ANNUAL REPORT

OF THE

COCOA RESEARCH INSTITUTE OF NIGERIA, IBADAN

YEAR 2024

COCOA PROGRAMME REPORTS

OVERVIEW

The Cocoa Research Programme has since the inception of CRIN, been saddled with responsibility of coordinating research activities pertaining to the Institute's first mandate crop- cocoa. Although several research breakthroughs have been evident in the past decades, the Cocoa Programme pushed further to greater effectiveness in the year 2023 when it took-up two crucial, but specific research tasks namely: (a) Cocoa Integrated Pest Management, and (b) New Cacao Cultivar Development. Funded Cocoa research activities in the Institute consequently became focused on either of the two Tasks. In the 2024 research year, Cocoa Scientists were able to further their search into the development, acceptance and adoption of safer alternatives (biopesticides and other Integrated Pest Management techniques) for the control of field and storage pests/diseases of the crop, using multidimensional tools across disciplines. The Programme has also continued to take practical scientific steps at developing new cacao cultivars with higher yields and greater tolerance to drought in the coming years, through series of targeted experimental trials, establishment of new clonal gardens and resuscitation of the existing ones.

Experimental Title: Development and Formulation of Biofungicides for the Control of Blackpod Disease of Cocoa

Investigators: Okeniyi, M. O., Agbeniyi, S. O., Adedeji, A. R., Orisajo, S. B., Otuonye, A. H., Ogundeji, B. A., Ayanwole, S. and Oladigbolu, Y. O.

Introduction

Agriculture has had to face the destructive activities of numerous pests like fungi, weeds and insects from time immemorial, leading to radical decrease in yields. With the advent of chemical pesticides, this crisis was resolved to a great extent. However, the over dependence on chemical pesticides and their eventual uncontrolled use have necessitated the need for safer alternatives mainly for health and environmental concerns. Degraded soils and groundwater pollution have resulted in nutritionally imbalanced and unproductive lands. Pesticide residues also sometimes raise food safety concerns among domestic consumers and pose trade impediments for export crops. Therefore, eco-friendly alternatives (biopesticides) are the need of the hour (Gupta and Dikshit, 2010).

The United States Environmental Protection Agency (EPA) define biopesticides as, "certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals". They pose less threat to the environment and to human health. The most commonly used biopesticides are living organisms, which are pathogenic for the pest of interest. These include biofungicides (e.g. *Trichoderma*), bioherbicides and bioinsecticides (e.g. *Bacillus thuringiensis*). There are few plant products also which can now be used as major biopesticide sources. Plant-incorporated protectants include substances that are produced naturally on genetic modification of plants. Such examples are incorporation of Bt gene, protease inhibitor, lectinase, chitinase etc., into the plant genome so that the transgenic plant synthesizes its own substance that destroys the targeted pest(s). The potential benefits to agriculture and public health programmes through the use of biopesticides are considerable (Kandpal, 2014). The interest in biopesticides is based on the advantages associated with such products which include inherently less harmful and less environmental load, designed to affect only one specific pest or, in some cases, a few target organisms. Often effective in very small quantities and often decompose quickly, thereby resulting in lower exposures and largely avoiding the pollution problems. When used as a component of Integrated Pest Management (IPM) programs, biopesticides can contribute greatly to higher yield of crops which are much safer for consumption and thus, enhance environmental health (Kandpal, 2014).

In view of the above, this study aimed at developing cheap, safer and environmentally friendly biopesticides as suitable alternatives to synthetic chemicals for the control black pod disease of cocoa caused by *Phytophthora* spp.

Materials and Methods

Ash forms of selected air-dried botanicals (singly and in combinations) were prepared at 10g/3ltrs water and sprayed at 21-days interval on selected cocoa plot at CRIN Ajassor Substation between September-November, 2024. A metalaxyl-M based fungicide approved for use on cocoa was also applied at recommended dosage (as standard/positive control) at the same time, on the said plot. Data

obtained from the study were recorded and subjected to statistical analysis.

Results and Discussion

Figure 1 shows the effect of the botanical treatments on cocoa pods and cherelle production at the Ajassor Substation of CRIN. Significantly highest average number of healthy cocoa pods (134.5 – 157.25 pods) were observed on cacao trees sprayed with ash botanical suspensions, followed by the trees sprayed with the synthetic fungicide (standard) (67.75 pods), while the untreated trees had an average of 38.75 pods. Highest average numbers of healthy cherelles (66.50 and 65.50 cherelles) were however recorded on the trees sprayed with the synthetic chemical and ash botanicals, respectively. The highest average number of infected cocoa pods (15 pods) was recorded for the untreated control, while the least (7 pods) was observed on the ash botanicals treated cacao trees (Figure 1).

As observed in Figure 2, cocoa blackpod incidence was highest (27.91%) on the untreated control trees followed by those treated with the synthetic fungicide (13.42%), while the botanical treatments gave the least blackpod incidence (5.06%).

Results obtained from this preliminary field study agrees with the findings of Oguntade and Adekunle (2010) and Ogundeji *et al.* (2025) which concluded that wood ash obtained from some plants can be used as a natural method to inhibit the growth and production of secondary metabolites in some plant pathogens.

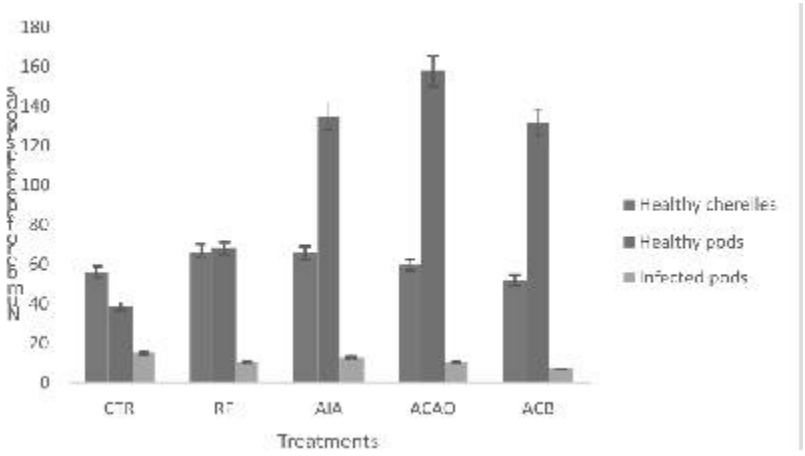

Figure 1. Effects of botanical treatments on cocoa pods and cherelles production at Ajassor substation

Key: CTR – Untreated control RF – Standard (Synthetic fungicide) AIA – Ash botanical 1
ACAO – Ash botanical 2 ACB – Ash botanical 3

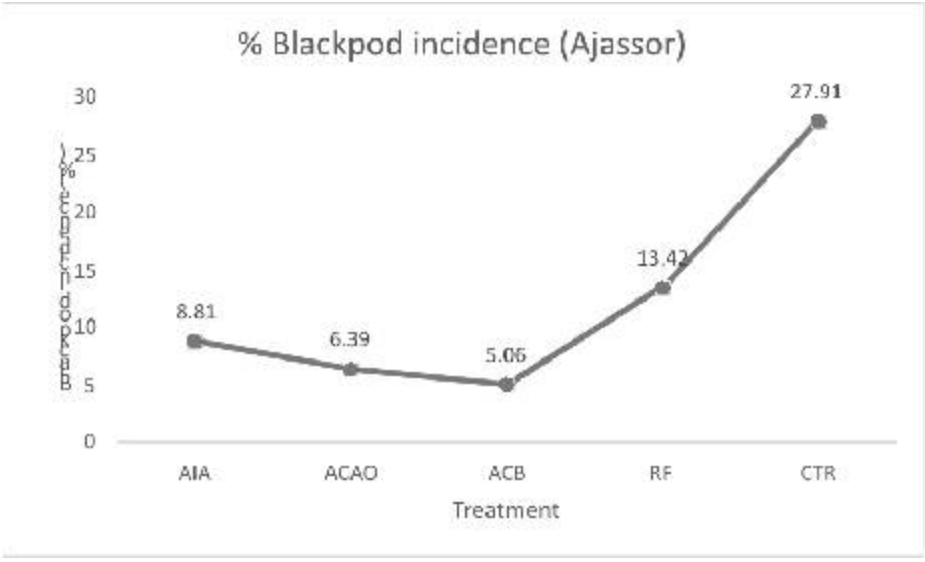

Figure 2. Effects of botanical treatments on cocoa blackpod incidence at Ajassor Substation

Key: AIA – Ash botanical 1 ACAO – Ash botanical 2 ACB – Ash botanical 3
RF – Standard (Synthetic fungicide) CTR – Untreated control

Conclusion and Recommendation

Ash botanicals used in this study effectively controlled black pod disease of cocoa and enhanced cocoa pod production in greater proportions, compared with the synthetic chemical used. The former therefore have good potentials as possible replacements to the latter.

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Experimental Title: Development of Eco-Friendly and Safe Approach for Preservation of Stored Cocoa Beans

Investigators: Agbeniyi, S. O., Adedeji, A. R., Orisajo, S. B., Okeniyi, M. O., Oyedokun, A. V., Otuonye, A. H., Ogundeji, B. A., Olorunmota, R. T., Ayanwole, S. and Oladigbolu, Y. O.

Introduction

Cocoa beans are of commercial, nutritional and medical importance to man. Wholesome cocoa beans can be processed into different products like chocolate, cocoa beverages, cocoa butter, etc., which are of immense benefits to the body systems of consumers. Cocoa is a very important ingredient in foods such as cakes, biscuits, child-foods, ice-creams and sweets. It is also the source of cocoa powder (Sánchez-Hervás *et al.*, 2008).

Since neither storage nor processing conditions of cocoa are strictly controlled in the tropics, fungal contamination of cocoa beans is possible at many critical points in the cocoa production chain. The beans are susceptible to fungal spoilage before, during and after fermentation, drying, storage, and in the course of shipment to foreign countries. Fungal species belonging to the genera *Aspergillus, Mucor, Penicillium* and *Rhizopus* have been observed on mishandled or improperly dried fermented beans (Sánchez-Hervás *et al.*, 2008; Fagbohun *et al.,* 2011).

The development of moulds on cocoa beans during storage has constituted a major challenge to cocoa production in Nigeria and other cocoa growing countries. Continuous presence of these organisms results in some alterations in the physical and biochemical properties of the stored beans, thereby reducing their overall qualities, marketing values and overall acceptability in the world market. Some of these fungal species are capable of producing toxic substances known as mycotoxins (aflatoxins, ochratoxins, fumonisins, etc.) which if taken in with the infected beans or their products, may pose much threat to life (Fagbohun *et al.*, 2011; Ogundeji and Olufolaji, 2014).

In a bid to reduce the impacts of storage moulds on stored cocoa beans, farmers have resulted in the use of synthetic fungicides within the stores and even on the stored beans, which has consequently made consumption of the commodity harmful mainly because of the associated health concerns.

The effective, eco-friendly and safe potentials in the use of botanicals for the control of toxigenic moulds and mycotoxin contamination of feed and food have made their possible application as storage fungi management/control options on dried fermented cocoa beans a necessity. Exploring these safer alternatives would no doubt, significantly reduce the huge postharvest losses experienced by cocoa farmers across the tropics, and make cocoa beans and their by-products safer for consumption across the globe.

In order to address the highlighted problems, this study sought to develop botanical pesticides for effective control of stored cocoa beans contamination and bio-deterioration.

Materials and Methods

Freshly prepared dried fermented F3 Amazon and Tc series cocoa beans varieties were treated *in vivo* with ash forms of neem and scent leaf singly and in combinations, at the rate of 20 g/kg and 40 g/kg cocoa beans. The treated beans were stored in jute

bags for four months and representative samples were placed on sterile but moist filter papers in sterile petri dishes for 5-7days, to determine the presence (survival) of storage moulds, as possible indication of mycotoxin production in them. Data obtained from the study were recorded and statistically analyzed.

Results and Discussion

Table 1 below, shows the percentage occurrences of moulds (mouldiness) observed directly on the stored/treated cocoa beans varieties. The untreated cocoa beans varieties showed highest number of moulds occurrences (4 to 5 moulds), compared with their ash treated counterparts which gave lesser numbers. While some of the ash-treated cocoa beans still showed the presence of a few toxigenic moulds, F3 Amazon beans treated singly with the ash botanicals and their combinations, at 40g/kg concentration only allowed the growth of non-toxin producing moulds (*Rhizopus* and *Mucor* spp.). The situation was the same for Tc series cocoa beans treated with neem ash at 40g/kg (Table 1). Findings from this study agree with the assertion of several authors on the suitability of some wood ash treatments (including neem) as seed protectants (Ogundeji *et al.*, 2025; Koné, *et al.,*2023; Oguntade and Adekunle, 2010).

Conclusion and Recommendation

Results obtained from this study showed the effectiveness of neem and scent leaf ash forms in the prevention of toxin producing moulds in stored F3 Amazon and Tc series cocoa beans. Hence, their potentials as possible replacements to the use of synthetic chemicals used in handling, storage and preservation of cocoa beans, particularly during wet seasons of the year.

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Table 1. Effects of ash botanicals treatments on stored cocoa beans mouldiness

Sample	Moulds/Percentage occurrence (%)										
	AF	AN	AFm	AP	PP	FS	MC	RS	PT	LT	NS
FCTR	14.29	14.29	0	0	14.29	14.29	0	42.86	0	0	0
FAI20	28.57	0	0	0	0	0	71.43		0	0	0
FAI40	0	0	0	0	0	0	0	100	0	0	0
FOC20	0	0	0	0	0	25	0	75	0	0	0
FOC40	0	0	0	0	0		50	50	0	0	0
FOA20	0	16.67	0	0	0	16.67	16.67	50	0	0	0
FOA40	0	0	0	0	0	0	0	100	0	0	0
FCU	0	0	20	0	40	0	40		0	0	0
TCTR	11.11	22.22	0	0	0	0	0	44.44	0	0	22.22
TAI20	50	0	0	0	0	0	0	25	25	0	0
TAI40	0	0	0	0	0	0	33.33	66.67	0	0	0
TOC20	0	0	0	0	0	20	0	80	0	0	0
TOC40	0	0	0	0	0	25	25	0	50	0	0
TOA20	0	28.57	0	0	0	0	0	14.29	0	57.14	0
TOA40	50	0	0	50	0	0	0	0	0	0	0
TCU	0	0	0	0	0	40	60	0	0	0	0

Key: AF: *Aspergillus flavus* AN: *A. niger* AFm: *A. fumigatus* AT: *A. terreus* PP: *Penicillium* spp. FS: *Fusarium* spp.
MC: *Mucor* spp. RS: *Rhizopus* spp. PT: *Pythium* spp. NS: *Neurospora* spp. LT: *Lasiodiplodia theobromae*
AI20: 20g neem ash/1kg beans OC20: 20g scent leaf ash/1kg beans AO20: 20g neem+scent leaf ash/1kg beans
AI40: 40g neem ash/1kg beans OC40: 40g scent leaf ash/1kg beans AO40: 40g neem+scent leaf ash/1kg beans
CTR: Untreated control F: F3 Amazon T: Tc series

Experimenta Title: Effectiveness and Profitability of Integrated Pest Management for Improving Yield on Small Holders Cocoa Farms in Nigeria.

Investigators: Yahaya, A.T., Orisasona., T.M. and Ali, M.O.

Introduction

Increasing agricultural productivity is critical to sustainable economic growth and development. This can be achieved through an application of improved agricultural technologies and management system. Output potentials can be obtained when crops are grown in a suitable environment of adequate moisture and nutrients, free from pests and diseases problems (Aneani, 2020). Incidence of emerging pests and diseases arising from change in climatic conditions has given rise to concerns about the yield, quality and revenue from agricultural productions. Similarly, the appropriate method of controlling these infestations without affecting the safety and health of consumers is another most pressing concern that calls for attention. Therefore, a responsive and proactive technology known as Integrated Pest Management (IPM) practices was introduced with the main goal of controlling these pests and diseases in a way to eliminate the harmful effects that might results from usage of agro-chemicals as control; that is, using other plants to control these pests and diseases to economic advantage and ensure food safety.

Cocoa has remained a crucial agricultural commodity in Nigeria. Cocoa contributed approximately 80% of the foreign exchange in Nigeria between 1950-1970. Cocoa still remains the main driving force behind Nigeria's progress in trade diversification. Cocoa production in Nigeria has suffered a decline in the past decades. This is due to various factors ranging from low yield varieties, inconsistent production pattern, diseases and pests infestation, aging of cocoa farms and farmers. The impact of the declining production level is the fall in income accruing to cocoa farmers, stakeholders and the GDP at large. Incidence of diseases and pests infestation has been identified as a great cause of the losses occasioning from continual change in climate. Sustainable cocoa production, socioeconomic development through remunerative income for farmers and all stakeholders in cocoa chain, and ensuring that the environment precursors meet tomorrow's demand is guaranteed. The mitigation of the problem described above is needed, hence the need for this study. The overall objective of the study is the assessment of productivity impact of IPM and, specifically, the need to: evaluate level of adoption of IPM in the study areas and estimate the effect of IPM on yield in the study areas

Materials and Methods

The study was carried out in three Cocoa growing local governments' areas (Atakumosa East, Obokun and Ayedaade) of Osun state. Random sampling method was used to select fifty cocoa farmers from two communities in each LGA's thus making one hundred and fifty respondents contacted in the study areas. Primary data was collected with the aid of structured questionnaire and focus group discussion for the study. Data collected were analyzed using descriptive statistics and regression analysis.

Results and Discussion

Attributes of respondents is as shown 1 below in table 1. The p-value of 0.197 for sex indicates that no association occurred between sex and IPM practices adoption. The p-value of 0.637 for membership of farmers' association shows that no association occurred between membership of farmers' association and IPM practices adoption. The p-value of 0.103 for marital status indicates that no association occurred between marital status and IPM practices adoption. However, no significant differences were observed in sex, membership of farmers association, and marital status among the respondents. This implies that decision to adopt IPM practices is not determined by sex, marital status or membership of farmers group. On the other hand, access to credit was significantly related to adoption of IPM practices, which evidently depicts a significant positive correlation between access to credit on the adoption of IPM hinting that ability to obtain credit helps farmers reduce their expenses related to implementing IPM technologies. This result was in contrast to Uwagboe *et al (*2016), who found that sex, has role to play in adoption IPM. Similarly, the result shows a significant relationship between adoption of IPM practices and contact with extension training. This suggests that access to extension training plays a crucial role in driving the adoption of IPM practices. This implies that extension training equips farmers with the vital understanding and abilities to carry out IPM practices efficiently. The result equally shows

significant relationships between awareness and adoption of IPM practices. This implies that getting useful information about IPM helps in effective implementation of the practices. In the same vein, results show a significant relationship between access to IPM methods and adoption. This indicated that easy availability and accessibility helps the respondent in decision to adopt IPM practices.

Table 1. Attributes of respondents

Descriptive Variable	Chi-square	P-Value
Sex	1.667	0.197
Access to credit	5.656	0.017***
Access to extension training	7.069	0.008***
Membership of farmers association	0.222	0.637
Marital status	20.944	0.103
Awareness of IPM	10.242	0.001***
Access to IPM	4.059	0.044**

Source: Field Survey, 2024;
Note: ***,**are significant at 1%, & 5% respectively

Integrated Pest Management practices adopted by farmers

The level of adoption of IPM practices is presented in Table 2. The result shows that, considering all the IPM practices, most of the respondents (83.33%) adopted the use of chemical as the most generally accepted practices, ranking as first, while, 8.67% adopted combination of chemical and cultural methods, ranking second and 4.67% adopted cultural method, ranking third, while mechanical method ranked fourth (3.33%) among the farmers in the study area. It can be deduced from this result that the adoption of integrated pest management practices is still low although awareness creation is high for more uptake of integrated pest management practices to mitigate the effects of residues in cocoa bean, and ensure healthy, clean and safe food for consumers.

Table 2. Distribution according to the adoption of Integrated Pest Management practices

CSA practices	Frequency	Percentage	Rank
Chemical	125	83.33	1st
Cultural	7	4.67	3rd
Mechanical	5	3.33	4th
Chemical &Cultural	13	8.67	2nd

Source: Field Survey, 2024

Effect of adoption of IPM practices on cocoa yield

The analysis shows that age of the cocoa farmers does not significantly impact cocoa yields for both adopters and non-adopters of IPM practices ($p = 0.970$ and $p = 0.369$, respectively). This indicates that physical ability may not be a significant factor in yield outcomes. These findings align with previous studies that suggest productivity improvements are more influenced by technical knowledge and resource access than by age. Sex does not significantly influence yields for either group ($p = 0.800$ for adopters and $p = 0.748$ for non-adopters). This indicates that while sex differences may exist in access to resources or participation in IPM adoption, they do not translate into significant differences in yield outcomes. Household size significantly and negatively affects cocoa yields among adopters ($p = 0.098$), suggesting that larger households may face labour constraints or resource competition that marginally reduce yields. In contrast, household size has no statistically significant impact on non-adopters ($p = 0.344$). The coefficient of education significantly affects cocoa yields for both adopters and non-adopters ($p < 0.000$). The positive effect is slightly stronger for adopters, with coefficients of 0.0320 and 0.0297, respectively. This emphasizes the importance of education in facilitating better farm management practices and the effective implementation of IPM techniques.

Farm size does not significantly influence yields among adopters ($p = 0.407$), while it has a significant positive impact on non-adopters ($p = 0.056$). Larger farms may offer economies of scale for non-adopters, but this advantage may be neutralized for adopters who rely on intensive, climate-resilient techniques. Land ownership is a strong predictor of cocoa yields for both groups, with coefficients of 0.2619 (adopters) and 0.5096 (non-adopters), both significant at the 1% level ($p < 0.000$). Non-adopters appear to benefit more from land ownership, possibly due to higher reliance on traditional practices that require secure tenure for long-term investments. Experience significantly improves yields for adopters ($p = 0.084$) but has no significant impact on non-adopters ($p = 0.310$). This finding highlights the synergistic effect of experience and IPM adoption, suggesting that experienced farmers may better leverage IPM practices to enhance productivity.

For adopters, membership of farmers' associations has a negative effect on yields ($p = 0.067$), while it has no significant impact on non-adopters ($p =$

0.863). Off-farm income positively influences yields for adopters (p = 0.031) but negatively impacts non-adopters (p = 0.017). The positive effect for adopters suggests that additional income is ploughed into farming inputs, while the negative effect for non-adopters may indicate resource or labour diversion.
Access to Credit significantly enhances yields for both adopters (p < 0.000) and non-adopters (p = 0.083). However, effect is stronger for adopters, reflecting the importance of financial resources in facilitating the adoption and effective use of IPM. Extension services have a highly significant positive impact on yields for adopters (p < 0.000), while the effect is minimal for non-adopters (p = 0.013). This highlights the critical role of technical support in maximizing the benefits of IPM practices. These findings supported Uwagboe *et al (*2016) who posited that adoption of IPM practices enhances cocoa yield.

Table 3 : Endogenous switching regression results for adoption of IPM practices and impact of IPM on cocoa yields

Variable	Selection Equation		Outcome Equation – cocoa yields			
	IPM adoption		Adopters		Non-adopters	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Age	0.0183	0.375	-0.0002	0.970	-0.0020	0.369
Sex	-1.0082*	0.077	-0.0354	0.800	-0.0183	0.748
Household size	0.1144	0.238	-0.0240*	0.098	-0.0121	0.344
Education	0.2176***	0.008	0.0320***	0.000	0.0297***	0.000
Farm size	-0.0396	0.784	-0.0112	0.407	0.0389*	0.056
Land ownership	0.0320***	0.000	0.2619***	0.000	0.5096***	0.000
Experience	0.0898***	0.002	0.2720*	0.084	0.0071	0.310
Membership association	0.7125**	0.039	-0.0050*	0.067	0.0061	0.863
Off-farm income	4.83e-08***	0.003	1.98e-06**	0.031	-8.25e07**	0.017
Credit access	0.1599**	0.018	0.2828***	0.000	0.2515*	0.083
Extension	-0.2586	0.347	0.5096***	0.000	0.0013**	0.013
IPM information	1.7881***	0.000	-	-	-	-
Awareness of IPM	2.0206**	0.015	-	-	-	-
Constant	-3.1141	0.015	7.3197	0.000	6.7764	0.000
Diagnostic						
sigma_1			0.1330 (0.0210)			
sigma_2					0.1384 (0.0980)	
rho_1			0.8112 (0.4160)			
rho_2					-0.5723 (0.4890)	
Wald chi2(11)	81.19***					
Log likelihood	-319.028					
Wald test of indep. eqns.: $\chi^2(1)$	3.93**					
Number of observations	150					

Outcome variable is in log-transformed form. Standard errors are presented in parentheses;
*, **, and *** represent significance level at 10,5,1 percent respectively.

Conclusion and Recommendations

The study discovered that the adoption of integrated pest management practices has a significant positive effect on cocoa yield. Farmers with better education, who are land owners, members of farmers' association and more experienced, were more likely to adopt IPM practices. The findings equally show that chemical method is the most frequently used IPM method in the study areas. Similarly, in improving cocoa yield and adaptation of integrated pest management practices, awareness and accessibility are key factors. It's therefore recommended that for farmers to adopt IPM practices, sensitization programm should be

intensified. IPM should be made accessible to the farmers for easy of adoption.

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TASK: Cocoa Integrated Pest Management

Project Topic: Innovative Cocoa Research Adoption of Integrated Pest Management in Osun State, Nigeria: A Multi-Level Framework of Determinants and Opportunities for Future Research.

Investigators: Uwagboe, E. O., Abdul-karim, I. F., Orisajor, S. B., Akinsola, M. H. Adewumi, I. A. and Awodumila, D. J.

Abstract

The deterioration in cocoa production in Nigeria is mainly due to the incidences of insect pests and diseases along with other factors which require a holistic approach of Integrated Pest Management (IPM). Using a multi-level framework, this research examines the demographic characteristics, production practices, and the level of IPM adoption of cocoa farmers,. Data were collected from randomly sampled 68 cocoa farmers with structured questionnaire at Atakumosa East and Ife East Local Government Areas (LGAs) of Osun State. The majority (58.8%) of the farmers are in their prime working age, (70.59%) were male, (61.76%) had secondary education, (79.41%) were married,This suggests that the cocoa farmers are likely to be physically active and have accumulated experience and knowledge from their basic educational background. Their marital status suggests that they may have access to a stable source of labor and resources, potentially facilitating IPM adoption. Nearly all (94.12%) of the farmers in the sample are aware of IPM practices which suggests that they may be more likely to adopt these practices in the future. Majority (42.65%) use Local cocoa varieties which may be more susceptible to pests and diseases, requiring more intensive IPM practices. The results show that 70.59% of cocoa farmers use chemical pesticides to manage pests, while 29.41% do not.. The high prevalence of blackpod disease and the presence of other pests such as mirid, stem borer, and termites suggest that farmers need to adopt IPM practices to manage these pests effectively. The fact that 89.7% of cocoa farmers implemented IPM practices within 10 years after IPM training suggests that IPM training can lead to sustained IPM adoption. Majority (52.9%) of cocoa farmers adopted IPM practices because they wanted to reduce their chemical usage while (64.7%) of the farmers indicated that extension services are very important for adopting IPM. The chi-square shows the association of Education and IPM Adoption ($\chi 2$= 16.175, p-value=0.001, df=3). There is a significant association between education level and IPM training among cocoa farmers in Osun State, Nigeria ($p = 0.001$). This high reliance on chemical pesticides requires more intensive training on IPM. Extension services should be provided to farmers for knowledge, skills, and support needed to adopt IPM practices, such as training, demonstration plots, and farmer field schools.

Keywords: Innovation, Integrated Pest Management, Extension, Training, Determinants.

Introduction

Cocoa was first located in Mexico and in other areas of central America thousands of years ago (Vulcanotec, 2020). Cocoa was grown in many ancient south American cultures, the Aztecs and Mayans being the most well-known indigenes. Cocoa trees were found growing wild in some areas of the amazon and in current times, cocoa cultivation has spread and it can be located in West Africa, Asia, Central America and South America with each of them having different cocoa variety (Vulcanotec, 2020). About 60% of the world's cocoa is grown in

West Africa, it has been the largest cocoa producer since the end of World War 1 and in recent times is the international center of production (Wikipedia Online Encyclopedia, 2010).

Nigeria used to be the second leading world producer of cocoa in the 70s but currently the world's fourth largest producer after Ivory Coast, Indonesia and Ghana. The drop in production has been due to diverse factors such as ageing cocoa farmers and cocoa trees which occupy a large proportion of established plantations, government neglect of agriculture huge investments in the oil sector and inadequate fund to acquire inputs [Sanusi and Lawal, 2006; FAOSTAT, 2018; Wikipedia, 2020]. Also, the deterioration in cocoa production in Nigeria is mainly due to the incidences of insect pests and diseases along with other factors [Asogwa et al., 2004]. The major insect pests of cocoa are Brown mirids (Sahlbergella singularis) and Black mirid (Distantiella theobroma) which could cause an estimated loss of 100,000 tonnes. The main disease of cocoa is the 'Black pod' caused by Phytophthora palmivora and Phytophthora megakarya which results to 100% total loss [Wood and Lass, 1985].

Cocoa production is a vital sector in Nigeria's economy, providing livelihoods for millions of smallholder farmers (ICCO, 2020). However, cocoa production is constrained by numerous challenges, including pests and diseases, which significantly reduce yields and income for farmers (FAO, 2017). Integrated Pest Management (IPM) is a holistic approach that combines physical, cultural, biological, and chemical controls to manage pests and diseases sustainably (Oguntimehin & Erinle, 2015). Despite its benefits, IPM adoption remains limited among cocoa farmers in Nigeria (Adegbola et al., 2020).

This research set out to integrate research findings on both by formulating a multi-level model of organizational innovation adoption that incorporates determinants at both the organizational and the individual level. These (organizational and individual) adoption models help suppliers of innovations to analyze and identify the potential key drivers of an effective launch of an innovation. As such, the models on innovation adoption derived in this project can serve as analytical tools that can be used in new product marketing planning. In addition, our discussion of farmers group adoption helps us to identify areas that we feel need further attention in future research on innovation adoption of organizational adoption helps us to identify areas that we feel need further attention in future research on innovation adoption.

However, this farmers' group adoption decision marks merely the beginning of the actual implementation of an innovation. From this point onward in the adoption process, the acceptance or assimilation within the group becomes important. The innovation process can only be considered a success to the extent that the innovation is accepted and integrated into the farmers group (Rogers 1995; Zaltman, Duncan and Holbek 1973) and the target adopters demonstrate commitment by continuing to use the product over a period of time (Bhattacherjee 1998). This line of thinking is consistent with Rogers (1995, p. 21) who defines adoption as '... the decision to make full use of an innovation as the best course of action available'. Thus, the full and actual adoption of (many) innovations in an organizational context implies that adoption also occurs within the organization, at the individual level. We refer to this as intra-organizational acceptance. The instance where the usage of an innovation by farmers' "end-users" is uncertain and contingent upon a former group adoption decision, is referred to as contingent innovation decisions or "forced adoption" (Rogers 1995)

Objectives

The objectives of the study are to;

1. Examine the demographic information of the respondents
2. Ascertain the respondents' cocoa production practices
3. Identify IPM Adoption level of the farmers,
4. Determine the factors affecting IPM adoption among the respondents,
5. Investigate the opportunities for future research among the respondents

Hypotheses

HO_1 There is no significant relationship between demographic characteristics of the respondents and IPM adoption practices

Methodology

Both qualitative and quantitative data were collected from 68 cocoa farmers with structured questions

administered through questionnaire at Atakumosa East and Ife East Local Government Areas (LGAs) of Osun State. Two communities (Iwara and Erefe) were selected from the two LGAs respectively. Other questions that were asked pertained to institutional aspects such as farmer's accessibility to agricultural information, prior participation in IPM pest control activities or farmer's accessibility to agricultural extension staff. In addition, farmer's access to credit, their input-acquisition decision making process, and their managerial ability were other factors that were studied. Descriptive statistics was used for data presentation while Chi-square was used to test the hypothesis.

Results and Discussion

Table 1: Personal Characteristics of the respondents

Variables	Frequency	Percentage
Age		
20-40	16	23.5
41-60	40	58.8
61-80	12	17.7
	68	100.0
Sex		
Male	48	70.6
Female	20	29.4
Education		
No Formal Education	5	7.3
Primary	13	19.1
Secondary	42	61.8
Tertiary	8	11.8
Marital Status		
Single	8	11.7
Married	54	79.4
Widowed	5	7.4
Seperated	1	1.5

Source: Field Survey, 2024

Age Categories of the Cocoa Farmers

The results show that 23.5% of cocoa farmers are in the 20-40 age category, 58.8% of cocoa farmers are in the 41-60 age category while 17.7% of cocoa farmers are in the 61-80 age category. This implies that the majority (58.8%) of the farmers are in their prime working age This suggests that cocoa farmers are likely to be physically active and have accumulated experience and knowledge. The presence of younger farmers (23.5%) in the 20-40 age category is encouraging, as they can bring new ideas and energy to cocoa production. The 17.7% of the aging farmers in the 61-80 age category may indicate an aging farmer population, which could lead to labor shortages and knowledge gaps in the future (International Cocoa Organization (ICCO), 2020).

Sex Distribution of Respondents

The sex results show that the majority of respondents (70.59%) were male, while 29.41% were female. This sex disparity is consistent with other studies on agricultural research adoption in Nigeria, which have reported a higher proportion of male respondents (Oyewole & Ogunlade, 2013) and Adebayo & Okuneye (2015) The result has implications for IPM adoption in cocoa production which relates to a research that has shown that male and female farmers may have different levels of knowledge, attitudes, and practices regarding IPM (Doss & Morris (2001). For example, a study in Ghana found that male cocoa farmers were more likely to adopt IPM practices than female farmers (Asante & Amoah (2017).

Educational qualification

In this study, the majority of respondents (61.76%) had secondary education, which suggests that they may have a basic understanding of agricultural practices and be more receptive to IPM adoption. However, the presence of respondents with no formal education (7.35%) and primary education (19.12%) highlights the need for IPM training and education programs to be tailored to the needs of farmers with varying levels of education. Research has shown that farmers with higher levels of education are more likely to adopt new technologies and practices, including IPM (Feder & Umali, 1993). This is because education can enhance farmers' ability to understand and apply new knowledge and skills.

The results show that majority of the respondents had formal education and only 7.35% of respondents had no formal education. Majority (61.76%) had secondary qualification. The level of education has implications for IPM adoption in cocoa production.

Marital Status

In this study, the majority of respondents (79.41%) were married, which suggests that they may have access to a stable source of labor and resources, potentially facilitating IPM adoption.

The marital status of respondents has implications for IPM adoption in cocoa production. Research has

shown that married farmers may have different levels of access to resources, such as land, labor, and credit, compared to single or widowed farmers, Doss (2001). This can influence their ability to adopt new technologies and practices, including IPM.

However, the presence of single, widowed, and separated respondents highlights the need for IPM training and education programs to be tailored to the needs of farmers with varying marital statuses.

Table 2: Distribution of respondents based on varieties cultivated

Varieties	Frequency	Percentage
Hybrid	19	27.9
F3 Amazon	16	23.5
Local	29	42.7
F3 Amazon/Local	1	1.5
F3 Amazon/Hybrid	3	4.4
Total	68	100.0

Source: Field Survey

The use of different cocoa varieties has implications for IPM adoption in cocoa production. Majority (42.65%) use Local cocoa varieties which may be more susceptible to pests and diseases, requiring more intensive IPM practices. Hybrid and F3 Amazon cocoa varieties, on the other hand, may be more resistant to pests and diseases, requiring less intensive IPM practices. (International Cocoa Organization (ICCO), (2018).

Table 3: Distribution of Respondents Based on Awareness of IPM

Variables	Frequency	Percentage
Aware	64	94.1
Not Aware	4	5.9
Total	68	100.0

Source: Field Survey, 2024

The high level of IPM awareness among farmers is a positive indicator for IPM adoption. Awareness is a critical first step in the adoption process, as farmers must be aware of the existence and benefits of IPM practices before they can adopt them (Rogers, 2003). The fact that nearly all (94.12%) of the farmers in the sample are aware of IPM practices suggests that they may be more likely to adopt these practices in the future.

Table 4: Distribution of Respondents Based on Pest Control Measures

Control Measures	Frequency		Percentage	
	Yes	No	Yes	No
Chemical	48	20	70.6	29.4
Biological	17	51	25.0	75.0
Cultural	35	33	51.5	48.5
IPM	24	44	35.3	64.7

Source: Field Survey, 2024

The results show that 70.59% of cocoa farmers use chemical pesticides to manage pests, while 29.41% do not. This high reliance on chemical pesticides is consistent with other studies on cocoa production in Nigeria (Ajayi & Akinnagbe, 2017). The results show that only 25% of cocoa farmers use biological control methods, such as introducing natural predators or parasites of pests, to manage pests. This low adoption rate of biological control methods is consistent with other studies on cocoa production in West Africa (Asante & Amoah, 2017)The results show that 51.47% of cocoa farmers use cultural control methods, such as pruning, sanitation, and crop rotation, to manage pests. This moderate adoption rate of cultural control methods is consistent with other studies on cocoa production in Nigeria (Oyewole & Ogunlade, 2013). The results show that only 35.29% of cocoa farmers use Integrated Pest Management (IPM) practices, which involve a combination of chemical, biological, and cultural control methods. This low adoption rate of IPM practices is consistent with other studies on cocoa production in West Africa (International Cocoa Organization (ICCO), 2018).

The results of this study highlight the need for increased adoption of IPM practices among cocoa farmers in Osun State, Nigeria. The high reliance on chemical pesticides and low adoption rates of biological and cultural control methods suggest that farmers may not be aware of the benefits of IPM practices or may face barriers to adoption.

Table 5: Types of Pest infestation on farmers' farms

Pests	Frequency		Percentage	
	Yes	No	Yes	No
Mirid	32	36	47.1	52.9
Black Pod	60	8	88.2	11.8
Stem Borer	14	54	20.6	79.4
Termites	15	53	22.1	77.9

Source: Field Survey, 2024

The high prevalence of blackpod disease and the presence of other pests such as mirid, stem borer, and termites suggest that farmers need to adopt IPM practices to manage these pests effectively (International Cocoa Organization (ICCO), 2018).

Table 6: Year of IPM Adoption after Training

Period	Frequency	Percentage
1-2	14	20.6
3-4	19	27.9
5-6	15	22.1
7-8	4	5.9
9-10	5	7.4
>10	4	5.9
None	7	10.3
Total	68	100.0

Source: Field Survey, 2024

The results of this study highlight the importance of IPM training in promoting IPM adoption among cocoa farmers. The fact that 89.7% of cocoa farmers implemented IPM practices within 10 years after IPM training suggests that IPM training can lead to sustained IPM adoption (International Cocoa Organization (ICCO), 2018).

However, the results also suggest that there may be a delay in IPM implementation after IPM training, with only 20.6% of cocoa farmers implementing IPM practices within 1-2 years after IPM training. This delay may be due to various factors, such as lack of access to credit, inadequate extension services, or limited availability of IPM inputs (Asante & Amoah, 2017).

Table 7: Respondents' Motivating Factors on IPM Utilisation

Motivating Factors	Frequency		Percentage	
	Yes	No	Yes	No
Increases yield	40	28	58.8	41.2
Reduces chemical usage	36	52	52.9	47.1
Improves quality	19	69	27.9	72.1
Economic Benefits	11	57	16.2	83.8
Reduces Pests	18	50	26.5	73.5

Source: Field Survey, 2024.

The results show that 58.8% of cocoa farmers adopted IPM practices because they expected to increase their yields. This is consistent with other studies that have found that yield improvement is a key motivator for farmers to adopt IPM practices (Asante & Amoah, 2017).

The results show that 52.9% of cocoa farmers adopted IPM practices because they wanted to reduce their chemical usage. This is consistent with other studies that have found that reducing chemical usage is a key motivator for farmers to adopt IPM practices (Ajayi & Akinnagbe, 2017). The results show that 27.9% of cocoa farmers adopted IPM practices because they expected to improve the quality of their cocoa. This is consistent with other studies that have found that improving quality is a key motivator for farmers to adopt IPM practices (International Cocoa Organization (ICCO), (2018).

The results show that 16.18% of cocoa farmers adopted IPM practices because they expected to receive economic benefits. This is consistent with other studies that have found that economic benefits are a key motivator for farmers to adopt IPM practices (Food and Agriculture Organization (FAO) of the United Nations. (2017).

The results show that 26.5% of cocoa farmers adopted IPM practices because they wanted to reduce pests. This is consistent with other studies that have found that reducing pests is a key motivator for farmers to adopt IPM practices (World Bank, 2018).

The results of this study highlight the importance of understanding the motivation factors that encourage farmers to adopt IPM practices. By understanding these factors, policymakers and practitioners can design more effective strategies to promote IPM adoption and improve the sustainability of cocoa production.

Table 8: Respondents' Rating of importance of Extension Services in adopting IPM

Variables	Frequency	Percentage
Very Important	44	64.7
Important	13	19.1
Undecided	5	7.4
Not Important	1	1.5
Not Very Important	5	7.3
Total	68	100.0

Source: Field Survey, 2024

The results on Table show that 64.7% of cocoa farmers reported that extension services are very important for adopting IPM practices, 19.1% reported important, 7.4% were undecided, 1.5% reported not important while 7.3% reported that extension services are not very important. The results of this study highlight the critical role of extension

services in promoting IPM adoption among cocoa farmers. Extension services can provide farmers with the knowledge, skills, and support needed to adopt IPM practices, such as training, demonstration plots, and farmer field schools (Asante & Amoah, 2017).

Table 9: Chi-Square showing the Association of some Personal Characteristics and IPM Adoption

Variables	$\chi 2$	p-value	df	Remark
Sex	0.001	0.973	1	NS
Education	16.175	0.001	3	S
Primary occupation	23.696	0.001	6	S

Source: Field Survey, 2024.

The chi-square results; $\chi 2$=0.001, p-value=0.973 and df=1, indicate that there is no significant association between IPM training and sex among cocoa farmers in Osun State, Nigeria (p = 0.973). The variable IPM adoption and sex are independent, meaning that the probability of adopting IPM does not depend on the farmer's sex.

The Implications include, IPM training programs should be designed to reach all farmers, regardless of sex and collecting sex-disaggregated data can help identify potential sex-based differences in IPM adoption and training (International Cocoa Organization (ICCO), 2020).

The chi-square results for the association of Education and IPM Adoption are: $\chi 2$= 16.175, p-value=0.001 while df=3. There is a significant association between education level and IPM training among cocoa farmers in Osun State, Nigeria (p = 0.001).

The variables education level and IPM training are dependent, meaning that the probability of receiving IPM training depends on the farmer's education level.

The implications of the result are as follows; Education and training programs should be designed to reach farmers with lower education levels, who may be less likely to receive IPM training. Also, targeted interventions, such as adult education programs, may be necessary to improve the education level of farmers and increase their likelihood of receiving IPM training (UNESCO, 2019).

The chi-square results indicate that there is a significant association between primary occupation and IPM training among cocoa farmers in Osun State, Nigeria (p = 0.001).

The variables primary occupation and IPM adoption are dependent, meaning that the probability of adopting IPM depends on the farmer's primary occupation.

The implications of the results are that there is need for targeted interventions, such as training programs, may be necessary to improve IPM adoption among farmers with primary occupations other than farming. Occupation-specific training programs may be necessary to address the specific needs of farmers with different primary occupations (African Development Bank, 2020).

Conclusion and Recommendations

The study reveals that most of the farmers were in their prime age which suggests that cocoa farmers are likely to be physically active and have accumulated experience and knowledge.The result of sex has implications for IPM adoption in cocoa production which relates to a research that has shown that male and female farmers may have different levels of knowledge, attitudes, and practices regarding IPM. Most of the farmers had secondary education, which suggests that they may have a basic understanding of agricultural practices and be more receptive to IPM adoption.

The results of this study highlight the need for increased adoption of IPM practices among cocoa farmers in Osun State, Nigeria. The high reliance on chemical pesticides and low adoption rates of biological and cultural control methods suggest that farmers may not be aware of the benefits of IPM practices or may face barriers to adoption.

The implications of the results are that there is need for targeted interventions, such as training programs, which may be necessary to improve IPM adoption among farmers with primary occupations as farming and other occupations. Occupation-specific training programs may be necessary to address the specific needs of farmers with different primary occupations.

The results of this study highlight the critical role of extension services in promoting IPM adoption among cocoa farmers. Extension services should be provided to farmers for knowledge, skills, and

support needed to adopt IPM practices, such as training, demonstration plots, and farmer field schools.

Acknowledgement
I wish to acknowledge the Executive Director Dr. Patrick Adebola and his management team for the opportunity granted to execute this project.

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Experimental Title: Comparative Analysis of Integrated Pest Management System and Agrochemical use in Cocoa Production in South West, Nigeria

Investigators: Oladokun Y.O.M., Oluyole K.A., Ogunwolu Q.A., Adesanya K.A. and Adeyemi E.A

Introduction

Cocoa, *Theobroma cacao*, is a perennial tropical tree crop whose fruit yields cocoa beans. Originating in the Americas, cocoa held significant value in early South American civilizations. Today, it stands as a principal agricultural export from West Africa, where over 99% of African cocoa is produced. West Africa leads the global cocoa production, with a notable growth of 2-3 million tons since the 2000s, as highlighted by Fountain and Hütz-Adams (2015). In this region, cocoa cultivation is primarily carried out by smallholder farmers who traditionally plant cocoa amidst thinned forest shade, employing a low-input cultivation system that relies on forest soil fertility and natural shade. This method extends across approximately six million hectares of the West African forest zone, contributing around 70% of the world's total cocoa production. Cocoa beans serve as the raw material for various chocolate industry by-products, including liquor, paste, butter, cake, and powder, with chocolate being the most recognizable end product. Cocoa beans thrive in tropical regions near the Equator, where the hot and humid climate favours cocoa tree growth. Notably, four West African countries—Côte d'Ivoire, Ghana, Nigeria, and Cameroon—account for about 70% of the world's cocoa bean production.

Cocoa thrives in hot, rainy climates, typically within 20 degrees north or south of the equator. Optimal growth conditions include a mean shade temperature of 27°C, minimal daily temperature variation (less than 8°C), and well-distributed rainfall of at least 12 cm. To ensure good output, an annual rainfall range of 1,100mm to 3,000mm is necessary, with a dry season not exceeding three months and a minimum monthly rainfall of approximately 100mm. Cocoa is typically cultivated directly from seeds or through seedlings raised in nurseries. Once seedlings reach around 5 cm in height, they are transplanted at a distance of 3 to 4 meters apart, with shade plants often interspersed between rows to shield young plants from strong winds and direct sunlight. The most commonly cultivated type of cocoa may yield a small harvest after about five years, although this timeline varies significantly based on local conditions and farming practices. A full crop usually matures after at least ten years. While the economic lifespan of a cocoa tree remains unknown, under optimal weather, soil, and management conditions, it can bear fruit almost indefinitely. The global production of cocoa beans exhibits irregular patterns due to various factors such as pests and diseases, weather dependency and low farm gate prices. Integrated pest management (IPM) represents a comprehensive, sustainable approach to pest management over the long term. It employs a combination of biological, cultural, and chemical tactics aimed at minimizing pests to levels deemed tolerable, all while imposing minimal costs on the grower and reducing environmental impact. Research and experimentation have demonstrated the effectiveness of IPM, surpassing classical methods such as biological or chemical control (Van Lenteren, 1995).

It is crucial to evaluate the social and economic sustainability of integrated pest management (IPM) and the use of agrochemicals in the cocoa industry in order to support farmers' livelihoods and guarantee market access. According to Oztas *et al*. (2018) agrochemicals can result in pesticide resistance and have substantial financial costs, which can eventually reduce their long-term efficacy and farmers' financial advantages. IPM techniques, on the other hand, may result in financial savings, increased agricultural profitability, and a decrease in the dangers to farmers' and consumers' health (Oluwole and Cheke, 2009). Stakeholders may develop solutions to increase farmers' income, advance social fairness, and fortify the resilience of cocoa producing communities by comparing the economic performance of IPM and pesticide usage. Additionally, knowledgeable decisions may be made by farmers and politicians to reduce ecological impact and protect biodiversity in cocoa-producing areas. This study aimed to compare the productivity of cocoa production using IPM and agrochemicals to come out with policies to promote the use of IPM system among cocoa farmers in South West, Nigeria.

The broad objective of the study is to compare the productivity of cocoa production using IPM and agrochemicals. The specific objectives are to:

i. describe the socio-economic characteristics of farmers in South West Nigeria;
ii. evaluate the productivity of cocoa farmers using agrochemical and IPM;
iii. determine the factors influencing the use of IPM and agrochemicals in cocoa production; and
iv. compare the profitability of IPM and agrochemical users in cocoa production.

Materials and Methods

Study Area

The study was carried out in South West Nigeria. Oyo and Ogun states specifically.

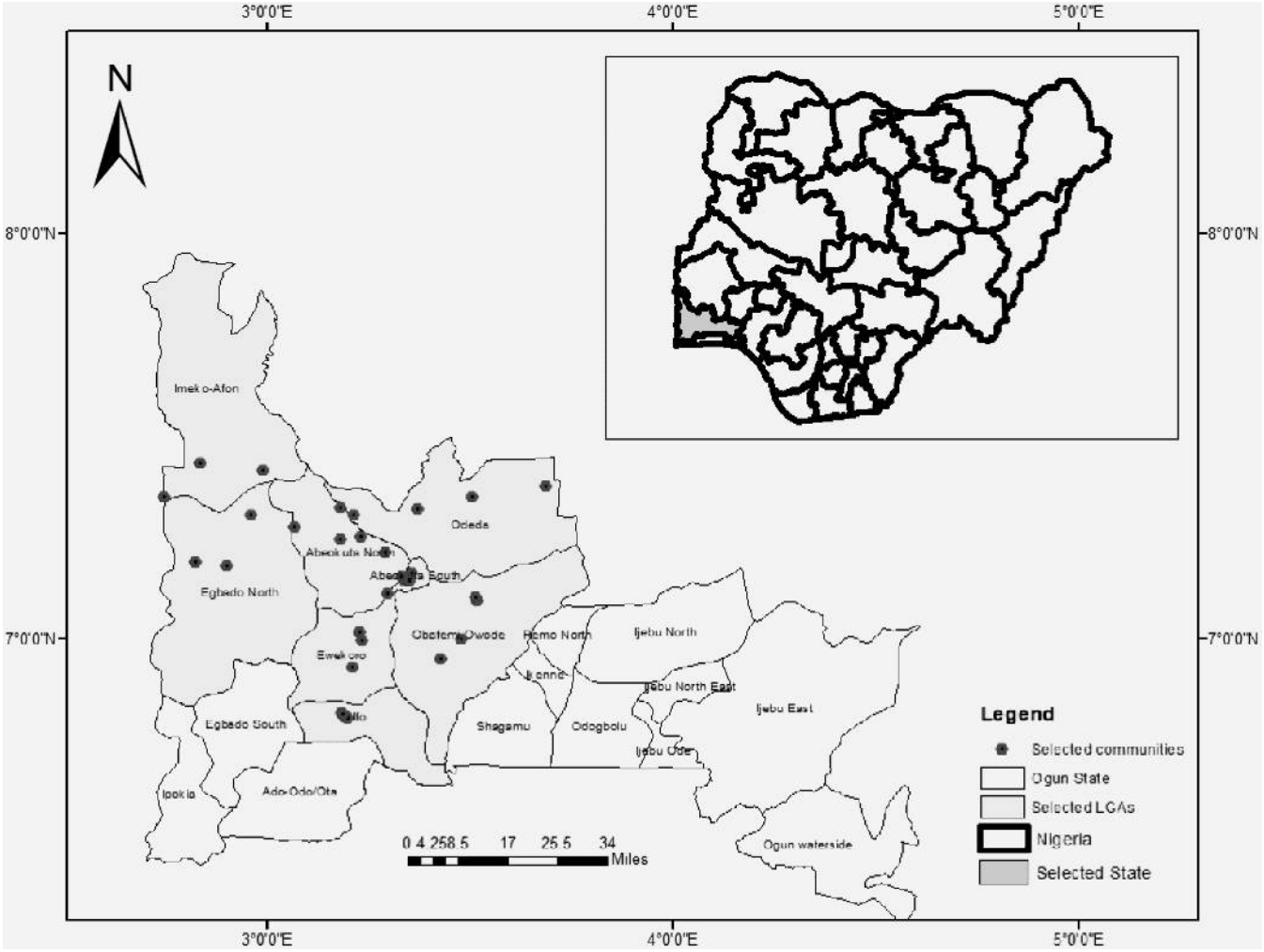

Figure 1. Map of Ogun State (Surakat *et al.,* 2023)

Figure 2. Map of Oyo State (www.researchgate.net)

Sampling Techniques

Multistage sampling technique was used to select respondents in the study area. The first stage involved the selection of two states with the high cocoa production in the Southwest. Oyo and Ogun states were selected. In Oyo state Akinyele and Ibarapa Northwest Local Government Areas (LGAs) were selected while Obafemi Owode and Ijebu North LGAs were selected in Ogun state. Thirty cocoa farmers were randomly selected in each LGA. A total of fifty cocoa farmers were selected in each state. After sorting out for missing data ninety-four cocoa farmers' information was used for analysis.

Analytical Techniques

Descriptive statistics was used to describe the socio-economic characteristics of cocoa farmers in both states. Total Factor Productivity was used to determine the productivity of cocoa using IPM and agrochemical. Total factor productivity (TFP) is the ratio of the value of total farm output to the value of the total inputs used in farm production. Following Key and Mcbride (2003) and Rahji (2007), the productivity of cocoa was determined using the following formula in Eq. (1):

$$TFPi = Y_i / \sum PiXi \quad (1)$$

Where Y is quantity of output in Kg;

P is unit price of ith variable input; and

Xi is the quantity of ith variable input.

The TFP will also be measured as the inverse of average unit cost of production

$$TFP = Y/TVC = 1/AVC = Y/\Sigma PXi \quad (2)$$

where Y is quantity of total farm output using conversion factor (grain equivalents) in Kg; TVC is Total Variable Cost in naira; AVC is Average Variable Cost in naira; P is unit price of ith variable input; and Xi = quantity of ith variable input. This approach ignores the role of Total Fixed Cost (TFC) as this does not affect both the profit maximization and the resource-use efficiency conditions.

