awareness of CRIN developed technologies at Effraya IN Etung Local Government Area and Akparabong in Ikom Local Government Area in Cross River State on 24th and 25th November 2021 respectively at Council Hall Effraya and Unity Town Hall Akparabong. Some issues that needed to be attended to which generated from the workshop include availability of CRIN products and training on the processing of the products in the cocoa growing communities, more extension services required in the cocoa growing areas etc.

Encroachment on CRIN Ajassor sub-station land by Ajassor indigenes
This act kept on reoccurring over the years and there has been series of reports by OICs and HOSs on this issue to the headquarters which is yet to be addressed holistically. Several meetings have been held by the current HOS with some of the encroachers to abstain from the land but they kept on increasing by the day. A form was designed by Legal unit at CRIN headquarters to distribute to the encroachers willing to farm arable crops and to pay a token. This move was rejected as they insisted on planting cocoa on the land. A proposal of GIS survey project to know the extent of CRIN land was made to the Institute by the HOS (Dr. Uwagboe), Mr Obatolu and Dr. Ogunwolu (HOD Sub-station) in 2019 but it was not approved. I wish to appeal that this new management revisit that proposal for execution.

Other pressing needs of CRIN Ajassor Substation
1. Vehicles: One new Hilux Pick-up Van and one 18-Seater Staff Bus
2. Motorbikes: Based on the volume of the field work and the need for constant patrol of our plots by the security, there is a need to have 5 functioning motorbikes at our substation.
3. Quick intervention by CRIN Headquarters on the issue of completing the connection of CRIN Ajassor sub-station transformer to National Grid by Port-Harcourt Electricity Distributor (PHED). So much money has been spent on this issue and yet the PHED has refused to complete the job to enable us have electricity at the station.
4. Surveying and fencing of the station: Surveying of our lands is the only way CRIN can permanently stop the encroachment problem presently being faced by the station. Wire or Perimeter fencing with Oil-palm will also be an added advantage.
5. Construction of concrete and metallic signposts in all plots for easy identification of name of plants, year of establishment, varieties of plant used, size of each

plot, location, and general history of all our plots and plants.

6. Tarring or grading of 1km road from Border Road to CRIN Ajassor main gate which is becoming unmotorable.
7. An internet connection: This could be a broadband internet facility that will facilitate speedy surfing of the web and transfer of research related information to the headquarters. This will help the station to key into the present policy of internet administration strategy in CRIN.
8. Renovation of residential quarters: The buildings at CRIN Ajassor are all dilapidated while toilet facilities are becoming a mirage. Although, government quarters had been monetized, an urgent rescue mission on our Residential buildings to avoid total collapse of these 'farmhouses'. Once collapsed, the tenants and staff will move out of the quarters and that will spell doom for the safety of all farm produce at the station.
9. Construction of farmhouses in the zones for the field workers to serve as coverage during rainy season.
10. Renovation of nursery seedling shade nets which are in very bad state.
11. Installation of inverter at the station to bring down the running cost on gasoline/diesel operated generator.
12. Repairs of meteorological station which quotation has been submitted and awaiting approval
13. Re-printing and painting of the CRIN Ajassor Sub-station signpost at the entrance of the station
14. Renovation of the fermentation house, purchase of tarpaulin for drying of cocoa beans, drying oven shed and construction of raised platforms for drying cocoa.
15. Provision of a modern and better equipped laboratory for CRIN Ajassor.
16. Completion of Cocoa bread bakery in the station
17. Repairs of leaking roof of the administrative block building.

OWENA (Head of Station: Dr. AKANBI O.S.O)

Staff Disposition List: The staff list at the station during the year 2021 is as shown below

S/N	Designation	Owena	Alade	Onisere
1	Chief Research Officer	1		
2	Assistant Chief Agric. Superintendent	1		
2	Principal Agric. Superintendent 1	2		
3	Principal Executive Officer I	1		
4	Chief Health Assistant	1		
5	Higher Executive Officer	2		
6	Executive Officer	1		
7	Work Superintendent	1		
8	Chief Agric. Field Overseer (CAFO)	4		1
9	Asst. Chief Agric. Field Overseer (ACAFO)	4		
10	Senior Motor Driver Mechanic Grade 1	1		
11	Senior Agric. Field Overseer	1		
12	Agric. Field Attendant 1	3	1	
13	Agric. Field Attendant II	2		
	Total	**25**	**1**	**1**

Land Area

At Owena main Substation, the size of all the plantations is 17.95ha but the effective hectarage is 10.4ha; at Alade Outstation, the total hectarage is 0.5ha and the effective hectarage is 0.3ha while at Onisere Outstation, the total hectarage is 2.5ha and the effective hectarage is 1.0ha.

Activities

On-going Research: Some of the experiments under the station's supervision include:

1. Continuation of Cocoa Soils core trial (Dr. Ogunlade *et al.*)
2. Continuation of experiment on “Evaluation of field establishment of tea under shade plant and organic manure and low cocoa ecology of Nigeria” (By Mr. Adeosun, S)
3. Completion of Life mulch weeds control system on the development and growth of seedling of cocoa (By Mr. Idrisu Muhammed)
4. Ongoing Research on Genetic diversity studies on Robusta coffee (*Coffea canephora*) assisted by molecular markers (By Mr. Muhammed Baba-Nitsa)
5. Fungicide screening activities were carried out to

determine the efficacy of fungicides (Mackezien Gold and Prolab)

Achievements
1. Training of 500 students from Adeyemi College of Education, Ondo, Ondo state on Nursery practices
2. Training of delegates of foundation for partnership initiative on the Niger Delta (PIND) on Nursery activities of cocoa seedlings
3. Construction of cocoa bread factory in the Station (Owena)
4. Maintenance of all plantations at Owena main Station and out station with little resource and available labour.
5. Creation of awareness on CRIN product to market women in Akure by Scientists from Extension and end use Research Department.
6. Raising and distribution of 40,000 Cocoa seedling to Nigeria Cocoa farmers

Revenue
A total sum of One million, five hundred and forty-nine thousand, one hundred and twenty naira only (N1, 549,120.00) was realized from the sales of farm produce and other services. This is an improvement over the previous year

Challenges/Constraints
1. Illegal excavation of CRIN Agricultural land and encroachment on the station's landed properties
2. Paucity of Fund: There is paucity of fund, and this affects the station negatively. Station's overhead which cares for the expenses of the day to day running of the station is not forthcoming and this makes the running of the station very difficult.
3. CRIN/FRIN Boundaries dispute: This crisis has lingered on for too long without any reasonable resolution.
4. Shortage of Field Workers: Considering the enormity of the work in our plantation, the present field staff is grossly inadequate to take care of the work. There is a total of six (6) field staff to manage 15ha of cocoa plantations. These are grossly inadequate.
5. Shortage of Security Staff: The present number of security staff is inadequate for effective guarding of the office, staff quarters and plantations.
6. Poor state of CRIN Staff Quarters Road: The road linking the staff quarters with the office is totally spoilt and this makes it difficult to be plied by vehicles.

Suggestions for improvement
1. The overhead should be reviewed upward and made available on time to cater for some urgent and pressing issues. This will make the administration of each substation easy.
2. The Substation's guest house needs a light renovation to make it a more habitable for our researchers that are coming from the headquarters to carry out research work at the substation.
3. Rehabilitation of most of our cocoa plantations to guide against total loss of the cocoa trees
4. Shortage of field staff: Considering the enormity of the work in our plantations, there is a need for more farm workers to complement the few numbers on ground.