Gross Margin Analysis

Budgetary analysis will be used to estimate the cost of production and revenue generated from cocoa production using IPM and Agrochemical.

Gross Revenue (GR) = Total Output (Total number of tons of tea sold) X unit price…… (i)

Gross Margin (GM) = GR – Total Variable Cost (TVC) ……..... (ii)

Results and Discussion

Table 1 revealed the socio-economic characteristics of cocoa farmers using agrochemical and IPM. The mean age of farmers using IPM was 49.9 ± 13.7 while those using agrochemical were 51years old on the average. Farmers that use IPM and agrochemicals are in their mid-age thus they are active, gathered experience over the years and thus this should affect their production positively. Cocoa farmers that use IPM system are more male (71.9) compared to women (28.1%). For agrochemical user male constitute 64.9% while women constitute 35.1%. Women in Nigeria are more involved with arable crop production, processing and marketing of tree crops. Majority of cocoa farmers that use IPM (92.9%) and agrochemicals (89.2%) are married. These farmers could readily have labour available through members of their family and they could also use most of their returns from their farm to care for their families.

The mean of years of farming experience of farmers using IPM was 27years while for those that use agrochemicals the mean years of experience was 24years. Cocoa farmers in both categories have experience in cocoa farming and could make informed decisions concerning cocoa production. In both categories farmers in the study area are educated having a secondary level of education. Their educational level could help in the adoption of new technologies and techniques. The mean household size for IPM and agrochemical users was 7. This moderately large household size could be of benefit for the farmers. Wives and children could help in cocoa beans scooping, fermentation and drying. The main occupation of respondents in both categories was farming. The mean farm size for IPM users was 2.8± 2.2 hectares while that of agrochemical users was 3.1±2.7. Cocoa Farmers in both categories are smallholder farmers. Majority of farmers in both categories owned their farm. This is very important as farmers could be able to get loans from banks as a result of land ownership. Farmers are secured about their production as cocoa are tree crops and could stay on their farm for a long time and even be passed down to their children compared to if the land was rented.

Table 1. Socio economic characteristics of cocoa farmers using agrochemical and IPM

Variable.	IPM		Agrochemical	
	Freq.(N=57)	%	Freq (N=37)	%
Age (years)				
= 30	4	7.0	2	5.4
31-60	42	73.7	28	75.7
61-max	11	19.3	7	18.9
Mean 49.9 ± 13.7			50.7 ± 12.5	
Gender				
Male	16	28.1	13	35.1
Female	41	71.9	24	64.9
Marital status				
Single	4	7.1	3	8.1
Married	53	92.9	33	89.2
Widow			1	2.7
Years of farming experience (years)				
= 10	8	14.0	8	21.6
11-20	13	22.8	6	16.2
21-30	21	36.8	15	40.5
31-40	9	15.8	5	13.5
41-50	9	15.8	1	2.7
51-60	3	5.3	2	5.4
61-70	2	3.5		
>70	1	1.8		
Mean 26.7± 13.0			24.3± 14.1	
Educational Level				
No formal education	3	5.3	7	18.9
Primary	20	35.1	13	35.1
Secondary	27	47.4	14	37.8
Tertiary	7	12.3	3	8.1
Household size				
= 5 persons	19	33.3	10	27.0
6-10 persons	33	57.9	25	67.6
>10 persons	5	8.8	2	5.4
Mean 6.7 ± 2.9			6.6±2.7	
Main occupation				
Cocoa farming	49	85.9	34	91.9
Trading	3	5.3	1	2.7
Artisan	3	5.3		
Civil service	1	1.8		
Others	1	1.8	2	5.4
Farm size(hectares)				
0-5	52	91.2	31	83.8
5-10	3	5.3	13.5	97.3
>10	2	3.5	1	2.7
Mean 2.8± 3.2			3.1±2.7	
Land Ownership				
Own	47	82.5	35	94.6
Rent	10	17.5	2	5.4

Source: Field Survey, 2024

4.2 Total Factor Productivity

IPM Users

Total Factor Productivity (TFP) measures the efficiency with which all inputs (land, labor, agrochemicals are used to produce output. A TFP value of 0.148 for cocoa production means that the efficiency of cocoa production has increased by 14.8%. A TFP of 0.148 suggests that cocoa production is becoming more efficient over time. For every unit of input (like labor, land, or capital), the production of cocoa has increased by 14.8%. This indicates improvements in technology, farming practices, or management in cocoa farming.

Quantity of output (Kg) =3,376,391
Variable cost for Herbicide = ₦12,425,456
Variable cost for Insecticide = ₦ 6,442,968
Variable cost for Fungicide = ₦ 3,929,300
Total cost of inputs =₦22,797,724
TFP= 0.148

Agrochemical users

The figure of 0.0175 could reflect several factors contributing to productivity gains, such as better use of inputs, technological innovations, better farming practices, higher-quality seeds, or more efficient labor usage. Cocoa farmers are able to produce more output with less or the same input, which is crucial for improving profitability, sustainability, and long-term growth in the cocoa sector.

Quantity of output (Kg) = 582762
Variable cost for Herbicide = ₦29,753,812
Variable cost for Insecticide = ₦ 2,515000
Variable cost for Fungicide = ₦ 1,104000
Total Input cost = ₦ 33372812
TFP= 0.0175

4.3 Factors affecting the use of IPM and agrochemicals in cocoa production

Table 2 revealed the factors influencing the use of IPM and agrochemicals in cocoa production. The factors include pest and disease severity, availability of agrochemicals, cost of chemicals, tradition, availability of chemicals, training and guidance from extension agents. Thirty-nine percent of IPM users identified Pest and Disease severity as the major reason for the use of IPM. Also 81.1% of cocoa farmers that use agrochemicals only affirmed that pest and disease severity is the major reason for the use of agrochemicals. IPM and agrochemical users also affirmed that the second reason for the use of these categories are the availability of agrochemicals. The other factors were tradition, training and guidance from extension agents.

Table 2: Factors influencing the use of IPM and agrochemicals in cocoa production

Variable	IPM		Agrochemicals	
	Freq.(57)	%	Freq.	%
Pest and Disease Severity	39	68.4	30	81.1
Availability of Agrochemicals	8	14.0	4	10.8
Cost of Agrochemicals	2	3.5	1	2.7
Tradition	1	1.8		
Training and guidance from extension agents			2	5.4

Source: Field Survey, 2024

4.4 Gross Margin Analysis

For IPM Users the Gross revenue was ₦ 36,895,002 and the Gross revenue per farmer was ₦ 647,280.75. The Total Variable Cost (TVC) for IPM users was ₦ 3,856,602 and the TVC per farmer was ₦67,659.68. Gross margin was ₦33,038,400 and Gross margin per farmer per year was ₦579,621. On the other hand, the Gross Revenue for agrochemical users was ₦ 12,597,360.9 and the Gross revenue per farmer was ₦340,469.21. The Total Variable Cost (TVC) for agrochemical users was ₦38,566,024 and the TVC per farmer per year was ₦257,328.71. Gross margin was ₦ 3,076,198.5 and Gross margin per farmer per year was ₦83,140.5. Cocoa farmers that use IPM had more Gross Revenue compared to only agrochemical users. Agrochemical users incurred more variable costs compared with IPM users. This may be due to the high cost of chemicals used.

IPM Users
Gross Revenue (GR) = ₦ 36,895,002.7
Gross Revenue per farmer/year= ₦ 647,280.75
Total Variable Cost (TVC) = ₦ 38,566,024
TVC/ farmer = ₦ 12,866,436
Gross Margin (GM) = ₦ 330,384,003.1
GM/farmer/year= ₦ 4,157,025

Agrochemical users
Gross Revenue (GR) = ₦12,597,360.9
GR/farmer/year = ₦340,469.21
Total Variable Cost (TVC) = ₦ 9,521,162.4
TVC/farmer/year = ₦ 257,328.71
Gross Margin (GM) = ₦ 3,076,198.5
GR/farmer/year = ₦83,140.5

Conclusion and Recommendations
Findings revealed that cocoa farmers using IPM demonstrated greater efficiency in resource utilization and higher profitability compared to those relying solely on agrochemicals. IPM users incurred lower variable costs while achieving higher gross margins, making it a more economically viable option. Additionally, factors such as pest and disease severity, availability and cost of inputs, tradition, and extension support played significant roles in farmers' decisions to adopt either method.

Based on these findings, the following recommendations are proposed:

1. **Promotion of IPM Adoption:** Policies should encourage wider adoption of IPM practices among cocoa farmers by emphasizing its long-term benefits through targeted awareness campaigns.
2. **Subsidies and Support for Sustainable Practices:** Government and stakeholders should provide financial incentives or input subsidies to support farmers transitioning to IPM, reducing cost barriers to adoption.
3. **Strengthening Extension Services:** Training programs and field demonstrations should be expanded to improve farmers' knowledge of IPM techniques and their effectiveness in pest control.
4. **Regulation of Agrochemical Use:** Stricter regulations and monitoring should be implemented to ensure the responsible use of agrochemicals, minimizing their environmental and health risks.
5. **Research and Development:** Further studies should focus on developing innovative and cost-effective IPM strategies to enhance sustainability in cocoa production while ensuring improved yield and profitability.

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Experimental Title: Resuscitation by Replication of Hybrid Trial Materials

Investigators: Muyiwa, A. A., Adeigbe, O. O., Adepoju, A. F., Olasupo, F. O., Sobowale , I. O., Babanista, M., Adenuga, O. O., Olaniyi, O. O.

Introduction

A hybrid trial plantation, comprising 23 bi-parental crosses and an open-pollinated F3 Amazon control, was established at the CRIN Headquarters in Ibadan (07.02°N, 03.09°E; 122 m above sea level) during June-July 1999. The experimental design followed a randomized complete block layout with six replications, each consisting of a 10-tree plot spaced at 3 m x 3 m. Observations focused on precocity, defined as pod production during the 24–36 months of field establishment. Notably, among the 23 bi-parental crosses, the CRIN TC series was screened and subsequently released to Nigerian farmers in 2011, reflecting a significant advancement in local agricultural practices.

The resuscitation of this trial has become imperative following the recent fire outbreak on the site. It is recommended that the trial plantation be replicated to facilitate the Institute's capacity to meet the escalating demand for improved planting materials, which continues to rise annually. The re-establishment of these 23 bi-parental crosses will enhance the availability of superior planting materials for farmers, subsequently increasing cocoa production in the country and boosting farmers' income generation.

This study therefore sought to revitalize hybrid trial materials via cloning techniques, thereby addressing the pressing needs of cocoa farmers for sustainable production practices.

Materials and Methods

Vegetative materials (budwood) will be systematically collected from various remaining resources within each block of the field. Selected young stems from designated cocoa trees will undergo grafting onto established rootstock at the CRIN headquarters nursery. The successful grafts will subsequently be utilized to replace any missing stands within the one-hectare hybrid trial plot.

Results and Discussion

A total of two thousand cocoa seedlings have been raised in the nursery as rootstock (Plate 1), poised for the grafting process. This critical phase is scheduled to commence in three to four months, allowing for the development and enhancement of the seedlings' genetic attributes. The careful management of this process is essential for ensuring the successful propagation of superior cocoa varieties.

Plate 1: Raised cocoa seedlings to be used as rootstock

Conclusion and Recommendation
The current work is still in progress and cannot be terminated at this time. Subsequent activities will be undertaken following the grafting process.

Experimental Title: Expansion of Parental Clonal Garden; A Source of Planting Material for Nigeria Cocoa Farmers

Investigators: Muyiwa A. A, Sobowale, I. O, Orisajo S. B, Adejobi K. B, Ogundeji B. A.

Introduction
The global demand for cocoa continues to rise, largely driven by the increasing consumption of chocolate in conjunction with economic development. However, cocoa production is facing significant challenges, including ageing tree stocks, inadequate planting materials, pest and disease occurrences, fire outbreaks, and declining soil fertility. To address these issues and ensure sustainable cocoa production, the adoption of superior planting materials is essential. Enhanced cocoa productivity not only stabilizes the industry for all stakeholders but also aligns with the growing demand from emerging markets, particularly in Nigeria. The Cocoa Research Institute of Nigeria (CRIN) has developed eight hybrids that outperform the widely used F3 Amazon cocoa variety in yield and early productivity. Despite the clear advantages of these hybrids, the supply remains insufficient to meet the growing demand due to limited parental materials. Establishing these parental clones is crucial for increasing the availability of improved planting materials, thereby boosting national cocoa production and enhancing farmers' income.

The objective of establishing a one-hectare parental clonal garden is to effectively address the pressing demands of cocoa farmers for sustainable production

Materials and Method
Vegetative materials, specifically budwood, were meticulously collected from various field trials of parental materials across multiple locations. These materials were subsequently grafted onto pre-existing rootstock at the nursery located at the Cocoa Research Institute of Nigeria (CRIN) Headquarters. The resultant successful grafts were then established over an expanse of one hectare at the CRIN Headquarters, facilitating further research and development.

Results and Discussion
In the nursery, over three thousand cocoa seedlings were raised as root stock, from which 1,760 seedlings were subsequently selected for grafting. A success rate of 50 percent was achieved (Plate 1), resulting in 798 seedlings being transplanted into the field, specifically within a hectare of pre-established shade crops (plantain) (Plate 2).

Plate 1. Successful grafts

Plate 2. Established parental clonal garden plantation

Conclusion and Recommendation

The ongoing efforts in the project are marked by the successful raising of an additional set of rootstocks, intended for grafting. This initiative aims to complete the establishment of a one-hectare parental garden, while simultaneously addressing the gaps in existing stands. The meticulous management of this process underscores our commitment to enhancing the overall productivity and sustainability of the garden.

Experimental Title: Effect of Rootstock on Drought Tolerance abilities of Cocoa in Nigeria

Investigators: Ayegboyin, K. O. and Famaye, A. O.

Introduction

In Nigeria, new establishment of cocoa farms are usually made at the onset of the rainy season around early April but post establishment losses are now high during the first two dry seasons. This could be a result of degradation of farmland soil as a result of previous successive cropping that has reduced the organic matter and water-holding capacity of the soil. However, the most serious reason for current high establishment mortality of cocoa farms is the emerging global climate change coupled with local deforestation which had resulted in less predictable dry seasons during early establishment. Strategies to improve establishment can include exploitation of different genotypes and use of cultural practices such as overhead shade and fertilisation (Acheampong *et al*., 2015). An area that has received relatively little attention to date is the use of different rootstocks which had been fully established to improve growth, development and yield of many other tree crops like Apple, Oranges etc. However, despite the success stories in other crops, almost all cultivated cocoa in Nigeria is grown from seeds unlike what is obtainable in other cocoa-producing regions like Brazil, Ecuador and Indonesia where the use of vegetative propagation like the use of rootstock is now a well-known tool among cocoa farmers. It is therefore pertinent to consider the impact of rootstocks on cocoa within a Nigerian context. In Nigeria, the first attempt at investigating the relative importance of the interaction between rootstock and scion in cocoa plantation establishment started in 1971 (Atanda, 1975) but the results showed a general poor performance and the failure was attributed mainly to late transplanting and the period of time that the budded materials stayed in the nursery (Atanda, 1975). However, no information exists for cocoa as to whether the performance of the scion is impacted by rootstock under water-limiting conditions in Nigeria. The aim of the experiment was to test the performance of a range of cocoa clones on two genetically distinct rootstock and develop cocoa

cultivars that are high yielding and relatively more tolerant to water stress to enhance cocoa production in marginal cocoa climates of Nigeria. The expected output will include getting the information on the drought characteristics performance of the grafted cocoa genotypes while their first filial generation would also be tested for their yield production and abilities to withstand water stress for possible recommendation for farmers' use in marginal cocoa areas.

Materials and Methods

Both nursery and field trials were involved to test the materials for the scions and rootstocks. The study was carried out at the Cocoa Research Institute of Nigeria (CRIN) Headquarters in Ibadan, Oyo State, Nigeria. Ibadan is located between 7°26′ North and 3°54′ East with an altitude of 200 m above sea level and has a bimodal rainfall pattern; annual rainfall for the period of the study ranged from 1045-1237 mm. The project was in 3 different phases as follows:

Phase 1: Study on the cocoa clones to be used as rootstocks in the greenhouse.

Phase 2: In-situ study of the cocoa clones to be used as scions.

Phase 3: Grafting of scions on the rootstocks.

For the purpose of this report, only phases 1and 2 above were covered. The 1st phase involved hand self-pollination to produce cocoa pods for greenhouse and phase 3 study. The 2nd phase was the field study whereby the selected cocoa clones were tested in-situ. The 3rd phase will be the planting out of the grafted scions upon rootstocks cocoa. All the agronomic and physiological performance of the grafted cocoa genotypes on the field. This report presents part of the result for the 1st and 2nd phases of the project which involves the screening of cocoa g to be used as scions and rootstocks to produce the cocoa genotypes for drought tolerance. For this greenhouse experiment, the cocoa seeds were pre-germinated in the sawdust for two weeks before being transplanted into pots containing 4kg of topsoil collected between 0 and 15 cm of the soil surface. The top soil was passed through 10 mm sieve before being placed in the experimental pots. There were 330 experimental seedlings with 11 cocoa genotypes, 5 stands per genotype, 2 field capacities at 50 and 100% field capacities and 3 replications to make up of 330 experimental cocoa seedlings. At 2 weeks after sowing, the seedlings were transferred from the pre-germination chamber into the soil in the pots and were watered at the same rate for another 2 weeks. Imposition of water regimes on the seedlings started exactly at 1 month after sowing (MAS) at 50 and 100 field capacity (FC) using procedure described by Ayegboyin, K. O. (2012).

For the statistical analyses, the average data obtained for the growth parameters (plant height, stem girth, number of leaves and number of branches) of cocoa seedlings (rootstock materials) and those tested in-situ for scions were (and are still being) analysed using ANOVA with an F-test. The treatment means were compared using a Duncan Multiple Range Test at the 5% probability level (Gomez and Gomez, 1984).

Results and Discussion

Greenhouse Experimental Results

Physio-chemical analysis of soil used in the greenhouse experiment

Soil samples were taken from the top layer of soil used for the greenhouse experiment in Ibadan. The samples were air-dried under room temperature for three weeks and then bulked together. A sample of the air-dried bulked soil was taken and kept in a sealed coded zip lock bag before being sent to an internationally accredited laboratory for soil analysis. The result is shown in Table 1.

The physico-chemical properties of the soil as presented in Table 1 showed that soil used for the greenhouse trial has a pH of 6.9 which is ideal for cocoa growth. Cocoa grows well in soils with a pH in the range of 5.0 - 7.5. It can therefore cope with both acid and alkaline soil, but excessive acidity (pH 4.0 and below) or alkalinity (pH 8.0 and above) must be avoided. Cocoa is tolerant of acid soils, provided the nutrient content is high enough. Based on the established critical levels for soils in Southwest Nigeria, the soil was good in organic matter compared to the critical level at 2.49 % O.M. (Agboola and Corey, 1973). The total N was 0.15 % and considered optimal for most crops according to Sobulo and Osiname, 1981. The available P was 10.79 m gkg-1 and higher than 10m gkg-1 P regarded as adequate for crop production (Agboola and Corey, 1973). The exchangeable K, Ca, Mg and Na were higher than 0.2 mmol/kg regarded as the critical levels for cocoa seedlings (Folorunso *et al.,* 1995),

thus, indicating rich soil fertility. The distribution of particle sizes of Sand (85.04%), Silt (12.00%) and Clay (2.60%) showed that the sampled soil was Sandy loam. These results revealed that the soil used for the greenhouse experiment was ideal for cocoa production. Cocoa requires deep and well drained soils. Poorly drained soil affects growth of plants. Majority of area under Cocoa cultivation is on clay loam and sandy loam soil.

The results of the exchangeable bases, Ca, Mg, K and Na) in the sampled soil showed that the soil had enough of Calcium, Magnesium and Potassium nutrients for good cocoa production. The term "exchangeable bases" or "total exchangeable bases" refers to the sum of the bases (calcium, magnesium, potassium, and sodium) in exchangeable form expressed as milligram equivalents per 100 g of soil. The 0.07 exchangeable Al+H showed a very low exchangeable Aluminum hydride. However, hydrated Aluminum species (combined with hydroxyl [OH]$^-$) usually are not toxic to plants because their charge is too weak to displace basic cations (Ca^{2+}, Mg^{2+}) from soil exchange sites. As soil pH becomes lower, decreasing soil pH provides increasing H^+ ion activity, which reacts with OH- ions combined with the Al^{3+} ion, stripping the OH^- away from the Al^{3+}, thereby increasing the charge on the Al-species to a +2 or +3 charge.

Table 1. Results of laboratory analysis of soil samples for greenhouse trial

	Parameter	Unit	Value
	pH		6.9
Particle size	Sand	%	85.40
	Silt	%	12.00
	Clay	%	2.60
Exchangeable Bases	Ca	Cmol/kg	5.36
	Mg	Cmol/kg	1.08
	K	Cmol/kg	0.364
	Na	Cmol/kg	0.494
	Al+H	Cmol/kg	0.07
	ECEC	Cmol/kg	7.37
Base	Salinity	%	99.05
Total	N	%	0.149
Total	Organic C	%	2.49
Available	P	mg/kg	10.79
Micro nutrients	Mn	mg/kg	66.30
	Fe	mg/kg	1.35
	Cu	mg/kg	6.47
	Zn	mg/kg	12.75

Performance of Cocoa seedlings in the Greenhouse: The performance of 11 genotypes of cocoa seedlings under 50% and 100% field capacities an are shown in Figures 1-4.

Plant height, stem girth, leaf number and number of branches (growth parameters) of the cocoa seedlings increased with time during the first 3 months after sowing. While there were no significant differences ($p = 0.05$) among cocoa genotypes at the 3rd MAS for seedlings under 100% FC, there were significant differences ($p = 0.05$) between treatments for those under 50% FC at 3 MAS in all parameters tested. While the height of TC2 (30 cm) was significantly higher than that of AMAZ15 (25 cm) at $p = 0.05$, the average stem girth of AMAZ15 (30 mm) was not significantly higher ($p = 0.05$) than those of TC2 (29 mm) under 50% FC. At 6 MAS under 100 and 50 FC, there were significant differences between treatments and genotypes. For instance, at 6 MAS under 100%, the height of N38 (57.8 cm) was significantly higher than those of P 150 (51.2cm) but on the contrary, at 50 FC at 6 MAS, the height of N38 (40.8 cm) was significantly lower than those of P150 (46.2 cm) and hence established some traits of variations in the drought tolerance abilities of cocoa genotypes during the period. In conclusion, the experiment confirmed a genotypic differences in the drought tolerance abilities of the cocoa clones in the Cocoa Research Institute of Nigeria, Ibadan although, the project is still on-going and more studies would still be performance later. The budding

of rootstock and field establishment aspects of the experiment will be carried out later in 2024.

There was no siginificant differences between clones leaf area in the 2024 dry season. However, the plant leaf areas ranged from 101.2 cm^2 for N 38 to 149.3 cm^2 for IMC 47. There was a significant overall clone*season interactions (P = 0.06). While the leaf area of IMC 47, SCA 6 and SPEC 54/1 remianed relatively stable in the tested dry season while the leaf area of N 38, UF 676 and AMAZ 15/15 were more affected by dry season.

There was an observed significant clone*season interactions both in the leaf area and leaf RWC performance cocoa clones is similar to the observations of Rajagopal and Balasimha (1994) on their work conducted on trees of drought-tolerant and drought-susceptible cocoa clones grown as a mixed crop with Arecanut palms. The authors discovered that the transpiration rate, stomatal conductance and net photosynthetic rate varied significantly with seasons. The authors further explained that the major adaptation for water conservation in cocoa plants is the regulation of stomata by internal stress and external factors which eventually leads to a decrease in the transpiration rates and reduction in the leaf area. As cocoa trees continued to experience water stress, there is a time when an extensive decrease in their water content or an increase in water deficit reaches a level which negatively affects their physiological processes (Grossnickle, 2000). Consequently, effective reduction in water loss is highly desirable for cocoa plants to survive water stress condition. Adjustment in the leaf growth is the last major physical consequences of changes in the physiological processes due to water stress since a decrease in leaf expansion rate is usually the result of a reduction in stomatal conductance and photosynthesis (Farooq *et al.*, 2010).

Status of the work: The in-situ study of the cocoa scion materials is still ongoing while the grafting of scion on the rootstock will be done later. The project is ongoing.

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Experimental Title: Adoption of New Cocoa Cultivars (Crin Tc1-Tc8) among Farmers in Osun State

Investigators: Akinsola, M. H., Adewumi, I. A., Uwagboe, E. O., Orisajo, S. B., Famuyiwa, B. S., Agbongiarhuoyi, A. E., Abdulkarim, I. F. and

Williams, O. A.

Introduction

Cocoa production has been a critical sector in Nigeria's agricultural economy, providing employment and income for smallholder farmers (Aiyede, 2021; Amuda, 2020). Osun State, located in southwestern Nigeria, is one of the country's largest cocoa-producing regions alongside Ondo and Oyo (Alamu, 2013). However, despite its significance, cocoa farming in Nigeria faces challenges such as declining yield, ageing tree stocks, and vulnerability to pests and diseases (Afolayan, 2020). The Cocoa Research Institute of Nigeria (CRIN) developed improved cocoa cultivars (CRIN TC1-TC8) with enhanced yield potential, disease resistance, and adaptability to changing climatic conditions to address these issues (Akinwale & Folarin, 2018). Adopting these new cocoa cultivars is critical for ensuring sustainable production and improving farmers' livelihoods (Lawal & Omonona, 2014). Understanding the factors influencing farmers' adoption of CRIN TC1-TC8 cultivars can inform policy and extension services to promote improved agricultural technologies. Despite the documented benefits of these cultivars, there is limited empirical research on their adoption in Osun State. This study seeks to bridge this gap by examining the adoption rate, determinants of adoption, and associated challenges among cocoa farmers in the region.

This research focuses on assessing the awareness and adoption of CRIN TC1-TC8 among cocoa farmers in Osun State. It also investigates socio-economic, institutional, and environmental factors influencing adoption decisions. In addition, the study explores the perceived benefits and constraints associated with adopting these improved cultivars. Previous studies have emphasised the importance of improved cocoa varieties in enhancing productivity and sustainability in the cocoa sector. However, most research efforts have focused on agronomic performance and yield trials (Edet *et al*., 2018; Olasupo & Aikpokpodion, 2019; Aikpokpodion & Adeogun, 2011) rather than farmers' adoption behavior. Limited studies (Akinwale & Folarin, 2018 and Ilesanmi & Afolabi, 2020) have examined how socio-economic, institutional, and behavioral factors shape the uptake of new cocoa technologies in Nigeria, particularly in Osun State. This study contributes to existing knowledge by providing insights into farmer decision-making regarding improved cocoa cultivars. This study primarily sought to assess the adoption of CRIN TC1-TC8 cocoa cultivars among farmers in Osun State, with the specific aims of:

1. examining the socio-economic characteristics of cocoa farmers in the study area;
2. describing the cocoa enterprise characteristics of farmers;
3. determining the adoption rate of new cocoa cultivar; and
4. identifying constraints to the adoption of new cocoa cultivar.

Methodology

Description of the study area

Osun State, situated in southwestern Nigeria (7°30'N, 4°30'E), shares boundaries with Kwara State to the north, Ekiti and Ondo States to the east, Ogun State to the south, and Oyo State to the west. According to the 2006 national census, the state had approximately 3.4 million people. The state capital, Osogbo serves as its administrative hub. Osun State is divided into 30 Local Government Areas (LGAs), with an economy driven by agriculture, small-scale industries, and commerce. The region's fertile soils support the cultivation of commodity crops like cocoa, oil palm, and kola nuts, alongside staple crops such as yam, cassava, and maize. The state's economy is predominantly agrarian, with agriculture as the mainstay. Notably, Osun State is recognized as the third-highest cocoa-producing state in Nigeria, exporting over 50,000 tons of cocoa annually. Within Osun State, several Local Government Areas (LGAs) play significant roles in its demographic and economic landscape. Ife East LGA, for instance, had a population of 188,087 per the 2006 census, making it one of the most populous LGAs in the state. Similarly, Ife Central LGA recorded a population 167,204 in the same census. Ife North and Ife South LGAs had populations of 153,694 and 135,338, respectively. Ilesha East LGA had a population of 106,586, while Atakumosa East and Ede South LGAs had populations of 76,197 and 76,035, respectively. These LGAs are predominantly inhabited by the Yoruba ethnic group, with Yoruba being the widely spoken language. Cocoa production is a vital economic activity across these LGAs. The

Osun State government has recently implemented initiatives to bolster cocoa farming. In 2021, the government distributed 100,000 cocoa seedlings to about 1,000 farmers to rejuvenate cultivation. Furthermore, in 2024, over 3,500 farmers received financial incentives totaling over ₦150 million to promote sustainable cocoa production. These efforts underscore the state's commitment to enhancing cocoa yield and quality, contributing to economic diversification and growth.

Study Design

This research employed a cross-sectional descriptive survey design to investigate the adoption patterns of CRIN TC1-TC8 cocoa cultivars among farmers in Osun State, Nigeria. This design was selected for its appropriateness in simultaneously capturing time-specific data across multiple variables. It allows for examining relationships between farmers' characteristics and their adoption behaviours without manipulating variables or establishing causality. The cross-sectional approach enabled the researchers to obtain a comprehensive snapshot of the current adoption landscape while accommodating the resource and time constraints inherent in agricultural research in developing regions.

Sampling procedure and sample size

A multistage sampling procedure was employed to obtain a representative sample of cocoa farmers in this study. The first stage was a purposive sampling of seven Local Government Areas (LGAs), namely Atakumosa East, Ede South, Ife Central, Ife East, Ife North, Ife South, and Ilesha East, based on their prominence in cocoa production in Osun state. The second stage involved a stratified sampling of cocoa farming communities into two groups: adopters and non-adopters of new cocoa tissue culture (TC) cultivars. The last stage was a proportionate sample of 104 cocoa farmers from these strata, comprising 32 adopters (30.8%) and 72 non-adopters (69.2%).

Data collection and analysis

Data collection was conducted through structured questionnaires administered to cocoa farmers across seven purposively selected Local Government Areas in Osun State (Atakumosa East, Ede South, Ife Central, Ife East, Ife North, Ife South, and Ilesha East), which represent key cocoa-producing regions with varying agroecological conditions. The questionnaire was designed to capture six critical dimensions: socioeconomic characteristics of cocoa farmers (age, gender, education, household size, marital status, and farm size); enterprise characteristics (water management systems, pest management practices, farming systems, crop diversification patterns, labor sources, market access, plantation age, and training exposure); adoption status of CRIN TC1-TC8 cultivars (varieties adopted and implementation of recommended practices); farm productivity indicators (harvesting frequency and output utilisation); and constraints to adoption (technical, economic, institutional, and environmental barriers).

The collected was analysed using descriptive statistics such as mean, frequency distribution, and percentages.

Results and Discussion

Socio-economic characteristics of respondents

The age distribution of cocoa farmers in Osun State reveals an ageing farming population, with a significant concentration in the 45-56 years bracket (38.5%). The percentage of farmers aged 45 years and above constitutes approximately 75% of the total respondents, while only 1% fall within the young farmer category of 21-32 years. This age distribution pattern mirrors findings from Akinwale and Folarin (2018), who reported that the mean age of cocoa farmers in Oyo State was around 55 years. The predominance of older farmers has profound implications for the adoption of CRIN TC1-TC8 cocoa hybrids, as Akinwale and Folarin (2018) have established that a farmer's age can negatively influence technology adoption decisions. Older farmers tend to be more conservative and risk-averse, potentially limiting their willingness to experiment with new cocoa cultivars, requiring different management practices and initial investment. The minimal representation of young farmers in cocoa farming underscores a generational gap that could impede the sustainable adoption of new technologies. Younger farmers typically demonstrate excellent receptiveness to agricultural innovations and possess the physical vigour required to implement labour-intensive aspects of new cocoa cultivation techniques. Therefore, the ageing farmer population might constitute a structural barrier to the widespread adoption of the CRIN TC1-TC8 cocoa hybrids, necessitating targeted strategies to attract

younger individuals into cocoa farming while simultaneously addressing the concerns of older, established farmers.

The gender distribution reveals a male-dominated cocoa farming sector in Osun State, with males constituting 65.4% of respondents compared to 34.6% females. This gender imbalance closely aligns with findings from similar studies in other Nigerian cocoa-producing regions where approximately 65.0% of cocoa farms were operated by males as reported by Nmadu *et al*. (2015). Gender has been identified as a significant factor affecting adoption decisions concerning disseminated cocoa technologies. The male dominance in cocoa farming may reflect underlying socio-cultural norms and gendered access to productive resources such as land, credit, and agricultural extension services, ultimately influencing technology adoption patterns. While substantial female representation is a minority, it represents an important demographic that should not be overlooked in cocoa improvement programs. Women farmers often face unique constraints in accessing information, inputs, and extension services necessary for adopting new technologies. For effective dissemination and adoption of CRIN TC1-TC8 cocoa hybrids, gender-sensitive approaches that specifically address the needs and constraints of female cocoa farmers would be essential to ensure inclusive technological transformation in the cocoa sector.

The result presented in Table 1 reveals a predominance of married individuals among cocoa farmers in Osun State. 89.4% of respondents are married, only 2.9% are single, and 7.7% are widowed. This high percentage of married farmers closely aligns with findings from Maduka *et al*. (2023) who found that 84.4% of female and 82.3% of male cocoa farmers were married, underscoring the prevalence of married individuals in the cocoa farming sector across different locations. Similarly, Okidim et al. (2023) reported that 64% of farmers were married. The representation of married individuals in cocoa farming reflects the socio-cultural organization of rural agricultural communities in Nigeria, where marriage is a social institution and an economic partnership that facilitates agricultural production. The family unit often serves as the primary source of labor for farm operations, with different household members performing complementary roles in the cocoa production process.

The educational profile of cocoa farmers in Osun State demonstrates a relatively high literacy level, with 94.2% having formal education. The majority (51%) have completed secondary education, 20.2% have primary education, and 23.1% have pursued tertiary or postgraduate education. Only 5.8% lack formal education. This educational distribution represents a positive indicator for the potential adoption of CRIN TC1-TC8 cocoa hybrids, as education enhances farmers' ability to process information, understand complex agricultural technologies, and implement new cultivation practices.

Education measures human capital and reflects the capacity to implement new technologies (Oluyole & Sanusi, 2009). Research has consistently shown that a farmer's educational level significantly affects technology adoption decisions and cocoa production levels Nmadu *et al.* (2015). The relatively high educational attainment among Osun State cocoa farmers suggests a favourable environment for disseminating knowledge about CRIN TC1-TC8 cocoa hybrids. Farmers with secondary education and above are more likely to appreciate the scientific rationale behind improved cultivars and implement the recommended agronomic practices for optimal performance. Educational advantages would be particularly relevant for understanding the distinctive characteristics of each CRIN TC variety and selecting the most appropriate ones for specific agro-ecological conditions. This result agrees with (Oluwalade, *et al*., 2023).

The predominance of small farm holdings is evident from the result in Table 1, with 62.5% of respondents operating farms between 1-4 hectares. Medium-sized farms (5-8 hectares) account for 23.1% of the sample, while larger farms (9-12 hectares) constitute 12.5%. Very few farmers (1.9%) manage extensive farms exceeding 12 hectares. This finding is consistent with Nmadu *et al*. (2015), who reported cocoa farming in Nigeria as predominantly small-scale. Farm size has been identified as a significant determinant of cocoa production levels, with larger farms generally associated with higher production capacities (Nmadu *et al*., 2015).

The prevalence of small farm holdings has

significant implications for adopting CRIN TC1-TC8 cocoa hybrids. Small-scale farmers often face resource constraints that may limit their ability to undertake the initial investments required for adopting new cocoa cultivars, such as purchasing seedlings, establishing nurseries, and applying recommended agrochemicals. The high cost of agrochemicals has been identified as a significant constraint toward adopting CRIN TC cocoa hybrids (Akinwale & Folarin, 2018). Additionally, small farm sizes may restrict farmers' ability to dedicate portions of their land for experimentation with new cultivars without compromising their immediate income needs, thereby increasing the perceived risk of adoption.

The household size distribution indicates that most cocoa farmers (65.4%) have households comprising 4-6 members, while 19.2% have 7-9 members. This household composition pattern aligns with findings from Akinwale & Folarin (2018), who reported a mean household size of approximately 5 persons among cocoa farmers in Nigeria. Household size can influence technology adoption by impacting labor availability and household income needs. Adopting CRIN TC1-TC8 cocoa hybrids may require additional labour inputs, particularly during the establishment phase and for implementing recommended maintenance practices. The predominant household size of 4-6 members suggests moderate labour availability within most farming households, which could facilitate the adoption of labour-intensive aspects of the new technology.

Table 1. Socio-economic characteristics of respondents

Variable	Categories	Frequency (n = 104)	Percentage (%)	Mean	Standard Deviation
Age	21 – 32	1	1.0	52.85	11.87
	33 – 44	25	24.0		
	45 – 56	40	38.5		
	57 – 68	25	24.0		
	69 – 80	11	10.6		
	81 – 92	2	1.9		
Sex	Male	68	65.4		
	Female	36	34.6		
Marital Status	Single	3	2.9		
	Married	93	89.4		
	Widowed	8	7.7		
Education Level	No formal education	6	5.8		
	Primary education	21	20.2		
	Secondary education	53	51.0		
	Tertiary education	14	13.5		
	Postgraduate	10	9.6		
Farm Size	1 – 4	65	62.5	4.87	3.43
	5 – 8	24	23.1		
	9 – 12	13	12.5		
	13 – 16	2	1.9		
Household Size	1 – 3	9	8.7	5.83	2.07
	4 – 6	68	65.4		
	7 – 9	20	19.2		
	10 – 12	6	5.8		
	13 – 15	1	1.0		

Source: Field Survey, 2025

Enterprise characteristics of respondents

Table 2 presents the enterprise characteristics of cocoa farmers in Osun State. According to Table 2, a significant majority (95.2%) of these farmers rely solely on natural rainfall for water, with only 14.56% utilizing irrigation systems. This heavy dependence on rainfall creates a significant vulnerability to seasonal rainfall variations and climate change impacts, which could influence farmers' decisions regarding adopting new cocoa cultivars. The CRIN TC1-TC8 varieties, developed by the Cocoa Research Institute of Nigeria, have specific water requirements during their establishment phase and for optimal productivity. Research has shown that adequate soil moisture is critical for the survival of cocoa seedlings during the first 2-3 years after planting, with water stress significantly reducing establishment rates and early growth.

The limited prevalence of irrigation infrastructure among cocoa farmers presents a potential constraint to the widespread adoption of CRIN TC1-TC8 cultivars, particularly if these improved varieties require more consistent water availability than traditional varieties. The seasonal nature of rainfall in Osun State, characterized by distinct wet and dry seasons, could restrict planting windows for new cocoa seedlings to periods with reliable rainfall. This temporal limitation might slow the adoption rate as farmers must wait for favourable planting conditions. Furthermore, in periods of extended drought or irregular rainfall patterns, which are becoming increasingly common due to climate change, farmers without irrigation capabilities might experience higher mortality rates among newly established CRIN TC1-TC8 seedlings, potentially creating negative perceptions about these improved varieties.

Pest management practices among these farmers are predominantly traditional, with 85.6% adhering to conventional methods and only 14.4% implementing integrated pest management strategies. This predominance of traditional pest control methods has significant implications for adopting CRIN TC1-TC8 cocoa cultivars, which were bred with improved disease resistance characteristics but still require appropriate pest management for optimal performance. Studies have shown that while these improved cultivars demonstrate enhanced resistance to black pod disease (Phytophthora spp.) and cocoa swollen shoot virus disease (CSSV), they still require systematic pest management for mirid insects (*Sahlbergella singularis* and *Distantiella theobroma*), which remain significant pests in West African cocoa production systems. The limited adoption of integrated pest management approaches suggests potential knowledge gaps in pest control strategies that could undermine the performance advantages of CRIN TC1-TC8 cultivars. These improved varieties were developed to perform optimally within a comprehensive management system, including judicious pesticide application, biological control measures, and cultural practices. The predominance of traditional pest management methods might result in suboptimal performance of the improved cultivars if farmers continue to apply conventional practices that might be insufficient or inappropriate for the new varieties. This disconnect between available pest management technology and cultivar requirements could create a perception that the new varieties underperform when, in fact, the management system rather than the genetic potential of the cultivars is the limiting factor.

A small fraction of farmers use organic (11.5%) and inorganic (4.8%) farming methods. The limited adoption of these practices suggests that most farmers may not be utilizing specific farming techniques that could enhance the performance of new cultivars. This suggests that most cocoa farmers in Osun State employ mixed or undefined farming approaches, incorporating elements of both organic and conventional practices without strict adherence to either system. This farming system diversity has implications for adopting CRIN TC1-TC8 cocoa cultivars, which were developed and tested under specific management conditions. Research has demonstrated that these improved varieties respond differently to organic and conventional management practices, with variations in yield, disease susceptibility, and quality characteristics depending on the farming system employed.

Diversification is evident in crop cultivation, with high percentages of farmers growing cassava (91.3%) and maize (90.4%). This diversification indicates a strategy to mitigate risks associated with cocoa farming. This high prevalence of intercropping has significant implications for adopting CRIN TC1-TC8 cocoa cultivars. Growing multiple crops reflects farmers' risk management

strategies and efforts to maximize land productivity. However, it also means that farm resources (labor, inputs, management attention) are divided among several enterprises rather than concentrated on cocoa production. The widespread cultivation of food crops alongside cocoa suggests that farmers prioritize food security alongside cash crop production. This diversification strategy influences adoption decisions regarding new cocoa cultivars, as farmers must consider how introducing new varieties would affect their overall farming system rather than cocoa production in isolation. Research on cocoa agroforestry systems has shown that the performance of improved cocoa varieties can be significantly influenced by companion crops, with potential competition for light, water, and nutrients affecting growth and yield.

The sampled farmers' labour sources vary, with 40.4% relying on family members, 78.8% hiring labour and 14.4% employing stable workers. The labour profile of cocoa farms in Osun State reveals a complex mixture of labour sources, with 78.8% of farmers employing hired labour, 40.4% utilizing family labour, and 14.4% maintaining farm-stable workers. This distribution indicates that most farms employ multiple labour sources, suggesting varied labour intensity and management approaches. The adoption of CRIN TC1-TC8 cocoa cultivars would be influenced by the labor requirements associated with these improved varieties, particularly during the establishment phase and for implementing recommended management practices. Improved cocoa varieties often require more intensive management, including more frequent pruning, systematic pest monitoring, and precision in fertilizer application, all of which have labor implications. The predominance of hired labour (78.8%) suggests that most cocoa operations involve significant cash outlays for labour, making the economic returns to adoption a critical consideration. If the CRIN TC1-TC8 cultivars require additional labor inputs without commensurate increases in yield or price premiums, farmers might be reluctant to adopt these varieties due to increased production costs. However, if the improved varieties reduce specific labor requirements, such as less frequent spraying due to enhanced disease resistance, this could be an incentive for adoption.

The cocoa marketing channels in Osun State demonstrate a diverse but predominantly intermediary-based system. Most farmers (60.6%) sell to off-takers, while 32.7% sell through general markets, 22.1% to individuals, 17.3% to cocoa processors, and only 3.8% directly to companies. This marketing structure has profound implications for adopting CRIN TC1-TC8 cocoa cultivars, particularly regarding how quality differentials and potential price premiums for improved varieties are transmitted to farmers. Marketing systems dominated by intermediaries often face challenges in preserving product identity and rewarding quality attributes, which could undermine incentives for adopting improved varieties. The limited direct linkages between farmers and end-users (processors and companies) suggest potential challenges in creating market-driven incentives for adopting CRIN TC1-TC8 cultivars. If these improved varieties produce beans with superior quality characteristics such as higher fat content, better flavor profiles, or reduced mycotoxin contamination, these attributes may not be adequately rewarded in a marketing system dominated by intermediaries who may purchase based on volume rather than quality-specific parameters.

The age distribution of cocoa plantations in Osun State reveals a diverse structure, with 41.3% of farms aged 19-36 years, 28.8% relatively young (1-18 years), and 29.8% older than 37 years. This age structure has significant implications for the adoption of CRIN TC1-TC8 cocoa cultivars through two primary pathways: replanting of ageing farms and expansion with new plantings. Cocoa trees typically peak productivity between 15-25 years and gradually decline thereafter, suggesting farms older than 25 years might be candidates for renovation with improved varieties. With a mean farm age of 28.70 years, a substantial proportion of cocoa farms in Osun State may be approaching or have passed peak productivity, creating a potential opportunity for the introduction of CRIN TC1-TC8 cultivars. The presence of ageing plantations represents both an opportunity and a challenge for adoption. These older farms likely have declining productivity and higher susceptibility to pests and diseases, creating a strong incentive for renovation with improved varieties. However, the substantial investment required for replanting, coupled with the income gap during the establishment period of new trees, may

deter farmers from undertaking comprehensive renovation, particularly if they lack access to financing mechanisms or alternative income sources during the transition period.

The harvest frequency indicates that most cocoa farmers in Osun State harvest either three times (58.7%) or twice (40.4%) annually, with a mean of 2.89 harvests per year. This harvest pattern reflects the biological characteristics of cocoa varieties currently under cultivation and the management practices employed by farmers. The adoption of CRIN TC1-TC8 cultivars would be influenced by their potential to alter harvest patterns, either by increasing the number of harvests per year or enhancing the yield per harvest. Improved varieties have shown potential for more consistent production throughout the year, which could reduce the seasonality of cocoa income and improve cash flow for farmers. The current productivity patterns suggest potential opportunities for yield enhancement by adopting CRIN TC1-TC8 cultivars. If these improved varieties can increase the proportion of farmers harvesting three times annually or introduce the possibility of four harvests in favorable conditions, this would represent a significant productivity advantage. Additionally, if the improved varieties produce larger pod sizes or more beans per pod, yield per harvest could increase even without changing harvest frequency.

The utilisation of cocoa by-products appears limited among Osun State farmers, with only 41.3% utilising cocoa pods and 25.0% utilising cocoa husks for additional value streams. This relatively low level of by-product utilisation has implications for the comprehensive value proposition of CRIN TC1-TC8 cocoa cultivars. The improved cocoa varieties can produce pods with distinctive characteristics, including different sizes, shapes, and compositions, which could affect their suitability for alternative uses. Adopting these new cultivars could be enhanced by developing and promoting complementary technologies for by-product utilisation to increase the overall economic returns from cocoa cultivation.

The limited engagement with by-product utilisation suggests opportunities for integrated technology packages combining improved cocoa cultivars with value-addition techniques. For instance, if CRIN TC1-TC8 varieties produce pods with higher pectin content or other valuable compounds, training farmers on extraction techniques could create additional income streams that would enhance the economic attractiveness of these varieties. Similarly, if the improved varieties produce more vigorous prunings, technologies for utilising these materials (such as composting or mulching techniques) could improve overall system productivity and sustainability, further incentivising adoption.

Less than half of the respondents (48.1%) have received training in recent years, with CRIN being the most common training provider (23.1%), followed by the private sector (18.3%) and NGOs (14.4%). This limited exposure to technical training has profound implications for adopting CRIN TC1-TC8 cocoa cultivars, as successful implementation of new varieties typically requires specific knowledge regarding their establishment, management, and harvesting. Only 23.1% of farmers have received training directly from CRIN, which suggests limited penetration of information about these improved varieties among the target farming population. The training gap identified in the survey represents a significant constraint to the effective dissemination and adoption of CRIN TC1-TC8 cocoa cultivars. The limited reach of current training efforts suggests the need for expanded and diversified training approaches, potentially leveraging the established presence of various actors (CRIN, private sector entities, and NGOs) to create a more comprehensive knowledge dissemination network. Farmer-to-farmer knowledge transfer mechanisms could also be enhanced to amplify the impact of formal training initiatives, particularly in reaching farmers who have not participated in organized training programmes.

Table 2. Enterprise characteristics of respondents

Variable	Categories	Frequency (n = 104)	Percentage (%)	Mean	Standard deviation
Source of Water	Natural rainfall	99	95.2		
	Irrigation	14	14.56		
Pest Management Practice	Traditional	89	85.6		
	Integrated	15	14.4		
Farm Practice	Organic Farming	12	11.5		
	Inorganic Farming	5	4.8		
Other Crops Cultivated	Cassava	95	91.3		
	Maize	94	90.4		
	Vegetable	48	46.2		
	Soya Beans	13	12.5		
	Oil Palm	2	1.9		
	Banana	5	4.8		
	Plantain	4	3.8		
	Yam	16	15.4		
Source of Labour	Family Member	42	40.4		
	Hired Labour	82	78.8		
	Farm Stable Workers	15	14.4		
Selling Point	Off Takers	63	60.6		
	General Market	34	32.7		
	Companies	4	3.8		
	Individuals	23	22.1		
	Cocoa Processors	18	17.3		
	Export	1	1.0		
Farm age	1 – 18	30	28.8	28.70	17.42
	19 - 36	43	41.3		
	37 - 54	21	20.2		
	55 - 72	8	7.7		
	73 – 90	2	1.9		
No of Times of Harvest	0	1	1.0	2.89	0.99
	2	42	40.4		

Adoption of new cocoa cultivar of respondents

Table 3 shows the CRIN cocoa TC series and their adoption rate in the study area. The adoption rates of the CRIN TC cocoa cultivars demonstrate a marked preference for certain varieties over others among farmers in Osun State. TC1 emerges as the most widely adopted cultivar, with 19.2% of respondents incorporating this variety into their farming systems. This represents more than twice the adoption rate of the next most popular variety, TC2, which has been adopted by 9.6% of farmers. The remaining cultivars show progressively lower adoption rates: TC4 (8.7%), TC3 (7.7%), and TC5 (5.8%), while TC7 and TC8 (both at 1.9%) and TC6 (1.0%) exhibit minimal adoption levels.

This uneven adoption pattern suggests a hierarchical preference structure among farmers that may reflect specific varietal characteristics or differential dissemination efforts. The CRIN TC series, developed through a 10-year breeding program, represents significant genetic advancement in cocoa cultivation in Nigeria, with the varieties possessing distinctive traits including early bearing (fruiting within two years), high yield potential ranging from 1,340 to 2,120 kg per hectare, tolerance to phytophthora pod rot (black pod disease), and other beneficial agronomic characteristics. However, the substantial variation in adoption rates indicates that these benefits are not perceived equally across all varieties or that knowledge and access barriers may exist for specific cultivars. The significantly higher adoption rate of TC1 suggests that this variety may possess attributes that particularly resonate with the farming conditions and preferences of Osun State cocoa farmers. These could include superior performance under the specific agroecological conditions of Osun State, more excellent resistance to locally prevalent pests and diseases, or more noticeable yield advantages. Additionally, TC1 may have benefited from earlier or more intensive dissemination efforts, greater seedling availability, or more substantial demonstration effects through successful early adopters within farming communities.

Table 3. New cultivars adopted

Variable	Frequency	Percentage%
TC1	20	19.2
TC2	10	9.6
TC3	8	7.7
TC4	9	8.7
TC5	6	5.8
TC6	1	1.0
TC7	2	1.9
TC8	2	1.9

Source: Field Survey, 2025

Table 4 shows the various recommended practices with the new cocoa cultivars embraced and practiced by the cocoa farmers in the study area. The recommended practices for new cocoa cultivars demonstrate considerable variation in adoption levels among farmers in Osun State. Spacing and pruning emerge as the most widely implemented practices, each adopted by 20.2% of respondents. Soil fertility management is followed closely by 16.3% adoption, while fungicide application is practised by 15.4% of farmers. The remaining practices show notably lower adoption rates: shade trees (9.6%), mulching (7.7%), sanitation (6.7%), and shade management (5.8%). The relatively higher adoption rates for spacing and pruning reflect farmers' recognition of these practices as fundamental to successful cocoa cultivation. Appropriate spacing is essential for maximizing land utilization while allowing sufficient access for management activities and reducing competition among trees. Research on cocoa agroforestry systems has demonstrated significant associations between planting arrangements and productivity outcomes (Mills *et al*., 2024). Similarly, pruning represents a critical management practice that directly influences canopy structure, light penetration, and, ultimately, the productive capacity of cocoa trees. Adomaa *et al*. (2022) examined the transfer of pruning practices from research to farms. They identified pruning as particularly important but often subject to adaptation based on farmers' specific circumstances and understanding. The moderate adoption of soil fertility management (16.3%) appears consistent with findings from soil studies in cocoa-growing regions of Southwestern Nigeria, including Osun State. Research has revealed significant impacts of long-term cocoa cultivation on soil properties, particularly concerning decreases in available phosphorus in cocoa plantation soils compared to adjacent plots (Azeez *et al*., 2021). This

suggests that while some farmers recognise the importance of soil fertility management for the performance of improved cocoa varieties, there remains substantial scope for expanding the implementation of this practice.

The notably low adoption rates for shade management (5.8%) and shade trees (9.6%) represent potential areas of concern for the optimal performance of CRIN TC1-TC8 cultivars. Mills *et al*. (2024) on cocoa agroforestry systems have identified shade regulation as a critical factor influencing cocoa productivity, disease incidence, and overall system sustainability. While these improved varieties were developed to perform under specific light conditions, they still benefit from appropriate shade management, particularly during establishment and in mitigating the impacts of climate extremes. The limited implementation of shade-related practices may reflect insufficient knowledge regarding the specific shade requirements of CRIN TC1-TC8 cultivars or challenges transitioning from traditional shade management approaches to those optimised for these improved varieties.

Table 4. Recommended practices for new cultivars

Variable	Frequency	Percentage%
Spacing	21	20.2
Pruning	21	20.2
Sanitation	7	6.7
Fungicide Application	16	15.4
Shade Management	6	5.8
Shade Trees	10	9.6
Soil Fertility	17	16.3
Mulching	8	7.7

Source: Field Survey, 2025

Table 5 captures the adoption category of the new cocoa cultivar among farmers in the study area. The adoption pattern among cocoa farmers reveals that 69.2% fall into the low adoption category, while only 30.8% demonstrate high adoption levels. This substantial disparity indicates that over two-thirds of farmers have not adequately embraced the improved CRIN TC1-TC8 cocoa cultivars. This adoption pattern aligns with broader trends in Nigeria's cocoa sector, where the "lack of adoption of improved technologies" has been identified as one of the primary reasons for the country's decline in cocoa production standing (Oguniyi & Jayeioba, 2015).