The additional staff request by cadre is as follows:

Field Attendant 1	4
Field Attendant II	8
Security Guards	4

However, if the above categories of workers are not available, it will be highly appreciated if we can be allowed to recruit contract workers to replace them.

Appendix
2020 Internally Generated Revenue

Items	N
Cocoa Beans	407,380
Cocoa Pods	852,450
Cocoa Seedlings	50,000
Rent	189,250
Rest House	40,000
Damages	10,000
TOTAL	**N1,549,120**

Visitors
Prominent among the visitors to the station in the year 2021
1. Director of Extension Service Federal Ministry of Agriculture
2. Executive Director CRIN Dr. P.O Adebola
3. 500 Student from Adeyemi College of Education
4. Dr. S.O Agbeniyi
5. Dr. Famaye A.O
6. Dr. F.O Olasupo
7. Babalola E.A (Mrs.)

OCHAJA
Staff Disposition/Human Resources: As at end of the the year 2021, the staff strength of the substation under review\remains 28 with the transfer of new Head of station (Dr. D.O. Adeniyi) who reported on 1st February 2021.

S/N	Names	Designation	Responsibility	Remark
	Senior Staff category			
1	Dr. D.O. Adeniyi	CRO/GL13	Head of Station	
2	Mr. Uloko B.A.	CAS/GL13	Field officer	
3	Mr. Elugbe M.O.	ACAS/GL12	Field officer	To retire 2022
4	Mr. Okonta Patrick	PAS I/GL11	Field officer	
5	Mr. Magaji Muhammed	PAS I/GL11	Field officer	
6	Mr. Ibrahim Wasiu A.	SEO Acct/GL08	Office	
7	Mr. Musa Ibrahim Y.	ASEO-Acct/GL07	Office/Store	
8	Mrs. Samuel Ladi E.	SSA I/GL07	Office/Secretary	
9	Mr. Oguche Nathaniel	CAFO/GL06	Field officer	
10	Mr. Ibrahim Noah	CD/MECH/GL06	Office/Driver	
11	Mr. Opaluwa Pius	CAFO/GL06	Field officer	
	Junior Staff category			
12	Mrs. Aye Fatima	AS/GL05	Field	
13	Mrs. Abah Janet	SHHA/GL05	Office	
14	Mr. Musa Abdullahi	ACAFO/GL05	Field	
15	Mr. Alih Muhammed	ACAFO/GL05	Field	
16	Mrs. Yahaya Musa A.	ACAFO/GL05	Field	
17	Mr. Nda Okpanachi	ACAFO/GL05	Field	
18	Mr. Alfa Ndah	ACAFO/GL05	Field	
19	Mr. Attah Ojone	AFA I/GL 03	Field	To retire 2022
20	Mr. Unubi Attah	AFA I/GL03	Field	
21	Mr. Alu Friday	AFA I/GL03	Field	
22	Mr. Atawodi Jibrin	AFA I/GL03	Watchman	
23	Mr. Otanwa John	AFA I/GL03	Watchman	
24	Mr. Nifu Yahaya	AFA I/GL03	Field	
25	Mr. Husseni Yahaya	AFA I/GL03	Field	
26	Mr. Abubakar Yahaya	AFA I/GL03	Field	
27	Mr. Simon Sunday	AAFO II/GL02	Field	
28	Mr. Umoru James	AAFO II/GL02	Field	

Land Resource/Asset

The Substation has a total land mass of 351 hectares, out of this land mass, about 70 hectares had been cropped mainly with cashew and some other crops like kola, oil palm and arable crops. About 17 hectares of this land had been encroached upon by the indigenes. The table below shows the details of the land mass and its usage in the Substation with regards to plot names and hectarage:

Land Resource and Utilization

- Total land coverage of the Substation: 351 Hectares
- Total land area already cropped with cashew: 59.2 Hectares
- Total land area encroached upon by Indigenes: 17 Hectares
- Newly cultivated Cashew Plot in 2021: 3.2 Hectares

Total land area under permanent crops cultivation: 71.2 Hectares:

Plantation Management/Activities

a. Maintenance of Research plot: The period under review had hired labour (engaged through funding from the headquarters) in plantation clearing to minimize competition by weeds and reducing weed density on research and commercial plots. The activities were carried out timely in preparation for cashew fruiting season of 2021 and satisfactorily delivered.

b. **Pruning:** Regular removal of chupons and unwanted outgrowth was carried out on commercial cashew plots on the plantation.

c. **Fire Traces:** Fire tracing all-round some plantations to check fire outbreak of fire incidence which started in December 2020 was carried out also in January 2021.

d. The stations Boundaries**:** The substation boundaries were re-visited, and the staff quarters boundaries were well maintained, however record of land encroachments and unauthorized access to the land were recorded.

e. Nursery: The temporary nursery site at the station was cleared of over-grown and uncollected cashew seedlings and made ready for new season activities.

f. Weather station: The weather station was being resuscitated for adequate record keeping of weather parameters.

g. Touring of facility at Ochaja: A tour of CRIN facilities, research, trial and commercial plots as well as boundaries showed that about one hundred (100) hectares of our facilities have been encroached with close proximity to research plots

Research/Activities

a. The 19 cashew plots were maintained although with some level of difficulties and prepared for ease of nut picking during the fruiting season of year 2021.

b. On-going research experimental plots were maintained in collaboration with the scientists involved. Some of the experiments under the station's supervision include:

c. Participated in the facilitation of cashew farmers training sponsored by APPEALS project in Kogi state.

d. Raising of cashew seedlings and distribution to the three Senatorial Districts of Kogi state (APPEALS project).

e. Facilitation of GAP training for cashew farmers through APPEALS project

f. Facilitation of training for cashew farmers in Kogi East (PROCashew-Nigeria project).

g. Resuscitation of One (1) hectare of fire gutted plot was reopened for research activities.

h. Biochar trial and cashew intercrop; Research study by Ibiremo O.S., Ogunlade M.O., Adeyemi E.A., Akanbi O.S.O.

I. Peelable cashew project by Olasupo F.O., Adeniyi D.O., Adeigbe O.O.

j. Delivery of 500kg of raw nut (jumbo, large & medium) to Department of Production and Substation, headquarters, Ibadan.

New Cashew plot establishment:

a. Establishment of 2.0 hectares of polyclonal cashew seeds of Ghana and Tanzania origins with 9m-by-9m tree spacing.

b. Establishment of 0.5 hectare of polyclonal cashew seeds of Ghana and Tanzania origins with 12m-by-12m tree spacing.

c. Establishment of 0.7 hectare of Brazilian large cashew biotypes (Ochaja material) with 10m-by-10m tree spacing.

Visitor to the station

a. Students field trip/excursion: Students of the Department of Agriculture, College of Agriculture, Ankpa, Kogi state were on study tour to the station. About 100 of them were guided round the research plots, nursery site and facilities of the station for knowledge sharing and mandate of the Institute and the research station.

b. Scientists from headquarter: Dr. Festus Olasupo, Mrs E.A. Adeyemi, Dr O.S.O. Akanbi, Mr Tony Agbongiarrhoyi, Dr Mrs Agunana.

c. Alhaji Adamu of the Kogi State College of Education, Ankpa.

d. Mr Olorunfemi and Prof Peter Masawe (Tanzania) both of the CNFA-PROCashew – Nigeria project.

Substation needs

a. The substation needs alternative power source: 5KVA (office complex & 2KVA for HOS quarters).

b. Renovation of office complex and furniture for staff.

c. Security personnel and watch light to oversee research plots and staff quarters

d. Printing gadget (Printer, Photocopy machine, scanner) and stationeries.

e. Funding is strongly solicited for in form of "overhead" for very pressing needs at the station.

Achievements

a. Efforts were made to maintain research and commercial plots at the substation with the little resources and available labour.

b. Establishment of 2.0 hectares of polyclonal cashew seeds of Ghana and Tanzania origins with 9m-by-9m tree spacing.

c. Establishment of 0.5 hectare of polyclonal cashew seeds of Ghana and Tanzania origins with 12m-by-12m tree spacing.

Challenges/Constraints

a. There is paucity of fund, and this affects the station negatively. Station's overhead which cares for the expenses of the day to day running of the station is not forthcoming and this makes the running of the station very difficult.

b. The current numbers of field officer are grossly inadequate compared to the magnitude of work to be carried out.
c. Security is a major challenge at the substation, security personnel are small to effectively man the research plots, office and staff quarters.
d. Incessant thefts of farm produce (raw cashew nut, oil palm) on the field.
e. The major road linking the office to the express road is totally out of use and the alternative route requires serious attention for clearing because it is difficult to be plied by vehicles.
f. The encroachment of CRIN facility in Ochaja and incidences of theft continue to be a major challenge to manage as staff are being threatened and attacked on the field on regular bases.
g. The Institute should plan a perimeter fencing and re-survey of the entire land belonging to Ochaja substation as contention over the land get worsened.

Suggestions for improvement

a. The 'overhead' should be disbursed regularly to substations
b. Alternative power supply (inverter, solar panel) should be installed in office complex for ease of administrative and research work at the station.
c. Solar powered security light should be installed round office complex to the staff quarter to help in the fight against theft and insecurity in the area.
d. More field workers should be engaged for effective management of our plantations.

Request

Field Attendant I (10), Field Attendant II (10), Security Guards (8).

Approval to recruit contract workers to serve in the above capacity.

Internal Generated Revenue (IGR): The sum of One million, two hundred and twenty-seven thousand, eight hundred naira (₦1,227,800) only, was the total amount remitted to Institute account as internally generated revenue for the sub-station during in the year 2021. The breakdown of revenue generated as shown below.

Summary of Internal Generated Revenue (January – December 2021)

S/N	Date	Details	Amount (₦)
1	04/06/2021	Sales of 12kg cashew nut at 1,500 each	18,000
2	04/06/2021	Sales of 15kg jum bo and 15 kg medium cashew nut at 1,500 and 1,000 respectively	37,500
3	04/06/2021	Sales of 300 kg cashew nut at 350 each	105,000
4	04/06/2021	Farmland rent	10,000
5	15/07/2021	Sales of 250 bunches of palm at 150 each	37,500
6	15/07/2021	House rent	16,000
7	08/04/2021	Sales of 1,154 kg cashew nut at 220 each	253,880
		Total (A)	₦477,880

Value of Produce Sent to Headquarters

1	Date	Details	Amount
1	31/12/2021	500 KG of cashew nut @ 1500 per kg	750,000

Actual revenue generated from Jan-Dec' 2021 A+B +c = ₦1,227,800

MAMBILLA

Plantation

Weed Control: Coffee, Tea, and Cacao Plots: Periodic weed control exercises were carried out during the quarter at the respective research plots and other holdings as indicated. Hired labour was engaged in plantation clearing of weeds aimed at reducing weed density and the activity was carried out satisfactorily on plots. This was augmented with approximately 80 litres of systemic herbicide (Glyphosate) to reasonably manage the weed incidences at the various fields. Clearing of cocoa seed garden and bud wood was also carried out during the period under review.

Pruning: In line with agronomic practices the tea and coffee germplasm plots comprising of were pruned to improve the yield plants. This yield includes leaves as well as materials for cuttings. This eventually enhanced uniformity of the plucking table for the tea plants and to encourage fresh shoots to boost high yield. The chupons were removed from the coffee plants for similar purpose and to prevent them from wild growth.

Cocoa Plot: The normal routine maintenance activities, which comprises of removal of chupons, mistletoes climbers, dead branches, epiphytes and harvesting of cocoa pods were carried out during the period of this report.

Disease Control: During the period, 15 sachets of fungicides (ultmax plus) were sprayed on cocoa trees against black pod disease infection.

Cocoa Seed/Budwood Garden: The World Cocoa Foundation/African Cocoa Initiative/CRIN (WCF/ACI/CRIN) which was established 2012 needs urgent attention as no fund has been release its for maintenance for about the past 5 years. Partial maintenance of the 2 plots of cocoa bud wood and seed garden was carried out using manual method of weed control during the year under review.

Fire Tracing:_The fire tracing all-round the plantation to check fire outbreak which activity started in December 2020 was completed in January 2021. This same activity was carried out in December 2021.

Nursery: The nursery of the station, which is the heartbeat of the plantation, was well maintained with the following activities carried out in the nursery. Regular watering of the young tea seedlings and the old coffee and tea few seedlings were carried out. In addition, hardening of tea seedlings in the tent, which were raised by some scientists from CRIN Headquarters for their research purpose, started and was completed during the year in review and with a very high level of survival of the seedlings and clones.

The nursery unit issued out a total of 224 cacao seedlings and 228 coffee seedlings for gapping-up purpose in the field, while a good number of seedlings are still being maintained in the nursery. Other routine activities were carried out in the nursery, which also included supporting research scientists from the headquarters in raising seedlings and clones of their respective crop of research interest. Various research interest of different research scientists from the Headquarters were attended to at the nursery, including the request of Dr. A. A. Adeosun's request to raise 1,560 cuttings among others. Fund presented by Dr Adeosun was used to construct another nursery shed from degradable plant materials.

Office/Rest House Premises: During the quarter, the office and the station's Rest House premises were well maintained to keep the surrounding clean.

Research Activities

The 8 experiments sited on the station were well maintained and data records collected when due and sent to the scientist concerned under request during the period under review.

The list of the experiments is shown in Table 1 below:

S/N0	Title of Experiment	Size	Year	Researcher	Remarks
1	The effect of varying levels of organic and in organic fertilizers on growth of coffee Arabica seedlings.	0.5	2009	Dr. Ipinmoroti	In progress
2	Evaluation of nutrients supplement on tea production	0.5	2009	Mr. Daniel	In progress
3	Setting of 75 Nigerian/China (NGC) 5 Tea clone C15 cutting each		2012		
4	Sinulteneous selection and genotype x environment interaction of tea in Nigeria Kusuku	0.048	2014	Mr. Olaniyi O.O.	In progress
5	Effect of Neem fortified fertilizers on tea yield.	0.048	2015	Mr. Olaniyi O.O.	In progress
6	Effect of tea yield in the open and under the eucalyptus intercrop.	-	2015	Dr. Ipinmoroti	In progress
7	Sunulteneous selection and genotype environment interaction of tea in Nigeria (11) Mayo-selbe	0.048	2016	Dr. Olaniyi O.O.	In progress
8	The effect of diseases on coffee Arabica	-	2016	Dr. Orisajo	In progress

Internally Generated Revenue (IGR)