The predominance of low adoption among farmers is particularly noteworthy, considering Nigeria's historical position in global cocoa production. Once ranked as the second leading producer of cocoa in the world at independence, Nigeria now occupies the fifth position after Côte d'Ivoire, Ghana, Indonesia, and Brazil (Oguniyi & Jayeioba, 2015). This decline in standing correlates with suboptimal productivity levels, as evidenced by the national average yield of 300-350 kg per hectare, which falls significantly below the recommended yield potential of 500-1000 kg per hectare (Oguniyi & Jayeioba, 2015). The low adoption rate of improved varieties like CRIN TC1-TC8 perpetuates this productivity gap and contributes to the continued underperformance of Nigeria's cocoa sector.

Table 5. Adoption Category

Adoption Category	Frequency	Percentage (%)
Low Adoption	72	69.2%
High Adoption	32	30.8%

Willingness to adopt CRIN TC cultivars

Table 6 reveals the farmers' willingness to adopt CRIN TC1-TC8 cocoa cultivars. According to the table, the farmers demonstrate a positive attitude toward CRIN TC cocoa cultivars, with 98.10% of respondents expressing willingness to adopt these improved varieties. This remarkably high percentage indicates near-universal openness to these technologies among the surveyed cocoa farmers in Osun State. Such widespread receptiveness represents a significant positive indicator for the potential future diffusion of these improved cocoa varieties and suggests a firm foundation upon which dissemination efforts can build. The near-unanimous willingness to adopt CRIN TC cultivars demonstrates a significant shift in farmers' perception toward improved cocoa varieties. This positive attitude aligns with research findings from other agricultural technology adoption studies in Nigeria, which have identified farmers' perceptions as a critical determinant of adoption intentions.

Table 6: Willingness to adopt CRIN TC cultivars

Willingness to adopt	Frequency	Percentage
Yes	102	98.10

Source of information

The result presented in Table 7 revealed the various information sources that shape farmers' awareness and knowledge of CRIN TC cocoa cultivars in the

study area. The distribution of information sources about CRIN TC cocoa cultivars reveals an institutionally dominated knowledge landscape where formal channels significantly outweigh informal networks. Availability of information (19.2%) and extension officer recommendations (15.4%) emerge as the primary sources, reflecting CRIN's recent institutional revival and enhanced extension activities following years of reduced effectiveness. Performance attributes serve as secondary information drivers, with the potential for higher yield (11.5%) motivating information-seeking behaviours, while physical access to planting materials (8.7%) creates additional exposure pathways. The strikingly limited role of peer influence (1.9%) indicates weak horizontal knowledge flow among cocoa farmers, suggesting that technical information about these improved varieties primarily reaches farmers through vertical institutional channels rather than farmer-to-farmer exchange networks. These findings have significant implications for adoption strategies. They suggest that while institutional channels have established a foundation for information dissemination, the weak social embeddedness of knowledge about CRIN TC cultivars may limit sustainable diffusion throughout farming communities.

Table 7: Source of information on CRIN TC

Source of information on CRIN TC	Frequency	Percentage %
Recommendation from extension officer	16	15.4
Peer Influence	2	1.9
Readily Availability of the new cocoa cultivar	9	8.7
Availability of Information	20	19.2
Potential for Higher Yield	12	11.5

Constraints to the adoption of CRIN Tc cocoa cultivars: Implications and indications

The analysis of constraints to CRIN TC cocoa cultivar adoption reveals a hierarchical barrier structure with pest and disease pressure emerging as the most significant impediment (2.34), followed by inadequate extension services (1.99), financial constraints (1.98), limited access to quality planting materials (1.94), and infrastructure deficiencies (1.89). This constraint pattern indicates that despite the CRIN TC cultivars being developed with improved disease resistance characteristics, farmers continue to perceive pest and disease management as a formidable challenge, with 88.5% identifying it as at least a mild constraint. The prominence of extension service inadequacies (68.3%) suggests significant gaps in technical support systems. In contrast, the high ranking of resource-related constraints (financial and planting material access) indicates that practical economic barriers prevent the implementation of adoption intentions. Notably, the lack of technical know-how ranks lowest, suggesting that farmers perceive themselves as having sufficient knowledge despite identifying extension inadequacies as a significant constraint.

These findings have profound implications for adopting enhancement strategies, indicating that interventions must simultaneously address multiple constraint dimensions to be effective. The prominence of pest and disease pressure suggests that adoption promotion must integrate robust pest management strategies alongside genetic improvement, while the high ranking of extension inadequacies indicates a need for strengthened technical support systems, potentially through expanded extension networks and specialized training programs.

Table 8: Constraints to the adoption of CRIN Tc cultivars

Constraints	Not a constraint	Mild constraints	Serious constraints	Mean±SD	Rank
	F(%)	F(%)	F(%)		
Limited access to quality planting materials	37(35.6)	36(34.6)	31(29.8)	1.94±0.81	4th
Financial constraints	34(32.7)	38(36.5)	32(30.8)	1.98±0.80	3rd
Land tenure issues	45(43.3)	46(44.2)	13(12.5)	1.69±0.69	8th
Lack of technical know how	51(49.0)	40(38.5)	13(12.5)	1.64±0.70	12th
Pest and disease pressure	12(11.5)	45(43.3)	47(45.2)	2.34±0.68	1st
Climate change impacts	37(35.6)	51(49.0)	16(15.4)	1.80±0.69	6th
Inadequate extension services	33(31.7)	39(37.5)	32(30.8)	1.99±0.79	2nd
Market access and price volatility	48(46.2)	43(41.4)	13(12.5)	1.66±0.69	10th
Labor shortages	43(41.4)	41(39.4)	20(19.2)	1.78±0.75	7th
Infrastructure deficiencies	36(34.6)	43(41.4)	25(24.0)	1.89±0.76	5th
Cultural preferences	48(46.2)	43(41.4)	13(12.5)	1.66±0.69	10th
Policy and institutional challenges	49(47.1)	39(37.5)	16(15.4)	1.68±0.73	9th

Conclusion and Recommendations

This study reveals that adopting CRIN TC1-TC8 cocoa cultivars among farmers in Osun State remains suboptimal, with only 30.8% of respondents actively using these improved varieties. Key barriers such as financial constraints, pest and disease pressures, inadequate extension services, and limited access to quality planting materials hinder widespread adoption. Despite these challenges, nearly all surveyed farmers would adopt the improved cultivars if provided with the necessary support and resources. The study underscores the importance of strengthening extension services to enhance farmers' knowledge of the benefits and proper management of CRIN TC1-TC8 cultivars. Additionally, access to financial support mechanisms, such as low-interest loans and subsidy programs, will enable farmers to invest in improved seedlings and farm inputs. Market incentives, including premium pricing for high-quality cocoa and stronger cooperative linkages, will also be critical in promoting adoption. Furthermore, the findings highlight the need for an integrated pest and disease management approach, ensuring that farmers can maximise the genetic advantages of CRIN TC1-TC8 cultivars. Government agencies, private sector stakeholders, and research institutions are pivotal in creating a sustainable adoption framework that includes training, input accessibility, and improved market structures. A multifaceted approach addressing key constraints is needed to improve farmers' adoption of CRIN TC1-TC8 cocoa cultivars in Osun State. First, strengthening extension services is essential. Government agencies and research institutions should expand farmer training programs to enhance knowledge about these improved cultivars' benefits and proper management. Extension officers should be more actively involved in providing hands-on training and demonstrations to ensure farmers can effectively implement best practices. Secondly, financial support mechanisms must be established to assist farmers in overcoming economic barriers to adoption. Providing low-interest loans, grants, or subsidy programs will enable farmers to afford improved seedlings, fertilizers, and necessary farm inputs. Additionally, financial institutions should collaborate with agricultural stakeholders to develop flexible credit schemes tailored to cocoa farmers.

Another critical step is improving access to quality planting materials. Establishing decentralized seedling distribution centers will help ensure that farmers can readily obtain CRIN TC1-TC8 cultivars. These centers should be strategically located across major cocoa-producing areas to enhance accessibility and affordability. Furthermore, an integrated pest and disease management strategy should be promoted. Farmers should be supported in adopting sustainable pest control techniques, including biological pest control and improved fungicide application methods. Training on integrated pest management will help farmers mitigate production losses and maximise the genetic advantages of CRIN TC1-TC8 cultivars. Finally, enhancing market linkages and providing economic incentives can significantly influence adoption. Farmers should be linked to premium cocoa markets where improved cultivars receive higher pricing based on quality attributes. Additionally, forming cooperative groups will facilitate collective bargaining power, improving farmers' ability to negotiate better prices and access market-driven support programs. Implementing these strategic interventions will significantly enhance the adoption of improved cocoa cultivars, leading to increased productivity, higher farmer incomes, and a more resilient cocoa industry in Nigeria.

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CASHEW RESEARCH PROGRAMME

Dr. O. O. Adeigbe (Cashew Program Leader)

During the research year 2024/25, the cashew programme supported 13 research activities including Nut Biotype Classification and Early Morphological Variability of Seedlings from Elite Cashew Genotypes, Enhancing Cashew Cultivar Development through Pollen Viability and In Vitro Germination, Cashew Mother Tree Scion Garden for New Cultivar Development, Phytophagus Insect Pests Complex of Cashew Germplasm and Plantations in Nigeria, Assessment of Cashew Cultivars Against Major Pathogens and Diseases, Economic Analysis of Cashew Farming Systems in Nigeria, Analysis of the Socio-economic Benefits Derived from Cashew Production in Oyo state, Farmers' Perspectives and Felt Needs in the Development of Cashew Varieties in Edo State, Assessment of Disease Incidence on Cashew Clones in the Nursery, Assessment of Economic Factors Influencing Cultivar Development Among Cashew Farmers in Southeast Nigeria, Multi-location Field trials of Elite Cashew Mother Tree Clones, Productivity Evaluation of Polyclonal Cashew Establishment, and Evaluation of Good Agricultural Practices on Health and Yield of Cashew Plantations. Report of some of these research findings and activities are hereby presented.

Experiment Title: Nut Biotype Classification and Early Morphological Variability of Seedlings from Elite Cashew Genotypes.

Investigators: Aremu-Dele O., Adeigbe O.O., Sobowale I.O., Ibe O. and Ogbeide E.C.

Introduction

Cashew is a major cash crop grown in the tropical part of the world (Malik and Bhadauria, 2020) with Nigeria being one of the major producers. According to the Food and Agriculture Organization (FAO, 2024), cashew production in Nigeria decreased from 800,000 tons in 2009 to 100,000 tons in 2019, placing Nigeria as the 14th producer of cashew nuts down from being 1st in 2009. Report from (FAO, 2024) has further proved that annual production has experienced yet a decline to 88,097 tons with an average yield of 514 kg/ha. This production index is quite low when compared with other major cashew growing countries. One of the major factors

responsible for the decrease in the production of cashew in Nigeria is the lack of quality planting material (Adeigbe *et al*., 2015). To improve the problem of lack of quality high yielding materials, there is a need to improve the existing ones through various crop improvement techniques and most especially through hybridization from elite mother trees. Elite mother tree selection is an important process for easy multiplication of tree crops that are of good quality in terms of growth, disease resistance and yield (Acquaah, 2015). It is also important for effective crop improvement or hybridization purposes (Nkumbula *et al*., 2023). Identification of some elite cashew mother trees in some states has been carried out by the CNFA ProCashew project in collaboration with Cocoa Research Institute of Nigeria (CRIN) of which one of the reasons of this process is for the development of high-yielding and resilient cashew varieties in Nigeria.

As part of the evaluation process, seedling establishment of these elite cashew mother trees from their respective nuts which first takes place in the nursery for 2 to 3 months before field transplant is a stage towards the development of resilient cashew varieties at CRIN. It affords the opportunity to examine the early growth pattern of these elite genotypes in the nursery by direct observation over a period of time. Information from this study will help provide data on the emergence, morphology and root development of the selected elite genotypes. There is also a need to examine the nut size classification of this elite cashew selections to help classify them into their respective biotypes. The information from this study could be vital during the nursery and field trial of the newly selected potential mother trees.

The objectives of this study were to:

1. Classify the nuts from the elite cashew genotypes into their respective nut biotypes.
2. Determine the seedling emergence, growth pattern and root development of seedlings raised from the selected elite cashew nut genotypes.

Materials and Method

This study was carried out at the nursery of the Cocoa Research Institute of Nigeria Headquarters in Ibadan, Nigeria. For the nut size classification, 25 nuts from each genotype were randomly picked and weighed using a pocket size electronic weighing scale. The mean weight per genotype was recorded using the formula: $\bar{W} = (\sum W_i) / n$

Where:

- $\bar{W}$ = Mean weight of cashew nuts (g)
- W_i = Individual weight of each cashew nut (g)
- n = Total number of cashew nuts (25)
- $\sum$ = Summation notation, representing the total sum of all individual weights

The nut weight scale as described by Adeigbe *et al*., (2015) was used for the classification of the genotypes nuts into biotypes. In the nursery, the experiment was laid in a Completely Randomized Design with only the elite cashew genotypes nuts as the treatments. The elite cashew genotypes used in this experiment are CEOP-4 (A), Igbotele T2 (B), Igbotele T1 (C), BJ36 (D), CEOP-6 (E) and Igbope T1 (F). Before-planting, soil samples of the topsoil used was collected for routine analysis to check its nutrient composition. The nuts were sown in perforated 25 cm by 12.5 cm nursery polythene bags filled with 2 mm sieved topsoil. Each treatment (elite cashew genotypes) had 8 seedlings per replication, a general total of 48 seedlings per replication and 144 seedlings in all as the experiment was replicated 3 times. Watering of the seedlings was done twice a week. Floatation test was carried out on the nuts before sowing as 25 cashew nuts were randomly picked per genotype for the test. Data on % seedling emergence was recorded at 2, 3 and 4 weeks after sowing (WAS). Morphological data such as height (cm), number of leaves, stem diameter (mm) and leaf area (cm^2) was collected monthly from 4 WAS to 12 WAS. Destructive sampling was done at 12 WAS and data such as tap root length (cm), root fresh weight (g), root dry weight (g), shoot fresh weight (g) and shoot dry weight (g) was recorded. All data obtained was subjected to Analysis of Variance (ANOVA) using the GenStat Statistical software package and treatment means separated using the Tukey Standardized Range Test at a 0.05% probability level.

Results and Discussions

Nut classification into biotypes as reported by Adeigbe *et al*., (2015) is of economic importance as it helps group the genotypes into their respective classes according to their weight, which is a function of the kernel content. Table 1 shows that B, D and F's average nut weight belongs to the Large biotype group while A and C belongs to the Medium biotype and E in the Small biotype class.

Table 1: Classification of the elite genotype nuts into biotypes

Treatments/Genotypes	Nuts Average Weight (g)	Biotype
A (CEOP-4)	7.0	Medium
B (Igbotele T2)	9.1	Large
C (Igbotele T1)	6.3	Medium
D (BJ 36)	8.1	Large
E (CEOP-6)	5.3	Small
F (Igbope T1)	8.2	Large

Note: Jumbo (>16g); Extra-large (15-12g); Large (11-8g); Medium (7-6g); Small (5-2g); Madras (=2g)

Floatation test is a seed viability test commonly used for grain, pulse and nut crops (Mendoza-egovia *et al*., 2022). Since the nuts used in this experiment were about 10 months old, there was need to test for their viability. The result from Table 2 suggests a relatively high viability of the nuts from each genotype as % of sinkers ranged between 64.00% to 88.00%. However, genotype A, D and F all had a superior viability text result of 88.00% which suggests that their nuts are more viable compared to the others.

Table 2: Floatation test of the elite genotype nuts

Treatments/Genotypes	No. of Sinkers	% of Sinkers
A (CEOP-4)	$^{22}/_{25}$	88.00
B (Igbotele T2)	$^{18}/_{25}$	72.00
C (Igbotele T1)	$^{17}/_{25}$	68.00
D (BJ 36)	$^{22}/_{25}$	88.00
E (CEOP-6)	$^{16}/_{25}$	64.00
F (Igbope T1)	$^{22}/_{25}$	88.00

It has been observed that cashew seedling emergence starts around 12 days after sowing and at 28 days after sowing, it is expected that germination would have stopped (Mog *et al*., 2017). This was the case in this experiment as cashew seedling emergence had already started across all the genotypes at 2 WAS and no further emergence was observed after 4 weeks of sowing. At 2 WAS as shown in Table 3, D had the highest seedling emergence of 80%, suggesting that the nuts are highly viable when compared with the other genotypes which all had less than 50% seedling emergence with A having as low as 6.67% seedling emergence. All genotypes had an increase in seedling emergence at 3 WAS with D reaching the maximum emergence rate of 100%. However, A and B still had below 50% seedling emergence. At 4 WAS, D had the highest seedling emergence of 100%, followed by F (86.70%), E (60.00%), C (60.00%) and B (53.30%) while A (26.70%) had the least. This seedling emergence observed at 4 WAS in Table 3 is highly commendable as the nuts sown were already 10 months old after collection. This indicate that the nuts from this elite cashew tree genotypes are highly viable as higher seedling emergence rate is even expected if planted earlier as Manjesh *et al*., (2022) reported that, cashew nuts lose their viability between 8 to 10 months after collection or storage.

Table 3: Percentage seedling emergence at 2, 3 and 4 WAS.

Treatments/Genotypes	% Seedling Emergence		
	2 WAS	3 WAS	4 WAS
A (CEOP-4)	6.67	26.70	26.70
B (Igbotele T2)	13.33	46.67	53.30
C (Igbotele T1)	20.00	53.30	60.00
D (BJ 36)	80.00	100.00	100.00
E (CEOP-6)	40.00	60.00	60.00
F (Igbope T1)	46.70	80.00	86.70

Note: WAS= Weeks after sowing

At 4 WAS as shown in Table 4, significant variability was observed in the growth parameters observed except for the seedlings leaf area. Treatment F had the tallest seedling height of 21.8cm, and closely followed by D (21.78cm) and E (20.63cm) while B (12.5 cm) had the least height among the genotypes and also notably different from all other genotypes. D (8.80) had a non-comparable number of leaves with A (7.7) but however, A (7.7), B (6.3), C (6.5), E (6.5) and F (6.5) all proved to be statistically the same. For the seedlings stem diameter, A (4.0mm) and D (3.9mm) showed to be non-comparable as they had a superior diameter over their counterparts as E (3.2mm) and D (3.0mm) also showed to be non-comparable as they had the least diameter respectively of all the genotypes. As the genotypes didn't show any notably difference in leaf area, F (53.64 cm^2) still had the largest leaf area of all the genotypes and closely followed by D (53.12 cm^2) while the smallest leaf area was observed in A (34.74).

Table 4: Cashew seedling growth parameters at 4 WAS.

Treatments/Genotypes	Seedling Growth Parameters			
	PH (cm)	NL	SD (mm)	LA (cm^2)
A (CEOP-4)	15.5b	7.7ab	4.0a	34.74a
B (Igbotele T2)	12.5c	6.3b	3.6b	40.11a
C (Igbotele T1)	17.5b	6.5b	3.0c	34.97a
D (BJ 36)	21.78a	8.8a	3.9ab	53.12a
E (CEOP-6)	20.63a	6.5b	3.2c	47.23a
F (Igbope T1)	21.8a	6.5b	3.6b	53.64a

Note: PH= Plant Height; NL= No. of Leaves;
SD= Stem Diameter; LA= Leaf Area

Conclusion

Genotype Igbotele T2, BJ36 and Igbope T1 all have large sized nuts while CEOP-4 and Igbotele T1 are both medium nuts. Igbotele T1 was classed as small biotype nuts. The viability test conducted was able to successfully predict the viability of the elite genotype nuts except for CEOP-4 with 88% viability score but only 26.70% emergence was recorded. The genotypes all showed early variable growth pattern except for their leaf area. The data presented are the data taken so far as the experiment is still ongoing.

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Experimental Title: Enhancing Cashew Cultivar Development Through Pollen Viability and in Vitro Germination Studies

Investigators: Babatunde, O. P., Adeigbe O. O., Sobowale I. O., Balogun S. T., Baba Nitsa M, and Odey C. F.

Introduction

Cashew (*Anacardium occidentale* L.) is a vital cash crop in many tropical and subtropical regions, valued for its economic importance and nutritional benefits (Adeigbe *et al.,* 2015). Despite the increasing global demand for cashew nuts, the industry faces several challenges, including limited adoption of improved cultivars with desirable traits such as high yield, disease resistance, and early maturity. Effective breeding programs are essential to address these challenges and enhance cashew production (Babatunde *et al.,* 2023). However, conventional hybridization techniques, though widely used, are time-consuming and constrained by the availability of suitable parental lines (Venna *et al.,* 2024). Advancements in reproductive biology, particularly studies on pollen viability and in vitro germination, offer new opportunities for accelerating cashew breeding efforts. Pollen plays a critical role in plant reproduction, serving as the male gametophyte responsible for fertilization. Pollen viability, which refers to the ability of pollen grains to perform fertilization, is an essential determinant of successful hybridization and fruit production (Asma, 2008). Studies have shown that pollen viability can vary among species and cultivars, influenced by factors such as ploidy level and hybridity (Ankit *et al.,*

2020). In vitro pollen germination techniques are reliable for assessing pollen quality and determining germination potential, making them essential tools in breeding programs (Nitsa *et al.,* 2020). Unlike staining techniques, which may overestimate viability, in vitro germination tests directly measure the pollen tube development under controlled conditions, offering more accurate assessments of fertility (Rodriguez and Dafni, 2000; Nitsa *et al.,* 2020).

Due to their conservative morphological features, including symmetry, shape, apertural patterns, and exine configuration, pollen have been extensively studied in angiosperm taxonomy and phylogeny (Keshavarzi *et al.,* 2012). These characteristics can provide insights into genetic diversity and evolutionary relationships among cashew cultivars. Moreover, effective pollination is a prerequisite for fruit and seed production, with pollen viability and tube growth being key determinants of reproductive success (Shivanna, 2003). In cashew, the andromonoecious flowering system, where male (staminate) and hermaphroditic (perfect) flowers coexist on the same panicle, necessitates a thorough understanding of pollen biology to optimize breeding strategies (Eradasappa *et al.,* 2014). Despite the significance of pollen viability and in vitro germination in cashew breeding, limited studies have explored these aspects in different genotypes, highlighting the need for further research. This study aims to evaluate pollen viability and optimize in vitro germination conditions across different cashew accessions. Understanding the genetic variability in pollen fertility and germination rates will contribute to the selection of superior pollen donors, enhance cross-breeding efficiency, and ultimately support the development of improved cashew cultivars. The findings of this research will provide valuable insights for breeding programs, facilitating the genetic improvement and sustainability of the cashew industry.

Materials and Methods

Twenty cashew (*Anacardium occidentale* L.) accessions were evaluated for pollen viability and in vitro germination.

Table 1: List of Cashew Accessions used in the study

S/N	Accessions	S/N	Accessions	S/N	Accessions	S/N	Accessions
1	OCJ2	6	OCJ9	11	EU202	16	India Large T40
2	KD202	7	KD102	12	India Madras T3	17	India Medium T14
3	EN103	8	CR102	13	India Medium T13	18	BEL 22
4	India Madras T1	9	BEL36	14	Brazilian Medium T1	19	YS103
5	ORO3	10	YS203	15	YO103	20	ORO9

Pollen viability was determined using the aniline blue (cotton blue) staining method (Hauser & Morrison, 1964). Fresh pollen grains from six anthers per accession were squashed onto glass slides, stained with aniline blue, and observed under a light microscope. Viable pollen stained dark blue, while nonviable pollen remained unstained or light blue. Viability was calculated by assessing 100 pollen grains per slide in three replicates.

$$\text{Percentage Pollen viability \%} = \frac{\text{Total number of stained pollen grains}}{\text{Total number of pollen grains count}} \times 100$$

Pollen germination was assessed using two different media based on the Brewbaker and Kwack (1964) method:

- **Medium 1:** 10% sucrose, 100 mg/L boric acid, 100 mg/L potassium nitrate, 200 mg/L magnesium sulfate.
- **Medium 2:** 10% sucrose, 100 mg/L boric acid, 150 mg/L potassium sulfate, 150 mg/L calcium chloride.

Pollen grains were placed in cavity slides containing either of the two media and incubated for 24 hours at room temperature. A pollen grain was considered germinated if its tube length was at least twice the pollen diameter (Kakani et al., 2002). Germination percentage was determined by counting pollen grains per field of view in three replicates.

$$\text{Pollen germination \%} = \frac{\text{Number of germinated pollen grains}}{\text{Total number of pollen grains count}} \times 100$$

Pollen viability and germination results were presented using bar charts. Visual representations of pollen stain and pollen tube growth were included to illustrate viability and germination responses.

Results and Discussion

The viability assessment of 20 cashew accessions, determined through aniline blue staining method of viability test, revealed considerable variability among the accessions, with viability percentages ranging from 56.25% to 97.22%. The highest viability was recorded in EU202 (97.22%), followed closely by CR102 (96.05%) and EN103 (94.17%), suggesting these accessions possess robust pollen viability, which may contribute to enhanced reproductive success and potential yield stability. Similarly, BEL 22 (93.33%) and YS103 (93.75%) also demonstrated high viability, further indicating their promise for breeding programs aimed at improving genetic performance.

However, lower viability was observed in accessions such as Brazilian Medium Tree 1 (56.25%), India Madras Tree 1 (59.52%), and India Medium Tree 14 (60.00%), suggesting possible limitations in their reproductive capacity, which could affect fruit set and overall productivity. Such accessions might require further investigation to understand the underlying causes of reduced viability, including potential genetic factors, and environmental influences. The majority of the accessions exhibited viability above 80%, including widely cultivated clones like KD202 (88.89%), India Medium Tree 13 (90.67%), and ORO9 (88.64%), indicating their suitability for further propagation and inclusion in breeding programs targeting yield improvement.

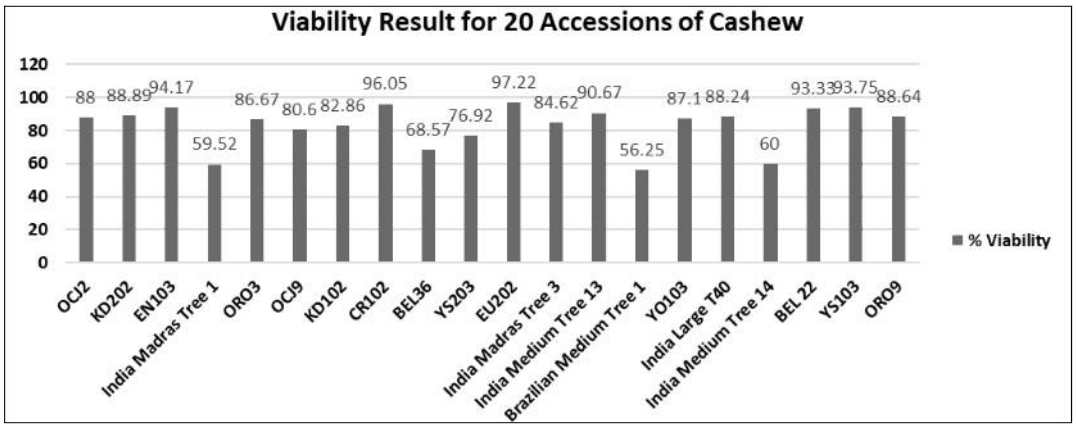

Fig. 1 Pollen Viability (%) of 20 Cashew Accessions

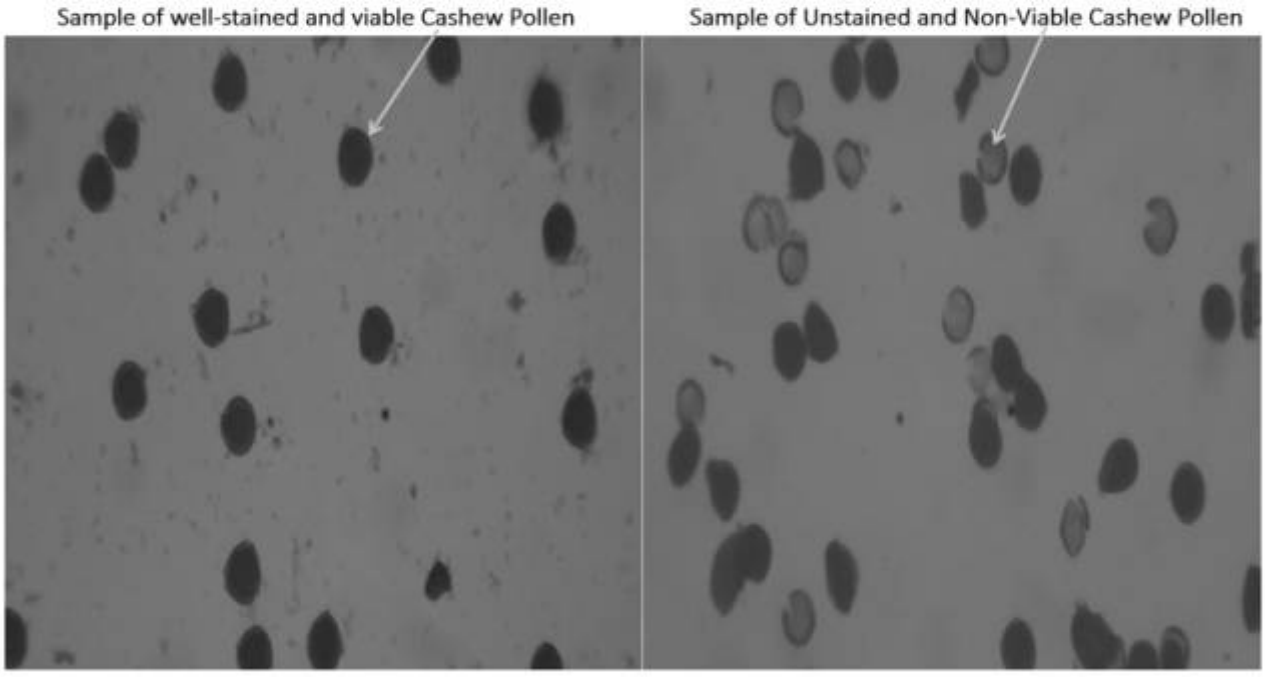

Plate 1: Visualization of Viable and Non-Viable Pollen in Cashew Clones Using Aniline Blue Staining

The pollen germination percentages across two different media varied considerably among the 20 cashew Accessions, revealing distinct patterns of pollen viability and media responsiveness. In Media 1, most clones exhibited moderate germination rates, with 50% germination observed in the majority of clones, except for BEL36 (0%), ORO3 (100%), YS103 (100%), ORO9 (25%), and BEL22 (65%). However, in Media 2, germination rates improved significantly for certain Accessions, with some reaching 100% germination, such as India Madras Tree 1, Brazilian Medium Tree 1, India Medium Tree 14, BEL36, YS103, and ORO9. However, some Accessions (e.g., ORO3 and YS203) exhibited zero germination in Media 2, highlighting potential media-specific incompatibilities.

These germination outcomes align with the previous viability assessments using aniline blue staining test. For example, Accessions with high viability percentages like EU202 (97.22%), CR102 (96.05%), and EN103 (94.17%) demonstrated consistent germination across both media, supporting the accuracy of the viability test as a predictor of pollen performance. Accessions like YS103 and BEL22, with viability rates above 93%, exhibited robust germination, particularly in Media 2, reinforcing their reproductive potential. However, Accessions with lower viability, such as Brazilian Medium Tree 1 (56.25%) and India Madras Tree 1 (59.52%), required more supportive media conditions to reach optimal germination, as reflected in their 100% germination in Media 2 but limited success in Media 1. The differential response across media highlight the influence of genotype-media interactions, suggesting that certain Accessions may benefit from tailored media formulations to maximize germination. For instance, Accessions like ORO3, which thrived in Media 1 but failed in Media 2, may possess specific metabolic or structural traits influencing their media adaptability.

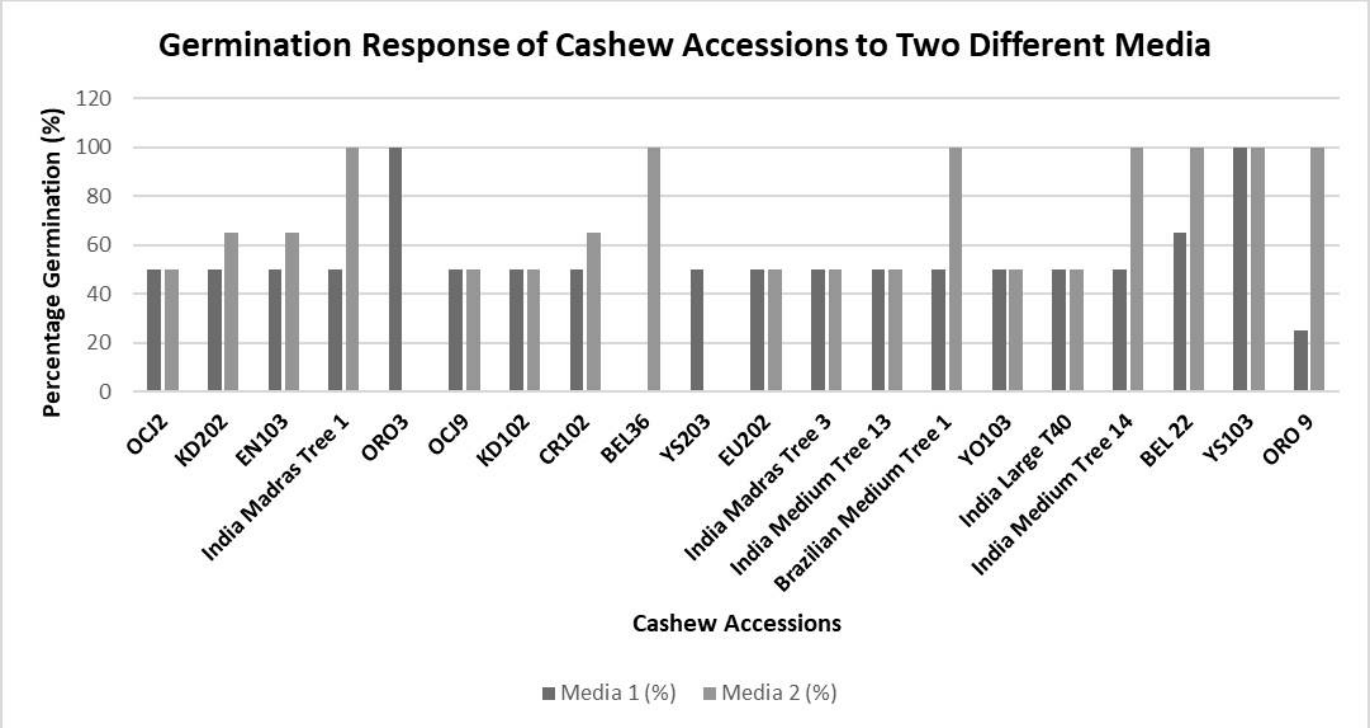

Fig.2: Comparative Germination Percentage of 20 Cashew Accessions in Two Different Media

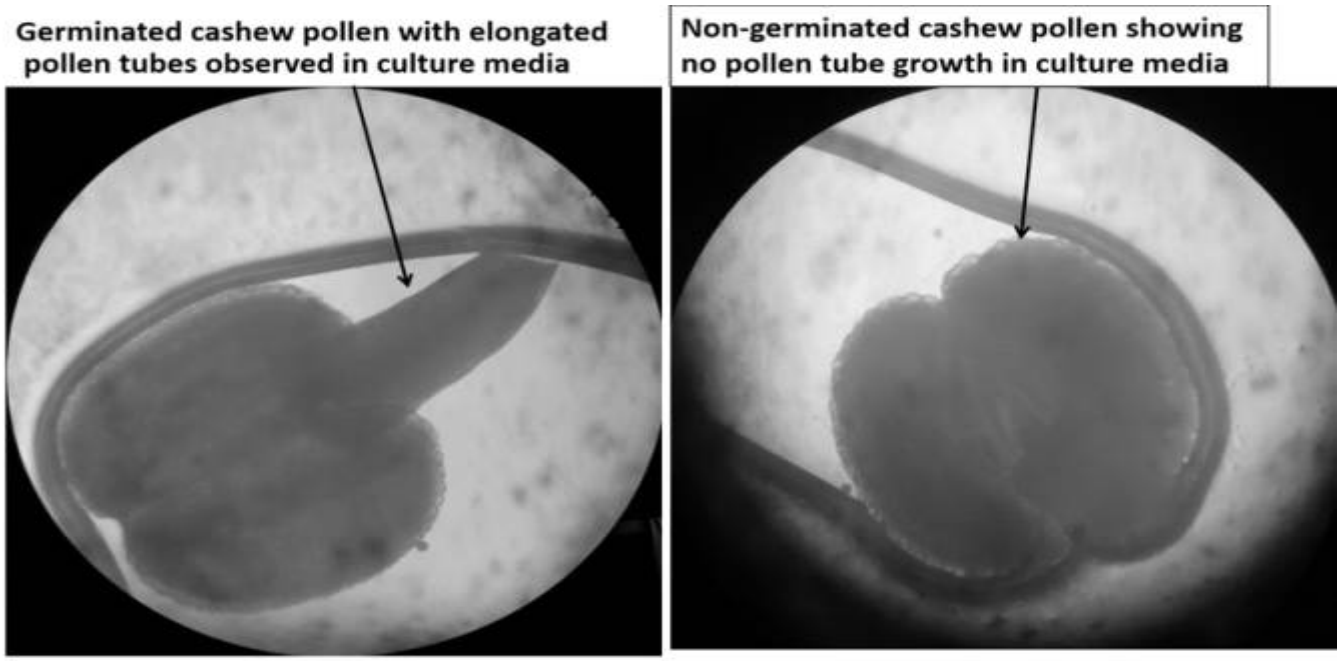

Plate 2: Visualization of germinated cashew pollen with elongated pollen tubes and non-germinated pollen

Conclusion

This study revealed the pivotal role of pollen viability and in vitro germination in enhancing cashew breeding efforts. The significant variability observed across the 20 cashew accessions highlights the genetic diversity within the species, providing valuable insights for the selection of elite parental lines. High-viability accessions like EU202 (97.22%), CR102 (96.05%), EN103 (94.17%), YS103 (93.75%), and BEL 22 (93.33%) demonstrated consistent germination across different media, reinforcing their potential as robust pollen donors for hybridization. Meanwhile, accessions with lower viability, such as Brazilian Medium Tree 1 (56.25%) and India Madras Tree 1 (59.52%), showed enhanced germination under optimized media conditions, emphasizing the importance of genotype-specific germination protocols. The differential responses across media further illustrate the influence of pollen-media interactions, suggesting that tailored germination environments can unlock the reproductive potential of less viable accessions. Ultimately, integrating pollen viability and germination data into cashew breeding programs will enhance the selection of compatible parental lines, improve hybridization success, and contribute to the development of high-yielding and genetically diverse cultivars. This approach can strengthen breeding strategies, supporting long-term efforts to improve crop productivity and adaptability in diverse growing environment.

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Experimental Title: Cashew Mother Tree Scion Garden for New Cultivar Development

Investigators: Adeigbe O.O., Olasupo F.O., Adeniyi D.O., Ibiremo O.S., Adejobi K.B., Akinpelu A.O., and Asogwa E.U.

Introduction

Cashew is a very important economic crop in Nigeria, Africa and the world at large. It is the source of the nutritious and delectable kernel usually taken as snacks and incorporated in different food components. Cashew has so many end use products from its apple, nuts and stem. It provides employment opportunity for youth, men and women across it value chain. Cashew is a source of income generation to small holder farmers and second to cocoa in terms of foreign exchange earnings for Nigeria. In the effort to making improved planting materials available to farmers in the Country, CRIN in collaboration with Pro-cashew have selected some good cashew genotypes for further evaluation and incorporation in breeding programs toward the goal of developing and releasing improved cashew cultivars. In this wise, there is need for a continual supply of grafts or clones of these materials to meet the needs for multiplication, distribution, evaluation and improvement research. The purpose of this proposal is to establish half a hectare scion garden of some of the identifies Nigeria potential cashew mother trees.

Materials and Methods: scions would be collected from the potential cashew mother trees identified across different locations in the country. These would be grafted on established rootstocks at CRIN headquarters nursery. Appropriate management practices would be taken by continuous checks to remove all side shoots, as well as ensuring good seedling establishment. The grafted seedling would be planted at a distance of 6m x 6m. Grafted seedling tip wounding would continually be done to stimulate shoot growth, while bud flowers would constantly be removed. The tree would be continually pruned and prevented from flowering.

Expected output: Readily available scions or bud wood garden of selected elite cashew mother trees for further use and improvement.

Saves cost and time of travelling outside institute for scion stick collection.

Clonal germplasm collection would be generated, i.e. cashew clonal gene bank for in-situ conservation.

Results

Scions were collected from the identified cashew mother trees at Ibarapa, Oke-ogun, Ogbomosho and Ilorin. These were grafted on already established root stocks at the CRIN HQs nursery. Adequate maintenance operation was adhered to including watering, spraying against pests and diseases, and removal of side shoots. One hundred and thirty tree clonal seedlings from 38 genotypes (Table 1) were planted on 0.5 ha land situated close to the zone 3&4 farm building of the Cocoa Research Institute of Nigerian, Ibadan. The plot was established at 6m by 6m spacing. The spot plan of the garden is presented in figure 1.

Table 1: list of materials established at clonal garden

S/N	Genotype lab. no.	Number of stands
1	522	2
2	497	12
3	498	10
4	499	21
5	500	5
6	526	7
7	528	2
8	548	9
9	573	4
10	461	1
11	463	2
12	495	3
13	421	14
14	445	2
15	456	5
16	389	3
17	407	1
18	538	3
19	546	3
20	359	1
21	360	3
22	532	2
23	558	1
24	530	1
25	487	3
26	493	1
27	494	1
28	422	1
29	425	1
30	568	1
31	544	1
32	546	1
33	567	1
34	571	1
35	572	1
36	574	1
37	363	1
38	511	1

Entrancefrom farm house				50 metres					
	522-1	499-8	499-9	548-5	548-6	456-2	456-3	547-1	571-1
	522-2	499-7	499-10	548-4	548-7	456-1	456-4	546-1	572-1
	497-1	499-6	499-11	548-3	548-8	445-2	456-5	544-1	574-1
	497-2	499-5	499-12	548-2	548-9	445-1	389-1	568-1	363-1
	497-3	499-4	499-13	548-1	573-1	421-14	389-2	425-1	511-1
	497-4	499-3	499-14	528-2	573-2	421-13	389-3	422-1	
100 metres	497-5	499-2	499-15	528-1	573-3	421-12	407-1	494-1	
	497-6	499-1	499-16	526-7	573-4	421-11	538-1	493-1	
	497-7	498-10	499-17	526-6	461-1	421-10	538-2	487-3	
	497-8	498-9	499-18	526-5	463-1	421-9	538-3	487-2	
	497-9	498-8	499-19	526-4	463-2	421-8	546-1	487-1	
	497-10	498-7	499-20	526-3	495-1	421-7	546-2	530-1	
	497-11	498-6	499-21	526-2	495-2	421-6	546-3	558-1	
	497-12	498-5	500-1	526-1	495-3	421-5	359-1	532-2	
	498-1	498-4	500-2	500-5	421-1	421-4	360-1	532-1	
	498-2	498-3	500-3	500-4	421-2	421-3	360-2	360-3	

Figure 1: Spot plan of cashew mother trees clonal scion garden

Conclusion

Thirty-eight (38) genotypes out of the over 50 identified potential cashew mother trees could be captured in this activity, there is need for a second phase of the clonal establishment to collect scion from the remaining identified mother trees and establish them in the institute. It is also necessary to increase the population of the fewer clones.

Constrained: the project was faced with the challenges of invasion from nearby staff farming activities, and Fulani herds incursion.

Experimental Title: Phytophagus Insect Pests Complex of Cashew Germplasm and Plantations in Nigeria

Investigators: Buari, R. A.; Oyedokun A. V.; Asogwa E. U. and Olorunmota, R. T.

Introduction

Cashew (*Anacardium occidentale* L.) *is* one of the important tree nuts grown for its delicious kernel. It is native to Brazil but introduced to other parts of the world, Nigeria inclusive. The tree belongs to the Anacardiaceae family (Ohler, 1979; Masawe, 2006). Cashew is the second highest value export crop after Cocoa in West Africa with Ivory Coast being the largest producer (Nitidae, 2019) while Nigeria produced an estimated 300,000 tons of raw cashew nuts in 2023 (Africashewsplit,2023) The commodity of commercial importance is the nut, which contains 47% fat, 21% protein and 22% carbohydrate. It also contains vitamins, especially thiamine (Ohler, 1979; Nandi, 1998). The crop also produces other products such as juices, jam, alcohol and non-alcoholic beverages; all of which are produced from the cashew apples (Sobhana *et al*., 2010).

All plant parts of Cashew tree (leaf, stem, bark, root, flower, apple and nut) are fed upon by at least one insect pest species at its different growth stages (Eguagie, 1974; Asogwa *et al*., 2009). It has been noted that damage to the vegetative growth of plants has significant effect on the resultant yield. Therefore, the objectives of this study are

1. To monitor the insect pest occurrence and diversity in Cashew Germplasm and plantations in Ogbomoso, Nigeria.
2. To determine the threshold of the insect pests monitored
3. To monitor the natural enemies of the insect pests recorded
4. To develop an ecofriendly management method

Materials and Method

The study was carried out at farmer's farm in Oguro Village, Ogo-Oluwa Local Government, Ogbomosho, Oyo State (15 hectares) and in CRIN Cashew Experimental Plot. Twenty cashew trees

from one-hectare plot were randomly tagged for observations on insect pest species presence, infestation signs and damage symptoms. All observations were carried out early in the morning. Also, their natural enemies encountered were identified. All developmental stages of insects (eggs, larvae, nymphs, pupae and adults) were looked out for. Materials used for collecting insect samples include sweep nets for flying insects, forceps and Camel hair brush for larvae, while hand picking was used for crawling insects. All insect species (pests and non-pests) collected were kept in the Kilners Jars containing Absorbent Cotton Wool impregnated with Ethyl acetate and were taken to the Insect Museum, CRIN, Ibadan for proper identification.

Results and Discussion

Different insect pest species were encountered during the period of survey and they included the defoliators (larvae stage), pollinators, fruit and apple sucking pest, ants and termites. Flower and young nuts abortion were prominent in the cashew farm surveyed and this might be due to the presence of *Pseudotheraptus devastans.* Leaf rust, Inflorescence Dieback was also very visible and this might be due to the infestation by *Helopelthis* sp. which feeds on growing tips, foliar and floral flush, apples and nuts.

Table1: Insect pests encountered in cashew plantation and their status

Pests	Status
Pseudotheraptus devastans Dist.	Pest (Fruit and pseudo-apple feeder)
Helopeltis sp. (Tea mosquito bug)	Pest (Twig and young flushes feeder)
Oecophylla longinoda Latl. (Tailor ant)	Natural enemy
Butterflies	Pollinators (Adult stage)
Acrocercops synagramma Meyrick (Leaf miner)	Pest
Apis mellifera (Honey bee)	Pollinators
Macrotermes bellicosus (Termites)	Pest (Decomposer)
Zonocerous variegatus Linn. (Grasshopper)	Pest (Herbivores)
Pachnoda cordata	Pest (Fruit scrapper)
Pachnoda maginata	Pest (Fruit scrapper)

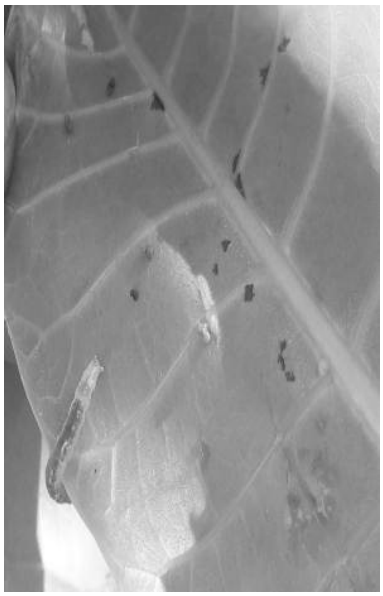

Plate1: leaf roller larvae

Plate 2: Apical bud dieback

Conclusion and Recommendation

Most of the cashew farms require proper sanitation whereby dead woods and debris need to be cleared from the farms as these encourages the breeding of insect pests as well as source of food for termites. Also, Cypermethrin 10% EC at manufacturer's dosage should be spot-sprayed so as not to kill the pollinators. However, lack of funds was a major setback in achieving the objectives of the study.

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Experimental Title: Assessment of cashew cultivars against major pathogens and diseases

Investigators: Adeniyi, D.O. and Adeji, A.O.

Introduction: Reported cases of decline in cashew nut production across growing ecologies of Nigeria have been associated with many factors which range from drought as experience through climate change related events, declining soil fertility, unimproved low yielding genotypes, insect pests and diseases (Ellias, 1980; Brown *et al.,* 1984). Of the factors, diseases: anthracnose, dieback of the inflorescence and twig, damping off of seedlings, gummosis, leaf and nut blight and recently the powdery mildew disease is presently causing serious devastating effect and severity in cashew production, especially at the South Eastern and North Central Nigeria. These diseases are important constrains to cashew production in both major and minor growing areas in Nigeria.

There is therefore a necessity to have a baseline information on the status, spread and severity of these diseases on cashew across growing regions, assess cashew genotypes against pathogens of these disease in Nigeria and develop effective management techniques to combat the pathogen and spread of the diseases.

Objectives: The general objective of this activity is to alert research managers of the need to collectively address cashew disease problems, especially the newly introduced, for plant breeders and or pathologists to develop resistant crop varieties and or integrated pest management options, respectively against the diseases.

Materials and Methods: The cashew germplasm of Cocoa Research Institute of Nigeria (CRIN) was surveyed for the presence of disease situations during the fruiting season of December 2024 to February 2025. The Brazilian and Indian biotypes of cashew trees in the germplasm were examined for the presence of pathogens on the cashew parts. Samples from trees that were naturally infected and showing disease symptoms were collected from different parts of cashew. The cashew twigs, nuts, leaves and fruits were observed and aseptically harvested into sterile sample bags and transferred to the laboratory for routine isolation procedures. Diseased samples were separately dissected into smaller pieces of about 3mm in diameter and surface-sterilized using 10% sodium hypochlorite solution for 3 minutes, the sample tissues were rinsed in three changes of sterile distilled water. The sectioned tissues pieces (3 mm) were dried in between sterile 90mm Whatman No. 1 filter paper and plated on Potato Dextrose Agar (PDA) routinely prepared in the laboratory in the petri dish. The inoculated Petri dishes were incubated at room temperature for 5–7 days for mold growth. Emerging fungal colonies were observed and the mixed culture plates purified by subculturing on freshly prepared sterilized PDA plates and incubated. Pure culture of isolates was observed using morphological features as Mycelial mat texture, colour, shape and spore structures. The fungi colonies were identified based on the morphological features and standard mycological references from manuals and identification keys.

Results: The results indicate that *Lasiodiplodia spp.* was the most frequently isolated fungus, commonly found in dieback, nut blight and anthracnose situation.

Table 1: Mycoflora distribution on infected cashew parts

S/N	Symptoms	Plant Part	Fungal occurrence
1.	Dieback	*Twig*	*Collectorichum sp,p Lasiodiplodia spp, Fusarium spp*
		Flora	*Lasiodiplodia spp, A.njger, Collectorichum spp*
2.	Nut blight	*Nut*	*A.niger, Lasiodiplodia spp*
3.	Mildew	*Ripe apple*	*A.niger , Rhizophus spp*
		Leaf	*A.niger, Alternaria spp,* pink colony *, Collectorichum spl*
4.	Anthracnose	Leaf	*A.niger, Botrlyrospheria sp, A. Flavus, Lasiodiplodia spp,* Yellow turning pink colony as it age(not identified)
		Fruit	*Fusarium sp, Lasiodiplodia sp, A.niger*
		Twig	*Lasiodiplodia sp, Collectorichum sp, A.niger,* Yellow colony

Colletotrichum spp. was particularly found in association with dieback and anthracnose conditions. *Aspergillus* species, *A. niger* and *A. flavus* were cultured from disease situation on nuts, fruits and leaves, causing more post-harvest deterioration in cashew apple. Other fungi, such as *Fusarium spp, Alternaria spp, Botryosphaeria spp,* and *Rhizopus* species, were also isolated from various parts of the cashew plant in table 1.

Conclusion and recommendation: It is difficult culturing from cashew apples infected with powdery mildew disease due to the obligate nature of the fungus. However, effort need to be intensified to develop an effective management system for the major pathogens affecting the crop.

Experimental Title: Economic Analysis of Cashew Farming Systems in Nigeria

Investigators: Ogunwolu, Q.A., Adesanya, K.A. and Aremu-Dele O.

Introduction

Cashew farming plays a crucial role in enhancing food security, generating income, and promoting socio-economic development, particularly in rural areas where the majority of smallholder farmers rely on agriculture for their livelihoods (Olawoye, 2017). Farming systems play a crucial role in the cultivation and success of cashew production. Some of its importance includes effective land use, income diversification, soil health conservation, water management, pest and disease control, sustainable practices and economic stability. In cashew farming systems, farmers can optimize their cashew yields while ensuring the long-term viability of their farms.

Despite its economic importance, there is limited empirical research on the economic performance and sustainability of cashew farming systems in Nigeria. Economic analysis of cashew farming systems in Nigeria is crucial for several reasons. Firstly, it provides insights into the cost structure, revenue streams, and profitability indicators of cashew production, which are essential for decision-making by farmers, policymakers, and other stakeholders along the value chain. Secondly, understanding the socio-economic impacts of cashew farming, such as its contribution to rural income generation, employment creation, and poverty reduction, is vital for assessing its overall significance in the national economy (Aremu-Dele *et al.,* 2021). Additionally, the findings of this study can guide the design and implementation of targeted interventions and investment strategies aimed at enhancing the productivity, competitiveness, and sustainability of cashew farming systems, thereby fostering inclusive growth and rural development in Nigeria. Overall, the economic analysis of cashew farming systems will provide valuable insights and evidence to support informed decision-making and policy formulation in the agricultural sector.

Objectives

To conduct an economic analysis of cashew farming systems in Nigeria to evaluate their financial viability, assess their contribution to the local economy, and provide recommendations for enhancing profitability and sustainability.