The sum of one hundred and fifty-six thousand, six hundred and seventy-five naira (N156,675) was generated as Revenue for the year 2021 and the summary of the breakdown of the IGR is stated below on appendix Table 2 below

Table 2. Summary Of Internally Generated Revenue (Igr) From January 2021– December 2021

ITEMS	JAN 2021	FEB. 2021	MAR 2021	APR 2021	MAY 2021	JUNE 2O21	JULY 2021	AUG 2021	SEPT 2021	OCT 2021	NOV 2021	DEC 2021	TOTAL
Rented Qty	3,125	6,250	625	-	1,875	-	-	-	-	-	-	-	11,875
Banana	1,000	1,200	1,000	2,200	600	-	-	-	-	-	-	-	6,000
Green Tea	-	10,000	-	-	30,000	-	-	30,000	-	-	-	-	70,000
Cocoa Beans	-	60,000	-	-	-	-	-	-	-	-	-	-	60,000
Pear Avocado	-	-	-	1,200	7,600	-	-	-	-	-	-	-	8,800
Total	**4,125**	**77,450**	**1,625**	**3,400**	**40,075**	**-**	**-**	**30,000**	**-**	**-**	**-**	**-**	**156,675**

Health Care Service

Even though the dispensary of the station lacks drugs for optimal functioning health-related issues were handled at the station in the year under review and are hereby presented on a quarterly basis. Within the period, some ailments were diagnosed in the Station Dispensary. Some were treated and others referred to hospitals. The list of patient ill health cases treated is shown in the following tables:

Table 3. Dispensary Report: January-December 2021

Diseases	JAN	FEB	MAR	APRIL	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
Malaria	25	15	30	11	18	6	4	2	-	7	-	-	118
Backpain	15	-	8	-	10	-	-	8	10	-	-	11	89
Cough	15	8	-	12	-	9	1	-	-	12	5	-	68
Catarrh	15	-	20	-	10	-	4	3	2	-	7	13	73
Heart burn	14	9	-	1	-	12	14	4	-	9	11	-	69
Body pain	11	6	7			21			10			20	75
Diarrhea	16	12	-	-	10	-	18	-	16	-	1	-	73
Sleepless night	15	-	13	-	-	15	-	-	1	-	-	-	44
Side pain	13	2	-	3	6	-	-	2	7	-	8	7	48
Vomiting	-	20	1	8	21	-	9	-	7	10	-	-	76
Typhoid fever	13	2	10	2	2	8	-	13	-	12	-	11	74
Cold	-	9	-	-	16	17	-	11	7	-	9	11	80
Stomach pain	8	8	-	-	11	-	12	-	14	-	19	-	59
Oedema	2	2	3	2	2	-	1	-	-	6	-	-	18
Neck pain	21	17	22	1	-	-	14	-	15	-	1	-	91
Hypetion	8	8	-	-	11	-	12	-	14	-	19	-	59
Headaches	16	12	-	-	10	-	18	-	16	-	1	-	73
Total	206	704	143	64	114	111	75	81	787	56	89	105	1,187

Staff Strength: The roll call of staffers at the Mambilla Substation during the year under review is presented below Table 4:

Table 4: Staffers at the Mambilla substation

S/N	Name	Designation
1.	Dr. O. O. Adenuga	Head of Station
2.	Mr. F. N. Chila	Chief Agric. Supt.
3.	Mr. Jesse Mbonyel	Chief Agric. Supt.
4.	Mr. Augustine Mari	Asst. Chief Agric. Supt.
5.	Mr. Ayere Cletus	Statistician
6.	Mr. Abass Saheed Temilade	Station Accountant
7.	Mr. Peter Numfor	Chief Secretariat Assistant
8.	Mr. Francis J. Wakaps	Senior Technical Officer
9.	Mr. Jonathan Danladi Magaji	Higher Executive Officer (Store)
10.	Mr. Huseini Usman	Chief Health Assistant
11.	Mr. Ephesian Thomas	Chief Agric. Field Overseer
12.	Mrs. Anester Lawal	Chief Agric. Field Overseer
13.	Mr. Ahmed Zubairu	Chief Motor Driver/Mechanic
14.	Mr. Adamu T. Dahiru	Chief Motor Driver/Mechanic
15.	Mrs. Regina J. Isaiah	Chief Agric. Field Overseer
16.	Mr. Philippian Moses	Chief Agric. Field Overseer
17.	Mr. James N. Musa	Assist. Chief Agric. Field Overseer
18.	Mr. Zephaniah Numfat	Assist. Chief Agric. Field Overseer
19.	Mr. Joshua N. Paul	Assist. Chief Agric. Field Overseer
20.	Mr. Ahmed S. Buba	Assist. Chief Agric. Field Overseer

21.	Mrs. Philina Stephen	Agric. Field Attendant I
22.	Mrs. Satu Musa	Agric. Field Attendant I
23.	Mr. Joseph Nuki	Agric. Field Attendant I
24.	Mr. Genesis Dogo	Agric. Field Attendant I
25.	Mr. Ephesian Clement	Agric. Field Attendant I
26.	Mr. Genesis Miku	Agric. Field Attendant I
27.	Mr. Alim Mohammed	Agric. Field Attendant II
28.	Mr. Manasseh B Andryia	Agric. Field Attendant III

Weather Record: The weather record during the year under review is presented as follows:

Table 5. Mean Temperature January_ December 2021

	8am mean Temp. (°C)	1pm mean Temp (°C)	4pm mean Temp(°C)
JANUARY	22.40	30.70	27.70
FEBRUARY	20.10	30.70	28.70
MARCH	21.90	30.30	27.20
APRIL	21.70	27.50	23.90
MAY	22.20	26.60	21.70
JUNE	22.50	24.90	22.80
JULY	21.25	24.39	22.82
AUGUST	19.57	23.63	20.96
SEPTEMBER	20.95	25.43	23.36
OCTOBER	24.61	28.24	26.42
NOVEMBER	23.50	27.18	24.10
DECEMBER	20.95	25.43	23.36

Table 6(A) Rainfall figures for January-March 2021

Month	Rainfall (mm)	Rain Days	Mean Rainfall (mm)
January			
February			
March	229.7	7	32.8

Table 6(B) Rainfall figures for April-June 2021

S/N0	APRIL	MAY	JUNE
1	4.4	2.9	-
2	-	-	4.5
3	2.5	-	20.0
4	13.4	18	21.1
5	-	37.1	4.1
6	1.4	-	-
7	10.3	-	2.9
8	-	-	24.5
9	-	-	-
10	16.6	-	-
11	9.2	-	3.7
12	12.2	-	5.6
13	-	34.8	-
14	18.4	10.1	-
15	-	31.05	-
16	12.6	11.2	-
17	60.2	-	3
18	10.8	2.3	-
19	3.6	-	9.2
20	-	-	-
21	14.5	-	20.6
22	2.7	51.8	30.3
23	-	2.8	21.7
24	26.5	-	-
25	-	4	37.1
26	-	34	-
27	1.3	13.8	-
28	-	-	9.4
29	-	20	7.1
30	-	2	6.0
31	-	73.3	-
TOTAL	220.6	349.15	230.8
AVERAGE	12.98	21.83	13.58

Table 6(C) Rainfall figures for July-September 2021

S/N0	JULY	AUGUST	SEPTEMBER
1	5.5	-	26.9
2	44.5	12.3	30.7
3	-	-	-
4	-	-	-
5	48.6	-	86.2
6	15.6	4.6	1.4
7	-	-	-
8	27.2	-	-
9	-	33.7	-
10	-	0.7	-
11	-	5.4	12
12	-	2.2	56.7
13	40	-	39.8
14	4	-	-
15	42.5	46.9	-