Specific Objectives:

1. Identify the various farming systems adopted by farmers in the study area.
2. Calculate and compare the costs and profitability indicators of the farming systems adopted by cashew farmers.
3. Identify the key factors influencing the choice of farming system adopted.

Methodology

Data Collection: Primary data through structured surveys and interviews with cashew farmers.

Sampling Procedure/ Techniques

Multi-stage sampling procedure was adopted for this study. The first stage involves the purposive selection of the key cashew producing states in Nigeria. The second stage involves the purposive selection of Ogbomoso agricultural zone in Oyo state due to the concentration of cashew farmers in this locality. A random selection of 3 LGAs in Ogbomoso (Orire, Ogooluwa and Ogbomoso North LGAs) was carried out in the third stage. The final stage involved random selection of 60 cashew farmers in each LGA to make a total of 180 respondents. However, only 151 farmers were successfully interviewed.

Analytical Tools

Descriptive analysis was adopted for the first objective while Gross Margin analysis and return on investment profitability analysis was employed for the second objective. The multinomial logistic regression (MNL) model was adopted for the analysis of the key factors influencing the choice of farming system in the study area. The model is expressed as thus:

Table 1: Socioeconomic Characteristics of the Respondents

Variable	Frequency	Percentage	Mean±SD
Age (years)			55±13.3
30 – 40	14	9.3	
41 – 50	67	44.5	
51-60	27	17.9	
>60	43	28.6	
Gender			
Female	33	21.9	
Male	118	78.1	
Marital status			
Single	0	0.00	
Married	122	80.8	
Divorced	10	6.6	
Widowed	19	12.6	
Education level			
No formal Education	20	13.2	
Primary	49	32.5	
Secondary	62	41.1	
Tertiary	20	13.2	
Household Size			6.8±2.3
1 to 5	47	31.1	
6 to 10	100	66.2	
>10	4	2.6	
Experience			24.1±11.5
1 to 15	45	29.7	
16 to 30	61	40.4	
>30	45	29.7	
Age of Farm			22.9±9.1
1 to 15	49	32.4	
16 to 30	73	48.3	
>30	29	19.3	
Farm Size			3.4±2.4
0.5 to 2	42	27.8	
2.1 to 4.0	58	38.4	
>4.0	51	33.9	
Number of Extension visit			
0	41	27.2	
1	70	46.4	
2	21	13.9	
>2	19	12.6	
Credit Access			
Yes	89	58.9	
No	62	41.1	

Source: Field Survey (2024)

Farming Systems Adopted by Farmers in the Study Area

Cashew Mono-cropping (11.9%)

A relatively small proportion of farmers (11.9%) engage in **cashew-only farming**, indicating that mono-cropping is the least common farming system. This suggests that most farmers prefer diversified cropping systems to minimize risks and enhance productivity (Bowman and Zilberman, 2013). Mono-cropping may be practiced by commercial farmers focusing on high-yielding cashew varieties for export markets, where quality control and uniformity are key considerations. However, its lower adoption may be attributed to concerns about soil depletion, pest susceptibility, and reliance on a single income source.

Cashew Intercropping with Other Crops (41.7%)

A substantial proportion of farmers (41.7%) practice cashew intercropping, integrating other crops alongside cashew. This system is common in Nigeria and other cashew-producing countries because it optimizes land use, enhances soil fertility, and provides multiple income streams (Lawal and Uwagboe, 2017). Intercropping cashew with crops such as maize, yam, or legumes helps to mitigate market risks associated with cashew price fluctuations while improving food security and household income.

Cashew with Animal Production (46.4%)

The highest proportion of farmers (46.4%) integrate cashew production with livestock farming. This approach provides several benefits, including natural manure for soil enrichment, improved weed control through animal grazing, and additional income from livestock sales (Osuafor, 2017). The popularity of this system aligns with sustainable agriculture practices, as it enhances resource efficiency, reduces environmental degradation, and supports climate-smart farming. The adoption of cashew-livestock integration could be further improved through targeted extension services and financial support for farmers adopting sustainable mixed farming.

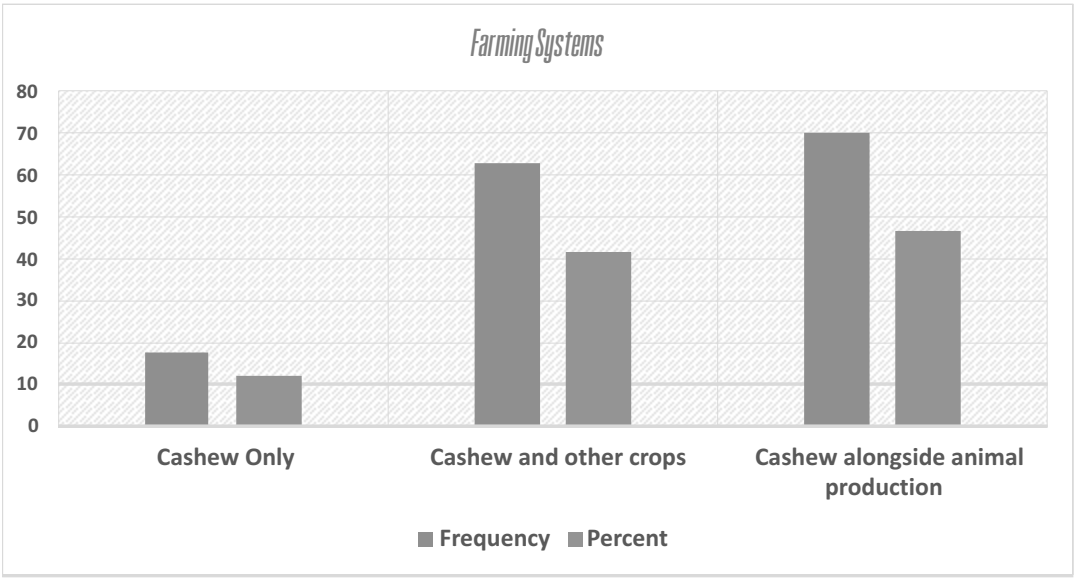

Figure 1: Distribution of cashew farmers by the farming system adopted
Source: Field Survey (2024)

Costs and Profitability Indicators of Cashew Farming Systems Adopted

The profitability analysis of cashew farming systems shows varying levels of revenue generation, cost implications, and economic returns. The study compares three farming systems: mono-cropping, intercropping, and mixed farming (cashew with livestock production). Farmers practicing mixed farming generated the highest total revenue (₦2,050,000), followed by inter-croppers (₦1,768,254) and mono-croppers (₦1,611,111). This higher revenue for mixed farming aligns with findings from Aminu and Okeowo (2016), who reported that integrating livestock with tree crops enhances income diversification and financial stability. Variable costs varied across systems, with mono-croppers having the lowest total variable cost (TVC) of ₦682,216, while intercropping farmers had the highest (₦929,056.2). The higher input costs

in intercropping are attributed to increased fertilizer (₦97,733.33) and pesticide (₦286,557.6) expenditures, which improve yield and protect crops from pests and diseases.

In contrast, mixed farmers had lower herbicide (₦204,535.3) and pesticide (₦208,270) costs, likely due to the role of livestock in natural weed control and soil fertility improvement. Gross margin (TR - TVC) was highest for mixed farmers (₦1,155,657), followed by mono-croppers (₦928,895.1) and inter-croppers (₦839,197.8). However, when considering total costs, net income (NI) showed mixed farmers achieving the highest profitability (₦920,763.1), with inter-croppers at ₦696,584.4 and mono-croppers at ₦619,206.1. This suggests that mixed farming offers better financial returns despite relatively higher total costs. The rate of return on investment (ROI) was highest for mixed farmers (0.81), meaning that for every ₦1 invested, they earned ₦0.81 in return. Inter-croppers followed with 0.65, while mono-croppers had the lowest ROI (0.62). Similarly, the benefit-cost ratio (BCR) favoured mixed farming (1.81), indicating that every ₦1 spent yielded ₦1.81 in returns. This confirms the economic advantage of integrated farming systems, as reported in previous studies on agroforestry and farm diversification (Rosa-Schleich *et al*., 2019).

Table 2: Cost and Profitability Indicators

Items	Mono-croppers (₦)	Farmers intercropping cashew with at least one other crop (₦)	Farmers engaged in mixed-farming (₦)
Total Revenue (TR)	1,611,111	1,768,254	2,050,000
Variable Costs			
Fertilizer	45,000	97,733.33	150,000
Herbicide	230,187.4	273,896.6	204,535.3
Pesticide	139,336.9	286,557.6	208,270
Harvesting	108,449.4	131,002.2	129,480.4
Weeding	159,242.2	139,866.4	202,057.2
Total Variable Cost (TVC)	682,216	929,056.2	894,342.9
Gross Margin (TR-TVC)	928,895.1	839,197.8	1,155,657
Fixed Cost			
Land (Lease/year)	20,000	20,000	20,000
Equipment	265,769.8	112,489.3	197,150.5
Depreciation	23,919.28	101,24.04	17,743.55
Total Fixed Cost	309,689.1	142,613.4	234,894
Total Cost (TC) = TFC+TVC	991,905	1,071,670	1,129,237
Net Income (NI) = GM-TFC	619,206.1	696,584.4	920,763.1
Rate of Return on Investment = NIVA/TC	0.62	0.65	0.81
Benefit Cost Ratio = TR/TC	1.62	1.65	1.81

Source: Field Survey (2024)

Factors Influencing the Choice of Cashew Farming System Adopted

The multinomial logit regression analysis identifies key significant factors influencing the choice of farming systems among cashew farmers, comparing mono-cropping, intercropping, and cashew-livestock integration (base category). Age has a significant positive effect on the likelihood of adopting mono-cropping ($\beta = 0.1407$, $p = 0.001$) relative to cashew-livestock integration. This suggests that older farmers are more inclined to specialize in cashew production, possibly due to their experience, risk aversion, or reduced labour capacity required for livestock integration. This finding aligns with Esan *et al*., (2018), who found that older farmers tend to prefer less labour-intensive agricultural systems, particularly perennial tree crops, due to lower physical exertion requirements. Education significantly increases the probability of choosing mono-cropping over cashew-livestock integration ($\beta = 1.5974$, $p = 0.004$). More educated farmers are likely to specialize in cashew production, possibly due to better market access, technical knowledge, or higher capital investment capabilities. This supports the findings of Mgbenka *et al*. (2016), who noted that higher education levels enhance commercialization and encourage specialization in cash crops, as

educated farmers are better equipped to exploit market opportunities and adopt improved management practices. Years of farming experience significantly reduces the likelihood of adopting both mono-cropping (β = -0.2291, p = 0.000) and intercropping (β = -0.2584, p = 0.000) compared to cashew-livestock integration. This indicates that experienced farmers recognize the benefits of diversification, particularly integrating livestock, as a risk mitigation strategy and an additional source of income. Similar conclusions were drawn by Amare and Balana (2023), who reported that experienced farmers in Nigeria prefer mixed farming systems due to their ability to enhance income stability and resilience against market fluctuations.

Marital status has a significant positive effect on the likelihood of choosing intercropping over cashew-livestock integration (β = 1.6436, p = 0.005). Married farmers are more likely to intercrop, possibly due to the need for household food security and diversified income sources to meet family responsibilities. Access to credit significantly increases the probability of adopting intercropping over cashew-livestock integration (β = 1.8727, p = 0.008). Farmers with access to credit are better positioned to invest in intercropping systems, which may require additional capital for inputs and management. This supports existing research by Adesiyan and Kehinde (2024), which emphasizes that credit access facilitates diversification and improved productivity in tree crop farming, allowing farmers to adopt more resource-intensive but profitable agricultural practices.

Table 3: Multinomial Logistic Regression Results

Variable	Cashew Production Only (Mono-Cropping)		Cashew Production with Intercrops	
	Coefficient (β)	P-value	Coefficient (β)	P-value
AGE	0.1407	0.001	0.0556	0.106
SEX	0.8818	0.366	-1.3697	0.07
Level of Education	1.5974	0.004	0.3987	0.376
Household Size	-0.2794	0.205	-0.0942	0.453
Marital Status	-12.0616	0.988	1.6436	0.005
Years of Experience	-0.2291	0	-0.2584	0
Farm Size	-0.1048	0.448	-0.2546	0.121
Access to Credit	0.5452	0.507	1.8727	0.008
Constant	16.809	0.992	-1.477	0.511
Log Likelihood: -76.8117				
LR $Chi^2(16)$: 140.72				
Prob > Chi^2: 0.000				
Pseudo R^2: 0.4781				

Source: Field Survey (2024)

Base Outcome: Cashew Production Alongside Animal Rearing

Conclusion

The study examined the economic implications of different cashew farming systems, focusing on mono-cropping, intercropping, and mixed farming. The findings indicate that farmers practicing mixed farming achieved higher profitability compared to those engaged in mono-cropping or intercropping. The results also highlight those key factors such as age, education, farming experience, marital status, and access to credit significantly influence the choice of farming systems. Additionally, the cost-benefit analysis underscores the advantages of diversification in enhancing farm income and sustainability.

These findings suggest that promoting diversified cashew farming systems can improve farmers' economic well-being and resilience. Policies aimed at enhancing financial access, knowledge dissemination, and technical support would be crucial in fostering the adoption of more profitable

and sustainable farming practices.

Recommendations

Based on the findings of the study the following recommendations are made:

Farmers should integrate livestock or intercrop cashew with other crops to maximize profitability, improve soil fertility, and enhance resilience to market fluctuations. Given that older farmers are more inclined to mono-cropping, awareness programs should be developed to encourage younger farmers to adopt intercropping and mixed farming for better long-term sustainability. Considering that mixed farming requires additional labour and inputs, farmers should be supported through input subsidy programs and mechanization initiatives to ease production constraints.

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Experimental Title: Analysis of the Socio-Economic Benefits derived from Cashew Production in Oyo State, Nigeria

Investigators: Agboola L.O., Adesanya K.A. and Ogunwolu Q.A.

Introduction

Cashew production is one of the major contributors to agricultural sector of Nigeria, during the past decade, the production of cashew nuts in Nigeria increased almost six-folds from 30,000 tonnes in 1990 to 176,000 tonnes in 2000. Cashew tree has been identified as having a number of social and economic significance from which the farmers in particular and the nation in general can derive a number of benefits. Oyo State is characterized by

high annual rainfall, good temperature and soil which favoured the production of cashew. As a result of this favourable climatic condition, Oyo State is one of the leading producers of cashew in the country (Aderounmu, 2023). The cashew seed serves as a snack or used in recipes, like others nuts, the pulp is very juicy. Cashew trees are usually grown for their kernels which when roasted have a very pleasant taste.

CTA (2007) reported that raw nuts which are much in demand in industrialized countries are processed into kernels that constitute a valuable export product for confectionery. They are used as an ingredient for making fruit paste, candied fruit, canned fruit, cashew apple, resins, jams and jellies, chutney, fruit juice, alcohol and vinegar. Cashew kernels rank third after almonds and hazelnuts in the international trade of tree nuts. Wine and pulp are produced from cashew apple. Apple is eaten as a raw fruit or is fermented to produce a delicious alcoholic drink. The pulp is the fibrous part obtained after extracting juice from the apple and could be used as animal feed or dried and processed into diet fiber biscuit. Another product of cashew is the Cashew Nut Shell Liquid (CNSL). It is greatly valued in the international market as a raw material for brake and clutch linings, paints, and vanishes. It is also used in lacques, agglutinants, insecticides and fungicides.

Objectives of the Study

The main objective of the study is to analyse the socio-economic benefits that are derived from cashew production by the cashew farmers in Oyo State, Nigeria. Specifically, the study aims to:

(i) Describe the socio-economic characteristics of cashew farmers in the study area;

(ii) Determine the income realized from cashew output in the study area;

(iii) Determine the socio-economic benefits derived from cashew production; and

(iv) Identify the constraints of cashew production in the study area.

Methodology

Data were collected using questionnaires and interview schedule. The study employed multi-stage sampling technique in the course of the research. The first stage involved purposive sampling where the local government predominantly known for cashew cultivation are identified. The second stage was a purposive random sampling of cashew farmers in Orire local government area of Oyo State. Finally, 60 cashew nut farmers were randomly selected from the frame of farmers that was got from the local government area. Descriptive statistics such as mean, percentages and frequency counts were used to analyse the data. Constraints affecting cashew production was measured using three points Likert scale of Very severe = 1, Severe = 2 and Not severe = 3.

Results and Discussion

Selected socio-economic characteristics

The findings on the socio-economic characteristics of the respondents are presented in Table 1. The results revealed that 81.70% are males, 11.70% are graduates of university while 28.30% have primary education. The mean age of the respondents was 55.47 years; this is an indication that more elderly people were involved in cashew production in the study area with the mean year of cashew farming experience at 21.12 years. Most (88.30%) of the farmers were married with mean household size of 7.62. The mean farm size of cashew farmers was 3.84 hectares.

Table1: Distribution of Respondents According to their Socio-Economic Characteristics

Variables	Frequency	Percentage	Mean
Gender			
Male	49	81.7	
Female	11	18.3	
Total	60	100.0	
Age			
31-40	6	10	55.47
41-50	26	43.4	
51-60	8	13.3	
>60	20	33.3	
Total	60	100.0	
Level of education			
Non-formal	6	8.3	
Primary	17	28.3	
Secondary	31	51.7	
Tertiary	7	11.7	
Total	60	100.0	
Marital status			
Married	53	88.3	
Divorced	4	6.7	
Widow/widower	3	5.0	
Total	60	100.0	
Household size			
1 – 5	11	18.4	7.62
6 – 10	45	74.9	
>10	4	6.7	
Total	60	100.0	
Farming experience (years)			
1 – 10	12	20	21.12
11 – 20	27	45	
21 – 30	11	18.3	
31 – 40	8	13.4	
>40	2	3.3	
Total	60	100.0	
Farm size (ha)			
1 – 5	24	40.2	3.84
6 – 10	29	48.2	
>10	7	11.6	
Total	60	100.0	

Source: Field survey, 2024

Income Realized from Cashew Output

Table 2 revealed that majority (48.3%) of the respondents produced between 21-30 bags of cashew per annum, 28.4% of the respondents produced between 1-10 bags of cashew per annum while 23.3% of the respondents produced between 11-20 bags of cashew per annum. The mean annual income of the respondents was ₦1466666.67 while majority (65%) of the respondents had an annual income between the ranges of ₦501000 – ₦1000000. The results also revealed that 75% of the respondents sold their cashew nuts to the local purchasing agents while 25% of the respondents sold their cashew to the commission agents. Table 2 further revealed that 66.7% of the respondents sold their cashew nuts in the village markets to the buyers while 33.3% of the respondents sold their cashew nuts at the farm gate to avoid the cost of transportation to the village markets.

Table 2: Distribution of Respondents According to Income Realized from Cashew Output

Variables	Frequency	Percentage	Mean
Bags of Cashew produced			
1 – 10	17	28.40	
11 – 20	14	23.30	
21 – 30	29	48.30	
Total	60	100.00	
Income (₦)			
≤ 500000	5	8.40	₦1466666.67
501000 – 1000000	39	65.00	
1500000 – 2000000	8	13.30	
≥ 2500000	8	13.30	
Total	60	100.00	
How cashew nuts are sold			
Local purchasing agents	45	75.00	
Commission agents	15	25.00	
Total	60	100.00	
Where cashew nuts are sold			
Village market	40	66.70	
Farm gate	20	33.30	
Total	60	100.00	

Source: Field survey, 2024

Socio-economic Benefits derived from Cashew Production

Table 3 shows the socio-economic benefits derived from cashew production in the study area. A total of 80.0% of the respondents in the study area used income generated from cashew production to purchase mobile phones while 78.3% of the respondents used income from cashew production to settle medical bills. Also, 38.3% of the respondents used part of the income from cashew to erect building while 85.0% of the respondents in the study used income from cashew production to pay their children's school fees. Table 3 further revealed that 10.0% of the respondents purchased fridge while 21.7% bought television. Moreso, 16.7%, 20.0%, 18.3%, 15.0% and 3.3% of the respondents bought radio, generators, motorcycles, cars and bicycle respectively from the income generated from cashew production. This finding agrees with that of African Cashew Initiative (ACI), 2012) that income from cashew production assist farmers to pay their children school fees and cater for other socio-economic benefits.

Table 3: Distribution of Respondents According to Socio-economic Benefits Derived from Cashew Production

Variables	Frequency	Percentage
Purchase of mobile phone	48	80.00
Settled medical bills	47	78.30
Residential building	23	38.30
Fridge	6	10.00
Radio	10	16.70
Television	13	21.70
Pay school fees	51	85.00
Bicycle	2	3.30
Car	9	15.00
Motorcycle	11	18.30
Generator	12	20.00

Source: Field survey, 2024

Constraints affecting cashew production

Table 4 showed that inadequate capital and inadequate extension services were the major constraints faced by cashew farmers with mean values of 1.25 and 1.95 respectively. Farmers also reported that insufficient price information and inadequate input supply limit their production with mean values of 2.38 and 2.43 respectively. This constraint was followed by poor marketing channel due to the activities of middle men with mean value of 2.70. Other challenges of concern in the study area were lack of awareness on cashew potentials (2.55) and insufficient labour (2.58). The inference that can be drawn from this finding is that the cashew producers are faced with several challenges in the study area, which require attention for improved cashew production.

Table 4: Distribution of Respondents According to the Constraints Affecting their Cashew Production

Variables	Very severe	Severe	Not severe	Mean
Inadequate extension services	20(33.3)	23(38.3)	17(28.3)	1.95
Inadequate capital	47(78.3)	11(18.3)	2(3.3)	1.25
Insufficient price information	10(16.7)	17(28.3)	33(55.0)	2.38
Lack of storage facilities	2(3.3)	2(3.3)	56(93.3)	2.90
Poor marketing channels	3(5.0)	12(20.0)	45(75.0)	2.70
Lack of awareness on cashew potentials	3(5.0)	21(35.0)	36(60.0)	2.55
Inadequate supply of input	13(21.7)	8(13.3)	39(65.0)	2.43
Insufficient labour	2(3.3)	21(35.0)	37(61.7)	2.58
Insufficient buyer	2(3.3)	6(10.0)	52(86.7)	2.83

Source: Field survey, 2024

Figure in parenthesis are percentages

Conclusion and Recommendations

This study concludes that 80% of cashew producers purchased mobile phone using income from cashew production, 85% pay children school fees and 78.3% settled medical bills using income from cashew production. The study recommends that adequate capital and other production incentives should be provided to the farmers in order to maximize their production in the study area. Also, awareness on cashew potentials should be carried out in order to maximize the potentials of cashew potentials.

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Experimental Title: Farmers' Perspectives and Felt needs in the Development of Cashew Varieties in Edo State, Nigeria

Investigators: Uwagboe, E. O., Oha, K. F., Adelusi and A. A.,

Introduction

Agriculture remains an important sector of the economy of most African countries including Nigeria and contributes significantly to economic growth. In the face of increasing global population, there is the need to step up agricultural production to continue to provide food, employment, and foreign exchange for developing economies. Cashew tree (*Anacardium occidentale* L.) originated from Southern part of Brazil and is an evergreen nut-bearing tropical plant. It is a multipurpose tree crop with great economic importance to developing countries including Benin Republic, Cote d'Ivore, Guinea Bissau, Ghana, Mozambique, Nigeria, Philippines and Sri Lanka (FAO, 2017).

In the last two decades a lot of resources have been utilised in the growth and development of some commodity crops such as cashew in Nigeria with the primary goal of improving the revenue of rural households' and livelihood through increased

productivity. In the past, some Researchers have put in efforts at producing some cashew varieties at Cocoa Research Institute of Nigeria which was truncated due to mass mobility of researchers from Research Institutes to Universities for greener pastures. Attempts have also been made to develop rapid methods of propagation, including budding, grafting, marcotting and tissue culture protocols for mass multiplication (Aliyu, 2000, 2001, 2005). Efforts in these directions have broadened knowledge of cashew as a crop and contributed to enhancing its productivity. Presently however, increase in cashew production in Nigeria is attributed to increase in cultivated area, rather than to increase in yield per hectare. Moreover, plantings materials are usually unimproved open pollinated seed nuts that do not breed true to type. There is therefore the need to step up research to produce cashew varieties with improved yields and quality as well as standardise effective propagation techniques to clone them.

Justification

It is noteworthy to remark here that the Nigerian cashew nuts sell at a discount in the world market in the region of 20 to 30% (Nugawela and Oroch, 2005; Topper, 2008). Limiting factors for good pricing of Nigerian cashew includes: Low quality, small nut and kernel size, and more importantly poor kernel peel-ability (that is, the difficulty in the removal of the testa from the kernel) which adds more to the cost of processing. Poor peelability may possibly be resulting from the single or complex effect of poor harvest, poor post-harvest handling, abiotic factors or inherent genetic composition of the Nigerian cashew. Understanding the cause(s) of this problem would be a relevant research pursuit.

According to *Hammed (200*8), the problem of high nut yield in Nigeria is based on high dependence on the Brazilian and Indian classifications, which gave different sizes of cashew nuts as follows; jumbo (16 g), extra-large (12-15g), large (8-11 g), small (2 g-5 g) and madras (2 g), which attracts low is averagely 8-10 kg/tree while the nut yields that currently exists on many plantations in Nigeria, falls below yield of jumbo nut-size, which is an equivalence of W180, while farmers' yield falls within W320 and W280 categories, which attracts low pricing in the International market. The highly priced matured medium and madras cashew trees fall between 30 kg/tree and 250 kg/tree.

Cashew is propagated mainly from the seed in Nigeria. Since seed nut incorporate a wide range of genetic diversity, the genetic integrity of a particular clone or genotype can only be preserved through vegetative propagation. Several methods of vegetative propagation have been attempted in cashew *viz.,* air layering, inarching, budding, marcotting or grafting which may be epicotyls, soft wood, or flush side grafting. The degree of success of each varied in different countries with attending limitations. Of all the methods, grafting was reported to be the best for large-scale clonal seedling production of cashew. Tip or bud grafting is used in East Africa, India, Brazil, and Ghana and up to 100% success rate have been obtained with 10-week-old seedlings. Some factors identified to affect the success of grafting includes period of the year or season of grafting (Adeigbe *et al*., 2015) The farmers do not need to travel long distances for the acquisition of improved cashew seedlings

Objectives

1. Examine selected personal characteristics of the respondents
2. Examine the awareness of the respondents on the development of new cultivars
3. Ascertain the preference of respondent on the characteristics of developed cashew cultivars
4. Determine the felt needs of the respondents in cashew cultivation.

Methodology

Multistage sampling procedure was used to select Owan East and Owan West Local Government Areas (LGAs) of Edo state while purposive sampling technique was used in the selection of two communities from the LGAs namely, Afuze and Ihievbe from Owan East while Ozalla and Uhonmora from Owan West LGAs due to high cashew production in the areas. Furthermore, seventeen (17) cashew farmers were randomly selected from each community, thereby giving a total of Sixty Eight (68) respondents.

Data were collected with structured questionnaire and analyzed using descriptive statistics such

as frequency counts, percentages and means. Chi-square was used to test the hypothesis of the study.

SPSS Version 25 was used for the analysis.

Hypothesis: There is no significant relationship between socio economic characteristics and the felt needs of the respondent.

Results and Discussion

Table 1: Personal Characteristics of the Respondents

Sex	Frequency	Percent
Male	44	64.7
Female	24	35.3
Total	68	100.0
Age		
<40	18	26.5
41-50	26	38.2
51-60	14	20.6
61-70	10	14.7
Education		
No Formal	5	7.4
Primary	12	17.6
Secondary	24	35.3
Tertiary	27	39.7
Marital Status		
Single	1	1.5
Married	63	92.7
Widowed	4	5.9
Household Size		
1-3	20	29.41
4-6	28	41.18
7-9	14	20.59
10 and above	6	8.82
Farming Experience		
1-5	10	14.71
6-10	9	13.24
11-15	8	11.76
16-20	10	14.71
21 above	31	45.59

Source: Field Survey, 2024

The results on Table 1 show that the majority of the respondents (64.7%) were male, while 35.3% were female. The majority of the respondents (38.2%) fell within the age range of 41-50 years, followed by 26.5% who were less than 40 years, 20.6% who were between 51-60 years, and 14.7% who were between 61-70 years. The Education result revealed that majority of the respondents (39.7%) had tertiary education, followed by 35.3% who had secondary education, 17.6% who had primary education, and 7.4% who had no formal education. In the marital status result majority of the respondents (92.7%) were married, followed by 5.9% who were widowed, and 1.5% who were single. Household Size Distribution results indicated that the majority of households (70.59%) have 4-6 people, indicating a relatively moderate household size. A significant proportion of households (29.41%) have 1-3 people, which may suggest a smaller family size or possibly single-person households. A smaller percentage of households (20.59%) have 7-9 people, indicating larger family sizes. Only 6 households (8.82%) have 10 or more people, which may represent extended family households or households with multiple dependents.

Also, Results on Table 1 reveals that (14.71%) had 1-5 years farming experience, (13.24%) had 6-10 years, (11.76%) had 11-15 years, (14.71%) had 16-20 years while (45.59%) had 21 years and above. The farmers that had 21 years or more of farming experience indicate a high level of expertise and knowledge in cashew production. Understanding farming experience is crucial for developing cashew varieties that meet the needs of different farmer groups (Ajewole & Adeyemo, 2020). The high proportion of experienced farmers suggests a need for cashew varieties that provide improved yields, disease resistance, and market competitiveness (Ogunsumi & Oyedele, 2019). The implications for cashew development from these results include the fact that Extension services should be targeted towards male farmers, who make up the majority of the respondents (Ogundari & Ojo, 2020). Training programs should be designed to cater to the needs of farmers across different age groups (Adegbite *et al*., 2020). Education and literacy programs should be implemented to improve the educational status of farmers, particularly those with no formal education (Adebayo et al., 2020). Marital status and household dynamics should be considered in the design of extension services and training programs (Ogunniyi *et al*., 2020). Understanding household size is essential for developing cashew varieties that meet the needs of different household types (Ajewole & Adeyemo, 2020). The relatively moderate household size (4-6 people) may indicate a need for cashew varieties that provide a stable income and food

security for these households (Ogunsumi & Oyedele, 2019). The presence of smaller and larger households suggests that cashew varieties should be adaptable to different household sizes and needs (Donkoh & Awuni, 2020).

Table 2: Distribution of Respondents based on Farm Size

Farm Sizes (Ha)	Frequency	Percentage
1 to 3	26	38.24
4 to 5	16	23.53
6 to 8	7	10.29
9 to 11	4	5.88
Above 12	15	22.06
Total	68	100.0

Source: Field Survey, 2024

The Farm Size Distribution results on Table 2 revealed that (38.24%) of the farmers had 1-3 hectares, (23.53%) had 4-5 hectares, (10.29%) had 6-8 hectares, (5.88%) had 9-11 hectares while (22.06%) had 12 hectares and above. A significant proportion of farmers (38.24%) have farm sizes between 1-3 hectares, suggesting a focus on small-scale cashew production. The distribution of farm sizes indicates a mix of small, medium, and large-scale farmers, highlighting the diversity of cashew production systems in Edo State. Understanding farm size is crucial for developing cashew varieties that meet the needs of different farmer groups (Ajewole & Adeyemo, 2020). The diversity of farm sizes indicates a need for cashew varieties that are adaptable to different production systems and scales (Donkoh & Awuni, 2020).

Table 3: Preferred Characteristics of Cashew Varieties

Characteristics	Frequency	Percentage
climate tolerance	2	2.9
early maturing	6	8.8
high yield	48	70.6
large nut size	2	2.9
nut quality	6	8.8
pest resist	4	6.0
Total	68	100.0

Source: Field Survey, 2024

The results on Table 2 show that the majority of the respondents (70.6%) identified high yield as the most preferred characteristic of cashew varieties, a significant proportion of the respondents (8.8%) identified early maturing as a preferred characteristic of cashew varieties, a similar proportion of the respondents (8.8%) identified nut quality as a preferred characteristic of cashew varieties and a smaller proportion of the respondents (6.0%) identified pest resistance as a preferred characteristic of cashew varieties. The results have implications for cashew development: The high demand for high-yielding cashew varieties suggests that breeding programs should prioritize the development of high-yielding varieties (Adebayo *et al*., 2020). The demand for early maturing varieties suggests that breeding programs should also prioritize the development of early maturing varieties to enable farmers to harvest their crops earlier (Ogundari & Ojo, 2020). The demand for high-quality nuts and pest-resistant varieties suggests that breeding programs should also prioritize the development of varieties with these characteristics (Adegbite *et al*., 2020).

Table 4: Awareness of Cashew Cultivar Developement

Awareness	Frequency	Percentage
Aware	53	77.9
Not Aware	15	22.1
Total	68	100.0

Source: Field Survey, 2024

The results on Table 4 show that the majority of the respondents (77.9%) were aware of cashew cultivar development, indicating a high level of awareness among farmers. However, a significant proportion of the respondents (22.1%) were not aware of cashew cultivar development, indicating a need for increased awareness and education.

The results imply that the high awareness of cashew cultivar development among farmers suggests that extension services have been effective in disseminating information about new cultivars (Adebayo *et al*., 2022). However, the limited awareness among some farmers suggests that targeted education and awareness programs are needed to reach all farmers, particularly those in remote or hard-to-reach areas (Ogundari & Ojo, 2022). The awareness of cashew cultivar development among farmers also suggests that participatory breeding programs, which involve farmers in the breeding process, could be effective in developing new cultivars that meet farmers' needs (Adegbite *et al*., 2022).

Table 5: Felt Needs of Respondents

Felt Needs	Frequency	Percentage
Government Support	23	33.8
High yielding Varieties	37	54.4
Large nut	1	1.5
Pest control	2	2.9
Price stability	5	7.4
Total	68	100.0

Source: Field Survey, 2024

The results on Table 5 show that majority of the respondents (54.4%) identified high-yielding varieties as their top felt need, indicating a strong desire for improved productivity and yields. A significant proportion of the respondents (33.8%) identified government support as a key felt need, highlighting the importance of policy and institutional support for cashew development. A smaller proportion of the respondents (7.4%) identified price stability as a felt need, indicating concerns about market volatility and price fluctuations.

The results have implications for cashew development: The high demand for high-yielding varieties suggests that breeding programs should prioritize the development of high-yielding and disease-resistant varieties (Kumar *et al*., 2022). The need for government support highlights the importance of policy and institutional support for cashew development, including provision of credit, inputs, and extension services (Okuneye *et al*., 2022). The concern about price stability suggests that market stabilization mechanisms, such as price insurance and commodity exchanges, should be explored to help farmers manage price risks (Adekunle *et al*., 2022).

Table 6: Chi-Square showing the Association of Farm Size, Farm Experience, Household size with Felt Needs of the Respondents

Variables	X2	Df	p-value	Sig
Farm size	16.04	4	0.003	S
Farm Experience	5.07	4	0.280	NS
Household size	7.10	3	0.068	NS

Source Field Survey, 2024

The Chi-square results on Table 6 provide insights into the relationships between farmers' perspectives, felt-needs, and demographic characteristics in the development of cashew varieties in Edo State, Nigeria. Household Size (HHS) and Felt-Needs result shows the Chi-square statistic (7.10) is not significant at the 0.05 level (p-value = 0.0686), indicating no significant association between household size and felt-needs. Farming Experience (farmexp) and Felt-Needs shows that the Chi-square statistic (5.07) is not significant at the 0.05 level (p-value = 0.2805), indicating no significant association between farming experience and felt-needs while Farm Size (farmsize) and Felt-Needs Chi-square statistic (16.04) is significant at the 0.05 level (p-value = 0.0030), indicating a significant association between farm size and felt-needs.

This suggests that farmers with larger farm sizes have different felt-needs compared to those with smaller farm sizes. In the context of developing cashew varieties, this finding implies that researchers and policymakers should consider the farm size of farmers when designing and disseminating new cashew varieties. For example, farmers with larger farm sizes may prioritize high-yielding varieties, while those with smaller farm sizes may prioritize disease-resistant or low-maintenance varieties (Ajewole & Adeyemo, 2020). Overall, the Chi-square results highlight the importance of considering farm size when understanding farmers' perspectives and felt-needs in the development of cashew varieties in Edo State, Nigeria.

Conclusion and Recommendations

Based on the findings Extension services should be targeted towards male farmers, who make up the majority of the respondents. The distribution of farm sizes indicates a mix of small, medium, and large-scale farmers, highlighting the diversity of cashew production systems in Edo State. Understanding farm size is crucial for developing cashew varieties that meet the needs of different farmer groups.

However, the limited awareness among some farmers suggests that targeted education and awareness programs are needed to reach all farmers, particularly those in remote or hard-to-reach areas. The high demand for high-yielding varieties suggests that breeding programs should prioritize the development of high-yielding and disease-resistant varieties.

Farmers with larger farm sizes have different felt-needs compared to those with smaller farm sizes. In the context of developing cashew varieties, this

finding implies that researchers and policymakers should consider the farm size of farmers when designing and disseminating new cashew varieties.

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Experimental Title: Assessment of Economic Factors Influencing Cultivar Development among Cashew (*Anacardium Occidentale L.*) Farmers in Southeast Nigeria

Investigators: Akinpelu, A.O., Adesanya, K., Oluyole, K.A., and Adeniyi, D.O.

Introduction

Cashew (*Anacardium Occidentale L.*) is a multipurpose tropical tree crop whose origin can be traced back to the amazon basin in Brazil (Salau *et al*., 2017). The crop was introduced to Africa and Nigeria by Portuguese explorers around the 15th and 16th century (Asogwa *et al*., 2008). The most important part of the fruit is the nut which has great economic value and usefulness (Tola and Mazengia, 2019). According to Adeigbe *et al* (2015), cashew was first planted in Nigeria at Agege, Lagos State, and later spread to other parts of the country. Cocoa Research Institute of Nigeria (CRIN) has developed and disseminated some cashew cultivars which are categorized as Jumbo size, medium size and small size, respectively. These varieties of cashew have been cultivated by farmers in different cashew growing ecologies of Nigeria. Similarly, the

introduction of Brazilian cashew biotype with improved and desirable nuts and quality characteristics by CRIN has further increased the popularity of the crop and the spread in Nigeria (Hammed *et al.,* 2007).

Meanwhile, the contribution of Kogi State to the nation's production is about 30% annually, however, the Eastern part of the State accounted for about 60% of the State's production. The average yield of the nuts of a mature cashew tree ranges from 7-11kg per annum (Adejo *et al*., 2011). Moreover, different improved production packages associated with these varieties were given to farmers in Nigeria in order to increase farmers' productivity and income. The characteristic features of these varieties include high yielding with very low input, early bearing, resistance to pest and diseases, very good quality kernel traits, ease of peel-ability and adaptability to climatic conditions of various growing regions of the country.

In view of the aforementioned characteristics of these cultivars, there is the need to add more varieties into the cashew germplasm in Nigeria. It is then imperative to develop a wholistic package for the development of new varieties of cashew as the varieties released decades ago need to be improved upon towards the development of varieties that will be resistant to emerging pests and diseases which may be attributed to climatic changes and other factors. Meanwhile, the low input for high productivity of these materials will greatly encourage enhanced cultivation of cashew, thus making the venture more profitable and attractive for those involved, while also encouraging others to tap into its production. These and other qualities will encourage farmers to accept the cultivation of these varieties. However, there is a dearth of information on economic factors influencing development of new cashew cultivars for smallholders who depend on it for livelihood.

Objectives

The broad objective of this study is to assess the economic factors influencing cultivar development among cashew farmers in southwest Nigeria.

Specific objectives are to:

1. assess level of awareness of cultivar development among the farmers
2. determine factors influencing cultivar development
3. identify factors influencing cashew production in the study area

Research Methodology

The study employed multistage random sampling procedure to select cashew farmers in the study area. The first stage involved a purposive selection of Enugu state from Southeast Nigeria based on the volume of cashew production in the state. The second stage involved a random selection of two Local Government Areas (LGAs) among the cashew producing LGAs of the state. The third stage involved a random selection of three communities from each of the randomly selected LGAs thus making a total of six (6) communities. A total of one hundred and twenty (120) cashew farmers were randomly selected for the study. Descriptive analysis (Mean, Frequency, Standard Deviation and Percentages) and inferential statistical analysis (Regression) were used to analyse the results from the study area.

Results and Discussion

Table 1 below shows the summary of the socio-economic characteristics of the respondents. The table reveals that average revenue per kilogram was N277.42, with an average total revenue of N62,689.17. This variability may perhaps be due to differences in farm size, productivity, and market access. The table also reveals that average age of respondents was 45.97 years, with a range from 25 to 66 years. This indicates that cashew production in Enugu State is predominantly carried out by youth. This finding aligns with Agada and Sule (2020), who reported that a significant proportion of cashew farmers in Ugwolawo District, Kogi State, were, within their active age. The implication of this is that cashew production in the study area is in the hands of the youth.

Similarly, table 2 indicates that cashew farming in the study area is relatively gender-balanced, with both men and women actively participating in cashew cultivation. This aligns with Bryson (1981), who highlighted the significant role of women in agriculture across sub-Saharan Africa. The study revealed that women often contribute more labour hours in agricultural activities compared to men, underscoring their vital role in crop production and rural development. Regarding marital status,

majority (83.3%) were married, while smaller proportions were single (5.8%), divorced (5.0%), widowed (2.5%), or widowers (3.3%). Also, educational background varied with 42% having secondary education, 35.0% tertiary education, 21.7% primary education, and 1.7% having non-formal education. These figures indicate that most farmers have at least basic formal education, which could influence their adoption of improved cultivars. The average farm size was 0.61 hectares, indicating predominantly smallholder farming. Farming experience averaged 14.99 years, with cashew farming experience closely matching at 14.82 years, implying that most farmers dedicated a significant portion of their farming lives to cashew production.

Furthermore, farmers' satisfaction with their current cashew varieties was mixed, with majority (61.7%) expressing contentment, while about 38.3 percent of the respondents cited challenges such as disease susceptibility, low yield, and the need for improved varieties. However, farmers identified key attributes they desired in new cashew varieties, including jumbo-sized nuts (97.5%), high-yielding varieties (96.7%), and resistance to drought, pests, and diseases (96.7%). Additionally, they preferred trees that were tolerant to high rainfall (96.7%), produced high-quality nuts (96.7%), did not experience flower abortion (96.7%), and had a dwarf growth habit (96.7%). The implications of these findings highlight the need for breeding programs which focuses on improving cashew varieties to meet farmers' demands for higher yields, resilience, and nut quality. These concerns align with findings from **Aliyu and Hammed (2014)**, who emphasized that disease-resistant and high-yielding cashew varieties are crucial for enhancing productivity. Similarly, **Sharma *et al* (2020)** noted that breeding programs should prioritize traits such as drought resistance, pest tolerance, and improved nut quality to meet farmer preferences. The strong preference for jumbo-sized nuts, high-yielding varieties, and trees tolerant to high rainfall and flower abortion resistance reflects earlier research by **Nair (2010)**, which identified that cashew farmers prioritize marketable nut size and agronomic resilience when selecting varieties (Table 3).

Table 4 below reveals factors influencing the yield and revenue of cashew farmers among respondents in the study area. The table shows that yield was influenced by farm size and farming experience at 1 per cent level of significant while revenue from cashew production was influenced by farm size (1%), educational level (1%) and age of cashew farm (5%), respectively.

Conclusion and Recommendations

The study highlights key factors influencing cashew farmers' satisfaction, yield, and revenue. The result shows that a larger percentage of the farmers in the study are expressed satisfaction with their current cashew varieties. However strong preference for jumbo-sized nuts, high-yielding varieties, and resistance to drought, pests, and diseases emphasize the need for breeding programs that cater to these demands. Hence, breeding programs should prioritize the development of high-yielding, disease-resistant, drought-tolerant, and high-quality nut varieties, as these are the most desired traits among farmers.

Similarly, the study identified farm size and farming experience as the most significant predictors of cashew nut yield. However, larger farms benefit from economies of scale and farmers with more years of experience in cashew cultivation has potential to achieve higher productivity. Thus, strategies should be implemented to improve the efficiency of large-scale cashew farms through better resource management, mechanization, and labor productivity enhancements.

Farm size, education background, and age of cashew tree significantly impacted revenue from cashew cultivation in the study area. Policymakers should encourage smallholder farmers to adopt intensive management techniques and provide access to improved seed varieties, soil conservation practices, and financial resources.

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Table 1: Summary Statistics for Socioeconomic Characteristics of the Respondents

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Age	120	25	66	45.97	9.624
Farm size	120	10	2.60	0.6067	0.45239
Farming Experience	120	2	32	14.99	8.197
Cashew Age	120	2	33	14.82	8.242
Yield	120	50	700	277.42	181.217
Revenue	120	400	285000	62689.17	46113.867

Source: Field Survey, 2024.

Table 2: Socioeconomic Characteristics of the Respondents

Variable	Frequency (N=120)	Percentage %
Gender		
Female	64	56.7
Male	56	53.3
Marital status		
Single	7	5.8
Married	100	83.3
Divorced	6	5.0
Widow	3	2.5
Widower	4	3.3
Education level		
Non formal Education	2	1.7
Primary	26	21.7
Secondary	50	41.1
Tertiary	42	34.0
Source of planting material		
Fellow farmer	57	49.2
CRIN	4	3.3
State Ministry	21	17.5
Market	36	30.0
Are you Satisfied with Current planting		
Yes	74	61.7
No	46	38.3
Why are farmers not satisfied		
No response	80	66.7
Disease	10	8.3
Old Yield	17	14.2
Old variety	13	10.8

Source: Field Survey, 2024.

Table 3: Desired Attributes of Cashew by Respondents

Desired Attribute	Frequency	Percentage (%)
Jumbo-sized nuts	117	97.5
High-yielding variety	116	96.7
Tolerance to high rainfall	116	96.7
Insect and disease resistance	116	96.7
Drought resistance	116	96.7
High-quality nut (weight, appearance, colour)	116	96.7
Non-flower aborting	116	96.7
Dwarf cashew tree	116	96.7
Large-sized nuts	94	78.3
Medium-sized nuts	27	22.5
Small-sized nuts	4	3.3

Source: Field Survey, 2024

Table 4: Factors Influencing the yield and revenue of cashew farmers among Respondents

Variable	Linear Y: - Yield (Kg)		Exponential Y: - Revenue (Naira)	
	Coefficient (β)	P-value	Coefficient (β)	P-value
(Constant)	-218.450	0.103	322639.995	0.030
Age	1.739	0.371	1.739	0.371
Sex	-35.892	0.157	33974.060	0.243
Mastat	-9.631	0.604	-31389.383	0.103
Edulv	23.299	0.087	-40177.661	0.033***
Farmsize	206.581	0.000***	-48780.375	0.022***
Farmexp	13.578	0.016***	-15558.800	0.324
Agecashw	-5.103	0.319	16483.462	0.054**
Pltsce	11.366	0.240	-22809.539	0.321
R:- 0 .817			R:- 0.645	
R-square:- 0.668			R-square:- 0.416	
Adjusted R Square:- 0.620			Adjusted R Square:- 0.204	
Std. Error of the Estimate:- 114.672			Std. Error of the Estimate:- 28398.815	
F-statistic = 13.947, p-value = 0.000			F-statistic = 1.969, p = 0.054	

Source: Field Survey (2024) Note: ***, **, * statistically significant at 1%, 5%, and 10%

Experimental Title: Biochar production from cashew leaf litter as influenced by method of thermal processing

Investigators: Iloyanomon, C.I., Ogunlade, M.O., Ibiremo, O.S. and Akanbi, O.S.

Introduction

Leaf litter is an important component of tree cropping system. This is because it builds up on the floor of the tree plantation and creates a layer of litter and nutrient in the soil. It is a major source of soil organic matter and it returns nutrients back to the soil through nutrient recycling. It reduces nutrient loss through leaching and erosion (Sunita and Uma, 1993) and provides biomass and a suitable microclimate for various micro-organisms responsible for the release of mineral nutrients in available form to trees. It also improves soil structure, water infiltration and water holding capacity.

Cashew generates 9.33 – 10.98 tons/ha of leaf litter which contains substantial nutrients (Iloyanomon and Taiwo, 2017). However, the high lignin content and unfavourable decomposition situation makes the release of nutrients from cashew leaf litter slow. This creates the presence of substantial quantity of cashew litter on the floor of the cashew plantation, hence disrupting the ease of picking cashew nuts. It also exposes the cashew plantations to forest fires during the dry season. Some cashew farmers at the beginning of cashew nut harvesting season gather the cashew litter on the

floor of the cashew plantation and burn to allow for ease of picking of cashew nuts. There is therefore need to discourage the practice of burning cashew litter, while finding alternative ways to enhance quick decomposition of the cashew leaf litter and better utilization of the litter to ensure faster decomposition of leaf litter for use by the cashew trees. Biochar production from cashew litter is a promising way of meeting the challenges of cashew litter management. Biochar which is a carbon rich material produced from heating organic material (biomass) in an oxygen limited environment (pyrolysis), helps maintain soil fertility and organic matter. Biochar when added to the soil increases soil carbon, soil available nutrient and cation exchange capacity. It reduces soil nutrient leaching and when applied with mineral fertilizer has been shown to increase yield (Lehmann, *et al*, 2009), thus decreasing the need for inorganic fertilizer. Biochar can be produced using the coal pot and pit method. There is therefore need to produce and evaluate biochar produced from cashew leaf litter using various methods.

Objectives

i. Production of cashew leaf litter biochar using the pit and coal pot method.
ii. Determine the influence of method of cashew biochar production on quantity and quality of cashew biochar.

Materials and methods

Study area

Leaf litter was collected from cashew plantation aged 16 and 20 years in Cocoa Research Institute of Nigeria (CRIN) Ibadan, Oyo state and from cashew plantation aged 21 and 30 years at CRIN at Ochaja, Kogi state. Ochaja is located in the Southern Guinea Savanna Ecological zone (latitude 070 301N and longitude 070151E), with a unimodal rainfall peaking in August. The dry season runs from early October to March/April, while the rainy season runs from April/May to late September. Ibadan is located at the forest ecological zone. Ibadan is located on latitude 07° 10^{1} N and longitude 03° 52^{1}E with an altitude of about 122 metres above the sea level. The climate is humid tropic with two seasons per year. A wet season from March to October or early November with two weeks dry spell in August. The dry season runs from November to March the following year with scanty rain.

Sample collection and processing

Each of the cashew plantation was divided into four blocks. Leaf litter was collected from 20 m x 20 m area within each block. The 4^{th} leaf at the tip of the growing plant of the cashew plant was sampled, while soil samples was taken at 0-20 cm and 20-40 cm soil depths using a soil auger at the points, at where leaf litter was collected. A representative sample of the litter was oven dried at 60 $^{\circ}$C milled and analysed for some of its chemical properties. Soil samples were air dried, passed through a 2 mm sieve and also analysed for some of its chemical properties. Leaf litter from each of the cashew plantation was used to produce biochar using the pit method, coal pot method and also subjected to open burning as practiced by some cashew farmers. For the open burning, leaf litter with known weight was subjected to open burning. The ashes obtained was allowed to cool and were weighed. In the coal pot method, leaf litter of known weight was placed in the coal pot and subjected to thermal heat. Similarly, the pit method was done using a pit. Leaf litter of known weight was placed in a pit and burning of the leaf litter was done in an oxygen limited environment. At the completion of the biochar production process, the biochar produced were allowed to cool and weighed. The percentage biochar yield/ashes yield was derived using the formulae:

$$\text{Biochar yield (\%)} = \frac{\text{Weight of biochar produced (kg)}}{\text{Weight of leaf litter (kg)}} \times 100$$

$$\text{Ashes yield (\%)} = \frac{\text{Weight of ashes produced (kg)}}{\text{Weight of leaf litter (kg)}} \times 100$$

Results and Discussion

Leaf litter collected in Ibadan ranged from 11.1 tons/ha to 14.8 tons/ha with mean values of 14.1 tons/ha and 12.3 tons/ha in the 16 and 20-year-old cashew plantation respectively (Table 1).

Table 1: Weight of leaf litter (tons/ha) from cashew plantations in Ibadan and Ochaja

Cashew plantation	Mean weight (tons/ha)	Range (tons/ha)
Ibadan (16 years)	14.1a	13.6 – 14.3
Ibadan (20 years)	12.3a	11.1 – 13.7
Ochaja (21 years)	7.9b	7.0-8.6
Ochaja (30 years)	7.0b	6.3-7
SE±	0.551**	

Means with the same letter(s) within the same column are not significantly different at P<0.05 using Duncan multiple range test (DMRT); SE± Standard error

In Ochaja, cashew leaf litter ranged from 6.3 tons/ha to 8.6 tons /ha with mean values of 7.9 tons/ha and 7.0 tons/ha in the 21 and 30-year-old cashew plantation respectively. Cashew leaf litter value in Ibadan was significantly (P<0.05) higher than Ochaja with increases of 76 – 101 %. The 16-year-old cashew plantation in Ibadan produced the highest leaf litter (14.1 tons/ha) and the 30-year-old cashew plantation in Ochaja produced the lowest (7.0 tons/ha). Similar observation was made by Iloyanomon and Taiwo 2017, who reported that cashew in Ochaja produced 9.3 – 10.78 tons/ha of leaf litter in Ochaja.

This high leaf litter value in Ibadan which is located in the rainforest belt can be attributed to the higher rainfall in Ibadan compared to Ochaja, which is in the Guinea Savanna ecological zone. This results to higher vegetative growth and leaf production, hence more leaves available to be shed in the dry season.

Processing of the cashew leaf litter using the pit and coal pot method resulted to the production of biochar, while open burning of the cashew leaf litter as done by cashew farmers resulted in ashes. This is due to the fact that in the pit and coal pot method, the leaf litter was processed in an oxygen limited environment (pyrolysis) which favored biochar production. In the open burning method, the leaf litter was processed in the presence of unlimited oxygen which led to complete ashing of the leaf litter. The influence of method of biochar production on biochar yield was significant (P<0.05) (Table 2). Biochar yield was (50.7 kg) 49 % and (29.72 kg) 30 % for pit method and coal pot method respectively, with the pit method having 71 % higher biochar yield than the coal pot method (Table 2). The pit and coal pot method also produced 180 % and 65 % higher dry matter weight respectively when compared with the ashes from the open burning method (Table 2)

Table 2: Biochar yield (kg/100kg leaf litter), biochar yield (%) and ashes yield (%) as influenced by method of thermal processing in Ibadan and Ochaja

Treatments	Biochar/ashes yield (kg/100kg leaf litter)	Biochar/ashes yield (% recovery) (%)
Plantation (P)		
Ibadan (16 years)	26.00c	26.33c
Ibadan (20 years)	28.33c	28.27c
Ochaja (21 years)	35.19b	35.00b
Ochaja (30 years)	41.19a	42.00a
SE±	1.50*	0.66*
Method of processing (M)		
Coal pot	29.72b	30.00b
Pit	50.70a	49.00a
Open burning	18.06c	19.50c
SE±	1.30*	0.57*

Means with the same letter(s) within the same column are not significantly different at P<0.05 using Duncan multiple range test (DMRT); SE± Standard error

Similar observation was made by Mohawesh *et al*. (2018) who reported biochar yield of 34.7 % from broccoli crop residue (shoots and leaves). This difference in biochar quantity between the pit and coal pot method could be attributed to processing temperature. Biochar yield is influenced by processing temperature (Kambo and Dutta, 2015) with biochar quantity decreasing with increasing temperature (Ronsse *et al.,* 2013). Biochar produced by coal pot method was processed at a higher temperature when compared with the pit method where it was processed at a lower temperature. This resulted to lower biochar yield in coal pot method when compared with pit method. Similar biochar yield variation due to processing temperature was observed by Ronsse *et al*., 2013 who reported biochar yield of 94.8 % and 28.5 % at 300 ºC and 450 ºC respectively using straw as biomass. Biochar production using the pit method is therefore more efficient and beneficial than the coal pot method. The influence of age of cashew plantation on biochar yield was significant ($P<0.05$) (Table 2). Biochar yield increased with increasing age of cashew plantation only in Ochaja (Table 2), with the 31-year-old cashew plantation (41.19 kg) had 17 % higher biochar yield than the 21-year-old cashew plantation (35.19 kg) in Ochaja. Age of cashew plantation however, had no influence on biochar yield in Ibadan. However, leaf litter from Ochaja plantation irrespective of age produced higher biochar yield than leaf litter from the Ibadan plantation with increases of 24 – 58 %.

Conclusion and Recommendation

The pit method produced more biochar than the coal pot method, with biochar yield of 49 % (50 kg) and 30 % (30 kg) for pit and coal pot method respectively. The pit method of biochar production is recommended for use by cashew farmers

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Experimental Title: Assessment of cashew cultivars against major pathogens and diseases

Investigators: Adeniyi, D.O., Agbeniyi, S.O., Adedeji, A.R., Orisajo, S.B., Okeniyi, M.O., Ogundeji, B.A., Adeji, A.O., Ayanwole, S.A., Oladigbolu, Y.O., Omoleye, M.T., Laoye, F.T., Bobinihi, M.A.

Introduction: Reported cases of decline in cashew nut production across growing ecologies of Nigeria have been associated with many factors which range from drought as experienced through climate change related events, declining soil fertility, unimproved low yielding genotypes, insect pests and diseases (Ellias, 1980; Brown *et al.,* 1984). Of the factors, diseases: anthracnose, dieback of the inflorescence and twig, damping off of seedlings, gummosis, leaf and nut blight and recently the powdery mildew disease which is presently causing serious devastating effect and severity in cashew production especially at the South Eastern and North Central Nigeria. These diseases are important constrains to cashew production in both major and minor growing areas in Nigeria.

There is therefore a necessity to have a baseline information on the status, spread and severity of these diseases on cashew across growing regions, assess cashew genotypes against pathogens of these disease in Nigeria and develop effective

management techniques to combat the pathogen and spread of the diseases.

Objectives: The general objective of this activity is to alert research managers of the need to collectively address cashew disease problems, especially the newly introduced, for plant breeders and or pathologists to develop resistant crop varieties and or integrated pest management options, respectively against the diseases.

Materials and Methods: The cashew germplasm of Cocoa Research Institute of Nigeria (CRIN) was surveyed for the presence of disease situations during the fruiting season of December 2024 to February 2025. The Brazilian and Indian biotypes of cashew trees in the germplasm were examined for the presence of pathogens on the cashew parts. Samples from trees that were naturally infected and showing disease symptoms were collected from different parts of cashew. The cashew twig, twigs, nuts, leaves and fruits were observed and aseptically harvested into sterile sample bags and transferred to the laboratory for routine isolation procedures. Diseased samples were separately dissected into smaller pieces of about 3mm in diameter and surface-sterilized using 10% sodium hypochlorite solution for 3 minutes, the sample tissues were rinsed in three changes of sterile distilled water. The sectioned tissues pieces (3 mm) were dried in between sterile 90mm Whatman No. 1 filter paper and plated on Potato Dextrose Agar (PDA) routinely prepared in the laboratory in the Petri dish. The inoculated Petri dishes were incubated at room temperature for 5–7 days for mould growth. Emerging fungal colonies were observed and the mixed culture plates purified by subculturing on freshly prepared sterilized PDA plates and incubated. Pure culture of isolates was observed using morphological features as Mycelial mat texture, colour, shape and spore structures. The fungi colonies were identified based on the morphological features and standard mycological references from manuals and identification keys.

Results: The results indicate that *Lasiodiplodia spp.* was the most frequently isolated fungus, commonly found in dieback, nut blight and anthracnose situation.

Table 1: Mycoflora distribution on infected cashew parts

S/N	Symptoms	Plant Part	Fungal occurrence
1.	Dieback	*Twig*	*Collectorichum sp,p Lasiodiplodia spp, Fusarium spp*
		Flora	*Lasiodiplodia spp, A.njger, Collect orichum spp*
2.	Nut blight	*Nut*	*A.niger, Lasiodiplodia spp*
3.	Mildew	*Ripe apple*	*A.niger , Rhizophus spp*
		Leaf	*A.niger, Alternaria spp,* pink colony, *Collectorichum spl*
4.	Anthracnose	Leaf	*A.niger, Botrlyrospheria sp, A. Flavus, Lasiodiplodia spp,* Yello w turning pink colony as it age(not identified)
		Fruit	*Fusarium sp, Lasiodiplodia sp, A.niger*
		Twig	*Lasiodiplodia sp, Collectorichum sp, A.niger,* Yellow colony

Colletotrichum spp. was particularly found in association with dieback and anthracnose conditions. *Aspergillus* species, *A. niger* and *A. flavus* were cultured from disease situation on nuts, fruits and leaves, causing more post-harvest deterioration in cashew apple. Other fungi, such as *Fusarium spp, Alternaria spp, Botryosphaeria spp,* and *Rhizopus* species, were also isolated from cashew parts various plant parts in table 1.

Conclusion and recommendation: It is difficult culturing from cashew apples infected with powdery mildew disease due to the obligate nature of the fungus. However, efforts need to be intensified to develop an effective management system for the major pathogens affecting the crop.

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Experimental Title: Evaluate the Productivity of Polyclonal Cashew establishment

Investigators: Nduka B.A., Adeniyi D. O., Adeigbe O.O., Uwagboe E, and Aremu-Dele Olufemi

Introduction

Cashew tree (Anacardium occidentale L.) has multiple uses which apart from it been used in several food and industry sectors (Nyirenda *et al*., 2021; Chen *et al*., 2023; Nunes Lemes *et al*., 2023), it is one among the top six high-income generating crops in African countries and ranks second after tobacco (Monteiro *et al*., 2017). However, its production is low and the need to improve desirable quality for better investment returns become necessitated (Weidinger *et al*., 2012). Behind the low yields of cashew orchards is the lack of high yielding varieties. This challenge, according to the cashew breeders, means higher-performance varieties, are essential for the increase of cashew orchard yields (Mishra *et al*., 2016; Ahmed *et al*., 2017; Tufa *et al*., 2019). Moreso, Masawe (2006); Bhat *et al*., (2010); Masawe *et al*., (2017); Matos Filho *et al*., (2019); Nayak and Muralidhara (2019) reported that few producing countries have formally coned improved varieties. In Nigeria, different landraces of cashew with differences in nut grades have been adopted for different ecological zones and these possess differing characteristics of growth, seed/nuts sizes, quality, and yields. In recent times, there is a shift in farmers' perception from production to productivity and profitability which can be achieved through accommodating cashew polyclonal plantations, that are more profitable compared to the already existing traditional plantation, whose constraints to cultivation have poor performance, insect and pests attack, all of which may contribute to low cashew yields. Thus, this study aimed at analyzing the differences in the physiological character, growth and canopy development at different stages of growth that existed between the polyclonal cashew and the local cashew variety, and to monitor the yield of both cultivars.

Methodology

The experiments were conducted at two different sites in cashew experiment plots at the Ochaja Substation of Cocoa Research Institute of Nigeria (CRIN), a southern guinea savanna region of kogi State. The choice of selection is due to the fact that it is among the top producing state of cashew nut in Nigeria. It possesses tropical climate with high and constant temperature. The planting dates were in 2023. Age:2 years, without any pruning activities imposed in the plantation of 100m X 100m. A random selection from the 9m x 9m plant spacing was used for this study which consisted of different polyclonal materials and normal sized cashew nuts arranged in Randomized Completed Block Design (RCBD) with three replications. The study evaluated vegetative growth, yield (yield & nut count), canopy area, while considering dry and rainy season at quarterly period of growth were noted. The 72 trees from both local cashew varieties and polyclonal varieties cashew plots, was measured in different tree dimensions and canopy area in the third growing season. Tree Girth was measured at 1.3 m above ground with metal diameter tapes and were recorded in metre (m), while the Heights were measured with ranging poles and recorded in Meters (m). The canopy from different direction (North South: NS, East West: EW) was measured and from the result obtained other canopy attributes of the trees were calculated. Data analysis was performed with Minitab using fisher pairwise comparisons and the results revealing significant differences ($P < 0.05$) on the performance of both the local and polyclonal cashew cultivar plantations recorded.

Results and Discussion

Table 1: Vegetative Growth of Polyclonal Cashew Plants

Plant No	Plant Height	Girth	Canopy NS	Canopy EW	No of Flowers	Canopy Spread	Crown Diameter	Canopy Radius
P1	3.67ab	33.63a	3.08a	3.08b	3.67ab	10.66b	0.97b	4.11b
P2	2.88ab	26.90b	2.42a	2.00b	3.00b	5.07b	1.38a	3.08b
P3	3.85ab	43.7a	3.77a	12.62a	3.00b	36.3a	0.64ab	7.97a
P4	3.26ab	37.07ab	3.79a	3.12b	4.00ab	11.94b	1.28ab	4.86b
P5	3.38ab	35.53ab	3.77a	4.07b	1.67ab	16.64b	0.96ab	5.13b
P6	3.15ab	43.70a	3.37a	3.26b	2.33ab	12.78b	1.07ab	4.46b
P7	2.68b	30.43ab	2.66a	2.97b	15.7a	7.48b	0.95an	3.59b
P8	4.12a	37.07ab	3.83a	3.28b	3.00b	13.28b	1.84ab	4.93b
P9	3.19ab	36.97ab	3.16a	2.82b	8.67ab	9.13b	1.26ab	4.01b
P10	3.71ab	37.13ab	3.76a	2.78b	1.67ab	10.53b	1.35a	4.68b
P11	3.71ab	40.33ab	3.97a	3.40b	12.67ab	13.26b	1.22ab	5.10b
P12	2.70b	27.13b	2.46a	2.34b	0.67ab	6.46b	1.11ab	3.24b

Means that do not share a letter are significantly different, NS: North South, EW: East West directions.

Table 2: Vegetative Growth of Cashew Nuts Plants

Plant No	Plant Height	Girth	Canopy NS	Canopy EW	No of Flowers	Canopy Spread	Crown Diameter	Canopy Radius
P1	5.27a	20.25ab	4.00abc	4.40ab	12.00ab	17.60abc	1.27ab	5.47abc
P2	2.98bc	20.27ab	1.81bc	2.25abc	0.00b	4.32abc	0.80b	2.56c
P3	4.30ab	33.60a	3.66a	3.90a	19.3a	14.43abc	0.97ab	4.96a
P4	3.53abc	17.17b	2.62abc	2.43abc	0.00b	6.97abc	1.16ab	3.43abc
P5	3.23abc	21.88ab	2.71abc	2.43abc	0.00b	7.28abc	1.22ab	3.51abc
P6	4.38ab	26.93ab	3.47abc	3.25abc	0.00b	10.73abc	1.21ab	4.56abc
P7	2.53c	16.87b	1.84c	1.71bc	0.00b	4.06bc	1.10ab	2.41bc
P8	3.91abc	3043ab	3.39abc	3.68a	0.00b	12.98abc	0.93b	4.62abc
P9	3.36abc	17.13b	2.39abc	1.62c	0.00b	4.06c	1.46a	2.93abc
P10	3.49abc	27.03ab	2.55abc	2.63abc	0.00b	6.58abc	1.09ab	3.43abc
P11	3.817abc	23.80ab	3.00abc	3.20abc	0.00b	9.52abc	0.94ab	4.06abc
P12	4.59a	33.90a	3.20abc	3.92a	1.00b	14.59a	0.79b	4.51abc

Means that do not share a letter are significantly different, NS: North South, EW: East West directions.

The productivity of fruit crops depends on several factors, management of canopy architecture being the most important one. Tables 1 and 2 shows the differences between a polyclonal and local cashew nuts plant with genetically differences among each other. Pruning was not done at the early stage which allows the formation of canopy architecture development more so in line with the report of mole (2002) and increase production and better yield is not achievable when trees are heavily pruned. This agrees with the findings of Balamohan *et al*., 2016, who reported that heavy pruning promotes excessive vegetative growth and often reduces the yield due to the dense canopy with reduced flowering during the early stage of plant growth. In table 2, local cashew types had the highest height of 5.27m compared to the polyclonal cultivar of 4.12m. Although the size of the cashew trunk increases with age the results obtain from table 1 and 2 shows that the girth size obtain in the polyclonal plant was bigger (43.7) in table 1. These may be due to the cultivar type. These results follow a consistence trend with the polyclonal plants 3 having a higher value on the canopy EW (12.62), canopy spread (36.3 and canopy radius (7.97) when compared to the local cultivar of 3.90, 14.43 and 4.96 respectively (Table 2).

Table 3: Vegetative growth at fruiting and yield attribute of Polyclonal Cashew Plants

Plant No	Plant Height	Girth	Canopy NS	Canopy EW	No of Flowers	Canopy Spread	Crown Diameter	Canopy Radius	Number of fruits
P1	3.50abc	29.17a	3.20b	3.43a	72.0a	12.34b	0.88b	4.35b	33.3a
P2	2.48bc	24.70a	2.19b	2.59a	69.3a	6.36b	0.80b	3.05b	59.0a
P3	3.42abc	38.9a	4.23b	4.22a	90.0a	21.2ab	1.02b	5.64b	36.7a
P4	3.12abc	34.1a	3.17b	3.55a	60.0a	13.21b	0.99b	4.35b	37.3a
P5	3.10ab	31.9a	3.61b	3.74a	76.3a	15.33b	1.05b	4.86b	13.67a
P6	2.48bc	37.8a	2.84b	2.88a	110.7a	12.7b	1.19b	3.80b	68.7a
P7	2.413c	24.43a	2.27b	3.24a	98.7a	9.61b	1.27b	3.35b	61.3a
P8	4.69a	41.60a	4.87b	4.51a	82.0a	22.91ab	1.08b	6.37b	51.3a
P9	3.28abc	38.47a	3.92b	3.22a	73.3a	13.46b	1.35b	5.00b	47.3a
P10	4.10ab	38.17a	4.00b	3.29a	90.0a	13.21b	1.27b	5.10b	77.3a
P11	3.85abc	40.73a	17.4a	3.66a	72.0a	57.3a	5.29a	18.6a	45.3a
P12	3.74abc	27.70a	2.27b	2.97a	74.7a	8.07b	0.93b	3.70b	56.0a

Means that do not share a letter are significantly different, NS: North South, EW: East West directions.

Table 4: Vegetative growth at fruiting and yield attribute of local Cashew Plants

Plant No	Plant Height	Girth	Canopy NS	Canopy EW	No of Flowers	Canopy Spread	Crown Diameter	Canopy Radius	Number of fruits
P1	4.66b	42.3a	4.98ab	4.02ab	60.0a	22.6ab	1.42ab	6.32ab	30.0cd
P2	4.04b	23.9ab	5.70ab	6.15ab	65.0a	35.24ab	0.92b	7.75ab	86.7ab
P3	4.21b	41.20ab	4.92ab	4.68ab	83.3a	23.92ab	1.03b	6.48ab	67.7abc
P4	16.2a	36.90ab	15.7a	3.74ab	85.0a	48.9a	5.19a	16.9a	45.3bc
P5	2.64b	20.60ab	2.26b	2.04b	100.0a	5.13b	1.09b	2.94b	96.7a
P6	2.87b	17.83b	2.33b	2.65ab	75.0a	6.55b	1.11b	3.21b	62.7abc
P7	3.31b	24.40ab	2.68b	11.19ab	69.1a	33.2ab	0.77b	6.41ab	78.7abc
P8	4.07b	27.83ab	3.58b	12.40a	90.0a	37.3ab	0.63b	7.71ab	41.7cd
P9	4.12b	31.40ab	3.65b	3.71ab	90.0a	14.35ab	0.97b	4.89b	0.00d
P10	4.00b	24.87ab	3.35b	2.58ab	0.00b	8.88ab	1.29b	4.22b	0.00d
P11	3.71b	24.53ab	3.21b	2.90ab	63.3a	9.47ab	1.12b	4.17b	0.00d
P12	3.62b	31.33ab	2.39b	3.49ab	87.7a	8.34ab	0.69b	3.56b	0.00d

Means that do not share a letter are significantly different, NS: North South, EW: East West directions.

The vegetative parameters measured on the fruiting stages is shown in table 3 and 4. The results obtained shows that the local variety had highest value in plant 4 (16.2m) compared to 4.69m seen in plant 3 of the polyclonal plants. These cannot be said to have been translated to the similarity observed in the girth which was not significantly different. However, a significant bigger girth size of 42.3 was recorded in the local variety. It should be note that the size, apart from age if influenced by cultural practices (spacing, pruning). Cashew trunk size also can depend on the environment and the type of cultivar use for planting. In the canopy direction of North South (NS) polyclonal cashew variety shows a significant larger spread when compared to that of the local types. The reverse was the case in the East West (EW) direction (12.4) on the local variety although not significantly enhanced. The canopy spread, crown diameter, and canopy radius of the polyclonal plants had values of 57.3, 5.29 and 18.6 which was significantly higher when compared to the local variety of 48.9, 5.19, and 16.9 respectively. Canopy architecture is amongst one management practice's that enhanced cashew trees productivity (Goswami *et al*., 2014). On average the results obtained in this study may lead to higher yield subsequently. The reproductive attribute of flowering was not significant different on neither that of the polyclonal plant non that of the local plant but translated to nut formation. The study failed to show any yield advantage of polyclonal plants because nut count (still ongoing) from the polyclonal plant was not significantly different from one another. Although as at time of this report the highest nut count (96.7) obtained was from the local variety, some of the variety flowers has not translated to fruit formation, hence Aliyu (2004) and Martin *et al*., (1998) reported that genotypic and environmental differences is among the attribute for yield variation.

This contrasts the report of Wim Simonse (2017): Away4africa January 2017 shows there exist not only a big difference between the 'local varieties 'and the high yielding varieties on yield performance, but on growth development, resistance to PMD, kennel output ratio (KOR) and nut count of the high yielding varieties performing much better in relation to the local varieties.

Conclusion

The canopy habit varies with cultivars and exhibit spreading habit. Cashew nuts are genetically different with respect to their presence in the same trees. The nut count was only assessed based on those found on the plant because as at the time of this report, nut picking is still on going.

Thus, a study on the relative performance of both polyclonal and local with spacing on tree survival is recommended as follow up.

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Experimental Title: Influence of Plant Spacing and Nut-Biotypes on Morphological Development of Cashew (*Anacardium Occidentale* L.) In Ogun State, Nigeria

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Introduction

Cashew (*Anacardium occidentale* L.) is a significant tropical tree crop, valued for its nuts and associated products. It plays an essential role in the economies of many developing countries, including Nigeria, which is one of the leading producers of raw cashew nuts in the world (Nigerian Export Promotion Council, 2021). Cashew was predominantly grown in the South-West, South-East and North Central but recently its cultivation has extended to States that hitherto had little or no attention for cashew cultivation (Ogunwolu *et. al*., 2020). Cashew, however, is challenged by various factors, among which planting density is a critical determinant of its growth and yield (Janani *et. al*., 2022). Planting density and nut biotypes could influence the growth, development, yield and eventual productivity of cashew plantation.

Despite the extensive research on cashew agronomy, there remains a gap in understanding how different planting densities affect the growth stages of cashew, especially for different nut biotypes. Among farmers, researchers and stakeholders, there have been arguments on which cashew spacing is appropriate for different nut biotypes in terms of growth, development and nut yield. This study aims to evaluate the morphological development of two cashew nut biotypes directly sown at varying planting densities in-order to identify the planting densities that result in vigorous growth and establishment of cashew on the field.

Materials and Method

The experiment was set up in August, 2023 on a farmer's farm at Adeniyi community in Obafemi Owode Local Government Area of Ogun State, located in the South-Western part of Nigeria. The two cashew nut biotypes (Jumbo and Medium) used as planting materials for this experiment were sourced from the Cocoa Research Institute of Nigeria (CRIN), Ibadan. The experiment was a two factorial laid in a split-plot design. The first factor was plant spacing at four levels viz: 6m x 6m (277 plants/ha), 8m x 8m (156 plants/ha), 10m x 10m (100 plants/ha) and 12m x 12m (69 plants/ha) while the second factor was cashew nut biotypes at two levels (Jumbo and Medium). Consequently, there were eight treatment (4 x 2) combinations where the plant spacing and cashew nut biotypes were the main and sub plots respectively. The cashew nuts were directly sown at recommended depth (Adeyemi *et. al*., 2017). Weed control was done manually. The morphology of cashew plant was assessed through data collection on plant height (cm), stem diameter (mm), number of leaves, number of branches and leaf area (cm^2) which commenced in October 2023, 2 months after sown (MAS) of the nuts and continued till August 2024, 12 MAS at bimonthly. Data were subjected to Analysis of Variance (ANOVA) using MINITAB-17 statistical software while treatment means were separated using Least Significant Difference (LSD) at 0.05% probability level.

Results and Discussion

Plant height

The highest plant height of 64.8 cm was observed at 8m x 8m spacing while 6m x 6m had the lowest (51.3 cm) at 2 MAS, though the differences were not significant ($p \leq 0.05$) (Table 1) . The plant height was consistently highest at 8 x 8m spacing throughout the periods of observation.

Table 1: Plant height of cashew seedling at different MAS as influenced by spacing and nut biotype

Treatment	Plant Height (cm)						
	2	4	6	8	10	12	Mean
Spacing (m)							
6 x 6	51.3	64.6	65.1	70.9	95.1	106.5	75.6
8 x 8	64.8	71.7	75.3	78.8	106.9	119.6	86.2
10 x 10	56.7	59.6	62.4	65.2	93.9	106.0	74.0
12 x 12	52.5	59.4	61.7	64.0	87.5	90.1	69.2
LSD @ 0.05%	***12.1***	***11.7***	***12.7***	***13.0***	***20.1***	***22.1***	
Nut biotype							
Jumbo	58.3	67.2	70.6	74.1	98.4	110.2	79.8
Medium	54.3	60.5	61.6	65.4	93.3	100.9	72.7
LSD@0.05%	***8.6***	***8.2***	***9.0***	***9.2***	***14.2***	***15.6***	
Factors interactions	ns	ns	ns	ns	ns	ns	

The mean seedling height was in the order of 8 x 8 > 6 x 6 > 10 x 10 > 12 x 12m for the periods of investigation. The jumbo nut biotype produced seedling with higher height (58.3 cm) than the medium (54.3 cm) at 2 MAS, though with no significant ($p \leq 0.05$) difference (Table 1). This trend was maintained till 12 MAS. Interactions of the two factors, spacing and nut biotype were not significant at each period of observations. The higher plant height in jumbo than in medium is in tandem with previous reports (Adeyemi *et. al*., 2017; Adediran, O. A. and Adeoye, K. O. 2016; Akinwale, R. O. and Owolabi, O. O. 2013). This height advantage could enhance light interception which could contribute to increased yield at the fruiting stage.

Stem diameter

Plant spacing of 8 x 8m produced cashew seedling with the thickest stem diameter of 8.3 mm while the thinnest diameter of 6.7 mm was obtained at 12 x 12m spacing and the difference was significant ($p \leq 0.05$) at 2 MAS as shown in Table 2. Similar trend was obtained for the other periods of observation.

Table 2: Stem diameter of cashew seedling at different MAS as influenced by spacing and nut biotype

Treatment	Stem Diameter (mm)						
	2	4	6	8	10	12	Mean
Spacing (m)							
6 x 6	8.1	9.9	10.7	12.1	15.5	19.7	12.7
8 x 8	8.3	10.9	11.4	12.1	17.1	20.3	13.4
10 x 10	6.7	9.3	9.9	10.5	14.2	17.4	11.3
12 x 12	7.4	9.3	10.0	10.9	13.9	16.0	11.2
LSD@0.05%	***1.0***	***1.5***	***1.5***	***1.8***	***2.8***	***4.9***	
Nut biotype							
Jumbo	7.8	10.0	10.6	11.5	16.0	19.0	12.4
Medium	7.4	9.7	10.3	11.3	14.4	17.6	11.8
LSD@0.05%	***0.7***	***1.1***	***1.1***	***1.3***	***2.0***	***2.3***	
Factors interactions	*	ns	ns	*	*	*	

The order of stem diameter for the plant spacing investigated was: 8 x 8 > 6 x 6 > 10 x 10 > 12 x 12m which was similar to the order reported for the plant height. The jumbo nut biotype had thicker stem diameter than the medium (Table 2). Interactions of the two factors were significant ($p \leq 0.05$).

Number of leaves

Number of leaves on cashew seedlings was highest and lowest in 8 x 8 and 10 x 10m spacing with values of 30 and 21 respectively at 2 MAS. The differences were significant at $p \leq 0.05$ (Table 3).

Table 3: Number of leaves of cashew seedling at different MAS as influenced by spacing and nut biotype

Treatment	Number of Leaves						Mean
	2	4	6	8	10	12	
Spacing (m)							
6 x 6	25.9	26.8	27.4	28.0	76.6	90.3	45.8
8 x 8	30.0	20.6	26.8	33.0	63.5	79.3	42.2
10 x 10	21.0	19.5	22.3	25.1	62.1	61.5	35.2
12 x 12	23.0	17.4	20.6	23.9	49.0	58.9	32.1
LSD@0.05%	***5.0***	***9.8***	***9.6***	***11.0***	***22.6***	***26.3***	
Nut biotype							
Jumbo	25.1	24.8	27.1	29.4	68.5	75.4	41.7
Medium	24.9	17.3	21.4	25.6	57.1	69.6	36.0
LSD@0.05%	***3.5***	***7.0***	***6.8***	***7.8***	***16.0***	***18.6***	
Factors interactions	*	*	ns	*	*	*	

However, from 4 MAS till the end of the observation at 12 MAS, the number of leaves was highest at 6 x 6m and lowest at 12 x 12m spacing and the differences were significant ($p \leq 0.05$). Consequently, the number of leaves was in the order: 6 x 6 > 8 x 8 > 10 x 10 > 12 x 12m spacing showing a decrease in number with increase in plant spacing. Increase in the number of leaves from 2 MAS (October 2023) to 8 MAS (April, 2024) was low probably due to the prevailing dry season which did not favour rapid growth of the cashew seedling at the period. The sudden upsurge in the number of leaves from 10 MAS (June, 2024) to 12 MAS (August, 2024) could be due to the prevailing rains at this period that was favourable for leaf flushes. The number of leaves was higher in jumbo than in medium nut biotype though the differences were not significant at $p \leq 0.05$ as shown in Table 3. Factors interactions were significant ($p \leq 0.05$) as reported for stem diameter.

Number of branches

At 2 MAS, 6 x 6m spacing had the highest number of branches while the lowest was at 10 x 10m spacing with values 2.1 and 0.6 respectively (Table 4). The differences were significant at $p \leq 0.05$. The same trend was observed at 4 MAS. However from 6 MAS till 12 MAS the lowest number of branches occurred at 12 x 12m spacing while the 6 x 6m maintained the highest number of branches status. Consequently the number of branches decreased with increase in plant spacing similar to the report on number of leaves.

Table 4: Number of branches of cashew seedling at different MAS as influenced by spacing and nut biotype

Treatment	Number of Branches						Mean
	2	4	6	8	10	12	
Spacing (m) 6 x 6	2.1	3.3	3.9	4.9	7.1	9.0	4.4
8 x 8	1.8	2.5	3.3	4.3	4.9	6.9	3.9
10 x 10	0.6	1.9	3.0	4.3	4.9	5.0	3.3
12 x 12	1.5	2.0	2.6	3.5	4.3	4.3	3.0
LSD@0.05%	***0.7****	***1.0****	***1.4ns***	***2.0***	***2.6****	***2.9****	
Nut biotype							
Jumbo	1.7	2.6	3.3	4.3	5.5	6.5	4.0
Medium	1.3	2.2	3.2	4.1	5.1	6.1	3.7
LSD@0.05%	***0.5***	***0.7***	***1.0***	***1.4***	***1.8***	***2.1***	
Factors interactions	ns	*	*	ns	*	*	

The number of branches on cashew seedlings from jumbo nut biotype was higher than its counterpart medium at each period of observation similar to the earlier reports of plant height, stem diameter and number of leaves. Interactions of the two factors investigated were found to be significant ($p \leq 0.05$) as shown in Table 4.

Leaf area

The cashew leaf area at 2 MAS was highest and lowest at 6 x 6 and 12 x 12m spacing respectively (Table 5). The mean differences were significant ($p \leq 0.05$).This was the general trend for the periods of observation. The leaf area was in the order: 6 x 6 > 8 x 8 > 10 x 10 > 12 x 12m similar to the reports on number of leaves and number of branches.

The jumbo nut biotype was higher in leaf area than the medium at each period of observation and the differences were significant ($p \leq 0.05$). The factors interactions were significant throughout the period of observation.

Table 5: Leaf area of cashew seedling at different MAS as influenced by spacing and nut biotype

Treatment	Leaf Area (cm^2)						Mean
	2	4	6	8	10	12	
Spacing (m)							
6 x 6	102.0	90.4	67.9	110.2	126.2	142.7	106.6
8 x 8	100.2	85.2	68.8	105.7	124.7	133.1	103.0
10 x 10	88.5	80.7	63.3	96.8	104.6	118.6	92.1
12 x 12	84.3	73.7	51.8	89.0	99.9	132.6	88.5
LSD@0.05%	***17.2****	***14.1****	***20.4ns***	***17.6****	***23.6****	***23.0****	
Nut biotype							
Jumbo	103.4	91.5	73.6	111.8	125.6	142.8	108.1
Medium	84.5	73.6	52.3	89.0	102.1	120.7	87.0
LSD@0.05%	***12.1***	***10.0***	***14.4***	***12.4***	***16.7***	***16.3***	
Factors interactions	*	*	*	*	*	*	

Each of the morphological parameters measured were ranked 1st to 4th position, the total and mean score were calculated to determine the overall mean ranking position under each of the plant spacing investigated as shown in Table 6.

Table 6: Performance ranking of morphological parameters under plant spacing at 12 MAS

Spacing (m)	Morphological parameters					Total	Mean	Mean rank
	Plant height	Stem diameter	No of leaves	No of branches	Leaf area			
6 x 6	2nd	2nd	1st	1st	1st	6	1.2	1st
8 x 8	1st	1st	2nd	2nd	2nd	8	1.6	2nd
10 x 10	3rd	3rd	3rd	3rd	3rd	15	3.0	3rd
12 x 12	4th	4th	4th	4th	4th	20	4.0	4th

The morphological performance under the spacing was in the order: 6 x 6 > 8 x 8 > 10 x 10 > 12 x 12m indicating a preliminary result that the morphology of cashew seedling decrease with increasing plant spacing on the field.

Conclusion

The genetic make-up of the jumbo and medium cashew biotypes played a more significant role in the outcome of this result than the spacing which wouldn't have made any notable impact within the first year of establishment. However, 6 x 6m and 8 x 8m spacing produced cashew seedlings with good morphological traits within the first year of field establishment. This project is still under further study.

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KOLA ANNUAL REPORT

Dr Adejobi K.B. (Programme Leader)

Experimental Title: Vegetative propagation in Germplasm Expansion: The search for Improved Cola Genotypes in Nigeria

Investigators: Sobowale, I. O, Adenuga, O.O, Adejobi K. B., Orisajo S. B, Adebiyi, S,

Introduction: Kola is a significant commodity crop contributing to local livelihoods and agricultural diversification. The cultivation and trade of Kola products create employment opportunities and encourage smallholder farming, thus enhancing food security and community resilience. Furthermore, as global demand for caffeine and specialty beverages continues to rise, Kola hold promise for expanding markets, fostering economic growth within the region (Dadzie *et al.,* 2013, Ndagi *et al*, 2012). The kola nut, derived from the fruit of the Kola tree, holds a significant place in both cultural traditions and nutritional value. Morphologically, this seed exhibits three distinct colors: white, red, and pink. Each hue not only contributes to its visual appeal but also signifies varying levels of caffeine and theobromine, compounds that are essential to its stimulating properties. In terms of nutritional composition, the kola nut is rich in key chemical elements, including water, fat, ash, fiber, carbohydrates, and proteins. Kola nut helps to reduce the sensations of hunger and tiredness (Lewis, 2017). Kola nuts are known for their high caffeine content, between 1.84 and 2.56% (Nyamien *et al.,* 2014). The nut and its extracts have become popular in Europe and North America as a natural or alternative medicinal source and in the production of soft drinks, candies, beverages, animal feed formulation, liquid soap, and dyes (Dadzie *et al.,* 2013, Ndagi *et al.,* 2012, Nyadanu *et al.,* 2020). It has also been reported that kola nut treats infections, skin diseases, ulcers, toothaches and or sore gums, morning sickness, intestinal diseases, headaches, depression, low sex drive, coughs and asthma, dysentery, constipation, and eye problems respectively (Osborn, 2018, Chinweike, *et al*., 2020). Advancements in *Cola* species improvement are crucial for enhancing yield, disease resistance, and desirable flavor profiles in cola nut production. Selective breeding programs, coupled with modern biotechnological approaches, hold significant potential for optimizing these traits. Sustained research efforts focused on genetic characterization and efficient propagation techniques are essential to ensure long-term sustainability and meet growing market demands. Propagation using clones obtained from grafts of selected desirable variety will enhance the possibility of obtaining uniformly growing trees, uniform maturation, moderate to dwarf trees and increased nut yield. Planting clones instead of open pollinated varieties could also reduce gestation time and to develop early-fruiting kola genotypes.

Objectives: This research attempts to produce and establish clonal lines of kola trees, sourced from both farmers' fields and the Cocoa Research Institute of Nigeria (CRIN) collections. The resulting clonal germplasm will serve as a foundation for the future development of improved kola varieties.

Materials and methods: Survey of kola trees exhibiting desirable traits was conducted across selected farms in Osun, Ondo, and Ekiti States. Budwood was subsequently harvested from these superior trees across various farms in each location. Collected budwood was then grafted onto established rootstock at the CRIN headquarters nursery. Successful grafts were then transplanted to a one-hectare plot at the CRIN Headquarters for field establishment

Result and Discussion: A total of 3,000 kola seedlings were cultivated to serve as rootstock. Of these, 1250 seedlings were subsequently grafted, and an additional 250 cuttings were propagated from collected budwood. Both the grafted seedlings and propagated cuttings remain in the initial green stage of development.

Fig 1: Grafted Kola seedling at the Nursery

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Experimental Title: Knowledge Sharing Behaviour and Social Media Use among Kola farmers in Nigeria

Investigators: Ogunjobi T.E, Aboderin A.K and Awodumila David

Introduction

Social media is a web-based platform that facilitates the acquisition and sending of information electronically among individuals of different occupations at any time and from their different locations across the world. 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 ResearchGate. 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 support synchronous and asynchronous learning as information can be communicated in real time. Social media use is relatively cheap, support sharing information in various formats and has a wider global acceptance of use for various purposes. It 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). However, knowledge sharing behaviour can be a factor that can influence social media use especially in Kola production. Social media promote communication of information to people in real time globally. This has made individuals to register on various social media platforms in a bid to communicate information of various purposes either to a person as well as to a group with common goals and objectives. Although, various information could be shared on the social media platforms, but certain actions of individuals could promote as well as limits social media use for knowledge sharing needed. This study seeks to bridge the knowledge gap on use of social media for knowledge sharing by kola farmers in Nigeria.

Objectives of the Study

The main purpose of this study was to examine the knowledge sharing behaviour and social media use among Kola farmers in Nigeria. The specific objectives were to:

i. determine the various types of social media use by Kola farmers in Nigeria;
ii. ascertain the frequency of use of social media by Kola farmers in Nigeria;
iii. investigate the benefits of use of social media by Kola farmers in Nigeria;
iv. identity the methods of knowledge sharing by Kola farmers in Nigeria;
v. find out the challenges to the use of social media by Kola farmers in Nigeria

Methodology

This study was carried out in Osun states, Nigeria with the use of multi-stage sampling technique. Two major Kola producing local government areas; Ife southwest and Ife east were selected for the study. In each local government area, two Kola producing communities was randomly selected while in each community, 20 Kola farmers were selected, hence a total of 80 farmers altogether. Data was collected with the use of structured questionnaire. Descriptive statistics of frequency count and percentages were used to analyse the data.

Results and Discussion

Section A

Table 1: Socio- economic Characteristics

Variable	Categories	Frequency	Percentage (%)
Sex	Male	28	35
	Female	52	65
Marital Status	Single	4	5
	Married	72	90
	Widow	4	5
Educational Level	No formal Education	18	22.5
	Primary	32	40
	Secondary	24	30
	Tertiary	6	7.5
Age (years)	6-10	10	12.5
	11-15	12	15
	16years above	58	72.5
Ethnic Group	Yoruba	78	97.5
	Igbo	2	2.5

Source: Field work 2024

Table 1 revealed that there were more females (65%) than males (35%) in kola production in Osun State, majority of Kola farmers were married (90%) with primary (40%) and secondary (30%) school leaving certificate educational background. Majority of them were ages 16 years and above (72.5%) from Yoruba tribe (97.5%).

Table 2: Types of social media platforms used by Kola Farmers

Social Media Platforms	Frequency	Percentage
Watssapp	40	50
Facebook	12	15
Twitter	1	1.25
Instagram	-	
Youtube	-	
Not at all	27	33.75
		100

Source: Field work, 2024

Table 2 revealed that most kola farmers in Osun state made use of WhatsApp (50%) while only few of them use Facebook (15%), other platforms (33.75%) were not used by them.

Table 3: Frequency of use of social media platforms

	Frequency	Percentage (%)
Daily	22	55
Weekly	13	32.5
Monthly	5	12.5
Rarely	-	
Never	-	
		100

Source: Field work, 2024

On frequency of use, table 3 revealed that Kola farmers used it on daily basis (55%), while few of them used it on weekly (32.5%) and monthly (12.5%) basis.

Table 4: Benefits of the use of social media by Kola Farmers

S/No	Purpose	Not at All	To a lesser extent	To a larger extent
14	Search for current market price of cashew	80	-	
15	Get information on Good Agricultural Practices on cashew	80		
16	Assess loans from government	80		
17	Get information of cooperative meeting days	55		25
18	Establishing professional interaction among cashew farmers	80		
19	Watching films and playing games	80		
20	Interactions with friends and families	40		40 (50%)
21	Get innovative information on Kola production, marketing and processing	80		
22	Call researchers on problem facing Kola farmers	80		
23	Facilitate the supervision and farm workers	80		

Source: Field work, 2024

The major benefit of using it was to interact with friends and families (50%), other benefits were not explored by them as it is shown in table 4.

Table 5: Methods of sharing knowledge by Kola farmers

Channels	Strongly Agreed (SA)	Agreed (A)	Disagreed (D)	Strongly Disagreed (SD)	Undecided (U)
Face to face	40	18	2	-	-
Phone calls	34	42	2	2	2
SMS	22	32	16	4	6
Facebook	8	18	30	2	22
WhatsApp Messages	8	18	32	2	20
WhatsApp Calls	10	18	30	2	20
Telegram	2	6	38	2	32

Source: Field work, 2024

From table 5 above, It is revealed that Kola farmers method of sharing knowledge were in the following order face to face (40), phone calls (34), SMS (22) and WhatsApp calls (10). Few of them used facebook and watsapp messages (8)

Table 6: Types of knowledge shared by Kola farmers

Knowledge Sharing	Strongly Agreed (SA)	Agreed (A)	Disagreed (D)	Strongly Disagree (SD)	Undecided (UD)
Farming Technique	36	40	2	-	2
Market Days	30	46	2	-	2
Pest Management	28	46	4	-	2
Weather Information	30	38	6	2	4
Pesticide Use	26	40	10	-	4
New varieties of Kola	28	32	16	2	2
New Prices	42	20	12	2	4

Source: Field work, 2024

Table 6 revealed types of knowledge shared by farmers in the following order; New prices (42), farming methods (36), market days and weather information (30), new varieties (28) and pesticide usage (26).

Table 7: Constraints to the use of social media by the respondents

S/No	Constraints	Strongly Agreed (SA)	Agreed (A)	Disagreed (D)	Strongly Disagreed (SD)	Undecided
36	Poor access to internet	65	5	-		10
37	High cost of data subscription	75	-			5
38	Erratic power supply	80	-			
39	Lack of access to public Wi-Fi					80
40	Fear of internet fraud stars hacking accounts of users					80
41	High cost of browsing mobile phone					80
42	Lack of adequate time due to other farm engagement					80
43	Lack of locally relevant contents and services					80
44	Lack of relevant infrastructure e,g mast	50				30
45	Lack of technical know-how	55	5			20

Source: Field work, 2024

According to table 7, the constraints to the use of social media are erratic power supply, high cost of data, poor access to internet and lack of technical know-how.

Conclusion

This study reveals that social media plays a significant role in knowledge sharing among kola farmers in Osun State, Nigeria. The findings discovered that Kola farmers who use social media are more likely to share knowledge and access valuable information to improve their farming practises in Osun State of Nigeria.

Recommendations

1. Training on technical know-how is therefore recommended for Kola farmers in Osun State as this will help them to understand and enjoy the benefits of social media usage.
2. State government should assist in ensuring that kola farmers have access to light and internet facilities in rural areas of Osun state as this will help them in unlocking the benefits of social media which will boost kola yield and will lead to increase in profit.
3. Farmers should be encouraged to use other channels of information to share knowledge among themselves.

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Experimental Title: Assessment of Export Potential of Kolanut In Ogun State Nigeria

Investigators: Yahaya, A.T. and Ugwu C.A

Introduction

Kola nuts have been a known commodity of commerce over a decade ago in Nigeria and other West African communities (Adesida *et al.,* 2021., Taiwo *et al.,* 2017., Akinbode, 1982). It has long been cultivated in southern and Eastern parts of Nigeria, consumed and marketed by the Northerners. Nigeria accounted for 70 percent of world kola- nut production (Asogwa *et al.*, 2012). Kola-nut is used as masticatory and stimulants in tropics, and it has a significant usage in traditional ceremonies in Nigeria (Asogwa *et al.*, 2012). It is used in industrial areas for pharmaceuticals, production of soft drinks, wines, and in confectioneries (Momoh et al, 2000; Adewumi, 2003; Baettie, 1970). Kola nut pod is widely used as by-products for animal feeding because of its high nutrients (Babatunde *et al*., 2005). Kola nut trading is done across all regions of Nigeria and is a bonding economic crop in the country (Taiwo *et al.,* 2017). Kola nut production is mostly dominant in southern west region of Nigerian. Empirical evidences showed south western region as dominant areas for kola production in Nigeria (Adesida *et al* 2021, Taiwo *et al.,* 2017) what is the export potential in these regions? This study presents good opportunity to improve the varietal development objective of the institute.

Objectives

The main objective of the study is to evaluate potential for Kola export through the production and marketing activities in these areas to be able to provide current and verifiable information on cultivation, marketing. Specifically:

A. Assess the production, marketing activities of Kola in the study areas
B. Evaluate the potential for Kola exportation in the area
C. Evaluate the challenges to production, marketing and exportation of Kola nut in these areas.
D. Determine the interventions need for enhancing export in these areas.

Methodology

Ogun state was purposively selected for the study. The study focused on kola actors in the study areas. Primary data was used in eliciting relevant data for the study. Focus group discussions as well as administration of questionnaire were tools used. Three Local government areas (Obafemi-Owode, Shagamu and Yewa-South) of the state were covered. A total of ninety-eight samples were collected in the study areas. Quantitative as well as descriptive methods of analysis were employed. Descriptive statistics (Mean, Standard Deviation and frequency table) were used for analyzing socio-economic variables.

Results and Discussion

Tables 1 show the socio-economic characteristics of the kola actors in Ogun state. The result reveals that majority of the respondents (46.9%) had primary and (37.8%) had secondary education while (15.3%) had no formal education. Larger proportions of the respondents are lettered and this will help their productivity and effectiveness in carrying out their business activities and their desire to participate in export. Table 1 equally shows most (51.0%) of the respondents were female, while (49.0%) were males.

This is noticeable from the number of women kola traders in all the markets visited. However, majority of both genders are interested in export. Majority (85.7%) of the respondents were married. The table also revealed that the primary occupation of most (87.8%) respondents is kolanut trading and (41.8%) of the traders have exported kola nut in the past. The implication of this is that the experience gained in marketing would help their potential if opportunities arise to expand their trading activities to other country thereby enhancing their economic gain thereof.

Table 1: Selected Socio-Economic Characteristics of Kolanut Traders in Ogun State, Nigeria.

Variables	Frequency	Percent
Level of Educational		
No formal	15	15.3
Primary education	46	46.9
Secondary education	37	37.8
Total	98	100.0
Sex		
Male	48	49.0
Female	50	51.0
Total	98	100.0
Marital status		
Married	84	85.7
Separated	4	4.1
Divorced	10	10.2
Total	98	100.0
Primary occupation		
Kola-nut trader	86	87.8
Farmer	8	8.2
Others	4	4.1
Total	98	100.0
Extension visits		
Yes	18	18.4
No	80	81.6
Total	98	100.0
Ever exported kolanut		
Yes	41	41.8
No	57	58.2
Total	98	100.0
Membership of cooperative society		
Yes	98	100.00
Total	98	100.00
Position in Kola value chain		
Trader	98	100.00
Total	98	100.00

Source: Field survey, 2024

Table 2 shows the summary statistics of kola actors in Ogun state, Nigeria. The table reveals that the mean age of kola actor in the areas is approximately 63 years. The implication of this is that kola actors in the areas are of advanced years with many years of experience in kola activities and are still in their productive age, and this may be responsible for the high volume traded and their readiness to partake in export of kolanut outside the boundaries of their zone. The table equally shows the high level of trade by the actor accompany by mean annual income of N10,000,000, implying that the volume of trade is a function of income, the larger the traded volume, the greater the income derived therein.

Table 2: Summary and descriptive statistics of kolanut traders in Ogun State, Nigeria

Descriptive Statistics	Minimum	Maximum	Mean	Std. Deviation
Age	50	80	63.52	7.93
Household size	3	12	6.91	1.79
Annual income (N)	2,000,000	20,000,000	10,000,000	4,213,380
Annual trade volume (Kg)	25	166	86.39	35.71
Kolanut trade experience	15	50	29.05	8.46

Source: Field Survey, 2024

Table 3 shows willingness of kolanut traders in the study areas to export kolanut. The table revealed that 64.3% of the respondents are strongly willing to export kolanut because of their past involvement in kola export and the profit derived from such. Also, there is increasing demand (93.9%) for kolanut in the study areas. Increase in demand will boost kola activities as well as the revenue gained. Hence, the actors are resolved to be effective in the kolanut business. However, the result further shows that demand cannot be matched by availability of kolanuts as replied by (91.8%) of the respondent because of scarcity of kolanut likewise, the result shows that with the current trend in the state, (90.8%) of the respondent agreed that the potential of increasing traded volume is not possible and (91.8%) of the respondents noted that the possibility of increasing traded volume is not realizable because of kola farms going to extinction from cuttings down of kola farms for building construction in the study areas thereby inhibiting kola nut export.

Table 3: Willingness of Kolanut Traders to Export Kolanut

How willing are you to export kolanut	Frequency	Percent
Undecided	6	6.1
Willing	29	29.6
Strongly willing	63	64.3
Total	98	100.0
Trend in kolanut demand in the study area	Frequency	Percent
Increasing	92	93.9
Decreasing	6	6.1
Total	98	100.0
Potential of traders to increase traded volume	Frequency	Percent
Yes	9	9.2
No	89	90.8
Total	98	100.0
Ability of traders to match demand on daily basis	Frequency	Percent
Yes	8	8.2
No	90	91.8
Total	98	100.0
Possibility of kolanut traded volume to increase	Frequency	Percent
Yes	8	8.2
No	90	91.8
Total	98	100.0

Source: Field Survey, 2024

Table 4 shows challenges militating against kolanut production, marketing and export in the study areas. The result shows that the major problem facing kolanut production is deforestation (48.0%), Urbanization (24.5%), climate change (13.3%), pest and diseases infestation (12.2%) and lack of interest in kola farming (2.0%) due to long gestation period. The implication of this is if there is no urgent interventions to savage the situation, kolanut might not be available again in Ogun state. The result from table 4 also revealed that, marketing aspect is hindered by scarcity of kolanut as the biggest problem hindering it effectiveness due to non-availability of nut resulting from the cutting downs of kolanut tress for building construction in Ogun state. This problem has also resulted into high cost of nut and fluctuations in prices. Similarly, kolanut export is affected by the scarcity of nut being the transferred effect of deforestation in Ogun state. The implication of this is that Ogun state could lose the revenue and other advantages associated with being one of the leading kolanut producers in Nigeria.

Table 4: Challenges Facing Kolanut Production, Marketing and Exportation

Challenges facing kolanut production in the study area		
Challenges production	Frequency	Percent
Pest	6	6.1
Diseases	6	6.1
Deforestation	47	48.0
Climate change	13	13.3
Urbanization	24	24.5
Lack of interest in farming	2	2.0
Total	98	100.0
Challenges facing kolanut marketing		
Price fluctuation	26	26.5
Poor demand for kolanut	2	2.0
Scarcity of kolanut	35	35.7
High cost of kolanut	24	24.5
Lack of capital	11	11.2
Total	98	100.0
Challenges facing kolanut exportation		
High cost of kolanut	36	36.7
Regulatory issues	2	2.0
Lack of market information	15	15.3
Scarcity of kolanut	21	21.4
Smuggling of banned items with kolanut	10	10.2
Poor quality standard	2	2.0
Lack of capital	12	12.2
Total	98	100.0

Source: Field Survey, 2024

Table 5: Shows the interventions needed to safe kola value chain in Ogun state. The result shows that majority of the respondent agree that there is need for a regulation prohibiting fallings of kola trees (53.06%), availability of improved seedling (35.7%) and enhancement of youth interest in kola farming.

Odo Otin LGA) based on the level of kolanut production. Thirty-two (32) questionnaires were administered to the farmers in Igbaye community (Odo Otin LGA) while Forty-three questionnaires were administered in Ikirun community (Ifelodun LGA) giving a total of Seventy-five (75) farmers in the Local Government Areas.

Analytical techniques

The analytical methods used in the study include descriptive statistics, probit regression and linear regression. The program used for analysis was SPSS version 25.

Descriptive statistics, such as frequency distribution tables, graphs, percentage, mean, and standard deviation were used to analyse the socio-economic characteristics and awareness level of the respondents.

Probit Regression model was used to determine the willingness of the respondents to pay for developed kolanut cultivars.

Probit regression models the probability that Y = 1 using the cumulative standard normal distribution function, $\varphi(z)$ evaluated at $Z = \beta_0 + \beta_1 X$.

The probit regression model is, $Pr(Y = 1/x) = \varphi(\beta_0 + \beta_1 X)$

Where φ is the cumulative normal distribution function and $Z = \beta_0 + \beta_1 X$ is the "z-value" or "z-index" of the probit model.

The probit model assumes underlying normally distributed latent variable.

$Y^* = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots + \beta_k X_k + U$

$U \sim$ standard normal distribution

$Y = 1$ if $Y^* > 0$

0 otherwise

Where

Y = willingness to pay for developed kolanut cultivar

X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8 = age, gender, marital status, education, household size, farm size, farm experience, farm age respectively.

Linear Regression model was used to estimate the determinant factors influencing cultivar acceptability in Osun State, Nigeria.

The model is:

$Yi = \beta_1 Xi_1 + \beta_2 Xi_2 + \ldots\ldots\ldots + \beta nXin + \varepsilon i$……..(1)

Where

Y = cultivar acceptability

εi = error term

Xi = education, household size, farm size, farming experience, small sized nuts, large sized nuts, high yield, early maturing, prolonged rainfall tolerance, prolonged dry season tolerance, pests and diseases resistance, non-abortion of flowers, dwarf trees.

Table 1: Socio-economic Characteristics of Farmers (n = 75)

Socio-economic characteristics	Frequency	Percentage
Age (Years)		
≤ 30	11	14.67
31-40	10	13.33
41-50	23	30.67
>50	31	41.33
Mean = 46 years		
Gender		
Female	27	36.00
Male	48	64.00
Marital status		
Married	73	97.33
Divorced	2	2.67
Educational status		
No Formal	10	13.33
Primary	20	26.67
Secondary	32	42.67
Tertiary	13	17.33
Household size		
1-5	21	28.00
6-10	47	62.67
>10	7	9.33
Mean = 7		
Farm size (ha)		
≤5	67	89.34
6-10	4	5.33
>10	4	5.33
Mean = 3.64		
Total		

Source: Field Survey, 2024

Table1 shows that 41.33% of the respondents that fall within the 50 years and above age category are the majority. A mean age of 46 years implies that majority of the respondents are young, are in their productive age and have the ability to partake effectively in production, as well as accepting innovation on cultivar development.