16	46.5	4	
17	-	57.3	20
18	12.4	6.2	-
19	-	20	10
20	11.3	18.6	-
21	63.6	34.7	38.1
22	14	7.5	-
23	-	-	-
24	-	6.6	-
25	-	17.1	-
26	9.2	80	-
27	-	62.8	-
28	-	9.8	69.3
29	-	30.2	-
30	-	15	43.9
31	5.3	-	-
TOTAL	390.2	460.6	435

Table 6(D) Rainfall figures for October-Decxember 2021

S/N0	OCTOBER	NOVEMBER	DECEMBER
1	-	-	-
2	-	-	-
3	-	-	-
4	-	-	-
5	27	-	-
6	-	16	-
7	-	-	-
8	16	-	-
9	-	-	-
10	-	-	-
11	-	21.9	-
12	-	-	-
13	-	-	-
14	-	11.3	-
15	-	-	-
16	-	-	-
17	61	-	-
18	22	-	-
19	-	-	-
20	38.7	-	-
21	-	-	-
22	-	-	-
23	47.2	-	-
24	-	-	-
25	-	-	-
26	10	-	-
27	38.2	-	-
28	-	-	-
29	-	-	-
30	-	-	-
31	_-	_-	-
TOTAL AVERAGE	32.5	16.4	-

Training of Coffee Farmers on Mambilla Plateau, Organised by Intel-Ape and facilitated by Crin Mambilla Substation

Three-day training was organized by INTEL-APE investors and facilitated by CRIN Mambilla Substation. The training was held from Wednesday, 30th June through Friday 2nd July 2021, with locations spread as follows:

(i) Wednesday, 30th June 2021. Venue: Kabri (Lat 6.876^{0}N; Long 11.419^{0}E; Alt: 1,636.37m)

(ii) Thursday, 1st July 2021. Venue: CRIN Subs. (Lat 6.858^{0}N; Long 11.134^{0}E; Alt 1,522.18m). The training centred on encouraging the farmers to produce coffee beans that are of best grade to ensure acceptance by foreign buyers, who have hitherto abandoned Nigeria's coffee beans. The CRIN HOS at the Mambilla Substation trained the participants on appropriate harvesting procedures; and wet processing of the berries so as to ensure that premium quality and clean coffee beans are supplied to buyers. These training activities were beneficial to the farmers, the researchers and other stakeholders in the entire coffee value chain.

Boundaries Maintenance: The station plantation and staff quarters of CRIN have boundaries close to Kusuku residents on all the sides as the station is situated right in the midst of the town. This is a major challenge for the station and its staffers, as the indigent residents of the town have always encroached upon CRIN Land with the intent of outright possession of the land by these locals. Insults, assault and threat to the lives of staff have been recurrent as a consequence.

Land boundary issue of CRIN Mambilla substation, therefore, needs a very urgent attention from the Management. The Institute urgently needs to put up a fencing structure on certain parts of its boundaries at this station so as to mitigate the constant threat to its staffers at the station**.**

In an instance in November 2021, some villagers of Kusuku came out for an outright physical fight the CRIN-staff, including Mr. F.N. (The Head of Plantation in CRIN Mambilla). The station staff, encouraged by the Head of Station (HOS) had to come out to resist the encroachment. The area where the villagers attempted to encroach this time round was Coffee arabica plot along the major road leading to Kakara town (the location of the Mambilla Beverage (Nigeria) Limited).

The village Head of Kusuku (Jouro Halidu) had to be brought in by the Substation to intervene in the dispute. He expressed his support for the CRIN staff as he attempted to calm tense nerves.

The village Head subsequently advised CRIN to fence its land to avoid encroachment. He further confessed that he was no longer finding it easy having his people under check as they consistently cause trouble to CRIN staff on the land issue. It took some courage and bravery by the staff at the station for CRIN not to have lost any portion of its land, while the boundaries were maintained. Management also needs to remember that the land dispute at the Mambilla substation seems to be a long-drawn battle, as it predates the current Administration. There is therefore an urgent need for the Headquarters to take practical steps to permanently secure its land at this substation so as to eliminate the encroachment tendencies of these locals, thereby preventing the continuous endangering of the lives of CRIN staff at the Mambilla substation.

IBEKU

Staff Disposition

The staff strength as at December 31, 2021 stood at nineteen (19). This comprises of eight senior staff, that is, the HOS, Station Accountant, three (3) Agric Superintendents, one (1) Secretariat Assistant and two (2) Chief Clerical Officers – one in store and the other in account, and eleven junior staff, that is, two (2) motor mechanic/driver, 1 watchman, 1 other watchman on borrow from the field, 6 field staff in Ibeku and only 1 field staff in Ugbenu Outstation.

Table 1. Staff list of CRIN Ibeku Substat on as at 31st December, 2021

S/N	Name	GL	PF	Design.	Date of Birth	Date of 1st Appoint.
1	Dr. Okeniyi Michael O.	13/4	254	HOS/Chief Research Officer	10/12/70	02/01/2002
2	Mrs. U.N. Nmeregini	13/4	281	ACAS	21/10/68	25/09/2002
3	Mr. Borokini Olufisayo	11/4	367	PAS 1	27/03/79	08/02/09
4	Mr. Agbor Charles	8/6	432	PAS II	27/05/78	13/10/2010
5	Mr Ayoade Oluwole P				Deseased	
6	Mrs Nya Emem	7/3	534	HAS	17/12/90	03/03/2021
7	Mr. Onwubiko Michael	7/2	1521	CD	17/08/64	01/06/2003
8	Mr. Onyemuwa J.C.	5/2	1736	SMD/MI	15/05/66	17/03/2010
9	Mr. Eze Joseph	5/3	1680	ACAFO	13/06/67	02/01/2009
10	Mr. Animba Michael	5/3	1686	ACAFO	28/01/65	02/01/2009
11	Mr. Nwachukwu Benedict	3/12	1678	HW	10/06/67	02/01/2009
12	Mrs. Chibuo Oluchi	4/2	1679	AFA I	02/01/70	02/01/2009
13	Mrs. Ihueze Chinedu	3/12	1681	AFA I	15/08/68	02/01/2009
14	Mr. Chimaobi E. I	4/3	1683	AFA I	15/03/68	02/01/2009
15	Mr. Ani Cyril	3/6	1684	AFA I	18/11/63	02/01/2009
16	Mr. Nwachukwu Anthony	4/2	1890	AFA I	12/12/75	14/12/2011
17	Mr, Uwakwe Innocent	2/10	1892	AFA I	14/03/65	14/12/2011
18	Mr. John Muo	1/3	1976	FA	06/11/76	05/03/2021
19	Mr. Uwakwe Christopher	2/2	1976	FA	06/11/76	05/03/2021

Transfer: Three staff were transferred to the station from CRIN headquarters Ibadan

1. Mr. Borokinni Fisayo (PAS)
2. Mr. Azeez Ojelabi (Station Accountant)
3. Mr. Enagu Victor (CAS)

Death: The institute lost a staff in Ibeku substation in the year 2021, Mr. Ayoade Oluwole P. (former station accountant)

Land Area

Please find below the landmark of CRIN Ibeku Substation:

Total land area: 80.0 hectares.

Effective hectares: 43.36 hectares

Ugbenu Cashew Experimental Outstation

Total land area: 19.33 hectares

Effective hectares: 11.20 hectares

Total Effective hectares: (43.36 + 11.20) hectares = 54.56 hectares

Activities

Field Activities: General maintenance of research and commercial plots - slashing, pruning, spraying, pollination, removal of mistletoes, fire tracing, harvesting and processing of pods and ground maintenance of both office blocks at Ibeku and Ugbenu were taken care of.

Achievements

Internally Generated Revenue: A total sum of Eighty Thousand Naira only (N80,000) was realized in the year 2021.

Below is the breakdown.

CRIN IBEKU SUBSTATION IGR SUMMARY FOR YEAR 2021

SN	ITEM	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1	Cocoa Beans		-		-	-	30000	-	-	-	-			30000
2	Cocoa Pods	-	-	-	-		-	-	-	-	-			
3	Agbalumo	-	-		-	-	-	-	-	-	-	-	-	
4	Ogbono	-	-		-	-	-	-	-	-	-	-	-	
5	Plantain	-	-	-	-	-	-	-	-	-	-		-	
6	Banana	-	-		-	-	-	-	-	-	-	-	-	
7	Cashew Nut	-	-	-	-	-	50000 -	-	-	-	-	-	-	50000
8	Firewood	-	-	-	-	-	-	-	-	-	-	-	-	
9	Cocoa Seedlings	-	-	-	-	-		-	-	-	-	-	-	
10	Palm Fruit	-	-	-	-	-		-	-	-	-	-	-	
	TOTAL						**80000**	-	-	-	-	-		**80000**

Peace: We were able to maintain peace in the station and communities.

Office and Ground Maintenance: Regular maintenance of the office premises, cutting flowers/lawn thereby maintaining neatness of the office as commended by all visitors of the station in spite of the few labour we have.

Field Activities: General maintenance of research and commercial plots - slashing, pruning, spraying, pollination, removal of mistletoes, fire tracing, harvesting, and processing of pods and ground maintenance of both office blocks at Ibeku and Ugbenu were taken care of.

Cocoa Seedlings: Seedlings were raised to boost our IGR and for replacing dead cocoa trees in some of our plots. Also, Cocoa seedlings were raised and distributed to the farmers through Cocoa farmers Association of Nigeria (CFAN) and Cocoa Association of Nigeria (CAN)

Visitors: The following persons visited our station over the year, CFAN and her members, and CAN members.

Challenges/Constraints

1. **Lack of portable water:** Both Ibeku substation and Ugbenu experimental station lack portable water
2. **Lack of Adequate Work Force:** Both Ibeku and Ugbenu lack adequate work force.
3. **Chemical Spraying:** The substation needs fungicides, herbicides and insecticides without which the crop productivity will be grossly reduced. Considering the humid weather at the substation, black pod disease is ravaging the pods coupled with high density of weeds due to shortage of labour and pesticides
4. **Overhead:** There is high dependency on fuel to keep the substation running effectively. Due to the fact that, out of the 6 substations CRIN Ibeku Substation is the only substation without residential quarters and electricity. The imprest is drastically

too small and does not even come on monthly bases.

5. **Vehicle Maintenance:** The tyres of the station's utility Hilux Project vehicles need replacement. The NCSGP Hilux is currently faulty and needs a total overhauling.
6. **Clinic:** We urgently need a nurse and health attendants to administer drugs and first aid services in case of emergency like snake bite or accidental cutlass cut injury. There is neither Nurse nor Health attendants in an isolated place like CRIN Ibeku Substation since 2012.
7. **Ugbenu Experimental Station:** The outstation has only one staff since 2013 and supported by two Project Contract Workers engaged in 2016. No security staff in the outstation. No office in the outstation.
8. **Furniture:** Lack of good furniture. The station needs tables and chairs for staff.
9. **Road:** Lack of good road from the station entrance to Admin Block to combat the serious erosion that has taken up CRIN Ibeku office.
10. The carpentry shade is profusely leaking, it needs renovation.

Additional Staff Request by Cadre

Security 10 (8 in Ibeku and 2 in Ugbenu)

Field Staff 48 (Following the standard set at the headquarters, CRIN Ibeku Substation will require nothing less than 55 field staff to cope with the current 54.56 effective hectares. Therefore, an additional 48 staff now is needed to complement the existing 7 field staff.)

Nurse 1

Health Attendant 2

Secretarial Assistant 2 (The only Secretarial Assistant we have will retire this year.)

Clerk 2

Driver 1

Total 66

Suggestions/Way Forward

Imprest: The imprest is drastically too small and is not paid to the station monthly. An increase in the imprest will be highly appreciated and receiving it monthly will help us a lot.

Furniture: We need furniture in all offices of the station. The furniture we have are mostly bad and obsolete, they have been the ones there since inception of the station.

Equipment and Stationery: A brand new laptop and toner-based HP printers are needed in the station. The secretarial staff has nothing to work with; the ocomputer in the office is totally bad and beyond repair. For over two years all typing works were done in the accountant's office. We need reams of A4 printing papers, toners, staplers and other stationeries for the smooth administrative running of the substation.

4 Bore hole should be dug in the station and Ugbenu to prevent water related disease.

UHONMORA (Head of Station: Dr. Famuyiwa B. S.)

S/N	Name	Designation	Phone Number
1	Dr. Famuyiwa Busayo. Solomon	HOS	08033978146
2	Edibo Gabriel	ACAS	08066545507
3	Philip Oguigo	ACAS	07033181107
4	Asein Oyakhire	SEO	08036657855
5	Oaihena Lydia (Mrs)	HEO	07031888644
6	Alaba Umahoin	CAFO	08062399335
7	Okpåise Idowu (Mrs)	CAFO	07060701641
8	Onoja Joseph	CD/M	07068129566
9	Iruobe Elizabeth	CCO	08067179194
10	Ifidon Ikhuoshio	PHA	07085713536
11	Anijese Funmilayo (Mrs)	CAFO	08065709602
12	Dannis Ojimah	ACAFO	08075154789
13	Amedu Achonu	ACAFO	08106290329
14	Ebale Benjamin	ACAFO	07083647934
15	Edeh Sim0n Tochukwu	ACAFO	07032472593
16	Nwagala Charles	ACAFO	08067179166
17	Amaze Augustine	ACAFO	08139184020
19	Joseph Ehidiamen	ACAFO	07037138092
20	Kokori Paul	AFA 1	08071310591
21	Imumolen Jeffery	FAF 1	08134881918
22	Okedion Friday	AFA 11	08135924292
23	Ehimika Ketu	AFA 11	09066749259
24	Jamgbadi Imoudu	AFA 111	09030653041
	Total	23	

Staff Disposition

Staff	Senior Staff	Junior Staff	Total staff
HOS	1		1
Agric Sup	2		2
Account	2		2
Transport	1		1
Health Officer	1		1
Field		9	12
Security		4	4
Total	10	13	23

Retirement
Mrs. Iruobe Elizabeth retired from the CRIN Service in April 2021

Land Area
The Substation was established in 1967and situated along Uhonmora/Ekpoma road, with map coordinates 6.837, 5.962 on 268 ha.