The male gender represents the highest proportion (64.00%) of the respondents while 36.00% are females. This could be because farm work is tedious and men can cope better with it than women. Also, this could be because some traditional cultures allow only male children to inherit farms. Majority (97.33%) of the respondents are married while 2.67% are divorced. Being married may be indicative of having children and hence more hands for production. This may also indicate that majority of the kolanut farmers are mature persons who had access to the opinions and advice of their spouses in making production decisions. The study also reveals that 13.33% of the respondents have no formal education while 86.67% have formal education ranging from primary to tertiary education. Hence, most of the respondents in the study area have formal education. Education is a social capital hence, it could impact production and acceptance of innovation.

The study further reveals that majority (62.67%) have 6-10 persons per household. The average household size is 7 persons. This shows that majority of the respondents have relatively large household size which may be indicative of the farmers perhaps utilizing members of households as labour for some operations relating to cultivation and management of crop. However, the farmers may engage the services of hired labour to complement family labour. The analysis on farm size shows that majority (89.33%) of the respondents have farm size of 5 hectares and below. The mean farm size is 3.64 hectares. This implies that most of the farmers are small scale farmers.

Table 1b: Farming experience of respondents

Farming Experience	Frequency	Percentage
=10	20	26.67
11-20	24	32.00
>20	31	41.33
Mean = 21 years		
Total	75	100.00

Source: Field Survey, 2024

Farming experience of the respondents as shown in Table1b reveals that 41.3% of the respondents had a farming experience of over 20 years with 21 years being the mean years of experience. This implies that the respondents are well skilled and experience is expected to have a positive impact on managerial ability of the respondents. This means that the more experience they have acquired over the years will come to bear on their activities.

Table 1c: Age of respondents' farms

Farm Age	Frequency	Percentage
=10	9	12.00
11-20	26	34.67
>20	40	53.33
Mean = 31 years		
Total	75	100.00

Source: Field Survey, 2024

Table 1c also revealed that 53.33% of the respondents have farms aged 30 years and above. The mean farm age is 31 years. This shows that most of the farms are old and hence productivity would reduce, as such rehabilitation of farms is needed.

Table 2: Linear Regression Result for Determinants of Cultivar Acceptability

Variable	Coefficient	Standard Error	T	Sig
Education	0.198*	0.037	1.759	0.084
Household size	0.068	0.055	0.581	0.563
Farm size	-0.023	0.007	-0.193	0.847
Farming experience	0.137	0.003	1.106	0.274
Small sized nuts	0.078	0.074	0.576	0.567
Large sized nuts	-0.214*	0.089	-1.909	0.061
High yield	0.313*	0.245	1.909	0.061
Early maturing	-0.215*	0.305	-1.829	0.073
Prolonged rainfall tolerance	0.537**	0.276	2.532	0.014
Prolonged dry season tolerance	-0.254	0.403	-1.637	0.107
Pests and diseases resistance	0.226	0.250	1.348	0.183
Non-abortion of flowers	-0.551***	0.176	-3.084	0.003
Dwarf trees	0.009	0.082	0.078	0.938
Constant		0.631	1.766	0.083
N = 75				
R^2 = 69.80				

Source: Field Survey, 2024

***=significant at 1%; **=significant at 5%; *=significant at 10%

Table 2 reveals the linear regression analysis result. The result shows that the regressors can explain 69.80% of the variations in the dependent variable, that is, the coefficient of determination (R^2) was 69.80%. The overall equation is significant at $p \leq 0.1$. The coefficients for education ($p \leq 0.1$), large sized nuts ($p \leq 0.1$), high yield ($p \leq 0.1$), early maturing ($p \leq 0.1$), prolonged rainfall tolerance ($p \leq 0.05$), and non-abortion of flowers ($p \leq 0.01$) were all significant. This shows that cultivar acceptability is highly influenced by these factors. Variables such as education, high yield and prolonged rainfall tolerance were positive at various level of significance. This indicates that these variables go in the same direction with cultivar acceptability, that is, as each of the variables increases, then, cultivar acceptability also increases. However, large sized nuts, early maturing and non-abortion of flowers were all negative, showing that as each of these variables increases, cultivar acceptability decreases. The implication of this is that developed kolanut cultivars with these characteristics (large sized nuts, early maturing and non-abortion of flowers) does not necessarily determine cultivar acceptability.

Table 3: Awareness Level of Respondents

Awareness	Frequency	Percentage
Aware	22	29.33
Not aware	53	70.67
Total	75	100.00

Source: Field Survey, 2024

Table 3 above reveals that majority (70.67%) of the respondents are not aware of CRIN cultivar development while 29.33% of the respondents are aware of such innovation.

Table 4: Probit Regression Result for Willingness to Pay for Developed Cultivars

Variables	Coefficient	Standard error	t-value	p-value
Age	0.047*	0.024	1.92	0.055
Gender	-0.576	0.754	-0.76	0.445
Marital status	-3.879**	1.550	-2.50	0.012
Education	0.350	0.403	0.87	0.386
Household size	1.923**	0.888	2.17	0.030
Farm size	-0.233**	0.098	-2.37	0.018
Farm experience	0.113**	0.050	2.26	0.024
Farm age	0.018	0.019	0.96	0.338
Constant	2.406	3.309	0.73	0.467
N = 75				

Source: Field Survey, 2024

***=significant at 1%; **=significant at 5%; *=significant at 10%

Table 3 shows the results of the probit regression analysis. The coefficients for age ($p \leq 0.1$), marital status ($p \leq 0.05$), Household size ($p \leq 0.05$), farm size ($p \leq 0.05$) and farm experience ($p \leq 0.05$) were all significant. This shows that the willingness to pay for developed cultivars is highly influenced by these factors.

It can be observed that variables such as age, household size and farm experience were all positive at varying levels of significance. This indicates that these variables go in the same direction with willingness to pay for developed cultivars, that is as each of the variables increases, the willingness to pay for developed cultivars also increases.

The implications are that older farmers may be more willing to pay for developed cultivars, suggesting that targeting this age group may be an effective strategy. Also, household size may be an important factor in willingness to pay for developed cultivars, suggesting that poverty and household income may be important factors in cultivar adoption. Farmers with more experience may be more willing to pay for developed cultivars, suggesting that learning and experience are important factors in cultivar adoption. However, marital status and farm size were negative showing that as both variables increase, then, the willingness to pay for developed cultivars decreases. The implication of these is that being married may mean less willingness to pay for developed cultivars. Also, smaller farm sizes may be more willing to pay for developed cultivars, suggesting that economies of scale may be an important factor in cultivar adoption.

Conclusion and Recommendations

Majority of the kolanut farmers are not aware of CRIN cultivar development. Cultivar acceptability in the study area is positively influenced by education, high yield and prolonged rainfall tolerance and negatively influenced by large sized nuts, early maturing and non-abortion of flowers. Willingness of kolanut farmers in the study area to pay for developed kolanut cultivars is positively influenced by age, household size and farm experience and negatively influenced by marital status and farm size. More awareness campaigns should be aggressively embarked upon by the institute to increase farmers' awareness of CRIN innovations and also to drive home the inherent benefits of accepting and adopting these technologies for improved productivity and increased income of kolanut farmers.

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Experimental Title: Economics of Botanical Usage for Kolanut Storage and Preservation among Stakeholders in Ogun State, Nigeria

Investigators: Lawal, J.O., and Oyedokun, A.V.

Introduction

It is estimated that field and storage pests destroy approximately 43% of potential production of Kolanuts in developing Asian and African countries (Jackobson, 1982; Ahmed and Grainge, 1986; Ogendo *et al*., 2004). A combination of botanicals/bio-pesticides and natural components for the storage and preservation of Kolanut by the stakeholders offers considerable promise for increasing income and sustainability on the crop. It nonetheless remains unclear whether or not these techniques are cost-effective and lend themselves easily for adoption by smallholder farmers than synthetic ones mainly because of the latter's adverse effects such as safety, cost and crop failure.

Abedi and Bedragheh (2011) asserted that indigenous knowledge is a principal factor at the field of research for sustainable development, decreasing poverty, local participation in farming activities and rural development programs which develops and produces appropriate technology, self-reliance of rural societies and country at large. In recent years, there has been an attempt to replace the synthetic insecticides with less expensive, locally available, ecologically safe and socio-friendly options including botanicals (Banwo and Adamu, 2003; Ogendo *et al*., 2006; Talukder, 2006; Isman, 2007). However, traditional farmers perceptions of pest problems and indigenous control methods employed are yet to be critically evaluated. The available information is mostly observational/ anecdotal and does not provide quantitative details about various socio-economic factors that influence the indigenous pest control practices (Altieri, 1993).

Hence, this study analyzed the factors driving the use of botanicals/bio-pesticides by farmers in the quest to manage pests and diseases of Kolanut for storability and for preservation in Ogun state. Since adoption of agricultural production technologies in developing countries is influenced by a wide range of economic, social, physical as well as technical aspects of farming, it is important to understand the role of these factors to ensure the development of sustainable technologies and the design of successful developmental projects.

According to Rogers (1995), the adoption of an innovation goes through a decision-making process beginning with awareness, then the formation of positive or negative attitudes, and finally deciding whether to adopt the technology or not. Each stage of this process is influenced by various factors, including: household factors (socio-economic, resource base and outside contacts), community factors (group thinking, access to extension, education, market, infrastructure, indigenous knowledge and ecological factors), and institutional factors (extension services, training and material support, through government and national/local NGOs).

Objectives of the study

1. Identification and documentation of botanicals//bio-pesticides used in Kolanut preservation and storage in the study area;
2. Analyze the factors driving the use of botanicals in Kolanut storage and preservation;
3. Determine the cost-effectiveness of the use of botanicals for storage and preservation.

Methodology

This study was carried out in Ogun state which is predominant for Kolanut trade of which the marketing functions that include postharvest

handling process of preservation and storage. Following a multistage sampling procedure, structured questionnaire was used to elicit information from the Kolanut stakeholders using a stratified random sampling technique, at the Local Government (LG) level, two LG areas planting and dealing in Kolanut were chosen and at the village level, three villages each from the LGAs were chosen of which the stakeholders were stratified into two. Each stratum was proportionately sampled based on size to give a population of 40 respondents.

Data collected were subjected to descriptive, budget and inferential analysis.

Results and Discussion

Socioeconomic Profile of Respondents

The results indicate that kolanut storage and preservation in Ogun State is primarily undertaken by middle-aged to older individuals, with an average age of 60.2 years. This suggests that younger generations may not be actively involved in the trade, potentially impacting knowledge transfer and long-term sustainability (Akinnagbe and Ikusika, 2016). The majority of respondents are female (75%), reflecting the significant role women play in post-harvest handling and processing of agricultural products in Nigeria (Balana *et al*., 2022). Additionally, most respondents are married (87.5%), which may imply a level of stability that supports investment in kolanut preservation.

Education levels vary, with 32.5% having no formal education and only 12.5% attaining tertiary education. This may impact the adoption of improved storage technologies due to limited access to information and training (Bokusheva *et al*., 2012). Household sizes are relatively large (9.4 on average), which could provide family labor for storage and preservation activities. Respondents also have substantial experience (38.4 years), indicating that kolanut storage is a long-established livelihood activity.

However, the low participation in cooperatives (20%) and limited access to extension services (7.5%) suggest weak institutional support, which could hinder innovation and efficiency (Ezima *et al*., 2023). Credit access is also limited (17.5%), potentially restricting investment in improved storage infrastructure.

Table 1: Socioeconomic Characteristics of the Respondents

Variable	Frequency	Percentage	Mean±SD
Age (years)			60.2±12.7
40 – 50	11	27.5	
51 – 60	15	37.5	
>60	14	35	
Sex			
Female	30	75	
Male	10	25	
Marital status			
Single	0	0.00	
Married	35	87.5	
Divorced	5	12.5	
Widowed	0	0.00	
Education level			
No formal Education	13	32.5	
Primary	8	20	
Secondary	14	35	
Tertiary	5	12.5	
Household Size			9.4±13.4
1 to 5	9	22.5	
6 to 10	26	65	
>10	5	12.5	
Experience (Years)			38.4±12.4
20 to 30	14	35	
31 to 40	16	40	
>40	10	25	
Cooperative Membership			
Yes	8	20	
No	32	80	
Extension Agent Contact			
Yes	3	7.5	
No	37	92.5	
Warehouse Storage Sources			
Communal	19	47.5	
Owned	20	50	
Lease	1	2.5	
Distance of Storage Location to Market (km)			2.6±2.9
1-2	25	62.5	
3-4	13	32.5	
>4	4	10	
Credit Access			
Yes	7	17.5	
No	33	82.5	

Source: Field Survey (2024)

Identification and Documentation of Botanicals/ Bio-pesticide use in Kolanut Preservation and Storage

As presented in Table 2, the study identifies lime (67.5%) and *Ewe Olorun* (32.5%) as the predominant botanicals used for kolanut

preservation in Ogun state. Lime juice (37.5%) is the most commonly utilized plant part, followed by leaves (27.5%) and roots (25%). These findings align with previous studies highlighting the efficacy of plant-based preservatives in controlling spoilage and insect infestation (Lawal, *et al,* 2024; El Alami *et al*., 2024). The preference for these botanicals may stem from their antimicrobial properties, affordability, and environmental sustainability compared to synthetic preservatives.

Table 2: Names of Botanicals Used

	Frequency	Percent
Lime	27	67.5
Ewe Olorun	13	32.5
Total	40	100

Source: Field Survey (2024)

Table 3: Part of Plants used as Botanicals

	Frequency	Percent
Lime Juice	15	37.5
Leaves	11	27.5
Root	10	25
Leaves and Root	4	10
Total	40	100

Source: Field Survey (2024)

Factors Driving Use and Classification of Botanicals in Storage and Preservation of Kolanut

Results presented in Table 4 shows that the adoption of botanicals for kolanut storage is primarily driven by the availability of cheap labour (ranked 1st) and the accessibility of botanical materials (ranked 3rd), this shows the important role of cost-effectiveness and convenience in post-harvest preservation as opined by Qadri *et al*. (2020). Cooperative membership (ranked 2nd) also plays a role, yet the low participation rate (20%) suggests limited access to shared resources and technical knowledge. Experience in kolanut storage (ranked 4th) significantly influences botanical usage, as long-term stakeholders recognize its effectiveness in extending shelf life and maintaining quality (Adeleye *et al.,* 2015). However, factors such as government policies (ranked 9th), subsidies and financial incentives (ranked 6th), and selling price (ranked 7th) had a weaker impact, reflecting the lack of institutional support and formal interventions in kolanut preservation. Despite these challenges, the reliance on locally available and affordable botanical preservatives suggests a need for targeted policies to improve access to credit, strengthen cooperative networks, and enhance knowledge transfer to optimize kolanut storage and marketing.

The top-ranked reasons for botanical usage are low cost (1st) and easy availability (2nd), emphasizing that affordability and accessibility are the major determinants. Profitability ranks 3rd, indicating that while botanicals are economically viable, their primary appeals lie in their affordability rather than high profit margins. Interestingly, reduction in health-related expenses (7th) is the least significant factor, suggesting that users may not fully recognize the potential health benefits of botanicals compared to synthetic preservatives.

Table 4: Factors driving the use of botanicals

Factors	Strongly Agree (%)	Agree (%)	Disagree (%)	Strongly Disagree (%)	Mean±SD	Rank
Profit	0	32.5	30	37.5	3.05±0.85	11th
Religion	20	50	22.5	5	2.13±0.80	13th
Variety of kolanut available per farming season	2.5	17.5	50	30	3.08±0.76	10th
Demand for Kol anut storage and preservation	2.5	10	47.5	40	3.25±0.74	5th
Years of experience in kolanut storage	2.6	10.3	43.6	43.6	3.28±0.76	4th
Selling price of Kolanut	5	12.5	42.5	40	3.18±0.84	7th
Buying price of kolanut at the point of storage	2.6	34.2	28.9	34.2	2.95±0.89	12th
Policies and programs of government	5.3	10.5	52.6	31.6	3.11±0.79	9th
Presence of subsidies, loans, grants for storage and preservation	7.9	7.9	39.5	44.7	3.21±0.91	6th
Membership of association	0	2.5	55.0	42.5	3.40±0.55	2nd
Availability of cheap labour	0	2.5	45	52.5	3.50±0.56	1st
Availability of trees	2.5	5	50	42.5	3.33±0.69	3rd
Availability of botanicals	7.5	7.5	47.5	37.5	3.15±0.86	8th

Source: Field Survey (2024)

Table 5: Classification for use of Botanicals

Factors	Mean±SD	Rank
More profitable to use botanicals for Kolanut storage and preservation	3.23±0.77	3rd
Botanicals are cheap	3.48±0.64	1st
Botanicals are easily available	3.38±0.67	2nd
Botanicals are easily accessible	3.18±0.54	5th
Botanicals are environmentally friendly	3.20±0.72	4th
No restrictions to the use of botanicals	2.75±0.92	6th
Reduction in amount spent on minor health challenges	2.63±0.87	7th

Source: Field Survey (2024)

Cost Effectiveness of Use of Botanicals for Storage and Preservation

The results of the cost effectiveness of botanicals used are shown in Table 6. With a Benefit-Cost Ratio (BCR) of 1.80, the results demonstrate that using botanicals for kolanut storage is economically viable, as every ₦1 invested yields ₦1.80 in return. The BCR value which is greater than 1 also shows that the use of botanicals for kolanut storage and preservation is cost effective. This aligns with previous research indicating that botanical-based preservation techniques can enhance profitability due to lower input costs and minimal environmental impact (Hassan *et al*., 2024).

However, the relatively high costs of transportation (₦209,550) and labor (₦178,162.2) suggest that logistical and operational expenses remain key cost components. Addressing these challenges through cooperative storage facilities or government interventions could further improve profitability.

Benefit Cost Ratio (BCR) =

$$\frac{\textit{(Total annual revenue from sales of stored kolanut)}}{\textit{(Total cost involved in the storage and preservation of kolanut)}}$$

Variables	Value (₦)
Total Revenue	1,257,500
Cost Items	
Transportation	209,550
Amount spent on botanicals	126,000
Levies and taxes	28,529.7
Labour	178,162.2
Maintenance	34,400
Rent	78,575
Water	39,794.1
Total Cost	695,011
BCR	1.80

Conclusion

The study reveals that kolanut storage and preservation in Ogun State is predominantly carried out by older individuals, especially women, with limited formal education, cooperative membership, and access to extension services. The use of botanicals, mainly lime and *Ewe Olorun*, is driven by affordability, accessibility, and cost-effectiveness. The economic analysis indicates that botanical-based preservation is viable, with a Benefit-Cost Ratio (BCR) of 1.80, confirming its profitability. However, high transportation and labor costs, weak institutional support, and limited financial assistance present significant challenges.

Recommendations

1. Stakeholders should be encouraged to join cooperatives to enhance knowledge sharing, access to resources, and collective bargaining power within the kolanut value chain.
2. Provision of training and extension services should be provided for kolanut storage stakeholders through government and research institutions to educate them on improved storage methods and botanical applications for better preservation.
3. Better credit access should be facilitated by offering low-interest loans to kolanut traders and store owners, enabling investment in modern storage facilities and preservation techniques.

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Experimental Title: Assay and Development of Botanical Alternatives against Storage Pests of Kola Nuts

Investigators: Agbeniyi, S. O., Adedeji, A. R., Orisajo, S. B., Okeniyi, M. O., Otuonye, A. H., Ogundeji, B. A., Olorunmota, R. T., Ayanwole, S. and Oladigbolu, Y. O.

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 kola nuts weevil both prior to the harvest and during storage. In order to prevent stored kola nuts from the attack of store pests and moulds, kola nuts farmers and traders use various types of chemical pesticides including banned ones. The applied 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 environmental matrices. Tolerances are pesticide residue levels that should not be exceeded in or on a raw agricultural commodity in the channels of interstate commerce when the pesticide is applied according to label directions. When plant and animal material having pesticide residues at concentrations inimical to human health are consumed, several health hazards could be created within the system which can lead to cancer, kidney failure and a host of other health problems.

Kola nuts are mostly consumed in its raw state except for industrial use. An array of pesticides residue in kola nuts samples from Ogun and Osun States include Chlordane, Endosulfan, Alachor and Endrin. Residues of these chemicals in kola nut have been found to have adverse effects on the health of the consumers. Hence, the need to explore plant extracts which are suitable alternatives to synthetic pesticides, thereby making the commodity safer for consumption. This study sought to bridge the gap in pesticide residues identified in kola nuts, through the development of botanical alternative control measures that could be easily administered and adopted by farmers.

Materials and Methods

Infected and apparently healthy stored kola nut samples were separately collected from randomly selected local markets in Oyo State and transported to the laboratory in sterile Ziploc bags. The kola nuts were sterilized with 2% sodium hypochlorite solution, inoculated into freshly prepared potato dextrose agar plates and incubated at room temperature (30±2°C) for 5-7 days. The isolated fungi were purified, characterized and identified using standard laboratory methods. Their percentages of occurrence were also computed. Fresh samples of *Azadirachta indica, Ocimum gratissimum, Chromolaena odorata* and *Vernonia amygdalina*, were collected (within the premises of CRIN headquarters, Ibadan), identified, air-dried under room temperature and ashed at 600°C using standard methods. The prepared ash botanicals were tested *in vitro* against most occurring kola nut storage pathogens, results of which were still being awaited.

Results and Discussion

A total of twelve fungi were isolated from both apparently healthy and infected kola nuts. Results from the experiment showed that all the implicated storage fungi (except for one- *C. gloeosporioides*, were isolated from the infected kola nut samples. Eight out of the twelve storage fungi were however isolated from the apparently healthy nuts at different percentages of occurrence (Table 1). These findings suggest that most of the implicated storage fungi of kola nut actually infected the nuts (though not visibly seen) prior to storage. Each of the isolated fungal pathogens has been known to induce rot in agricultural produce. The findings by Sharma and Pandey (2010) revealed the occurrence of *A. niger, Penicillium* sp, and *Fusarium* sp. on decayed vegetables. More than 10% occurrence was recorded for *C. lindemuthianum* (24.82%), *F. oxysporum* (18.18%), *P. expansum* (13.64%) and *A. flavus* (13.09%) on the apparently healthy nuts, while *Fusarium oxysporum* (25.18%), *L. theobromae* (16.09%) and *C. lindemuthianum* (15.02%). *Fusarium solani* (11.49%) however had high occurrence on the infected kola nuts (Oduwaye *et al.,* 2018).

Ash produced from the botanicals used in this study showed variations in appearance as *A. indica* and *O. gratissimum* were much brighter in appearance, while *C. odorata* and *V. amygdalina* were slightly dark (Plate 1). Textures of the ash forms were however similar. Differences in the appearances of the ash botanicals might be due to the differing nature and/or quantities of non-carbon ingredients and pigments in the said botanicals (Smolka-Daielowska and Jablonska, 2022).

Table 1. Percentage occurrences of fungi associated with apparently healthy and infected kola nuts

Fungi	Percentage occurrence (%)	
	Apparently healthy nuts	Infected nuts
A. flavus	13.09	10.1
A. niger	6.38	1.15
A. fumigatus	-	1.25
B. cinerea	-	8.09
C. gloeosporioides	4.55	-
C. lindemuthianum	24.82	15.20
F. oxysporum	18.18	25.41
F. solani	9.09	11.49
L. theobromae	9.00	16.39
P. expansum	13.64	4.00
P. atramentosum	-	7.02
R. stolonifer	-	1.15

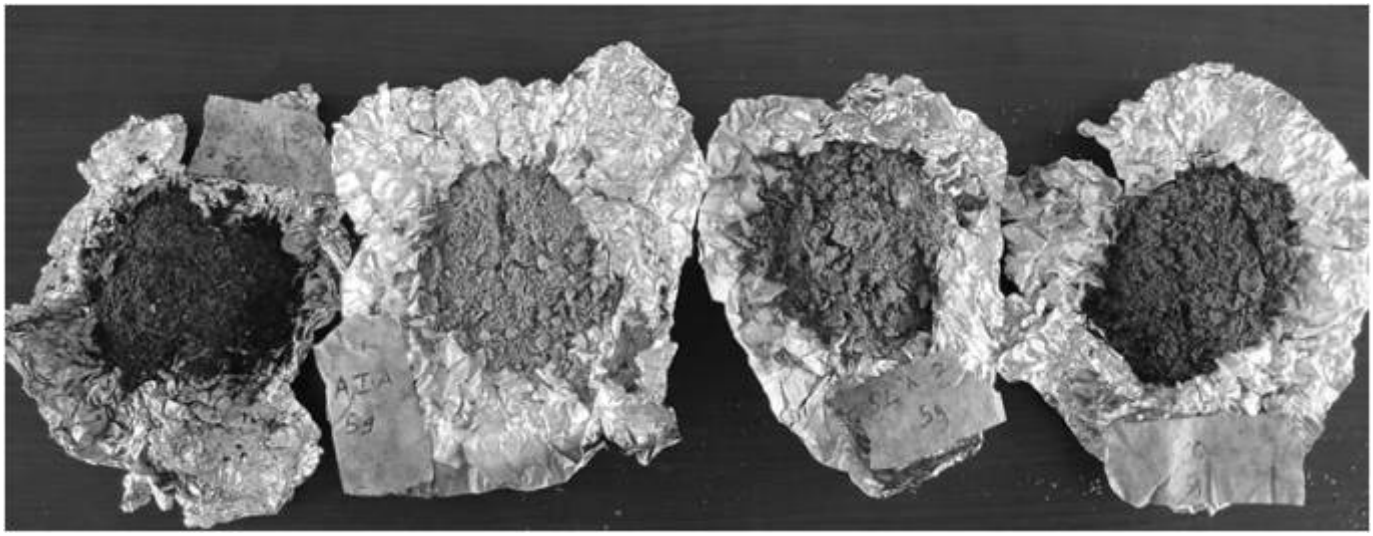

Plate 1: Ash forms of *V. amygdalina*, *A. indica, O. gratissimum* and *C. odorata*

Conclusion and Recommendation

Findings from this study showed that most of the storage fungi associated with kola nuts actually infected the nuts prior to their storage, while others gained access only during storage. Ash botanicals used in this study differed in their appearances due to differences in their antimicrobial potentials. There is therefore need to conclude the *in vitro* studies in order to have a good insight into their *in situ* effectiveness.

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TEA PROGRAMME REPORT

Experimental Title: Land Suitability Evaluation for Tea Cultivation Using GIS in Selected Locations of Abia State

Investigators: Okeniyi, M. O., Oloyede, A. A, Obatolu, B. O., and Ayanwole, S. A

Introduction

Land suitability refers to the ability of a portion of land to tolerate the production of crops in a sustainable way. Its evaluation provides information on the constraints and opportunities for the use of the land and therefore guides decisions on optimal utilization of resources, whose knowledge is an essential prerequisite for land use planning and development. Moreover, such a kind of analysis allows identifying the main limiting factors for the agricultural production and enables decision makers such as land users, land use planners, and agricultural support services to develop a crop management able to overcome such constraints, increasing the productivity. Tea (*Camelia sinensis*) a temperate and sub-tropical beverage crop popularly grown for different brands and types of tea; black tea -made from fermented tea leaves; oolong tea- made from partially fermented leaves. green tea made from unfermented tea leaves and white tea made from unfermented leaves buds of tea -this is an elitist tea brand as it is expensive and highly medicinal. Tea was introduced to the high land of Manbilla Plateau in the early 80s. the introduction of this important beverage crop has resulted in springing up of the Nigeria Beverage Production Company initially produced by the Gongola State Government,

presently been managed as public liability company. Tea cottage industries are springing up as well. As important as this crop is to the farmers and the companies, there is limited land due to competing demands viz; livestock, forest plantation, food crops and infrastructural projects. The above limitation has led to adaptation trials on some of the available tea clones on the Mambilla Plateau in the lowland areas of Nigeria. the trials have led to discovery of some adaptable clones to the lowland areas in Ibadan (Oyo State), Ajassor, Iyanonmon ([Edo State) Akwete (Abia) and Ikorodu (Lagos State). The identified adaptable clones are C143, C318, C35, C357 and C236. Of the above listed, the first two (C143 and C318) are outstanding. In the recent times, some tea seeds brought from China by the duo of Omolaja and Aroyeun were sown on the Mambilla plateau. The seedlings derivable were then established with obvious segregation. These when planted out manifested a lot of morphological variations. About 37 biotypes of these were then brought to Ibadan for further evaluation by Olaniyi *et al.* (2015) He identified another four of the China tea coded as NGC17,18, 25 and 40. The yield were comparable with C143, C318 and C357.

Objective

The need to expand tea southwards of lower altitude as well as unexploited highland areas in the Southern part.

Materials and Methods

Study Area

The study areas are Bende in Bende local government area and Ogbuebule in Ikwano Local government are of Abia State (Figure 1 - 4). Table 1 shows the coordinates.

Figure 1: Map of Nigeria Showing Abia State and Local Government visited

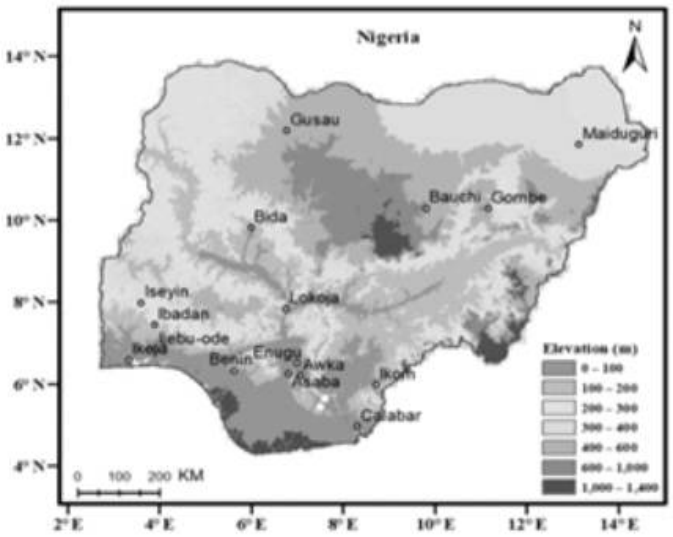

Figure 2: Map of Nigeria showing the elevation (m) of areas visited

Figure 3: Satellite image of site visited for land Suitability in Bende Local Government of Abia State

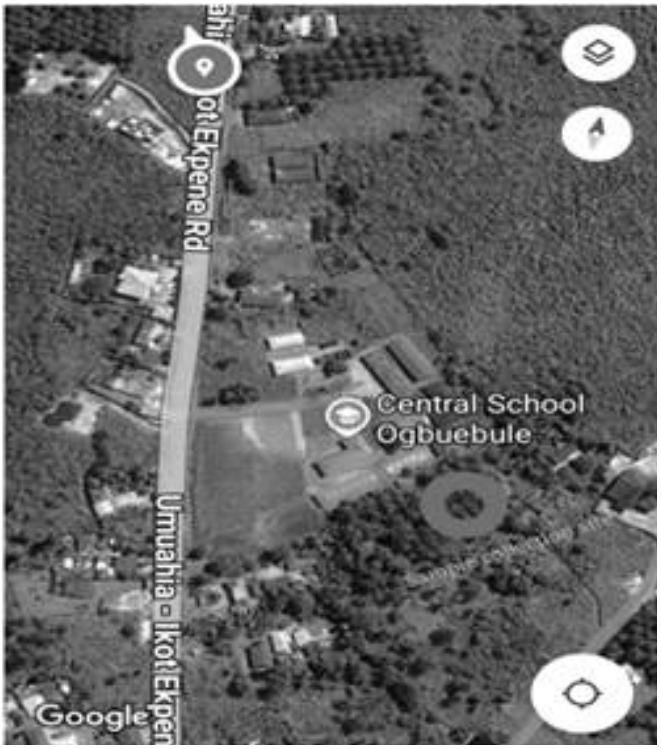

Figure 4: Satellite image of site visited for land Suitability in Bende Local Government of Abia State

In this study the method that was used to evaluate the land suitability for tea cultivation in the lowland was based on FAO guideline [2] and parametric evaluation method. This guideline has procedures to evaluate the suitability of the land for intended land use. Generally the procedure answers the following questions:

* For any specified kind of land use, which areas of land are best suited?
* For any given area of land, for which kind of use is it best suited?

In simplified form, the procedures used were as follows:

* Description of land-use types
* Selection of land qualities and land characteristics
* Mapping of land units and their characteristics.
* Generation of suitability maps

In order to evaluate land suitability, data regarding landform, soil properties and climate condition collected from the field and analysed in the soil laboratory. Landform parameters include depth, slope, Soil parameters include: texture, EC (electrical conductivity), and pH (Figure. 4.). To obtain suitability classes for each crop type in each Land Unit, firstly, the value of the established parameters was calculated for each land unit. Then, according to the crop requirements, a rating was assigned to each parameter value and the final score for each land unit was computed using the following mathematical formula:

Where: Si: suitability index for tea; S_d: rating of soil profile/depth; S_t: rating of soil texture; S_θ: Slope rating; S_{dr}: drainage rating.

Table 1: GPIS LOCATIONS

LOCATIONS VISITED WITH GPIS

Location	Altitude (m asl)	Latitude	Longitude	Local Govt
Bende	135	5.55718N	7.63676E	Bende
Ikwuano(Ogbuebule)	152	5.4045N	7.5670E	Ikwano

Results and Discussion

The land suitability evaluation takes account of all the inventory attributes of land and was used to compare them with the requirements of the crops, to get a suitability map which is easy to understand for crop production. The methodology used for the evaluation is according to the Sys *et al.*[11] Parametric method, based on FAO guidelines for land evaluation for agriculture. It requires matching land characteristics against crop requirements and assigning a suitability rating for each land characteristic. Crop requirements were further adjusted to fit better with the study area.

The result showed that Abia State soil is well drained with a mean annual temperature ranging between 2032 - 2540 (fig. 5 and 6). The soil type for the locations (Bende and Ogbuebule) both in Bende and Ikwuano local government is sandy loam with a soil pH ranging from 6.9 - 7.8 for Bende and 0.01 - 5.5 (fig. 9 and 10). the land is fairly highly suitable for mechanized farming with few physical limitations.

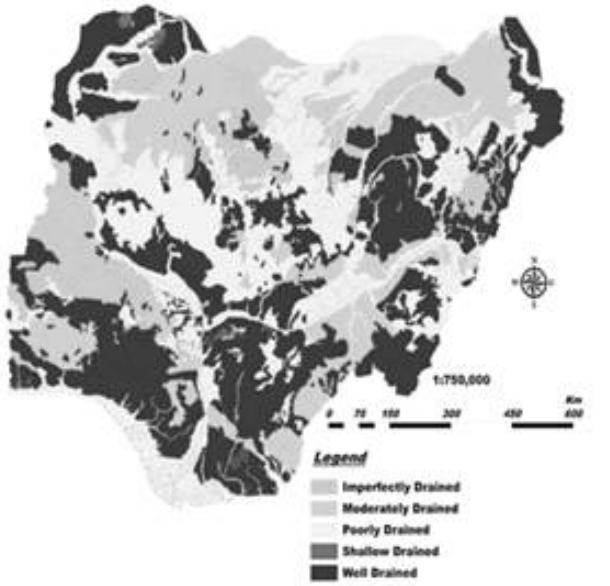

Figure 5: Map of Nigeria showing the Soil drainage pattern for sites visited

Figure 8: Map of Nigeria showig soil types of location visited

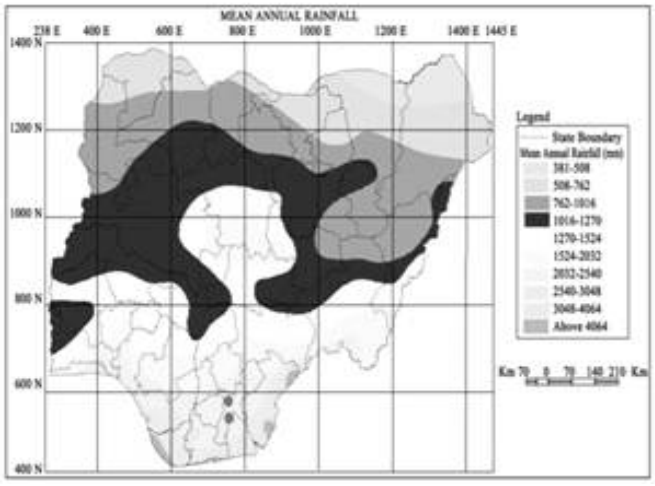

Figure 6: Map of Nigeria showing the Mean annual rainfall range for sites visited

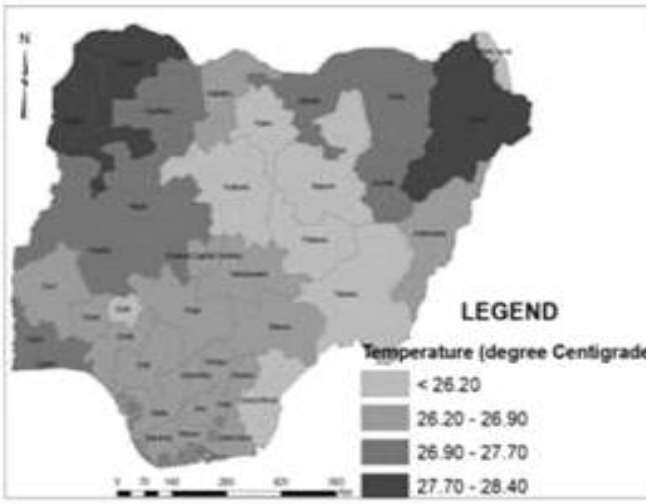

Figure 9: Soil type for site visited

Figure 7: Map of Nigeria showing land suitability for mechanized farming for locations visited

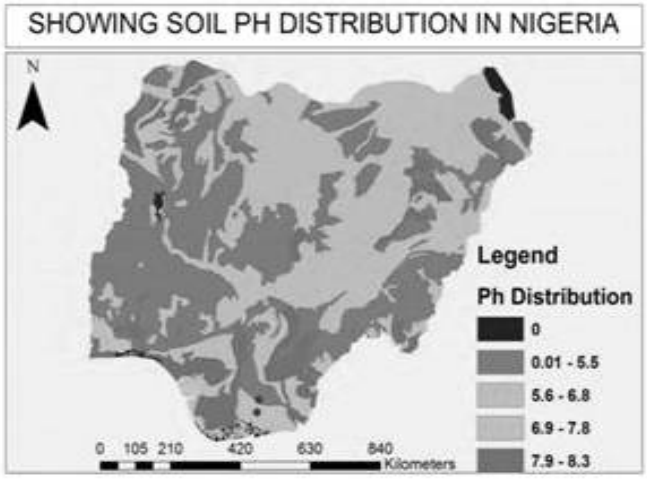

Figure 10: Land suitability for mechanized farming

The table below is showing the summary of the climatic variables and soil pH of the study areas.

Table 2: Climatic variables and pH of the study Areas

Climatic variables	Normal Range	Bende	Ikwuano
Temperature	13-26^{0}C	19-31	26-32
Rainfall(mm)	800-2500	2200-2400	1700-2351
Relative Humidity(%)	70-80	63-92	80-90
Soil pH	3.5-6.5	4.2-8.1	4.5-5.6

Cropping systems in Bende and Ikwano of Abia River State

Altitudes at the selected locations

Geographical locations are as indicated in Table 1 revealed the altitudes of 1519-1550m asl fall within the ideal for upland tea production as we have at the Mambilla plateau. Though Bende and Ogbuebule have lower altitude (135m and 152m asl respectively), the result obtained at CRIN Ajassor Substation on adaptation trail has manifested the imperativeness of suitability at lower altitude.

Climatic variables and pH in the study locations

The pH of the soils and climatic variables of temperature, rainfall and relative humidity as indicated in Table 2 fall within normal limits (Global Tea science, 2018). These are very important indicators for tea cultivation.

Conclusion and Recommendations

From the results gotten from this study considering the pH of the soils and favourable climatic variables of temperature, rainfall and relative humidity, it could be concluded that Abia State (Bende and Ogbuebule), considering adaptability of some notable clones of C143 , C318 and some selected NGC series is a good destination point for tea cultivation in Nigeria.

We therefore recommend that training along value chain should commence as the farmers through NACOFTAN.

Constraints: inadequate, untimely funding and deplorable state of roads

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Experimental Title: Multiplication of planting materials for expansion of tea cultivation to Cross River State

Investigators: Ayanwole S.A., Okeniyi M.O., Oloyede A.A., Adeosun S.A. and Olaniyi O.O.

Introduction

Nigeria's annual tea production is 1,640 tonnes, which is only about 10% of the country's domestic demand. The tea produced in Nigeria is labeled as

"Highland tea," and it is made using the CTC (Cut, Tear, Curl) method. To meet its domestic needs, Nigeria imports approximately 12,000 tonnes of tea annually. Some notable tea-producing regions in Nigeria include the Jos Plateau, Mambilla Plateau, and Obudu. The Nigerian tea industry faces challenges like climate change, pests, diseases, fluctuating prices, and a lack of infrastructure. The industry also has prospects for growth, including the development of new tea varieties, the introduction of lowland tea production, and increasing global demand for tea. While traditional tea production in Nigeria has been focused on highland areas, research indicates that lowland areas also hold promise for tea cultivation, with specific clones like 143 and 318 showing high adaptability. Tea was introduced into Nigeria in 1952 on Mambilla highland along Gembu, Arrdo-Gori, Kususku, Kakara, Maizat-mari and Ngoroje axis (Hainsworth, 1981; Adedeji, 2006). Commercial tea cultivation started in Nigeria in 1982. The confinement of commercial tea production to Mambilla highland was orchestrated by the fact that the highland is adjudged the most suitable ecology for tea production in Nigeria. This is as a result of its cool environment and acidic soil which are the main climatic and edaphic requirement for tea growth and development. However, the expansion of tea production has been constrained by the limited land availability for tea cultivation on the highland. This has necessitated the need to explore new areas for tea production. The new area which have potentials for tea cultivation include Ibadan, Iyanomo (Edo State), Akwete (Abia State), Ikorodu (Lagos State) and Ajassor (Cross River State) where tea adaptability trials have been successfully established (Omoloja and Esan, 2005). Among these locations, Ajassor is outstanding in enhancing tea growth and establishment because of its acidity soil as well as heavy and widespread rainfall. These attributes qualify Ajassor to be selected as site for tea expansion. This led to training and sanitization programme organized for prospective tea farmers in the location in 2022. In the training, many of the farmers developed interest in tea cultivation. However, they needed to be empowered with planting materials which were not readily available at the time of training. Therefore, this project is aimed at continuation of multiplying tea clonal materials for distribution to farmers at affordable cost.

Objectives

To multiply planting materials for expansion of tea cultivation in Ajassor in Cross River State through stem cutting.

Materials and Method

Nursery Establishment

Top soil for filling of polythene bags was obtained from Ajassor. Pots were filled with top soil first at the base of the pot to about 2/3 full followed by the sub soil to fill the remaining 1/3 portion. The pots were arranged in rows making a total of 1000 per block and a total of 6,000 in all.

Source of Tea cutting

Tea cuttings used were obtained from Tea plots in Ajassor Substation, the clone from which vegetative propagation was 318. The mother bushes were pruned two months before the leaf cutting was obtained.

Materials used

IBA- routine, budding knife, hand trowel, butanol, secateurs, polythene bag, top soil and polythene sheet.

Procedure

3 – 5 suitable cutting per shoot and 15 – 25 shoots could be obtained from a well-maintained mother bush. Only single node cuttings from a suitable shoot were used. The cuttings used consist of leaf containing about 2.5cm of stem below it and about 0.5cm of stem above it. The internode cuttings are prepared by giving a top cut immediately above the axillary bud parallel to the leaf blade. The cuttings were dropped into a water container immediately after the cut and were planted as soon as possible without leaving them to dry out. One cutting was planted per bag by inserting vertically down into the soil. 2 grams, of IBA-routine hormone were prepared in butanol of 1 liter to stimulate root growth; this enhances the chances of successful rooting. Soil in the polythene bags was lightly watered and gently pressed prior to inserting cuttings to ensure firm anchorage. Propagation was done under a sealed polythene tunnel to have considerable savings on water and labour. Planting of cuttings should be done in the manner the leaves are oriented in one direction at an angle to the row. After cuttings are planted, the bags as well as the beds are given a thorough watering and covered immediately with a

transparent, 300 guage polythene sheet, resting on semi-circular bamboo hoops. The edges of the sheet are buried well on all four sides and made air-tight to create a propagating environment. No additional watering is required in the tent as the water applied initially would be adequate for internal circulation within the tent. The condensed water was placed back in the potted bags by gently tapping the surface of the tent at frequent interval in the mornings. The cover could was retained for 3 months, depending on the rate of growth, and removed in stages extending over a few days for hardening.

Plate 1 and 2: showing the arrangement and dipping of cutting in routine hormone

Plate 3 and 4: showing the planting and covering of the bed with polythene

Results and Discussion

Three months after propagation, a success rate of above 80% was recorded (Table 1). The seedlings are currently undergoing hardening process. This result was in tandem with the work of Topacoglu *et al.,* 2016 which showed that IAA had the highest rooting percentage.

Table 1: The percentage survivor of Tea stem cuttings treated with IAA rooting hormone.

Block	Percentage Survivor (%)	Percentage Mortality (%)	New leaves		New shoots	
			Number	Area (cm)	Number	Length(cm)
1	65c	17.3c	2.42	3.09	1.0	8.5
II	50e	50e	2.12	2.74	1.0	8.0
III	70b	15b	2.6	3.20	1.0	8.6
IV	75a	10a	3.0	3.67	1.0	8.8
V	53f	32f	2.50	63	1.0	8.6
VI	62d	23d	2.32	2.98	1.0	8.7

The result showed that the percentage survival ranges from 68 to 80 in all the six blocks. The highest percentage survival was obtained from block IV and for new leaves formed it ranges from 2.12 to 3.0 which was the highest. The number of shoots formed was the same across the blocks. There was no significant difference in the length of shoots. According to Kathiravetpillai *et al.,* 1982, the use of a sealed polyethylene cover to propagate cuttings has the advantage that it effects considerable saving of water and of labour and this method could be expected to promote faster vegetative growth due to the higher temperature and humidity that prevails within.

The result of this study indicated the important role of determining the optimal rooting medium in the process of vegetative propagation. Retention of leaves seems to be necessary fo the cuttings as they do not have very large reserves. The ability of cuttings to survive and produce long and massive root is very important Kathiravetpillai *et al.,* (1982).

Plates 4 and 5 showing the success rate


Plate 6 and 7

Conclusion

This study has clearly shown that adaptable tea clones can be successfully propagated in the lowland as against the belief that it can only be done in the upland.

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Research Title: Land suitability and fertility evaluation for lowland tea production

Investigators: Olasoji H. O., Ogunlade M. O., Adeyemi E. A., Nduka B. A. and Fagbami O.

Introduction

The perennial evergreen shrub known as tea (*Camellia sinensis L.*) is one of the world's oldest beverages and a high-value commercial crop. The production of tea creates jobs and foreign exchange profits, making it a major contribution to the world economy. The production of tea has been recognized as a possible means of economic expansion and diversification in Nigeria. There are numerous documented health benefits of tea for humans, including increased calorie expenditure, decreased body fat, decreased risk of chronic disease death, improved insulin sensitivity, decreased risk of Alzheimer's disease and other neurodegenerative diseases, cancer prevention, improved oral health, increased fertility, and positively altering gut bacteria (Wang *et al.,* 2017).

Tea is a beverage crop cultivated for its fresh leaves (2 leaves + bud) in plantations as monocrop and requires high soil nutrients, particularly N, P, K, Ca and Mg (Bore, 1996). These nutrients are critical and their deficiency and or inadequate supply would eventually lead to poor tea seedling establishment and performance on the field. Poor soil fertility is a major abiotic limiting factor in its production in many tropical regions of the world, especially in Nigeria, where soils under tea cultivation and adaptability trials are poor in fertility when compared to soils of other tea producing regions of the world (Obatolu 1984). Some of the effects of poor soil fertility in tea include poor productivity, reduced

synthesis and accumulation of its quality components, poor seedling establishment, poor yield and retarded growth of apical meristem (Ipinmoroti, 2006). The objective of this study is to characterize and evaluate soil fertility of the study areas for lowland tea production.

Materials and Methods

The study was carried out in Abia State. Three Local Governments (Umuahia North, Bende and Ikwuano) were visited in the State. Two profile pits were established on 23rd January, 2025 at Ibeku (CRIN substation) in Umuahia North Local Government Area (LGA) and *described following the FAO (2006) guidelines. Coordinate of each profile pit was recorded and soil samples collected from each identified horizon. Surface soil samples at 0-20 cm depth were collected randomly with the use of soil auger at Umuorie village, Bendel in Bendel LGA and Ogbuebullu village in Ikwuano LGA. Collected soil samples were processed, and then taken to the laboratory for physical and chemical analyses. Particle size distribution, soil pH, organic carbon, phosphorus, total nitrogen, exchangeable cations (Ca, K, Mg and Na), exchangeable acidity (Al^{3+} + H^{+}) and micronutrients (Fe, Mn, Zn and Cu) contents of the soils were analyzed using standard laboratory methods.*

Results and Discussion

Morphological characteristics of the soils

The established profile pits are presented in Figure 1 and 2 (on latitude 5°32'29" N, longitude 7°34'58" E; altitude 61 m and latitude 5°32'28" N, longitude 7°35'00" E; altitude 58 m respectively). The result showed that the soils are well-drained, very deep as depths to impenetrable layers were not encountered. The colour of the soils varied from 2.5YR 3/2 to 5YR 2.5/2 at the surface horizons to 10YR 7/4 and 7.5 YR 5/3 in the subsoils. The colour of the soils became lighter with soil depth. The bright sub-surface soil colour is indicative of good internal drainage (Amusan 1991). Peter *et al.* (2022a) also reported that soils formed in well oxidized (drained), iron-enriched parent material are usually reddish or brightly coloured; adding that a bright coloured soil indicates good drainage, whereas dull colour indicate poor drainage and that poorly drained soils are nearly moltled with various shades of grey, brown and yellow especially within the zone of fluctuation of the water table. The structure of the soils was moderate medium angular blocky. The soil consistence (wet) was very sticky and plastic to very plastic in the surface and sub-surface horizons, respectively. Many very fine roots were observed at the surface horizons and its concentration decreased with soil depth. The soils are classified as vertisols (dark clay soils containing large amounts of swelling clay minerals (smectite). The soils crack widely during the dry season and became very sticky when wet (Plate 1).

Fig. 1: Profile pit 1

Fig. 2: Profile pit 2

Plate 1: Soil cracks at Ibeku

Physical and chemical properties of the soils

Ibeku soils

The soils' physical properties showed that the soils were sandy loam. Sand contents for profile pit 1 ranged from 69.2 - 71.2% while pit 2 varied from 63.2 – 71.2%. Sand had the highest content while clay recorded the least. Soil pH (H_2O) of profile pit 1 decreased with increasing depth and the values ranged from 5.41 to 4.75. The pH values were within the critical range of pH 4.50- 5.60 for tea production (Hajiboland, 2017 and Kariuki et al., 2022). This indicates that the soils could support lowland tea production aside nutritional problem. Organic carbon (OC) content of the soils decreased with soil depth. The values in pit 1 ranged from 0.3 – 3.21%. The content was higher than the critical level of 3% only at the surface soils. Therefore, soil fertility management that would improve the soil organic matter is needed for the soils for sustainable tea production. Total Nitrogen (TN) contents of both soil profiles were deficient; the values lower than the critical level (4.5 to 5 %) for soils suitable for tea (Egbe et al., 1989). There is need for addition of N based fertilizer to prevent manifestation of N deficiency. The soils' available phosphorus (AP) contents were adequate. Also, the soils' exchangeable calcium and magnesium are adequate for tea production. The result indicated that without potassium (K) fertilizer supplements, there would be threat to sustainable tea production since K contents of the soils were below the critical level of 1.5 to 1.8 cmol/kg. The soil sodium (Na) content range of 0.53 – 0.62cmol/kg soil indicated that the amounts are not likely to pose a threat to tea cultivation.

Ogbuebule and Umuorie soils

Table 1 shows the result of physical and chemical properties of soil samples from Ogbuebullu and Umuorie. The result indicated that the soil texture was loamy sand. Soil pH at Ogbuebullu was 5.74 while Umuorie result was 5.66.

The soils OC ranged from 1.75 – 2.32% with Umuorie soils having highest yet the value was lower than the critical level of 3% ideal for sustainable tea production. TN and K levels in these soils were considered low for sustainable tea production when compared with the critical value. The soils would thus need nutrient addition for optimal crop production. Ipinmoroti (2006) reported that soils of south west, south east and north east zones are highly leached with very low soil N, available P and basic elements. Thus, inadequate tea production to meet local tea processing industries is due to soil nutritional problems; there is hence need for adequate fertilizer application for optimum tea production on these soils.

The soil exchangeable Ca of 3.30– 4.21cmol/kg soil and Mg of 1.12-1.25cmol/kg soil were higher than their respective critical levels, indicating that these elements are in sufficient amounts for tea cultivation. However, Ipinmoroti et al., (2023) stated that for long term cultivation, application of organic fertilizers either of plant or animal origin or a combination of both, would help to replenish the soil with the nutrients along with building the soil organic matter base, which was considered very low especially in the lowland areas. The organic fertilizers would help to replenish the soil Ca and Mg uptake by tea plants. AP of the soils was higher than the critical level (2.6 to 3 ppm) for soils suitable for tea.

Table 1: Some physical and chemical properties of Ogbuebullu and Umuorie soils

Soil Properties	*Ogbuebullu village*	*Umuorie village*
Sand (%)	84.2	85.2
Silt (%)	9.4	9.4
Clay (%)	6.4	5.4
Textural class	Loamy sand	Loamy sand
Soil pH	5.74	5.66
O.C (%)	1.75	2.32
N (%)	0.14	0.18
AP (mg/kg)	36.87	24.96
Ca (cmol/kg)	3.30	4.21
Mg (cmol/kg)	1.12	1.25
K (cmol/kg)	0.20	0.26
Na (cmol/kg)	0.43	0.49

Conclusion

The study revealed that the soils of the three Local Government evaluated are suitable for tea cultivation. The soil profile met the conditions for recommended tea growth which include a well-drained, deep and well-aerated soil with more than 2% organic carbon. However, for long term cultivation, application of appropriate fertilizers is needed to replenish the soils with deficient nutrients. Likewise, further research in Bendel and Ikwuano LGAs is necessary to ascertain their soils' characteristics and classification.

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Experimental Title: Land availability and its suitability for lowland tea cultivation in tea suitable areas in Abia State, Nigeria

Investigators: Oluyole, K.A., Taiwo, O. A, and Ibrahim, . A

Introduction

Tea (*Camella sinensis*) is a green small tree from the genus *Camellia* (Adedeji *et al*, 2014). It is planted to produce a stimulant distil. There are two major varieties. *Camellia sinensis* var. *assamica* and *Camellia sinensis* var. *sinensis*. The former has fairly big leaves while the latter has few semi-erect leaves. The variety of assamica tea came from the forests of Assam in north-east India while the sinensis tea came from Sichuan province, South-west China (Van der Vossen and Wessel, 2000; Kamau, 2008). With science and breeding, most commercial tea today exhibits vegetative features that are in between these

two main types (Mondal *et al.*, 2004). The tea plant can grow up to 15 meters high and has a root system between the taproots to the oblique root system in its natural state (Bonheure, 1990). The total area of land used for tea cultivation in the world is 2600,000 hectares of which 86% and 8% are in Asia and Africa respectively (Famaye, 2006). The major tea-producing nations are China, India, Sri Lanka, Kenya, Indonesia, Turkey, Iran, Georgia, Japan, Vietnam, Bangladesh, Argentina, Malawi, Uganda and Tanzania. The primary crop consists of young tender leaves, which may be withered, rolled, fermented and dried to give different types of teas.

Cocoa Research Institute of Nigeria (CRIN) started its research on tea in 1982. Tea production started in the Mambilla Plateau of Taraba State in 1982 on a large scale. Thereafter, Nigerian Beverages Production Company (NBPC) started processing and packaging it. Only about one thousand two hundred hectares of land is presently used for tea production in Mambilla out of five thousand hectares that are proclaimed to be good for its production. The present production of tea is not enough to meet the demand of tea consumers necessitating Nigeria to be a major importer of tea products with an enormous foreign exchange outflow (Sowunmi *et al*, 2009). Oluyole (2014) reported that in 2008 alone about $ 11 million (N 1.7 billion) was spent on tea importation. However, there is a concerted effort by the Cocoa Research Institute of Nigeria to increase tea production by introducing low land tea production in Nigeria. To ensure a significant adoption of lowland tea production in Nigeria, it is imperative to have a study on the land availability and suitability of lowland tea production in Abia State, Nigeria. The growing demand for tea, potential for export earnings, and job creation keeps increasing and hence the need to explore suitable land for lowland tea production in Abia State. This underpins the essence of this study.

Objective of the study

The objective of the study was to ascertain the land availability and suitability for low land tea cultivation in Abia State.

Methodology

The study was carried out in Abia State. Two Local Government Areas (LGAs) (Bende and Umuahia North) were purposively sampled and in each LGA, two communities were randomly sampled. The communities were Ndume and Amizu Ubakala in Umuahia Local Government Area and Nkpa and Isimkpu -Okporoenyi in Bende Local Government Area. A structured questionnaire was used to collect data from the farmers in the communities. Data on the demographic characteristics of the farmers, availability and suitability of land for lowland tea production, land size and ownership amongst others were collected. The data collected were analyzed using descriptive statistical tools such as mean, frequencies and percentages.

Results and Discussion

The descriptive analyses shows that majority of the famers (75%) are married with 15% as singles (Chart 1). More married will increase the size of the families and hence will make family labour more available for farm work. Analysis further shows that an average farmer age is 53 years. This indicates that the farmers are a little bit old and hence may not be as such agile for farm work. Hence, there is a need to encourage youths into farm work for the sustainability of the farm work. Majority (80%) of the farmers' land are either inherited or purchased while just 20% of the available land are leased (Chart 2). This shows that majority of the farmers can get hold of their land without sharing the ownership with anybody. With this, the farmers can make use of the land in any pattern they wish to put it. All the farmers indicated no disputes on the lands been used for tea production and they all attested to the fact that they can use their land for tea lowland tea production (Chart 3). With this submission, there will be no problem regarding the availability of land for low land tea cultivation. Majority (95%) of the farmers indicated that crops on their land are doing well (Chart 4). This is a good finding as there is likelihood that lowland tea will also do well on the land. Furthermore, most (60%) of the farmers indicated that their land are well drained while 15% are marshy (Chart 5). This is showing that the substantial part of the farmers' land are likely to be suitable for lowland tea cultivation since well drained soil is good for cropping. Most (50%) of the farmers indicated that the nature of the land is flat in nature while 45% stated that their lands are gently slopy (Chart 6). Flat and gently slopy land are good qualities for cropping. However, with all these qualities, this is an indication that the land in the study area are suitable for low land tea production.

Conclusion and recommendations

Nigeria has potential for tea production, particularly in the low land areas with suitable climate and soil conditions. Therefore, assessing land availability and suitability in the lowland areas is crucial for successful tea production and can contribute to economic growth and development. The survey findings reveal that the majority of the assessed lands are

- Located in diverse but predominantly agricultural communities in Abia State,
- Inherited and long-held with no current land disputes and the farmers are ready to make their land available for tea cultivation, thus showing that land is available for lowland tea cultivation.
- Characterized with well-drained and gently slopy land showing that their land is suitable for lowland tea cultivation.

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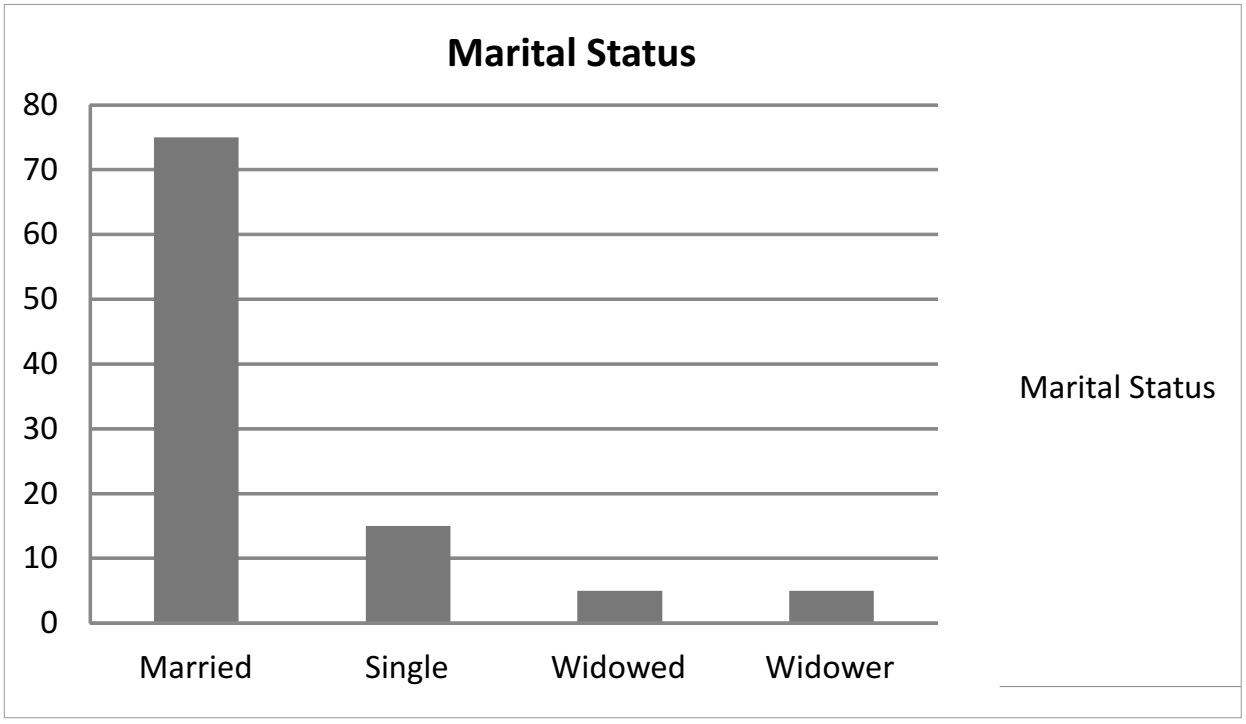


Chart 1. Marital Status of the farmers

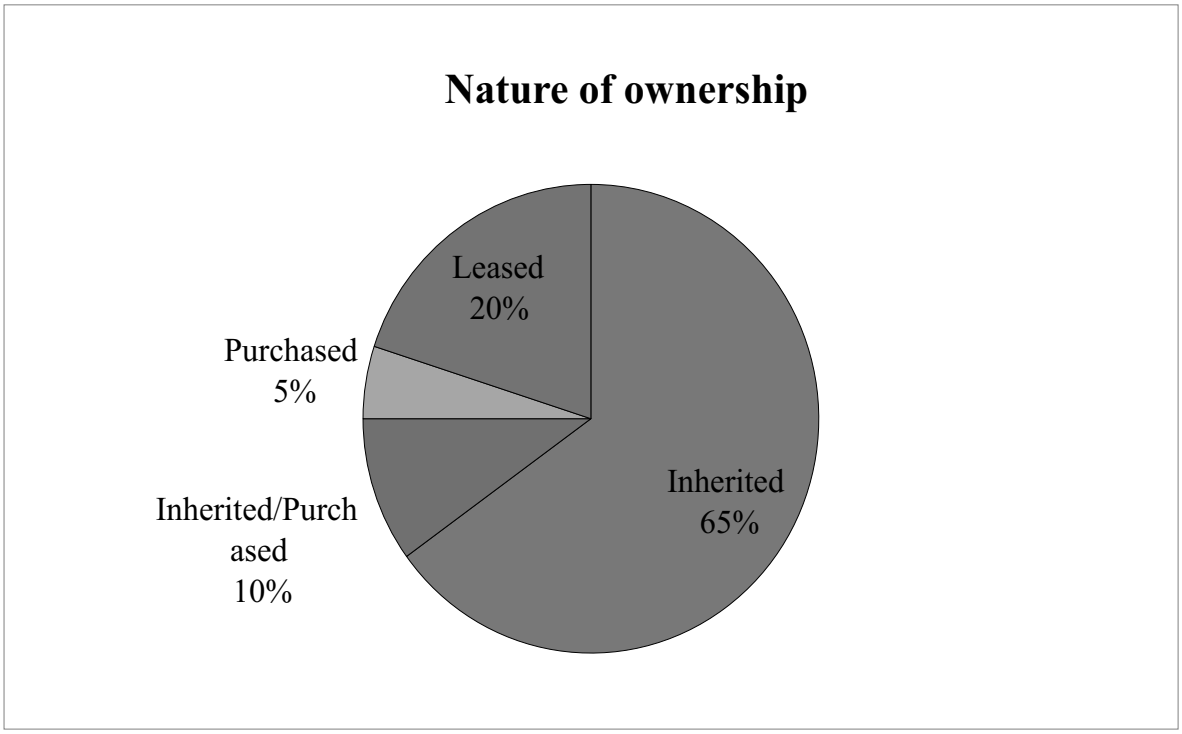


Chart 2. Nature of land ownership

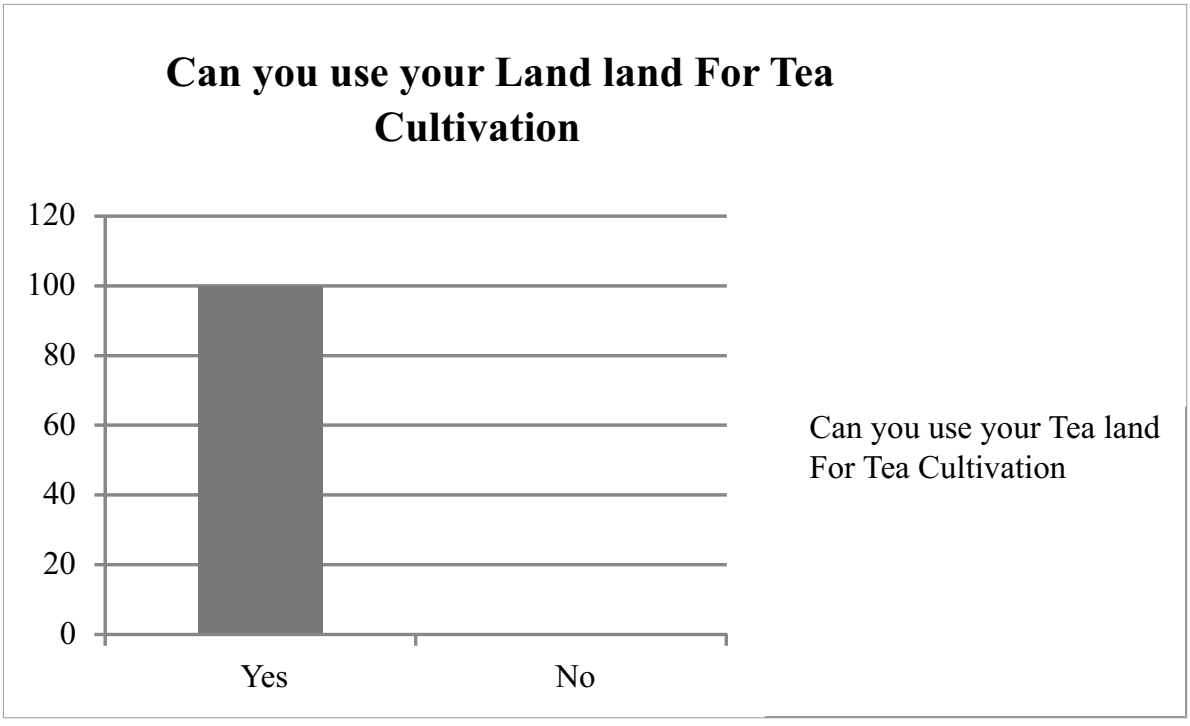


Chart 3. Willingness of farmers to use their land for tea cultivation

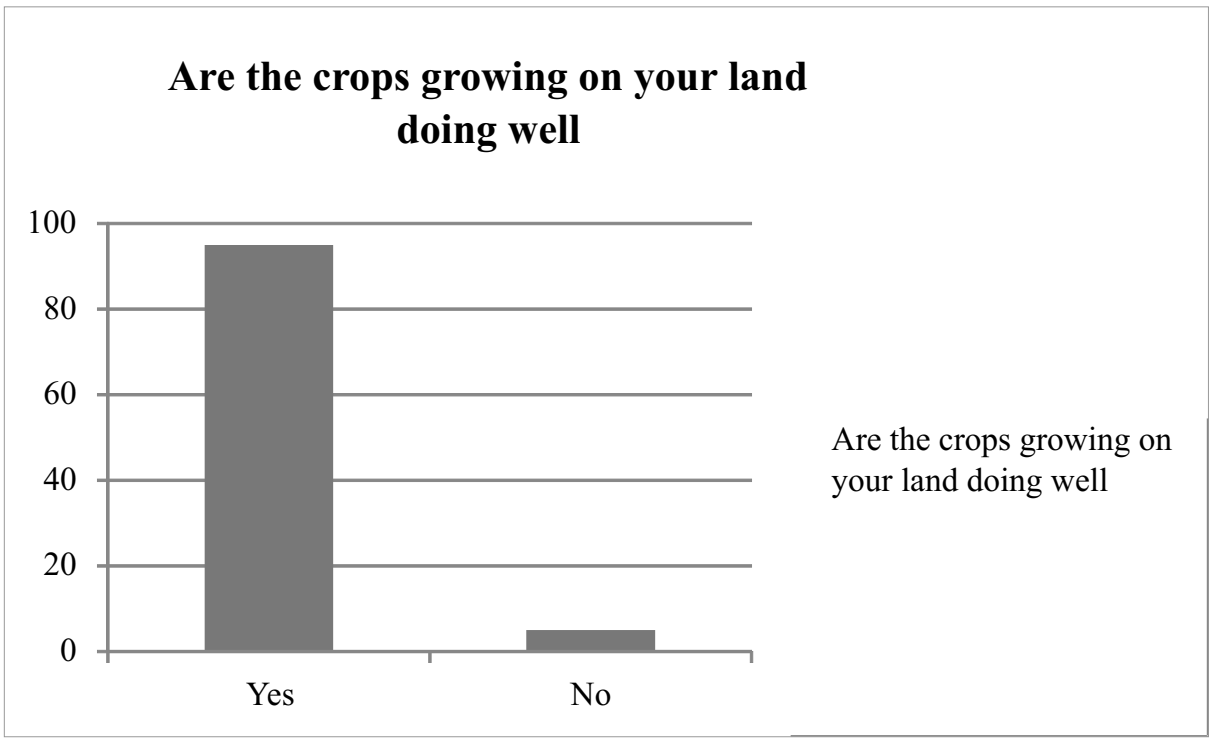


Chart 4. Survival of crops on land

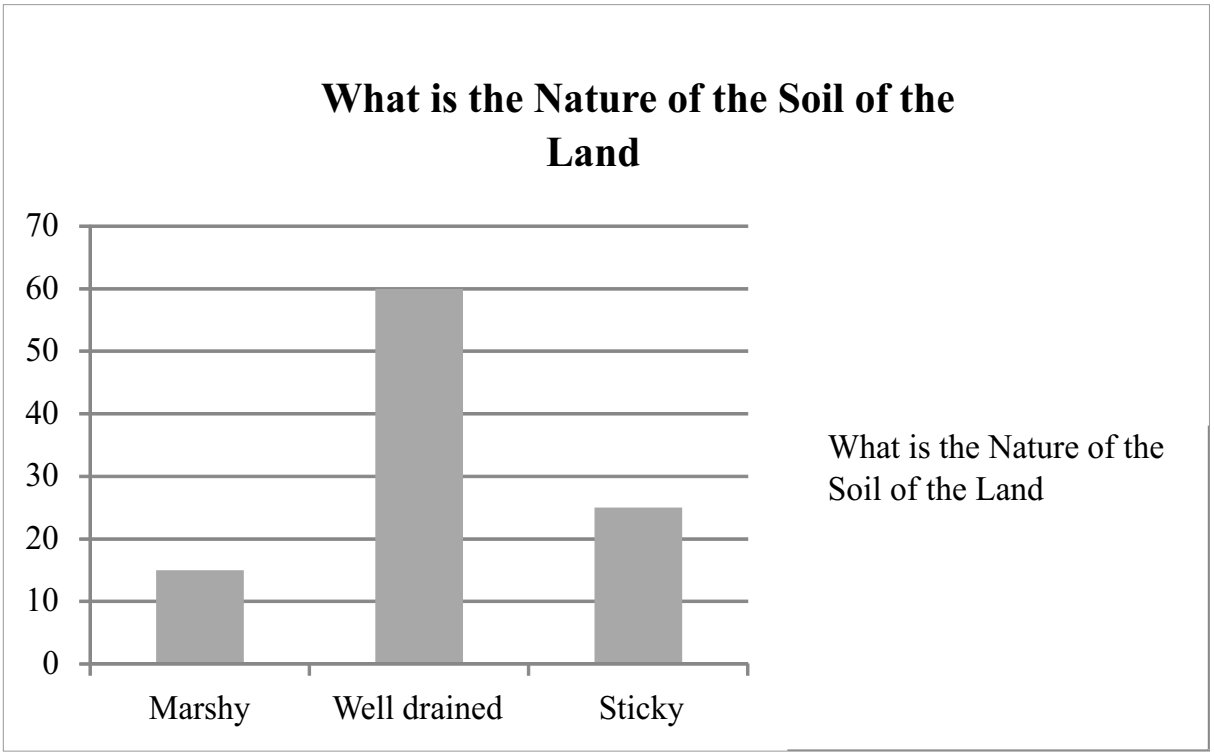


Chart 5. Nature of the soil on the land

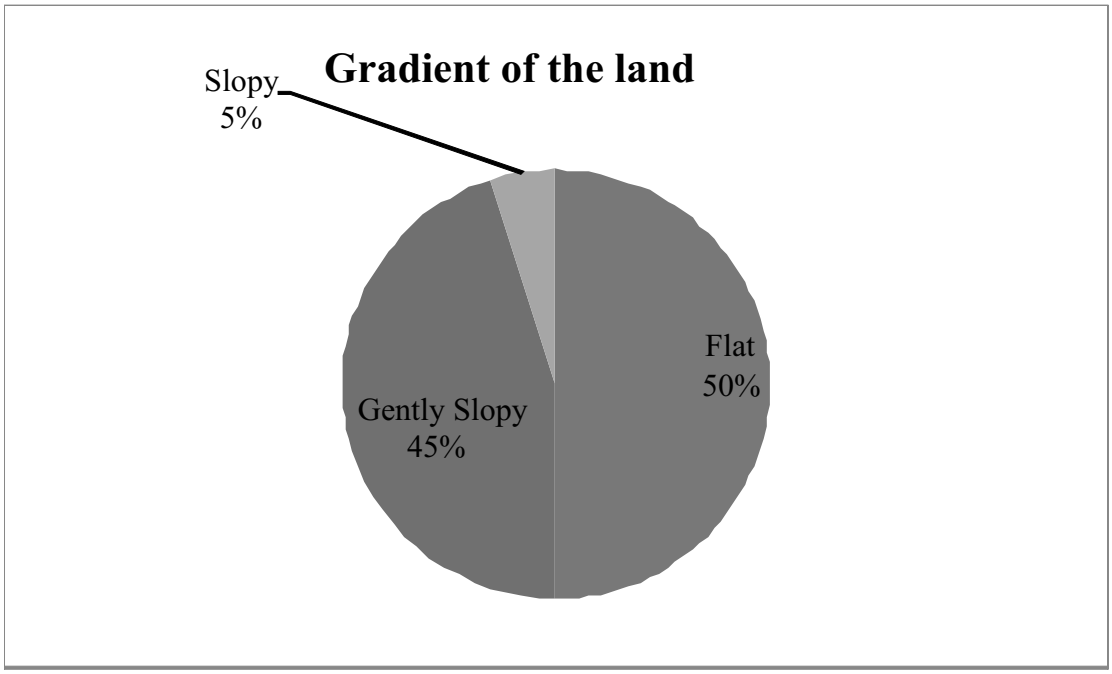


Chart 6. Gradient of the land.

Experimental Title: Screenng of Tea (*Camellia sinensis*) clones for resistance to root-knot nematode *Meloidogyne incognita* (Kofoid & White) Chitwood

Investigators: Agbeniyi, S. O., Adedeji, A. R., Orisajo, S. B., Okeniyi, M. O., Adeniyi, D. O., Ogundeji B. A., Omoleye M., Ayanwole, S. A., Oladigbolu, Y. O., Adeji, A. O.,and Bobinihi, M. O.

Introduction

Tea, Camellia sinensis is an evergreen shrub tree that produces more new branches by supervised trimming to maintain a plucking table for standard tea leaves (Ogunwolu *et al*., 2023).Tea,was brought from Kenya by the Nigerian Beverage Production Company (NBPC) in 1952. The commencement of commercial tea production in Nigeria took place in 1982. In 1982, the Cocoa Research Institute of Nigeria initiated tea research, focusing on tea breeding, by acquiring 33 clones from NBPC (Ipinmoroti *et al*., 2002). In addition to the predominant varieties, Camellia sinensis var. sinensis (Chinese tea) and Camellia sinensis var. assamica (Assam tea or Indian tea), other tea varieties have been identified and provided to farmers in the Mambilla highland in Nigeria. These include clones 35, 68, 143, 236, and 318 (Oloyede *et al*., 2012; Oloyede *et al*., 2017). According to Orisajo, 2012, several species of plant parasitic nematodes have been encountered in tea soils in the different tea-growing areas of the world with no positive evidence of pathogenicity established with respect to the majority of these nematodes. One of the main effects of plant parasitic nematodes on tea plants is the reduction in root development. Nematodes feed on the roots of the tea plant, causing lesions and damage to the root system. This damage can lead to a decrease in root mass and overall root health, which in turn affects the plant's ability to take up water and nutrients from the soil. As a result, tea plants infected with nematodes may exhibit stunted growth and reduced vigor. In addition to impacting root development, plant parasitic nematodes can also affect the nutrient uptake of tea plants. Nematodes can disrupt the normal functioning of the root system, leading to a decrease in the plant's ability to absorb essential nutrients such as nitrogen, phosphorus, and potassium. This nutrient deficiency can further exacerbate the negative effects of nematode infestation on tea plants, leading to reduced growth and yield (Ipinmoroti *et al*., 2002). Furthermore, plant parasitic nematodes can also weaken the tea plant's defense mechanisms against other pests and diseases. Nematode-infested tea plants may be more susceptible to secondary infections by pathogens such as fungi and bacteria, further compromising the plant's health and productivity. This can result in increased pesticide use and management costs for tea growers, as they try

to control both nematodes and other pests. Overall, the effects of plant parasitic nematodes on tea plants can be detrimental to the plant's health and productivity. Infestations of nematodes can lead to reduced growth, yield, and quality of tea leaves, as well as increased susceptibility to other pests and diseases (Orisajo, 2012). Effective management strategies, such as crop rotation, soil fumigation, and resistant cultivars, are essential for controlling nematode populations and minimizing their impact on tea plant health (Ogunwolu *et al.,* 2012). Therefore, the main objective of this research was to evaluate five tea clones for their reaction to root-knot nematode *Meloidogyne incognita.*

Materials and Methods

The experiment was carried out both in the greenhouse and nursery at the Cocoa Research Institute of Nigeria (CRIN), Ibadan, Nigeria (Lat 7.26^0; Long 3.54^0) and 122m above sea level. The annual rainfall ranges between 1200 and 2500mm distributed over 5 - 7 months from April to October. The average daily temperature range is 26 - 30^0C.

Well-drained sandy loam soil with a pH of between 4.5 and 5.5, high in organic matter, well sieved to remove stones, debris and weeds was collected in bulk from CRIN research field and sterilized in an autoclave at 1kg/cm3 for 15 minutes before distributing into a 5 litre plastic pots. The factorial experiment was laid out in Completely Randomized Design with four replicates. The two factors were *M. incognita* inoculum at two levels (0 and 5000 eggs per seedling) and the five Tea clones (C143, C318, 68, 35 and 236).

Raising of tea cutting: A single-node cuttings was obtained with the use of a sharp clean knife in a slanting form just above the bud and below the leaf. The cuttings were immediately placed in water to prevent desiccation. The cuttings were then inserted into IBA rooting medium before planting, the soil was firmed around the cuttings to provide support. High humidity was maintained with consistent moisture under shade.

Pathogenecity test: Four months after, the seedlings in four of the eight of each of the clones were inoculated with 5000 *M. incognita* eggs extracted from a culture of the nematode maintained on *Celosia argentea* L. roots. Nematodes were cultured by inoculating *Celosia* seedlings grown on sterilized soil with eggs and juveniles of *Meloidogyne incognita* identified through perineal pattern examination. The eggs were extracted using the Hussey and Barker (1973) sodium hypochlorite (NaOCl) method. The experiment was terminated 6 months after nematode inoculation.

The experiment was re-validated in the nursery for all clones, using four replications per treatment. Pots were arranged on nursery benches in a randomized complete block design with four replications. After inoculation, regular visual observations were made on disease symptoms expression. The experiment was terminated 6 months after inoculation. The growth parameters such as plant height, stem girth and number of leaves were recorded.

Assessment of infection: To assess infection, the roots were carefully rid of soil, washed under a gentle stream of tap water mopped and galls counted using a hand lens at 3 - 5X magnification. Root galling was assessed using 0 - 5 gall index (Sasser *et al.,* 1984). Nematode eggs were collected from each root system using sodium hypochlorite method (NaOCl) of Hussey and Barker (1973) and counted. Aliquots of $100cm^3$ soil samples from each pot were assayed for juveniles of *M. incognita* using the modified Baermann technique (Coyne *et al.,* 2007).

Data analysis: The data collected were subjected to Analysis of Variance (ANOVA) and the means were compared using the Least Significant Difference (LSD) test. Resistance rating was carried out using the quantitative scheme for assigning crop varieties into resistance categories based on crop yield, reproduction factor R, and gall index (GI) (Afolami *et al.,* 2004).

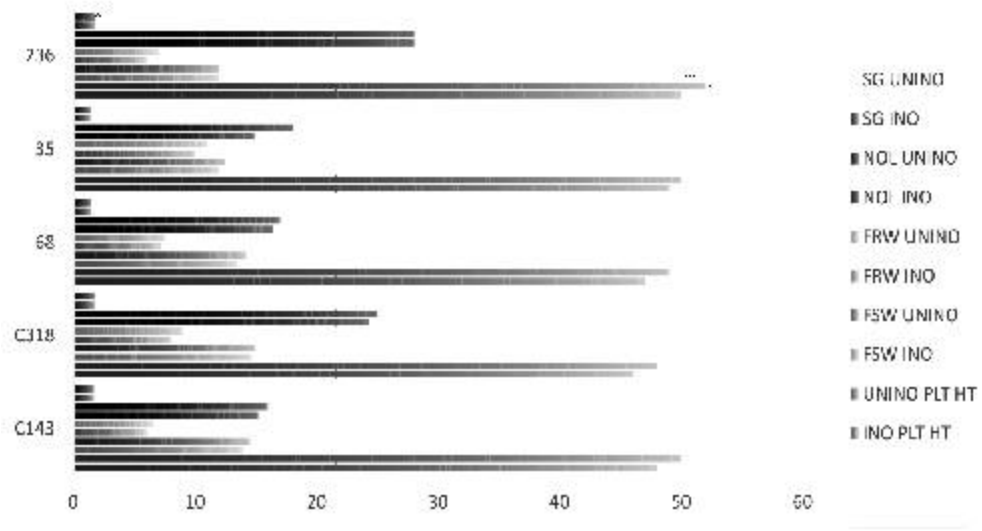
Results and Discussion

The result of the greenhouse for all the five clones (C143, C318, 68, 35 and 236) that were evaluated for resistance/susceptibility in terms of growth as expressed by plant height, number of leaves, fresh root weight and stem girth was not significantly (P = 0.05) suppressed by *M. incognita* at the initial population 5000 nematodes per plant (Figure 1).

Further investigation revealed that there was also no significant difference in root development despite the presence of galls when compared to the nematode free plant.

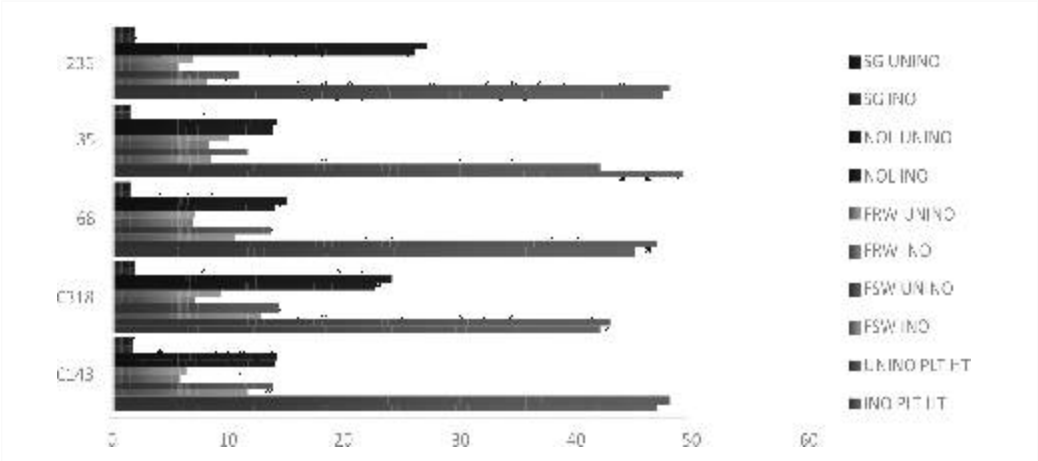
Out of all the clones evaluated, clones 236 and C143 heights, for both the inoculated and uninoculated expressed a significant increase (47.5 and 48 respectively) for the inoculated plants and 48 respectively for the two clones that were not inoculated.

Similar trend was observed in the nursery, for all the five clones in terms of growth as expressed by plant height, number of leaves, fresh root weight and stem girth as these were not significantly (P = 0.05) suppressed by *M. incognita* at the initial population 5000 nematodes in clones 236 and C143 as well as in root development when compared to the nematode free plant. (Figure 2).



SG = STEM GIRTH; NOL = NUMBER OF LEAF; FRW = FRESH ROOT WEIGHT; PLT HT = PLANT HEIGHT; INO = INOCULATED and UNINO = UNINOCULATED

FIGURE I: Effects of treatments on growth parameters in the greenhouse



SG = STEM GIRTH; NOL = NUMBER OF LEAF; FRW = FRESH ROOT WEIGHT; PLT HT = PLANT HEIGHT; INO = INOCULATED and UNINO = UNINOCULATED

Figure 2: Effects of treatments on growth parameters in the nursery

Table 1 clearly showed that nematode was able to reproduce in all the five clones that were evaluated both in the greenhouse and in the nursery. The reproduction factor ranges from 1.20 to 2.81 in the greenhouse and from 1.30 to 2.84 in the nursery. For the mean dry weight, there was no significant difference (P = 0.05) between the mean dry weight of both the inoculated and uninoculated clone of 68 and 236, similar trend was also observed in the nursery experiment for clones 68 and 236. all the five clones that were evaluated have the same gall index of 3 with mean number of gall ranging from 18.5 to 28.3 in the greenhouse and 19.0 to 29.5 in the nursery experiment.

Table 1: Resistance rating of five clones of tea using the quantitative scheme for assigning crop varieties int resistance categories based on dry matter, reproduction factor and gall index (Afolami 2000)

Clones	GREENHOUSE							NURSERY							
	Mean Number of Gall	Gall index (I)	Reproduction factor (R)	Mean Dry Weight			Resistance Category	Mean Number of Gall	Gall index	Reproduction factor	Mean Dry Weight			Resistance Category	Remarks
				A	B	A - B					A	B	A - B		
C143	25.0	3	2.25	5.8	6.3	-0.5NS	Tolerant	26.0	3	2.20	6.2	7.0	-0.8NS	Tolerant	Consistent
C318	24.3	3	1.20	4.2	5.7	-1.5	Tolerant	23.5	3	1.30	5.0	6.5	-1.5	Tolerant	Consistent
68	28.3	3	1.90	4.6	5.3	0.7NS	Tolerant	29.5	3	1.92	5.0	5.8	0.8NS	Tolerant	Consistent
35	28.6	3	1.92	3.7	4.7	-1.1	Tolearant	28.0	3	1.94	4.2	5.2	-1.0	Tolerant	Consistent
236	18.5	3	2.81	3.9	4.2	-0.3NS	Tolerant	19.0	3	2.84	4.5	4.9	-0.4NS	Tolerant	Consistent

Discussion

Drawing from the combination of root gall index, nematode reproduction factor, total dry matter and other growth indices, all the five clone that were evaluated are rated tolerant. The superiority of the clones C143, C318, 68, 35 and 236 in terms of plant height, number of leaves and the total dry matter could be attributed according to Okeniyi *et al.,* 2009 to the low level of root-knot nematode infection which resulted in enhanced root development and ability to tap nutrient from the soil. The ability to withstand nematode attack, good plant vigour and high yield are indication of high level of plant tolerant (Ploeg, 2001; Ononuju and Fawole, 1999). The finding of this evaluation is also in tandem with that of Orisajo, 2012, which showed that nematode reproduced successfully on tea clones 236, 318 and 143 but they all exhibited some level of tolerance to the nematode.

Conclusion

This study has shown that the tea clones evaluated can tolerate nematodes, therefore it recommended that farmers be encouraged to plant these clones as this will reduce seedling death, field establishment failure and the cost of nematodes management.

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Experimental Title: Training of Farmers on Methods of Tea Propagation in Abia State

Investigators: Okeniyi, M. O., Oloyede A. A., Akanbi, O. S. O. Olaniyi, A. O. and Oladokun Y. O. M

Introduction

Tea (*Camellia sinensis* (L) Kuntze) belongs to the family Theaceae; this plant is an evergreen shrub or small tree. Tea is a popular beverage produced from the young leaves of commercially cultivated tea plant and has become one of an important revenue source for tea producing countries in the world (Bandyopadhyay, 2011). Originally cultivated in East Asia, India and China or perhaps both of these countries are native home of tea plant. Today, tea is grown over a wide range of tropical and subtropical region in more than 50 countries throughout Asia and Africa (Balasubramanian *et al*., 2011). Tea was introduced into Nigeria by de Bouley from West Cameroon in 1952 (Kassboll -Smith, 1965). However, the first commercial clones were imported into the Mambilla Plateau in 1975 (Hainsworth, 1981). Since then, more clones have been imported to establish large commercial plantations. Due to limited land area for tea on Mambilla Plateau, tea adaptation trial plots were established in seven lowland locations in Nigeria (Omolaja *et al*., 2000).

Tea is propagated either through seeds or cuttings. Though seed is the traditional source of planting material and convenient to use it produces heterogeneous plant having variable yield, quality and suitability for fermentation. Besides variability, seed propagation delays the plant to reach for plucking. Therefore, the alternative choice is through vegetative propagation of the elite variety wherein single leaf internode cuttings, with an axillary bud are planted in polythene sleeves under shade for 12–18 months followed by the transfer of these rooted plants to the field (Mulatu, 2006). Plants propagated vegetative (cuttings) from original parent (mother bush) are collectively known as clones. They are genetic copies of the same parent and may be considered as parts of one individual clonal plants are remarkably uniform when grown under the same conditions clonal planting gives several advantages such as superior material with desirable characters predictable yields and convenience of management due to uniformity of plants. However clonal plants are specific to a particular environment and show greater variability a particular environment, more over they are more prone to pathogens and droughts. Vegetative propagation greatly improved the possibility of rapid multiplication of plants with high attributes for yield and quality. Since such plants are few in tea fields it is imperative to propagate and spread them. According to Wight (1958) only 0.5 percent of the plants with in existing tea population have superior genetic ability as high yielder. Willson, K, (1999) reported that vegetative propagated plants produce higher yielding uniform stand while vegetative propagation which was both economical and time saving. Banerjee (1993) concluded that the most successful method of vegetative propagation in tea is the use of single node cuttings because of the ease with which they can be propagated from the limited material the number of bushes suitable to serve as the base material for selection are always few. A research investigation was undertaken with the aim to compare the various size of nodal tea cuttings (single and double node) and to determine the optimum size and to find out the most suitable time to raise the clonal tea plants in the nursery and to make them available at farmer level in the areas to be cultivated.

Objectives

1. To train farmers on methods of Tea propagation
2. To expand the cultivation of lowland Tea

Materials and Methods

Participant were selected by farmers association in the local government visited during the land suitability evaluation in Abia State. 50 Framers were selected from two Local Government Area, these were: Bende, Umuahia North and Ikwuano local government area.

Farmers were trained on "Enhancing tea yield and quality through proper soil management, Economics of tea production in Nigeria, Good agronomic practices in tea nursery management and Pests and disease management in tea nursery."

Results and Discussion

The training aroused the interest of farmers and their readiness to start the nursery establishment and after the training the participant agreed to set up a clonal garden in Ogbebule, in Ikwuano Local Government Area of Abia State. The Farmers thanked the Management of Cocoa Research Institute of Nigeria, for bringing tea another export crop to the State, and the pleaded that it should not end here.




Conclusion and Recommendation

Based on the readiness and willingness of farmers to go into tea cultivation, it is hereby recommended that tea clonal garden be established in Ogbuebule as requested for by farmers in order to enhance tea propagation and field establishment.

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COFFEE RESEARCH PROGRAMME

Experimental title: Establishment of coffee clonal garden at Owena Substation

Investigators: Oloyede, Amos A; Orisasona, Taiwo, Famuyiwa, Busayo S. and Dada, Keji E.

Introduction: Robusta coffee, *Coffea canephora* Pierre ex Froener constitutes more than 90% of production in Nigeria. Cultivation spreads across 14 States of the country. Production is meagre with less than 500kg/ha at farm level. Research efforts have enabled the identification of clones that can produce more than 5000kg/ha. These clones have been established at the CRIN Headquarters since 2004. These clones consist of C36, C111, C96, T1049 and M10. Some of these materials have been lost due to incessant fire outbreak which came through arable crop farmers around the plantation. In view of the above, efforts have been initiated to rehabilitate the HQ plot through in-situ grafting and stem cutting propagation with success.

Objectives: the major objective of this work is to replicate the Robusta clonal garden at the headquarters at lowland substations of the Institute.

Materials and methods: The clonal materials namely: C1, C2 and C4 were obtained at the HQ's clonal garden early in the morning, cut into smaller sizes of one node and stored in water to avoid desiccation. The leaves were as well reduced by one third of the area. The base of the stems was put into a 2000mg/l concentration of IBA hormone. The cuttings were set and thoroughly watered with loop bent over before spreading transparent polythene sheet over it. The sheet was sealed along the edges and left for 2 months before hardening process.

For insitu grafting, the root stocks have been raised and already in the main nursery to grow to pencil size before transplanting and subsequent insitu top grafting is done.

Results and discussion: The stem cutting setting was done in March 2025. The hardening process has commenced and to last for 3 weeks. By June/July the clonal materials are to be taken to the field under moribund existing coffee plantation at Owena in June /July 2025. At the same time, the raised rootstocks are to be transplanted and top-grafted insitu. On bimonthly basis, the morphological

variables of height, stem diameter, leaf area, number of leaves and branches are to be measured. The various stages of stem cutting propagation at Owena and root stock propagation are presented in the plates below:

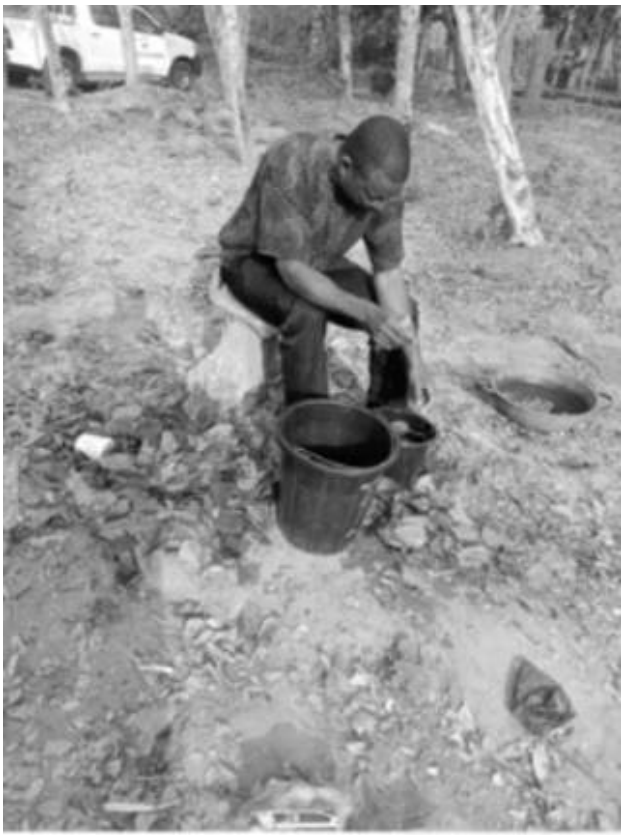

Plate 1: preparing the stem cutting

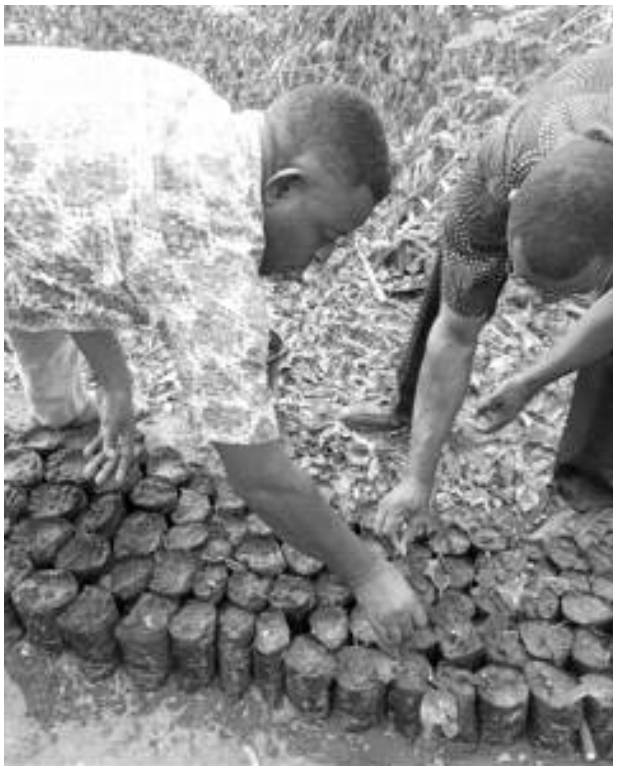

Plate 2: setting the cuttings

Plate 3: set stem cuttings covered with polythene sheet

Plate 4: palmfrond shade over the set

Plate 5: rootstock been raised for insitu grafting at Owena

Conclusion and recommendations: Clonal stem cuttings for ¼ of a hectare raised together with rootstock for insitu grafting at Owena is presently been nursed and are to be transplanted by June/July, 2025. From there, expansion will be made for further plantlets generations for research and for farmers.

Experimental Title: Model Robusta Coffee Plantation Establishment and Its Impact on Economic Empowerment of Farmers in Ogun State

Investigators: Adeyemi, E.A, Oladokun, Y.O.M., Ipinmoroti, R.R., Daniel, M.A., Adepoju, A.F. and Aremu-Dele, O.

Introduction

Coffee is primarily an agricultural export commodity that plays a crucial role in the economies of producing nations. Krishnan (2017) noted that in the Democratic Republic of Timor-Leste, Southeast Asia, coffee export earnings significantly contribute to the gross domestic product (GDP), while a large portion of the rural workforce depends on this sector. Coffee is widely valued for its rich taste, aroma and nutritional benefits (Gebeyehu & Bilika, 2015). It is also classified as a medicinal plant (Eva *et al*., 2016).

Reports indicate that Nigerian coffee farmers have abandoned their plantations due to market unavailability (Alli *et al*., 2021; Oladokun *et al*., 2022). To revive interest in coffee cultivation, a 2022 research initiative in Ogun State facilitated the distribution of ***Coffea canephora*** (Robusta coffee) seedlings to farmers, addressing the market challenge. This study aims to further sustain the renewed enthusiasm among farmers by establishing a model **Coffea** farm in Obafemi - Owode Local Government Area (LGA) of Ogun State.

Methodology

The project took place in Idofin-Igbore, Obafemi-Owode LGA, Ogun State. A contact farmer was selected alongside a farmers' group in the LGA and the project was implemented on the farmer's land. The effective experimental plot measured 24m × 15m, covering an area of 360m². Pre-cropping soil samples were collected using a soil auger at a depth of 0–20 cm. A composite soil sample, formed from core samples, was air-dried, ground and sieved through a 2.0 mm mesh. Physical and chemical soil properties were analyzed following the methods outlined by A.O.A.C., (1990).

Land preparation was carried out manually with the use of cutlass, the farm was laid out and planting of plantain shade crops alongside the transplanting of ***Coffea*** seedlings were carried out in October 2023. Three different planting materials used in the establishment were:

1) C111 - an improved clonal material obtained from stem cuttings
2) C36 - an improved clonal material obtained from stem cuttings
3) Seedling - obtained from seeds (*Coffea* beans) obtained through sexual propagation

The plant spacing for both the plantain shade crop and ***Coffea*** planting materials in the field was set at 3m × 3m. Three types of planting materials were used as treatments, randomly arranged and replicated three times on the demonstration/experimental plot. The quantities of ***Coffea*** planting materials used for field establishment were as follows:

Clone C111 – (20); **Clone C36** – (14) and Seedlings – (6) Total – (40)

An equal number (40) of plantain suckers were planted as shade crops. Data on the survival of plantain shade crops, as well as the survival and morphology (plant height, stem diameter and number of leaves) of ***C. canephora*** materials, were recorded at two months after transplanting (MAT) and at four months interval. Field establishment took place in the dry season (October 2023) due to the timing of research fund disbursement. As a result, irrigation was provided to minimize transplant losses and ensure proper establishment. Mulching with plant debris was also applied to reduce evapotranspiration, allowing optimal water retention for the ***Coffea*** cuttings, seedlings and plantain plant.

The data was analysed using descriptive statistics and ANOVA calculated using GenStat version 10, while Least Significant Difference (LSD) was used for means separation at $P \leq 0.05$.

Results and discussion

The survival assessment of the planted materials revealed that plantain achieved a 100% survival rate at 2 MAT (Table 1). Among the transplanted *Coffea* materials, seedlings exhibited the highest survival rate at 83.3%, followed by C36 (78.6%) and C111 (70.0%). The superior survival rate of seedlings may

be attributed to their greater hardiness compared to the clonal planting materials, as seedlings originate from sexual reproduction, which generally enhances genetic diversity and adaptability.

Table 1: Percentage survival of materials planted

Crop	Types	Number planted	Number survived	% survival
Coffea	CloneC111	20	14	70
	Clone C36	14	11	78.6
	Seedling	6	5	83.3
Plantain		40	40	100

The result in Table 2 indicate significant differences in plant height among the *Coffea canephora* planting materials across different months after transplanting (MAT). At 2 MAT, C111 exhibited the greatest height (52.3 cm), significantly surpassing C36 (25.3 cm) and seedlings (8.4 cm), suggesting a faster initial growth rate for clonal materials. By 6 MAT, C111 (59.9 cm) maintained its lead, while C36 (39.0 cm) showed moderate growth and seedlings remained the smallest (9.2 cm). At 10 MAT, both C36 (55.5 cm) and C111 (69.8 cm) demonstrated significant height increases similar to each other, while seedlings grew more slowly (17.1 cm). By 14 MAT, C111 (123.5 cm) remained the tallest, followed by C36 (86.7 cm), whereas seedlings continued to lag behind at 45.7 cm. The plant height order in the planting materials was C111 > C36 > seedling. The lower growth performance of seedlings compared to clones suggests that clonal materials may be more vigorous, likely due to their genetic advantages, whereas seedlings exhibit slower developmental growth, possibly due to poor genetic make-up.

Table 2: Height of *Coffea seedlings* as influenced by planting materials

Treatment	Plant height (cm)/MAT			
	2	6	10	14
C36	25.3^{b}	39.0^{ab}	55.5^{a}	86.7^{ab}
C111	52.3^{a}	59.9^{a}	69.8^{a}	123.5^{a}
Seedling	8.4^{c}	9.2^{b}	17.1^{b}	45.7^{b}
LSD@0.05	16.35	32.43	21.67	43.27

Treatments with the same letter(s) in the same column are not significantly different @ p< 0.05

At 2 MAT, C111 (0.46 cm) had the largest stem diameter followed by C36 while the least was obtained in seedling (0.23 cm) and the differences were significantly (p< 0.05) as shown in Table 3. A similar trend was observed at the other periods of observation. The stem diameter was in the order of C111 > C36 > seedling which was similar in trend to the order of plant height. The superior stem diameter in clonal materials (C111 and C36) over the seedlings could be due to the reasons adduced for the plant height.

Table 3: Stem diameter of *Coffea* seedlings as influenced by planting materials

Treatment	Stem diameter (cm)/MAT			
	2	6	10	14
C36	0.33^{ab}	0.33^{ab}	0.51^{b}	1.78^{ab}
C111	0.46^{a}	0.48^{a}	0.72^{a}	2.10^{a}
Seedling	0.24^{b}	0.24^{b}	0.34^{c}	1.17^{b}
LSD@0.05	0.134	0.151	0.123	0.327

Treatments with the same letter(s) in the same column are not significantly different @ p< 0.05

Significant differences in the number of leaves among the *Coffea canephora* planting materials over time was observed in Table 4. At 2 MAT, C36 (15.7 leaves) had the highest number, though not significantly different from C111 (14.2 leaves), while seedlings had the least (9.5 leaves). By 6 to 14 MAT, C111 showed the highest leaf count, followed by C36 and seedlings in that order with significant differences $p < 0.05$. The superior leaf production in C111 and C36 suggests that clonal materials have a higher vegetative growth potential compared to seedlings, which may be attributed to similar reasons reported for plant height and stem diameter.

Table 4: Number of leaves of *Coffea* seedlings as influenced by planting materials

Treatment	Number of leaves / MAT			
	2	6	10	14
C36	15.7[a]	11.2[ab]	23.7[b]	86.5[b]
C111	14.2[ab]	15.7[a]	37.0[a]	132.5[a]
Seedling	9.5[b]	9.0[b]	11.3[c]	19[c]
LSD@0.05	7.7[8]	6.59	10.31	42.13

Treatments with the same letter(s) in the same column are not significantly different @ p< 0.05

Conclusion

The study observed that the survival and growth of the *Coffea* materials especially C111 and C36 in the model plot enhanced farmers' interest to revisit coffee production in the study area. Thus, the *Coffea* clones C111 and C36 could be recommended as planting materials to replace the seedlings that were familiar to the farmers.

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Farming System Research Programme

Experimental Title: Effect of intercropping Cocoa (*Theobroma cacao* L.) with Bitter kola (*Garcinia kola* Heckel) in Nigeria

Investigators: Famaye, A.O., Ayegboyin, K.O. and Orisasona, T.

Introduction

Garcinia kola Heckel, also known as Bitter kola, is very important in African ethno-medicine and traditional ceremonies. The crop is found as a naturally grown volunteer trees in the humid tropical forests of West and Central Africa and a typical multipurpose agroforestry species which is regarded as one of the most important medicinal plants in Nigeria (*Adesuyi, et al., 2012).* The seeds are commonly chewed by rural and urban populations to avoid and treat gastric problems or simply for their typical astringent taste. *G. kola* naturally grows up to 30m in height with a maximum of 100cm in trunk diameter (Garcinia, 2024) but when cultivated, the plant can reach up to 12m within 12 years of emergence (Anegbeh *et al.*, 2006). The tree has a compact dense crown with erect, slightly drooping

branches while the trunk is straight and cylindrical with smooth bark, which is dark-brown outside and pinkish inside. When wounded, the bark exudates sticky yellow water-proof latex, typical for the Clusiaceae family. Leaves are simple, opposite, obovate-elliptic with short acuminate apex. Usually it takes about 7 years for a *G. kola* tree to start fruiting and this can be significantly reduced when using vegetative propagation (Onyekwelu *et al*., 2015). Despite its importance, potential and popularity in Nigeria, a great deal of information and basic knowledge about intercropping *G. kola* with other fruit trees like Cocoa is still missing. This is because about 70% of *G. kola* fruits in Nigeria are directly taken from wild stands in the forest and/or together with Cocoa and other fruit trees (Adebisi, 2004) and research is needed to determine the best planting conditions and spacing for intercropping Bitter kola with Cocoa. Hence, the objectives of this study is to the growth performance of Cocoa and *G. kola* when intercropped at different planting distances during field establishment.