Crops planted
1. Cocoa
2. Cashew
3. Oil palm
4. Plantain

Research Activities
On-going research experimental plots were maintained in collaboration with the scientists involved. Some of the experiments under the station's supervision include:
1. Establishment of 1.2 hectares of budded and grafted cacao clones in D1 plot, in collaboration with World Cocoa Foundation (WFC) and African Cocoa Initiative (ACI)
2. Establishment of 0.5 hectares of Cocoa germplasm with plantain for distribution to cocoa farmers
3. Establishment of a research plot to determine the appropriate time and height of coppicing in a rehabilitated cacao plantation
4. Establishment of research plot to evaluate the effect of planting pattern of cacao seedlings intercropped with plantain on cacao establishment in the face of prevailing climate change
5. Field evaluation of cocoa pod husk biochar fortified with fertilizer on cocoa yield and soil pshysiochemical properties
6. Field establishment of Tea (*Camellia sinensis*) under varying watering regimes and different plantain shade levels
7. Effect of different geometry cacao intercropping with cocoanut in ideal and marginal cacao environments of Nigeria
8. Pesticides residue assessment across some cacao ecologies in Edo

Structural Development
Renovation of Account Department building that was started in 2020.

Achievements
1. Efforts were made to maintain our plantations with the little resources and available labour.
2. Advocacy visits to Stakeholders
3. Intercrop of cassava into the cashew plantation
4. Improvement of the nursery irrigation system
5. Production of 40,000 cocoa seedlings
6. Purchase of farm inputs
7. Revenue: A total sum of six hundred and fifty-eight thousand, two hundred Naira Only (N658,200) was realized from the sales of farm produce and other services.
8. Distribution of Cocoa seedlings to farmers
   The seedlings prepared by CRIN, Uhonmora Sub Station for cocoa farmers were distributed as follows.

Number of seedlings prepared for distribution = 40,000
Number of cocoa seedlings ready for distribution = 30,000
Number of cocoa seedlings distributed to farmers = 16,200
Number of cocoa seedlings left uncollected = 13,800

Potentials

1. The Substation is at an advantage of land mass if well-funded could have generated more IGR
2. Availability of stable electricity to power investment such as bakery
3. The Guest House can be furnished for use to generate more IGR
4. Establishment of germplasm materials in Cocoa to augment for Headquarters supply to farmers

Challenges/Constraints

1. There was paucity of fund, and this affected the station negatively. Station's overhead which cares for the expenses of the day to day running of the station is not forthcoming and this makes the running of the station difficult.
2. Considering the enormity of the work in our plantation, the present field staff is grossly inadequate to take care of the work.
3. The field officer were not equipped with enough equipment such as cutlasses, files, safety boots and farm wears to work with
4. The Health Centre is moribund short of and health facilities to take care of the staff health.
5. The present number of security staff is inadequate for effective guarding of the office, staff quarters and plantations.
6. The effect of pandemic Covid 19 and the consequent sit at home by the Federal Government, culminated by the staff strike actually restricted the operation during the year.
7. No drinkable water to service the station
8. Serious fire out break

Suggestions for improvement

1. The overhead should be revived so that it will be regular. This will make it easy for the station to be taking care of her day-to-day expenses.
2. Provision of working inputs such as herbicides, pesticides, cutlasses, files, safety boots and farm coats
3. Provision of drinkable water either by borehole or well
4. The Substation's guest house needs to be furnished for our researchers that are coming from the headquarters to carry out research work at the substation.
5. Considering the enormity of the work in our plantations, there is a need for more farm workers to complement the few numbers on ground. The additional staff request by cadre is as follows:
   Field Attendant 1 10
   Security Guards 4
   Or in the alternative the station can be allowed to recruit casual workers.
6. The station can also be allowed to take Internship students and Copers from the National Youth Service

Appendix

2021 Internally Generated Revenue

S/N	Item	Amount
1	Land Rent	31,000
2	Cocoa seedlings	220,000
3.	Palm oil	300,000
5	Cocoa Pods	100,500
6	Access fee	6,700
7	Total	**658,200**

ADMINISTRATION AND SUPPLIES DEPARTMENT

The Administration and Supplies Department of the Institute applied itself meritoriously to its primary responsibilities of supporting and assisting the Executive Director in the day-to-day administration of the Institute in conformity with the Institute's Mandate and Mission Statements.

Structure of the Department

To facilitate the activities of the Department, the Department is structured into four (4) Divisions, viz Human Resource Management Division, Legal and Corporate Matters Division, Supplies Division and Health Services Division. In addition to the Divisions, the Department has the following Section: Pension, Catering Services, Supplies, Maternity and Dispensary Sections respectively.

Functions/Activities of the Department

The functions of the Department are as follows:

(i) Cost-effective management of all the administrative activities of the Institute, including all elements of Personnel function, Legal and Corporate Matters, incorporating Governing Board affairs and Public Relations.

(ii) Planning, organizing, co-coordinating and control of all activities, personnel, funds, materials, equipment and infrastructural resources in the Administration and Supplies Department of the Institute.

(iii) Identifying, articulating, formulating and reviewing from time to time the administrative activities of the Institute in compliance with the statutory mandate of the institute, current Government policies and priorities, as well as all rules and regulations for the management of Government Institutions and they affect the Institute, the demands of farmers for the Institute mandate crops and manufacturers of products derivable from the Institute's mandate crops, promotion of staff welfare and public image of the Institute.

(iv) Human Resources Management, including appointments, staff training and development, promotions, discipline, disengagement, post-disengagement and staff welfare. Records of the aforementioned administrative functions are highlighted below:

Achievement/Progress of the Department

Recruitment

No recruitment in the year 2021.

Promotions

The year 2021 promotion for Junior staff and Senior staff were successfully facilitated and done in the year under reference in accordance with the Honourable Minister of Agriculture's directive. 133 staff were promoted (both Senior and Junior).

Pension Administration

Pensioners were attended to as at when necessary. The eleven (11) potential retirees of CRIN for year 2021 attended the retirement training and enrolment exercise.

LEFT THE SERVICE

S/N	Mode of exit	No. of exit staff
1.	Retirement (statutory)	11
2.	Resignation	1
3.	Transfer of service	-
4.	Death	4
5.	Withdrawal	-

LEAVE MATTERS

Below are the summaries of leave matters for year order review.

S/N	Types of leave	No. of staff
1.	Annual leave	All staff that requested for annual leave got approval in the year under reference.
2.	Causal leave	All staff that re quested for casual leave got approval in the year under reference.
3.	Maternity leave	10
4.	Sabbatical leave	-
5.	Leave of Absence	1
6.	Study leave without pay	2
7.	Compassionate leave	3
8.	Exam leave	16

Crin Governing Board

The Institute's Governing Board was inaugurated on Friday, 09 March, 2018 in Abuja by the Minister of Agriculture and Rural Development, Chief Audu Ogbeh.

Governing Board Meetings

The Governing Board held her last meeting on 29 September 2021 at CRIN Headquarters.

Internal Management Committee Meetings

Four (4) IMC meeting were held between January – December of the year 2021.

Transfer of Service

No transfer of service in the year under reference.

TRAINING

The table below shows the list of categories of staff on the training in the year under review.

S/N	Category of staff	Course	Institution	Remark
1.	Mr. Fagbami Oluwole S. RO I	M.Phil/Ph.D. at the Department of Agronomy	U. I.	
2.	Mr. Gbalajobi Kehinde E. PAS I	Master degree in Agric. Extension and Rural Dev.	Ladoke Akintola University	
3.	Mr. Arobieke Sunday HEO	Post Graduate Diploma in Public Administration	National Open University, Akure	
4.	Mrs. Orimoloye Philo Olotie ROI	Ph. D	Ambrose Alli University	
5.	Mrs.Oyeledun Ibukun O. PNS II	B.N. Sc Nursing	U.I. Distance Learning	
6.	Mr. Ibrahim Wasiu SEO	Accounting Professional	Nigeria Institute of Accountancy, Jos.Plateau State	
7.	Mr. Abdullahi Olasunkanmi Idris HDPO	B. Sc in Computer Science	Kwara State University	
8.	Mrs. Onuh O. Paulina ACAFO	National Diploma in Agricultural Technology	Moor Plantation, Ibadan.	
9.	Mr. Philips Emmanuel Ovie CAFO	National Diploma in Agricultural Technology	Moor Plantation, Ibadan.	
10.	Mr. Olawole Sarafa Adekunle Accountant II	Master of Business Administration Finance Management	Kwara State University	
11.	Mr. Oyeledun Kehinde Olusola ROI	Ph.D in Crop Physiology	University of Agriculture, Abeokuta	
12.	Miss. Adeleye Kehinde CAFO	National Diploma in Business Administration Osun State.	Igbajo Polytechnic	
13.	Mr. Adenubi Busayo David AEO (Account)	B.Sc. Accounting	Ekiti State University	
14.	Mrs. Raji Monsurat Oyewale ROI	Ph.D. in Food Chemistry	U.I.	
15.	Miss. Ganiyu Bolanle O. CCO	HND in Accounting	Igbajo Polytechnic	

Conferences and Seminars

The table below shows the list of categories of staff on the training in the year under review.

S/N	Category of staff	No. of staff
1.	IMC members	21
2.	Agric. Supt. Cadre	7
3.	Executive Officer & Account Cadre	10
4.	Confidential Secretary	3
5.	Admin. Officer	1
6.	Agric. Field Cadre	67
7.	Union Labor Representative	6
8.	Store Officer	1

Corporate Visits

The Institute has so far received the following visitors:

I. The Chartered Institute of Public Resources Management and Politics (Ghana)
ii. WCF Consultant Flavour Quality
iii. Oyo young Agropreneur (OYAP)
iv. US Embassy Foreign Agric. Service
v. CORUS International

HEALTH CENTRE

Dispensary

Between January – December 2021 a total of 4,251 patients were seen.

Maternity

Between January – December 2021, a total of 1,149 patient were seen.

Delivery

Ten (10) Babies were delivered normally by spontaneous vaginal delivery without any complication.

Family Planning

Ninety-one (91) clients were attended to.

Death

No record of death.

Sick Off

Two patients were given sick off.

Referrals

Thirty-four (34) patients were referred to higher centre for expert care.

Immunization

Six hundred and eigty-six (686) children were immunized against preventable disease, while six-seven (67) pregnant mothers too were immunized against Tetanus infection.

Income Generated

Total income generated from both the Dispensary and Maternity was two hundred and ninety-nine thousand, two hundred and ten naira (**N**299,210.00) only.

		N
Dispensary	-	161,410.00
Maternity	-	132,800.00
Total	-	**299,210.00**

Achievements within the Period

1. Furnitures like tables, chairs and shelve were received.
2. Bore-hole was sunk at the clinic there by combating shortage of water.
3. Fund was received to procure personal protective equipment's (PPE) during the Corona epidemic in the country.

4. Payment of uniform allowance to Nursing personnel as well as the Health Attendants.

Challenges

1. No payment of imprest
2. Failure to implement the NHIS programme since accreditation
3. Lack of seminar/refresher course for staff
4. Lack of internet facility
5. Termite infestation of the building
6. Leaking roof of the garage
7. Lack of laboratory for diagnostic purposes
8. Non availability of fund to purchase drug
9. Non availability of fund to organize yearly babies' party

CATERING SERVICES (REST HOUSE)

Activities of the Section

1. The complete renovation and total furnishing of the newly (roofed) chalet with bedding materials and windows/doors.
2. Accommodation and provision of refreshment for auditors from Auditors General's Office in Abuja for a week.
3. Generation of reasonable IGR from CRIN Rest House which had been deposited into CRIN Federal Single Account.
4. Accommodation of CRIN staff from the six substations on staff provision.
5. Accommodation of NYSC officers posted to CRIN.
6. Provision of refreshments for the facilitators of 2021 promotion exercises.
7. Accommodation of CRIN staff on transfer to Headquarters Ibadan.

Challenges/Constraints

1. Poor access road to CRIN Rest House/Executive Director's lodge.
2. Weedy environment due to non-availability of personnels from maintenance section for the clearing of weed.
3. Non availability of mobility for running up and down for the section services

Supplies Division

Some of the activities performed during the period under review are as follows: -

1. End of yearn 2020 physical counting exercise was successfully carried out in the year under reference.
2. All items delivered into the Institutes Store are properly checked and certified to ensure the conformity of the materials to the quantity and quality required.
3. Receiving materials into stores and arranged them on the store rack accordingly.
4. Tally card were balanced and always intact on store rack with the materials.
5. Store ledger books were checked and balanced at the end of every month.
6. Taking materials on charge accordingly.
7. Materials issued and releasing of fuel and lubricant were done without delay.
8. General cleaning of store houses and rearranging of stock were carried out.
9. Keeping vigilant of store houses and stock.
10. Report writing
11. Both internal and external auditor were well attended to during their visit to the Division.
12. Committee work were effectively attended to
13. Obsolete materials were fished out for disposal.
14. Technical Store rack was repainted.

Contract

Total number of contractors that delivered materials to the Institute's store under capital project were analyses below according to each store unit.

Store Unit

Technical	13 contractors
Research	16 contractors
Stationery	2 contractors

Achievement of the Division

Provision of working materials. Some working materials were provided for the Division during the year under review. They are as follows:

i. Stationery materials
ii. Laptop with bag and accessories
iii. 4 nos of office table and chair and 1 no. of shelve

Challenges of the Division

1. Harmful and obsolete chemical were yet to be disposed.
2. Protective and preventive materials are needed for safety of store personnel.
3. Computerization of store is required to enhance our performance of duties
4. Building of toilet at Technical Store.
5. Store personnel training is highly required for more effective productivity in store activities.

6. Strong door and burglary proof for security purpose is yet to be attended to.
7. Electricity connection at Research Store yet to be corrected.
8. Provision of office space to store personnel
9. More hands needed in the Division
10. Protective nylon for tally cards
11. Construction of net at Medical store
12. Imprest account to maintain the Division is required
13. Hazard allowance is required to motivate staff performance.

Major obstacles of Administration and Supplies Department

1. Delay in the release of money for imprest and purchase of stationeries.
2. Inadequate office furniture for majority of staff.
3. Inadequate office equipment (complete computersets, laptops, refrigerators, and air-conditioners).
4. Inadequate release of funds to purchase consumables.
5. Acute shortage of Secretarial Assistants and Clerical Officers.
6. Lack of accommodation for Corp members and SIWES/IT students (i.e. beddings, mattresses, toilet etc).

Future Expectation

1. Computerization of the functions of Administration and Supplies Department.
2. Training and re-training of staff.
3. Provision of tally for vehicles and stickers for staff vehicles.
4. Provision of an office for the Head of CRIN Rest House at the Administrative Block to accommodate the materials needed for serving the Management meetings, Governing Board meetings and Committee meetings.