Materials and Method

This study is being carried out in 2 locations of Cocoa Research Institute of Nigeria (CRIN) in Ibadan and Uhonmora. Cocoa TC series are being used for the experiment while *G. kola* seedlings were purchased from Forest Research Institute of Nigeria, Ibadan. Both Cocoa and *G. kola* seedlings will be transplanted to the field at the same time in 2 sites in 2025 while Plantain will be used as a temporary shade or nurse crop for Cocoa.

Raising of cocoa and bitter kola seedlings for field establishment

The forest topsoil was used for raising the cocoa seedlings. A total of 3000 cocoa seedlings (TC series) seedlings are being raised at CRIN headquarters central nursery Ibadan and Uhonmora sites. The cocoa seedlings will be raised for a maximum of 6 months before being transplanted to the field in April 2025 while *G. kola* seedlings must 18-month old before they will be transplanted to the field. All *G. kola* seedlings would be purchased from FRIN, Ibadan while 1000 Plantain suckers had been purchased at each experimental site. Plantain suckers will be planted in April 2015 at 3m x 3m spacing in all treatments. The experimental design will be a Randomized Complete Block Design (RCBD) consisting 4 treatments and 3 replications times making a total of 12.

The treatments are:

1. Cocoa sole at 3m x 3m
2. Cocoa at 3m x 3m intercrop with *G. kola* at 9m x 9m
3. Cocoa at 3m x 3m intercrop with *G. kola* at 18m x 18m
4. Cocoa at 3m x 3m intercrop with *G. kola* at 21m x 21m

Data collection

Data will be assessed for percentage survival which will be determined as the number of living Cocoa and *G. kola* per treatment per replicate. The growth measurement such as the plant height, number of leaves, leaf area, stem diameter and number of branches will commence 4 weeks after the planting out both cocoa and G. kola materials on the field. Later, the Yield index for cocoa like Number of Mature Pods produced per Trees, Number of Cocoa Pods Infested with Black pods, Wet Weight of Cocoa Beans, Dry Weight of Cocoa Beans and Annual Income Generated on Cocoa Beans per Treatment per Site will be determined. The Yield index for Plantain like the Number of Plantain Bunches, Number of Plantain Fingers per Bunch, Weight of Plantain Bunch per Treatment per Site and the Annual Income on Plantain Bunches per Treatment per Site will be recorded. Weed Population, Composition and Biomass will be collected every six (6) month using 0.3m by 0.3m quadrant.

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Experimental Title: Effect of Cocoa intercrop with Bush mango (*Irvingia gabonensis*) and Banana (*Musa* spp.) in Nigeria.

Investigators: Ayegboyin, K.O. and Famaye, A.O.

Introduction

In Africa, multiple cropping systems is the common practice among the cocoa smallholding farmers with associated derivable advantages including higher yield returns, insurance against crop failure, more efficient use of available nutrients, improved environmental factors, reduction in weed infestation and efficient use of labour, among others. In Nigeria, combining shade trees with cocoa trees, otherwise known as cocoa agroforestry, has also emerged as a viable option for sustaining cocoa production in many smallholding cocoa plantations while pure cocoa plantations are currently more common among elite cocoa farmers and in research farms (Holmes *et al*., 2003). Technical solutions are therefore urgently needed to stabilize cocoa-growing areas in Nigeria, reduce pressure on forests and adapt to climate change. A balance can be struck in stands by combining cocoa trees with diverse trees chosen by farmers for their different uses, while maintaining a suitable and sustainable cocoa yield. However, lack of compatibility of some crops intercrop with cocoa, materials, haphazard planting distance, overcrowding of the farm, infestation of parasitic pests and diseases from other crops to cocoa and general lack of technical know-how on how to properly intercrop certain crop with cocoa have been some of the problem militating against cocoa production in Nigeria.

In Nigeria, many shade tree crops are combined with cocoa for food production, income generation, soil conservation and provision of shade to cocoa, among others. Due to its tree shape, height and canopy formation, *I. gabonensis* is used as shade tree for cocoa as well as for soil conservation in cocoa plantation. Therefore, the objective of this study is to determine the average yield of cocoa when intercrop with plantain and bush mango at different planting distances of Bush mango and plantain.

Materials and Methods

This study started at the Cocoa Research Institute of Nigeria (CRIN), Ibadan Ajassor. Cocoa seeds used were TC series while Bush mango seeds were collected from the Forest Research Institute of Nigeria, Ibadan. Both cocoa and Bush mango seeds are being raised at Cocoa Research Institute of Nigeria, Ibadan headquarters. A total of four thousand, five hundred (4,500) cocoa seedlings (TC series) and 1500 Bush mango seedlings were raised at CRIN headquarters central nursery. All bush mango and cocoa seedlings raised separately at the nursery were transplanted to the field at the same time with banana suckers in Ibadan and Ajassor. Banana are being intercropped with cocoa and bush mangos in all treatments. The experimental design is Randomized Complete Block Design (RCBD) consisting of 20 cocoa plants, 10 bush mango, 4 treatments and replicated 3 times to make a total of 2400 per location while 2 locations were used for the experiments . The treatments are:

1. Cocoa sole at 3m x 3m and Banana at 3m x 3m
2. Cocoa at 3m x 3m plus Bush mango at 9m x 9m and Banana at 3m x 3m
3. Cocoa at 3m x 3m plus Bush mango at 18m x 18m and Banana at 3m x 3m
4. Cocoa at 3m x 3m plus Bush mango at 21m x 21m and Banana at 3m x 3m

Data collection

Table 1. Survival rate of Cocoa after transplanting on the at Ibadan and Ajassor fields

S/N	**Treatment** (Note: Banana spacing is 3m x 3m)	3MAT	4MAT	5MAT	6MAT	7MAT
	Ibadan Field					
1.	Cocoa sole at 3m x3m	90%	85%	81%	80%	80%
2.	Cocoa at 3m x 3m plus Bush mango at 9m x 9m	90%	88%	85%	85%	85%
3.	Cocoa at 3m x 3m plus Bush mango at 18m x 18m	90%	90%	90%	90%	87%
4.	Cocoa at 3m x 3m plus Bush mango at 21m x 21m	90%	85%	84%	82%	80%
	Ajassor Field					
1.	Cocoa sole at 3m x3m	98%	98%	97%	95%	95%
2.	Cocoa at 3m x 3m plus Bush mango at 9m x 9m	98%	98%	95%	89%	90%
3.	Cocoa at 3m x 3m plus Bush mango at 18m x 18m	98%	97%	95%	95%	94%
4.	Cocoa at 3m x 3m plus Bush mango at 21m x 21m	99%	98%	97%	95%	95%

Expected output: The best planting distance for optimum yield and minimal disease infestation of cocoa when intercropping Bush mango with cocoa and banana will be determined. Cocoa farmers will also know the best way to apply fungicides to destroy possible causative pathogen of black pod that Bush mango could co-host for optimal cocoa production.

Reference

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Experimental Title: Determination of Appropriate Geometry in Cashew/Oil Palm Cropping System for Climate Change Mitigation

Investigators: Adeyemi, E.A., Oloyede, A.A., Aremu-Dele, O. and Ibe, O.

Introduction

Cashew cultivation in Nigeria is often integrated with other crops, including food crops, fruit trees, and various other tree species. These intercrops may be intentionally established or retained as volunteer species within cashew plantations (Undie *et al*., 2012). Typically, the intercrops are planted in a non-systematic manner by farmers. For an effective crop mixture, the component species must exhibit compatibility, practical feasibility, social acceptability, ecological sustainability, and economic viability. The management of such a cropping system should account for factors such as canopy structure, light interception, soil moisture, nutrient availability, and biotic interactions, including pests, diseases, and weeds. Although previous studies have explored intercropping cashew with various food crops (Famaye and Adeyemi, 2011; Aremu-Dele *et al*., 2021), there remains a critical need for scientific evaluation of cashew intercropped with other perennial tree crops.

Oil palm has emerged as a notable component in cashew-based intercropping systems (Aremu-Dele *et al*., 2021; Adeyemi *et al*., 2022). Consequently, this study aims to assess the influence of planting geometry on cashew-oil palm intercropping systems, a practice that has shown promising results in similar systems such as cocoa.

Materials and Method

The field experiment was set up at the Cocoa Research Institute of Nigeria Headquarters Zone 2 experimental plot. The single-factor experiment was set up using a Randomized Complete Block Design (RCBD). The planting geometry used in this experiment includes intercropping oil palm along the avenue of cashew and within the hollow square of cashew using a 9m by 9m spacing each for cashew and oil palm. The nuts were directly planted on the field and oil palm seedlings were also transplanted in July 2024. The four treatments being evaluated are:

1. Cashew sole @ 9m x 9m
2. Oil palm sole @ 9m x 9m
3. Cashew / Oil palm intercrop (Oil palm in the avenue of cashew) each @ 9m x 9m
4. Cashew / Oil palm (Oil palm in hollow square of cashew) each @ 9m x 9m.

Each unit plot was a 27m by 18m square and the four treatment plots were replicated 3 times. Morphological data on the cashew plant such as plant

height (cm), number of leaves, stem girth (cm), leaf area (cm^2) and number of branches were taken bi-monthly from four months of establishment. Data collected was subjected to analysis of variance using SAS statistical software and treatment means were separated using Least Significant Difference (LSD) at a 0.05% probability level.

Results and Discussion

Cashew seedlings in the Hollow square (Ho) treatment consistently exhibited superior growth with highest plant height at each period of observation from 4 to 12 MAE (Table 1), though the differences are not significant ($p \leq 0.05$). This superior growth suggests that the Ho planting geometry could provide a more favourable microenvironment that reduces competition for resources when compared to the other arrangements. In contrast, the Avenue (Av) treatment (oil palm planted in the avenue of cashew) showed the lowest plant height at most of the periods of observation, which may indicate higher competition for plant resources or less favourable spatial interaction between cashew and oil palm in this configuration.

Table 1: Plant height and stem diameter of cashew seedlings as influenced by oil palm intercropped at different MAE.

Treatment	Plant height (cm)			Stem diameter (cm)		
	4	8	12	4	8	12
Co	43.10a	50.67a	69.50a	0.75a	1.05a	1.46a
Av	36.43a	44.9a	63.30a	0.70a	0.83a	1.40a
Ho	51.80a	62.70a	105.30a	0.92a	1.23a	2.00a

There is no significant difference between means within same column and having same letters DMRT @ P ≤ 005.

The observable trend provides insight into the influence of planting geometry on cashew seedling stem diameter development. The Ho treatment consistently recorded the highest stem diameter values of 0.92 and 2.00 cm 4 and 12 MAE respectively (Table 1). This is an indication of more vigorous stem development similar to the pattern reported for plant height. However, the Av treatment showed the lowest stem diameter values across all the periods of observation. The sole cashew treatment (Co) was better in stem diameter performance than the Av, though the differences among the treatments were not significant ($p \leq 0.05$). The plant height and seedling diameter followed the order Ho > Co> Av. The highest value (30.7) for number of leaves was obtained in Ho at 4 MAE while the least value (19.0) was observed in Av geometry and this pattern was consistent for the periods of investigation (Table 2). Likewise, the Ho treatment consistently exhibited a progressive increase in the number of branches from 3.8 at 4 MAE to 5.7 at 12 MAE.

Table 2: Number of leaves and branches of cashew seedlings as influenced by oil palm intercropped at different MAE

Treatment	Number of leaves			Number of branches		
	4	8	12	4	8	12
Co	20.7a	25.3a	51.7a	3.3a	3.0a	3.0a
Av	19.0a	26.8a	37.3a	2.3a	2.7a	2.7a
Ho	30.7a	54.7a	64.0a	3.8a	5.0a	5.7a

There is no significant difference between means within same column and having same letters DMRT @ P ≤ 0.05.

These observations for the number of leaves and branches could suggest a better structural growth and potential for canopy development under Ho planting geometry (Table 2). However, the Av treatment showed fewer branches (2.3 – 2.7) from 4 to 12 MAE. The Co was outperformed the Av in number of leaves and branches on the cashew seedlings though the differences among the treatments were not significant ($p \leq 0.05$) both for the number of leaves and branches. The number of leaves and branches on cashew seedling was in the order: Ho > Co > Av. The Ho treatment consistently recorded the highest leaf area across the periods of observation (Table 3). This is similar to the pattern reported for plant height, stem diameter, number of leaves and branches in Tables 1 and 2. The highest values obtained in the Ho could indicate enhanced photosynthetic potential and vegetative growth. The Av and Co treatments showed lower and fluctuating values.

Table 3: Leaf area of cashew seedlings as influenced by oil palm intercropped at different MAE.

Treatment	Leaf area (cm^2)		
	4	8	12
Co	49.85a	43.52a	65.42a
Av	60.69a	44.38a	67.42a
Ho	67.40a	62.64a	85.50a

There is no significant difference between means within same column and having same letters DMRT @ $P \leq 0.05$

Conclusion

Among the three planting geometries evaluated for cashew, the Hollow square (Ho) configuration where oil palm was planted within the hollow square of cashew consistently supported superior morphological development in cashew seedlings across all measured parameters, including plant height, stem diameter, number of leaves, number of branches and leaf area which suggests that the Ho arrangement may create a more favorable microenvironment, likely due to better spatial resource distribution and reduced competition, thereby enhancing early plant vigor. These findings suggest that the Ho geometry holds promise as a climate-smart intercropping strategy, potentially enhancing early cashew growth while integrating oil palm for diversified production and climate resilience. The study is on-going.

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Experimental Title: Growth and Field Establishment of Tea (*Camellia Sinensis* [L] Kuntze) under Intercrop with Oilpalm in Mayo-Selbe, Taraba State.

Investigators: Adeosun, S.A., Adejobi, K.B., Oloyede, A.A., Orisasona, T., Adebowale, L., Ibe, O and Mamza, A.

Introduction

Intercropping is an agronomic practice of growing two or more crops simultaneously on the same piece of land for the purpose of maximizing land use. Intercropping is a superior and preferable cropping system compared to monoculture system owing to its numerous comparative advantages which include insurance against total crop failure through diversification; increasing income and profit per unit area of land and enhancing the efficient utilization of the arable land (Famaye *et al*., 2018). Intercropping other crops with tea for various purposes has been documented. Field survey reveals that many small holder farmers in Mambilla practice mixed cropping system where 64.0 %, 37.3 % and 32.6 % of the farmers intercropped tea with maize, cocoyam and pea, respectively (Ipinmoroti *et al*., 2018). Tea has also been intercropped with eucalyptus tree on Mambilla highland (Famaye *et al*., 2014; Ipinmoroti *et al.,* 2018) and with plantain in Ibadan and Owena (Adeosun *et al.*, 2021). Besides, tea has been recommended as intercrop with oil palm in India (Vora, 2020). However, there is scarcity of literature resources on intercropping tea with oil palm in Nigeria. Intercropping tea with oil palm could afford numerous benefits and possibilities. Tea stands the chance of enhanced field establishment under the shade canopy of oil palm, thereby ameliorating the effects of the scorching sun. Besides, both tea and oil palm have similar soil (Deep soil of pH 4.0-6.5) and annual rainfall requirements (1500-3000 mm) (Opeke, 2005). Therefore, this trial was aimed at assessing the field survival and growth performance

of tea grown in intercrop with oil palm at different geometries in Mayo-Selbe, Taraba State.

Objectives

1. To assess effects of oil palm intercrop on tea growth and survival under a warm climate

2. To determine the geometry of intercrop of tea/oil palm that would enhance the growth, field establishment and yield of tea

Materials and Methods

This field trial is on-going in Cocoa Research Institute of Nigeria (CRIN) Mambilla Experimental Station, Mayo-Selbe, Sardauna LGA. of Taraba State. The experiment is a 2 x 3 factorial comprising two tea cultivars (Cultivars 143 and 318) grown in intercrop with three levels of oil palm geometries (Hollow square arrangement, Avenue arrangement and control [tea sole]) arranged in split plots (oil palm geometries as main plots and tea cultivars as sub plots). The experiment was laid out in Randomized complete block design with three replications. Oil palm seedlings (Tenera) was obtained from open market; while 1600 tea clones raised in CRIN, Mambilla Station, Taraba State were transported to the experimental site. The experimental site was cleared of vegetation and laid out into three blocks. Soil samples were collected from the experimental sites for laboratory assay for particle size and chemical properties.

Results and Discussion

The experiment is ongoing

References

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Crop Improvement Division

Experimental Title: Generation and establishment of one-hectare cocoa hybrid parental clones at CRIN Headquarters

Investigators: Muyiwa, A.A., Adeigbe, O.O., Adenuga O. O., Adepoju, A. F., Olasupo F. O., Dada K. and Sobowale, I. O

Introduction

The escalating global demand for cocoa, fueled by increased chocolate consumption and economic development, is threatened by declining production due to factors such as ageing trees and disease. The establishment of well-characterized cocoa parental materials is paramount for the advancement of the cocoa industry. These foundational genetic resources serve as the cornerstones upon which improved cocoa varieties are built, offering a plethora of benefits ranging from enhanced productivity to increased resilience. Adoption of superior planting materials is therefore crucial for sustainable cocoa production, aligning with the growing demand, particularly in markets like Nigeria. While the Cocoa Research Institute of Nigeria (CRIN) has developed high-yielding hybrids, their limited availability, stemming from insufficient parental materials, hinders widespread adoption. Expanding the supply of these parental clones is essential to increase the availability of improved planting materials, thereby bolstering national cocoa production and improving farmer livelihoods.

Objectives

1. To strategically establish one-hectare parental clonal gardens in order to directly address the pressing need for sustainable cocoa production among farmers.

2. To provide superior genetic material, facilitating enhanced yields, improved disease resistance, and ultimately, a more secure and economically viable future for cocoa cultivation.

Materials and Methods

Cocoa Budwood was meticulously sourced from diverse field trials of cocoa parental materials across multiple locations. These vegetative propagules were then grafted onto established rootstock at the Cocoa Research Institute of Nigeria (CRIN) Headquarters nursery. Subsequently, successful grafts were transplanted and cultivated over one hectare at the CRIN Headquarters.

Result and Discussion

The nursery successfully cultivated over 3,000 cocoa seedlings for root stock, with 2,500 subsequently selected for grafting. Following a 50% grafting success rate, 1,256 viable seedlings were ultimately transplanted into a one-hectare field already populated with plantain as a shade crop.

Cocoa Rootstock ready for grafting

Newly grafted plants under protective care

Economics Section Reports

Experimental Title: Economic Impact analysis of *Theobroma cacao* varieties (TC1-TC8) on the Livelihood of Farmers in Nigeria (2011-2018)

Investigators: Lawal, J.O., Akinpelu, A.O., Oluyole, K.A., Obatolu, B., Olayinka, T., Yahaya, T., Orisasona, T.M., Dada, O.A., Ogunwolu, Q. A., and Ugwu, C.A.

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 and Nigeria is the third producer in Africa (World Cocoa Foundation, 2014). Cocoa is the most prominent export crop in Nigeria in terms of her production and export capacities (Nwachukwu *et al*., 2012). According to Oluyole (2016) cocoa contributed about 15 percent to the total Nigerian export in 1970 and also contributed $900 million to Nigeria's economy in 2012.

Meanwhile, in order to put Nigeria ahead in cocoa production, the Cocoa Research Institute of Nigeria (CRIN) distributed TC1-TC8 series of improved varieties to farmers in cocoa growing regions of the country. These were achieved when meeting with farmers, Farmers' field days, assistance from extension agents through Agricultural Development Programmes (ADPs), direct purchase from CRIN training and visits (T&V) to farmers' locations by research scientists in the Institute and other stakeholders including inputs and agro dealers. The dissemination and distribution which commenced in 2012 was implemented by the Institute under the auspices of the Agricultural Research Council of Nigeria of the Federal Ministry of Agriculture and Rural Development.

The characteristic features of these varieties include high yields with very low input needs, early bearing, and tolerance to pest and diseases of cocoa, very good cocoa quality traits and adaptability to climatic conditions of various growing regions of the country. According to CRIN (2011), the low input for high

productivity of these materials will greatly encourage and enhance the cultivation of cocoa, thus making the venture more profitable and attractive for those involved, also encouraging others to tap into it. These and other qualities made farmers to adopt the cultivation of these varieties of cocoa. In addition, unlike F_3 Amazon and Amelonado varieties which have potential yield of about 450-520kg/ha, high susceptibility to common pests/ diseases and late bearing (maturing). The TC1-TC8 varieties have potential yield of about 1500-2200kg/ha when managed well with Good Agricultural Practices by farmers.

The main objective of this study is to evaluate the impact of the newly developed improved varieties of cocoa on the Livelihood of Farmers in Nigeria. Specifically to:

i. profile cocoa producing households in the study area;
ii. identify their level of production;
iii. analyze the awareness, access to and use of improved cocoa varieties by the farmers;
iv. analyze the impacts of surge in cocoa prices on the livelihood of producing households;
v. and compare the cost and returns of farmers with cocoa hybrid and other cocoa farmers in the study area.

Methodology

The study was conducted in South-South and North-Central zones of Nigeria. The areas are particularly known for cocoa production in Nigeria (NCDC, 2008). Using well-structured questionnaire for the primary data collection, the study employed multistage random sampling technique to select cocoa farmers. The first stage involved selection of one cocoa producing State from each of the two zones. These are Cross Rivers in the South-south and Kwara in the North Central. The second stage involved a purposive selection of Etung Local Government Area (LGA) (5°52'25.73364"N 8°44'24.39528"E) from Cross River state, Iyun LGA (8°06'02"N 4°42'05"E) and Isin LGA (8°12'20.3"N 4°56'50.6"E) LGAs from Kwara States due to the level of production in the respective states and LGAs. The third stage was the random selection of one cocoa farming community in each of the LGAs (Effraya, Erin-ile and Oke-Onigbin). The final stage involved the random selection of 40 farmers from each community to make a total of 120 respondents. Secondary data sources such as literatures was also adopted. A total of 92 valid respondents were successfully captured after data cleaning. Data was analyzed using simple descriptive statistics (means, frequencies and percentages), and inferential statistics.

Results and Discussion

Socio-economic Profile of Cocoa Producing Households in the Study Area

The mean age of cocoa farmers is 47 years (±12.0), with the majority (65.5%) falling between 31 and 50years. This suggests that cocoa farming in the study area is primarily undertaken by middle-aged individuals, which aligns with findings from previous studies indicating that this age group is actively engaged in agricultural production due to their physical strength and economic responsibilities (Suh and Molua, 2022). Males dominate cocoa production, representing 80.4% of the sampled population, while females constitute only 19.6%. This finding highlights the male-dominated nature of cocoa farming business, which is consistent with studies that emphasize men's greater access to land, capital, and farm inputs in the sector, while women often play supporting roles in processing and marketing activities (Abidogun *et al*., 2019).

A substantial proportion of cocoa farmers are married (89.1%), which may indicate the importance of family labor in cocoa production. This aligns with the assertion that family-based agricultural enterprises benefit from shared responsibilities and labour contributions from household members (Moyo, 2016). The average household size is 7.0 (±3.0), with the majority (27.2%) having between 1 to 5 members per household. This indicates a moderate household size, which can be beneficial for farm labor availability, as larger households often contribute more workforce to farm activities.

Most farmers have at least some formal education, with 46.7% attaining secondary education and 26.1% reaching the tertiary level. This relatively high literacy level among cocoa farmers may enhance their ability to adopt improved production

techniques and access market information (Kehinde, 2021). The mean farm size is 1.9 hectares (±1.0), with the majority (71.7%) cultivating less than 2 hectares. This suggests that cocoa farming in the study area is predominantly small-scaled, consistent with national trends where smallholder farmers dominate the cocoa sector (ICCO, 2022). The mean farming experience is 19.2 years (±10.2), with 41.4% of farmers having 11 to 20 years of experience. This indicates that a significant portion of the farmers are well-experienced, which could positively influence their productivity and adoption of improved cocoa varieties.

Table 1: Socio-economic profile of Cocoa Farmers

Variable	Frequency	Percentage	Mean±SD
Age (years)			47±12.0
< 31	9	9.8	
31 – 50	60	65.5	
51 – 70	19	15.3	
>70	4	4.4	
Gender			
Female	18	19.6	
Male	74	80.4	
Marital status			
Single	7	7.6	
Married	82	89.1	
Widowed	3	3.3	
Education level			
No formal Education	7	7.6	
Primary	18	19.6	
Secondary	43	46.7	
Tertiary	24	26.1	
Household Size			7.1±2.8
1 to 5	25	27.2	
6 to 10	19	15.3	
>10	4	4.4	
Farm Size (Hectares)			1.9±1.0
1.1- 2.0	66	71.7	
2.0 – 4.0	22	23.9	
>4.0	4	4.4	
Experience			19.2±10.2
1-10	26	28.3	
11-20	38	41.4	
>20	28	30.5	

Source: Field Survey (2025)

Awareness, Access and Use of Improved Cocoa Varieties by Farmers

The awareness level of cocoa hybrids is relatively high, with 58.7% of farmers indicating knowledge of the improved varieties. However, a significant 41.3% remain unaware, suggesting the need for increased extension services and targeted information dissemination to ensure broader farmer education on the benefits of hybrid cocoa varieties (Akinwale and Folarin, 2018).

Despite the moderate awareness, actual ownership of cocoa hybrid trees is low, with only 18.5% of farmers cultivating hybrid varieties. This low adoption rate may be attributed to limited access to improved seedlings, high establishment costs, or a lack of adequate incentives to encourage the transition to hybrid varieties (Adebayo *et al*., 2022).

The average age of hybrid cocoa trees among adopters is 8.7 years (±5.2). This distribution suggests that a substantial proportion of hybrid trees

are older, indicating that farmers have had these varieties for almost a decade. The findings highlight the need for sustained efforts in distributing the high-yielding hybrids to accelerate the replacement of aging cocoa farms/plantations with more productive plant materials.

The results in Figure 2 below on the sources of improved cocoa varieties indicate that the Cocoa Research Institute of Nigeria (CRIN) is the primary supplier, providing 81.25% of hybrid seedlings to farmers. This highlights CRIN's significant role on cocoa research and seedling distribution. However, alternative sources such as the Agricultural Development Centers (ADC), fellow farmers, and state secretariats each account for only 6.25% of seedling supply. The limited involvement of other sources suggests that formal distribution channels beyond CRIN remain underutilized. Expanding access through ADCs and government agencies could enhance the availability of improved varieties and promote wider adoption among cocoa farmers.

Table 2: Awareness, Ownership and Use of Cocoa Hybrid

Variable	Frequency	Percentage	Mean±SD
Awareness of Cocoa Hybrid			
Yes	54	58.7	
No	38	41.3	
Ownership of Cocoa Hybrid			
Yes	17	18.5	
No	75	81.5	
Age of Hybrid Trees (Years)			8.7±5.2
1 – 5	6	35.2	
5 – 10	4	23.5	
>10	7	41.2	

Source: Field Survey (2025)

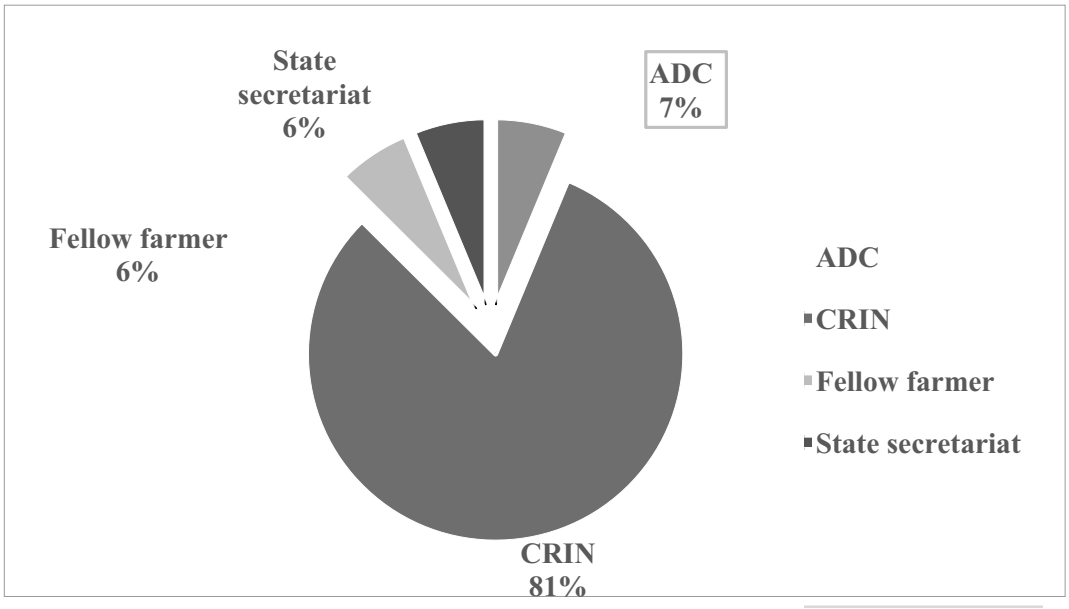

Figure 1: Sources of Cocoa Hybrid Acquired by Farmers
Source: Field Survey (2025)

The results presented in Table 3 below indicates that the top factors influencing farmers' decision to adopt the TC cocoa varieties are higher yield (2.79±0.48) and disease resistance (2.68±0.65). The prioritization of higher yield suggests that farmers are primarily motivated by increased productivity, which aligns with previous studies highlighting yield improvement as a major driver of hybrid adoption (Adebayo *et al*., 2022). Disease resistance ranking second indicates that farmers recognize the importance of reducing losses caused by prevalent cocoa diseases, which significantly impact farm profitability.

Table 3: Factors influencing farmers' decision to adopt Cocoa Varieti es

Factors	Mean±SD	Rank
Disease Resistance	2.68±0.65	2nd
Improved Quality of Cocoa	2.66±0.63	3rd
Adaptation to Local Climate	2.50±0.70	7th
Adaptation to Soil Conditions	2.58±0.65	6th
Higher Yield	2.79±0.48	1st
Early Bearing	2.63±0.66	4th
More Income	2.60±0.71	5th

Source: Field Survey (2025)

Impact of Windfall in Cocoa Prices on the Livelihood of Cocoa Farmers

The most common expenditure category was children's education (60.9%), suggesting that many farmers prioritized investing in their family's future by improving access to schooling.

In terms of agricultural reinvestment, 46.7% of farmers expanded their farms, while 20.7% purchased additional farmland, and 44.6% invested in more farm inputs. These findings highlight that a significant portion of cocoa farmers are using their additional income to enhance productivity and secure long-term sustainability in cocoa farming.

Additionally, 27.2% of farmers started new businesses, reflecting efforts to diversify income sources and reduce reliance on cocoa farming alone. Meanwhile, 43.5% allocated funds to capital projects, which may include infrastructure improvements such as housing, transportation, or storage facilities, further contributing to long-term wealth accumulation.

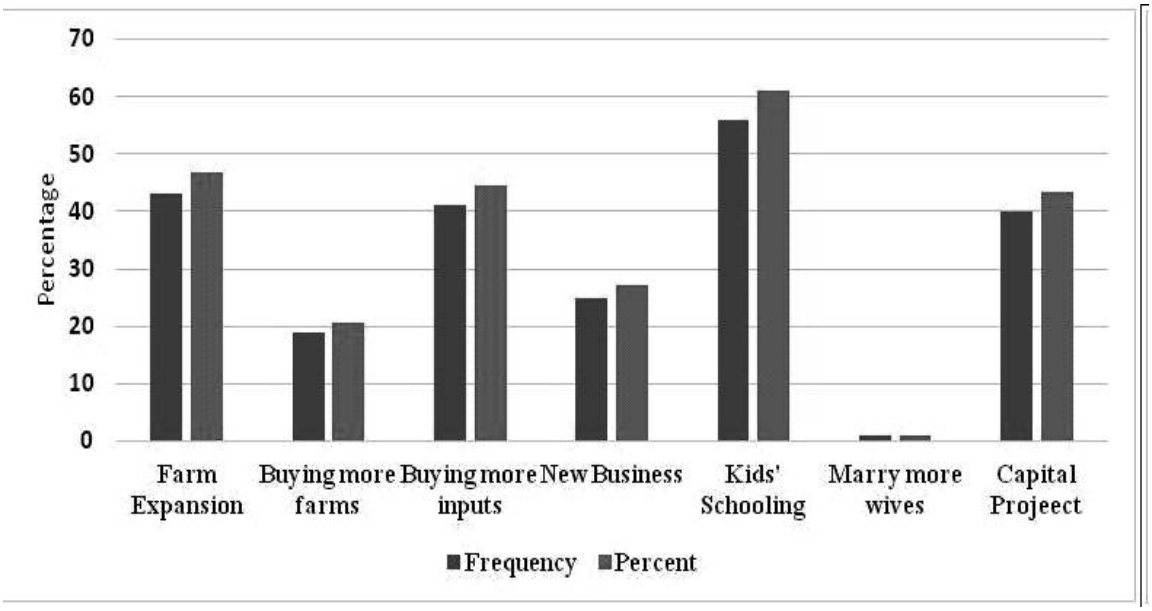

Figure 2: Impact of Windfall in Cocoa Prices on the Livelihood of Cocoa Farmers
Source: Field Survey (2025)

Comparison of Cost and Returns between Cocoa Hybrid Farmers and Other Cocoa Farmers

Farmers cultivating hybrid cocoa earned significantly higher revenue (₦5,206,667) compared to non-hybrid farmers (₦3,185,321). The increase is primarily due to higher cocoa bean revenue (₦5,206,667 vs. ₦3,032,821), indicating that hybrid varieties are more productive. Additionally, non-hybrid farmers generated some income from the sale of seedlings (₦152,500), which was absent among hybrid farmers.

While total costs were slightly higher for hybrid farmers (₦980,913.8) compared to non-hybrid farmers (₦898,834.6). Hybrid farmers achieved a much higher gross margin (₦4,733,744) compared to non-hybrid farmers (₦2,650,734). The substantial profitability gap reinforces the economic advantage of adopting hybrid cocoa varieties.

Table 4: Cost and Returns of Cocoa Farmers

Variables	Farmers with Cocoa Hybrid (₦)	Farmers without Cocoa Hybrid (₦)
Revenue		
Cocoa Beans	5,206,667	3,032,821
Sale of Seedlings		152,500
Total Revenue	5, 206, 667	3, 185, 321
Fixed Cost		
Land	15,000	28,029.4
Cutlass	18,672.4	15,622.9
GTH	6,354.4	2,997.1
Farm House	39,166.7	48,568.2
Motor Bike	428,797.7	269,029.9
Total Fixed Cost	507, 991.1	364, 247.4
Variable Cost		
Labour	250,882.4	252,225.8
Agro-chemicals	131,131.3	171,736.4
Seedlings	90,909.1	110,625
Total Variable Cost	472, 922.7	534, 587.2
Total Cost	980, 913.8	898, 834.6
Gross Margin	4, 733, 744	2, 650, 734
Profit	4, 225, 753	2, 286, 486

Source: Field Survey (2025)

Conclusion

The study revealed that cocoa farming in the study area is dominated by small-scale farmers with a relatively high level of formal education that may facilitate technology adoption. Awareness of hybrid cocoa varieties is moderate, yet actual adoption remains low. The windfall from cocoa price increases has been channeled into education, farm expansion, and income diversification. Furthermore, hybrid cocoa farmers achieved significantly higher revenue and profitability compared to non-hybrid farmers, reinforcing the economic benefits of adopting improved varieties.

Recommendations

1. Farmers should consider transitioning to hybrid cocoa varieties due to their proven advantages in terms of higher yields and disease resistance.

2. Extension services should be strengthened to increase awareness of improved cocoa varieties. Targeted education programs on the benefits of hybrid cocoa should be implemented through farmer cooperatives and agricultural agencies.

3. Expanding seedling distribution beyond CRIN to include Agricultural Development Centers (ADCs) and other government agencies will enhance availability and affordability, encouraging more farmers to transition to high-yielding hybrid varieties.

4. Government and private sector stakeholders should provide subsidies, credit facilities, and incentives to assist farmers in overcoming cost

barriers associated with adopting hybrid cocoa varieties.

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Experimental Title: Income Expenditure Pattern of Cocoa Farmers from 2023-2024 Price Boom Periods: A Case Study of Oluyole LGA of Oyo State, Nigeria

Investigators: Adesida F.A., Alli M.A., Adelusi, A.A., Agboola, L.O., Ujunwa, I., Ejugwu, J., Egesi, E.N., Adeoye, I.A., and Oluwole, V.O

Introduction

Cocoa is a vital commodity crop in Nigeria, contributing significantly to the country's economy and employing millions of smallholder farmers (ICCO, 2022; CBN, 2022). The Nigerian cocoa economy has a rich history which is well documented in literature. The contributions of cocoa to the nation's economic development are vast and the crop has also been a major source of livelihood and foreign exchange earner for many countries in Africa (Igbatayo, 2023).

In terms of foreign exchange earnings, no single agricultural export commodity has earned more than cocoa. With respect to employment, the cocoa sub-sector still offers quite a sizeable number of employments, both direct and indirectly. In addition, it is an important source of raw materials, as well as source of revenue to governments of cocoa producing states. Nigeria however, has a favorable climate that supports cocoa production from October to June every year with 1.4 million hectares of farmland for cocoa cultivation throughout the country.

Nigeria's cocoa is also known for its first-rate bean count, low slatey, low mold, and smooth flavor. According to the International Cocoa Organization (ICCO) latest data on global production, Nigeria is presently the world's fourth largest producer with 280,000 metric tons in the 2022–2023 seasons, after Ivory Coast, Indonesia, and Ghana. Nigeria also happens to be the third largest exporter of cocoa, after Ivory Coast and Ghana. According to data from the National Bureau of Statistics (NBS), Nigeria's cocoa exports rose by 304 percent in the first quarter of year 2024 due to higher demand for cocoa and naira depreciation in the country. The country's cocoa exports, which accounted for 42.4 percent of the N1.04 trillion agricultural exports for the period, surged to N438.7 billion in the first quarter of 2024 from N108.6 billion in the corresponding period of 2023. However, for the first time in the country, cocoa beans sold above N12 million per metric ton, as the worst deficit supply in decades from Ivory Coast and Ghana, two major commodity suppliers, disrupted global supply. According to data from ICCO, Nigeria's cocoa price hit historic price of $12,000 per tons in April 2024.Locally, prices of cocoa beans are also surging on weaker naira. This

price surge is causing Nigerian farmers to begin rehabilitation of their old cocoa plantations and plant more high-yielding seedlings to replace old and unproductive trees while expanding their growing areas. In spite of all these,

Source: United Nations COMTRADE database on international trade (2024)

Nigeria's cocoa exports face some challenges such as high transport costs probably due to poor road infrastructures and other issues relating to marketing. These challenges are making it difficult to access and participate optimally in international trade.

However, due to the importance of cocoa to the Nigeria economy, the Federal Government's concern of diversifying the export base of the nation has placed cocoa in the centre-stage as the most important export tree crop (Ihedioha *et al*., 2018).Given persistent and extreme poverty rates among cocoa producers worldwide (Fountain and Hutz Adams, 2019), since 2015 many actors in the cocoa sector have been reflecting on how to ensure that cocoa farmers earn at least a living income which is the amount they need to earn to be able to afford a decent standard of living. According to (Anker, 2018), leaders from across the cocoa and global chocolate industry came together in Abidjan, Côte d'Ivoire to provide feedback on the draft 'Living Income Benchmark Study for the Main Cocoa Growing Regions. Since then, many more independent studies on living income have been conducted around the world. (De los Rios and Tyszler,2020).

As earlier stated, the global cocoa market experienced a price boom between 2023 and 2024, driven by increasing demand and supply chain disruptions (FAO, 2023). These boom presents an opportunity to investigate the impact on cocoa farmers' income and expenditure patterns; hence this study.

Objectives

The principal objective of this study is to examine the income-expenditure pattern of cocoa farmers during price boom period (2023-2024) in Oyo state, Nigeria

Specifically, the study seeks to:

i. Identify the socioeconomic characteristics of cocoa farmers in the study area;
ii. Determine the average income of cocoa farmers in the study area during the cocoa price boom;
iii. Analyze the expenditure patterns of cocoa farmers in the study area.

Methodology

Study Area

The study was carried out in Oluyole LGA of Oyo State, South Western Nigeria. The state covers approximately 28,584 square kilometers in land area

and a population of 5,591,589 (Wikipedia, 2008). It is located between latitude 2°38′ and 4°35′ east of the Greenwich meridian. Agriculture is the major source of income for the greatest number of the people of the State. The state lies in the equatorial rainforest belt and the rainfall around this area varies from 155mm to 1800mm per annum. There is distinct wet season from April to late October and dry season from November to March, the areas have a mean annual temperature of 26.2 degree Celsius. The relative humidity is high between July and December and low between December and February. The luxuriant forests are arranged in two or three layers consisting of undergrowth, medium higher trees and tall tree. The variety of plant species found here is one of the richest in the world. The forest zone with high humidity favors the cultivation of tree crops such as Cocoa, Kola, Citrus and oil palm as well as arable crops like maize, cassava, Yam and Rice. Oluyole LGA was purposively selected for this research work since the Local Government Area comprises of many satellite towns and villages with a lot of farmers many of which engage in cocoa production. The farmers do have their monthly meetings at the Local Government headquarters Idi-Ayunre, Ibadan. Questionnaires were designed and used to elicit information from 41 sampled cocoa farmers through scheduled interviews during one of their monthly meetings.

Data Collection

Data was collected with the aid of well-structured questionnaire. Data collected included: gender, age of cocoa farmers, educational status, marital status, years of experience in cocoa farming, variety of cocoa grown, family size, total size of cocoa farms, quantity of cocoa produced in year 2023/24, quantities of cocoa sold, preoccupation of farmers, income from cocoa sales as well as their expenditure pattern.

Analytical Techniques

The analytical technique used was descriptive statistics which include frequency, percentage, mean and standard deviation were used to profile the socio-economic characteristics of the respondents as well as describe other relevant information and farmers' concerns.

Results and Discussion

Table 1: Socioeconomic Characteristics of Cocoa Farmers in Oluyole LGA

Variable	Frequency	Percentage
Sex		
Male	36	87.8
Female	5.0	12.2
Total	41.0	100.0
Age		
35-45	7.0	16.9
46-56	9.0	21.9
57-67	12.0	29.2
68-78	10.0	24.3
79-89	3.0	7.2
Total	41.0	100.0
Mean Age = 59.70		
S.D = 13.35		
Marital Status		
Single	1.0	2.4
Married	37.0	90.2
Widowed	3.0	7.3
Total	41.0	100.0
Educational Status		
No formal Education	3.0	7.3
Primary Edu	15.0	36.6
Secondary Edu	10.0	24.4
Tertiary Edu	13.0	31.7
Total	41.0	100.0
Family Size		
1-5	26.0	63.4
6-10	12.0	29.3
Above	3.0	7.3
Total	41.0	100.0
Farming Experience		
5-15	14.0	34.1
16-25	10.0	24.3
26-35	9.0	21.9
36-50	5.0	12.2
51 and Above	3.0	7.3
Total	41.0	100.0
Mean = 24.44		
SD = 14.18		
Farm Size		
0.5-2.50	28	68.4
2.51-5.0	9.0	22.0
5.01-10.0	4.0	9.6
Total	41	100
Mean = 2.62		
SD = 2.30		

Source: Field Survey, 2025

Table 1 above shows the socioeconomic characteristics of the sampled cocoa farmers. Socioeconomic characteristic such as ages of farmers, sex, marital status, family size, level of education, farm size of cocoa farms are important factors to consider in farmers decision making process as it relates to their income and expenditure as well as their performances. The table shows that majority of the sampled cocoa farmers were male (87.8%). This is in line with the general belief that more male farmers are into cocoa production in Nigeria compared with the females. This could be because cocoa farm work is tedious and men can cope better with it than women and also may be because some traditional cultures allow only male children to inherit farms.

Also from the table, most of the cocoa farmers are between the ages of 57-67 years with average age of 59.70 years. This means that farmers who engage in cocoa production in the study area are gradually aging and therefore, there is need for able bodied youth who are still energetic, enterprising and innovative to be encouraged into the cocoa farming business in the study area. This would surely have positive implication for farming in the study area. Majority of them 34.1% have between 5-15 years and 24.3% have 26-36 years of experience in cocoa farming (mean is 24.44 years) which means that they must have been in cocoa farming for quite a long period of time and as a result must have gathered a lot of experiences in cocoa farming. Most of the farmers are married (90.2%) with average family size of 5 or more people. This implies that family labor may be available for cocoa production in the study area and also indicate that majority of cocoa farmers are mature persons who have access to the opinions and advice of their spouses in making production decisions. A larger proportion of the sampled farmers (31.7%) had tertiary education. This implies that they would be able to utilize modern day farming technologies as well as agricultural and marketing information given to them through extension services. This would certainly go a long way to boost the production of this crop in the area. Also, the average cocoa farm size in the study area is 2.62 hectares. This is an indication that cocoa production is still at low scale in this region which could be as a result of small farm holdings in the country.

Table 2: Distributions of Respondents Based on other Relevant Information/Farmers Concerns

Variables	Frequency	Percentage
Preoccupation of farmers		
Farming	34.0	82.9
Others	7.0	17.9
Total	41.0	100.0
Association		
Yes	14.0	34.1
No	27.0	65.9
Total	41.0	100.0
Variety of Cocoa Cultivated		
Amazon	33.0	80.5
TC series	6.0	14.6
Others	2.0	4.9
Total	41.0	100.0
Income (N)		
10,000-100,000	14.0	34.1
110,000-250,000	9.0	21.8
260,000-500,000	8.0	19.4
510,000-1000,000	7.0	16.9
Above 1000,000	3.0	7.2
Total	41.0	100.0

Source: Field Survey, 2025

Table 2 above shows some other concerns as they relate to cocoa farmers in the study area, About 83% of the respondents affirmed to the fact that their primary occupation is cocoa farming but are also involved in other agricultural ventures such as rearing of animals and other agric related businesses while about 18% agreed to the fact that they have other preoccupation or businesses but are involved in cocoa farming as a secondary business. Also, 34.1% of the respondents are involved in one association or the other such as cooperative societies, farmers club and so on while 65.9% do not belong to any association. Social groups such as cooperative societies have a lot of benefits for farmers because the members would be able to pull their resources together access and spread information easily or solve their problems together. Majority of the cocoa farmers cultivated the Amazon variety of cocoa. Majority of the cocoa farmers (34.1%) earned on the average between N10,000 and N100,000 in the last year production season.

Table 3: Expenditure Pattern of Cocoa Farmers

Variables	Expenditure	Percentage
Food Expenses	44268.29	32.10
Household Exp	16634.15	12.06
Education Exp	28170.73	20.42
Health Exp	19341.46	14.02
Clothing Exp	18536.59	13.44
Entertainment Exp	10975.61	7.96
Total	137926.80	100.00

Source: Field Survey, 2025

According to table 3 above, 32.1% of the total income of the cocoa farmers was expended on food. This could be attributed to the high cost of foodstuffs due to inflation occasioned by the hike in the price of petrol last year (2024). This however made life difficult for most farmers as the prices of basic food items such as semovita, polished rice, meat, fish and so on skyrocketed. In the same vein, the cost of household materials also increased dramatically leading to increase in household expenses. Also, 20.42% of the farmer's income was expended on education. This was due to increase in resources expended on education of children. Many schools especially private schools increased their school fees and transportation or transport fares from one location to the other also increased astronomically leading to more financial stress to the farming households. Also, 14.02% of their income was expended on health care services or buying drugs for treatment of different ailments. However, the least (7.96%) of their total income was expended on entertainment

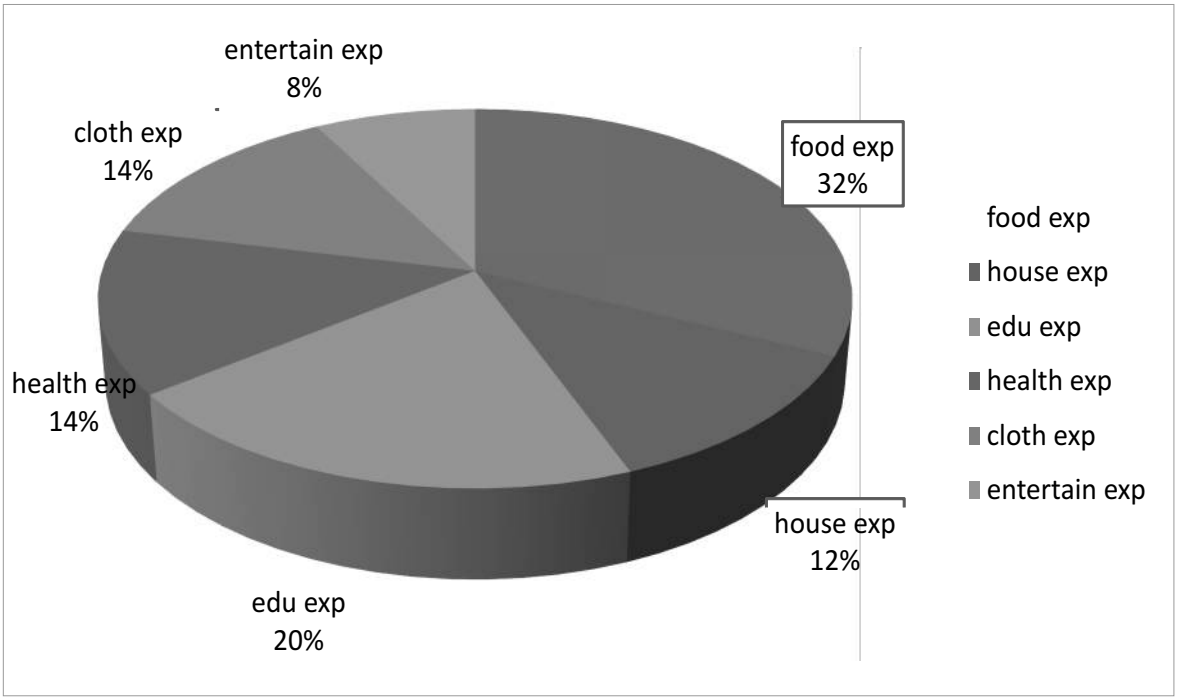

Figure 1: Pie chart showing the Expenditure Pattern of Cocoa Farmers in Oluyole LGA

Conclusion and Recommendations

Cocoa business in Nigeria and some other West African countries has contributed tremendously not only to the livelihoods of millions of farm families involved in cocoa production and along the value chain but also to the GDP of these nations. However, due to the importance of cocoa to the Nigeria economy and also cocoa being the most important export crop in Nigeria, one would think that cocoa farmers are the richest people in the country but that is not the case. The year 2023/24 production period, however, was a windfall for many of the cocoa farmers due to the record hike in cocoa prices in the international arket. Many cocoa farmers were able to produce enough for sales resulting in a tremendous increase in their income during this production year

It is also worthy of note that the expenditure patterns of the cocoa farmers in the study area also changed as many of them were able to access funds for developmental projects such as rehabilitation of their farms and invested more in other business ventures. They were also able to take care of their families better. It is however recommended that proactive steps should be taken by the Federal Government of Nigeria and other actors in the cocoa subsector of the nation's economy to encourage cocoa farmers to invest more in cocoa business and bring more people especially youths and women to join the train through public enlightenment and advocacy so that Nigeria could regain her position as the leading producer of cocoa worldwide.

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Extension Report

Farmers' Field Day

The Extension Section of Cocoa Research Institute of Nigeria (CRIN) hosted its annual Farmers' Field Day for the year 2024 on Thursday, February 27, 2025, at the CRIN Exhibition Ground of the institute. The event, themed "CRIN Developed Technologies for Improved Food Security and Economic Growth in Nigeria," aimed to showcase innovative agricultural research and foster collaboration among stakeholders in the tree crop sector.

Opening Ceremony

Dignitaries in attendance on the podium included the Executive Director/CEO of CRIN, Dr. Patrick Olusanmi Adebola; the Hon. Commissioner for Agriculture and Rural Development, Oyo State, Barrister, Olasunkanmi Olaleye represented by General Manager, Oyo State Tree Crop Development Unit, Mr. Babatunde Adewole; Director in charge of cocoa production at CRIN, Dr. A.O. Famaye, Director of Budgeting, Monitoring, and Evaluation at CRIN, Director in charge of Research Outreach, Dr. A.R Adedeji, Director of Plantations and Substations, Dr. Moses Ogunlade; and HOD of the Economics and Extension Department of CRIN, Dr. (Mrs.) Justina Oluyemisi Lawal, Head of Extension section, Dr. Uwagboe Ehosa Osas and other members of the CRIN's IMC. Mr. Akintola Olubanji Joseph, Chairman of the Cocoa Farmers Association, Oyo State branch

The CRIN's farmers' field day was organized at the CRIN's premises was anchored by Mr Anthony Agbongiarhouyi Eghe and Dr. Rahman S.B. The event commenced with a welcome address by Dr. Patrick Adebola, the Executive Director of CRIN, who emphasized the institute's commitment to advancing agricultural research and its pivotal role in enhancing food security and economic growth. Mr. Babatunde Adewole delivered the keynote speech, highlighting the significance of adopting CRIN's developed technologies to boost productivity in cocoa, cashew, coffee, kola, and tea sectors. Dr. Justina Oluyemisi Lawal, Head, Economics and Extension Division reiterated the significance of the event, stating that the gathering was a vital platform for sharing information and fostering collaboration aimed at revitalizing Nigeria's agricultural economy, particularly tree crop production. She chronicled the CRIN's national mandate and recent additions of black plum as a significant crop for Nigeria.

Technical Sessions: CRIN scientists presented their latest research findings, focusing on high-yielding and disease-resistant crop varieties, sustainable farming practices, and innovative processing techniques. Experts from various fields engaged in discussions and collaboration on the challenges and opportunities in the tree crop industry, addressing topics such as market access, value addition, and policy support.

Exhibition: An exhibition featured value-added products derived from CRIN's mandate crops, aiming to attract investors and promote commercialization opportunities. Exhibition of difference values addition research undergone in relevance to the mandate crops, such as wines from all mandate crops, cocoa bread, Choco Garri, Chocolate, Pure cocoa drink just to mention a few. Other Exhibitors at the program were Jubaili Agrotech Group, Harvestfield Industries Limited, National Centre for Genetic Resources and Biotechnology (NACGRAB), Forestry Research Institute of Nigeria (FRIN), BIOBEE, DIVA SECRET, Green World and National Horticultural Research Institute (NIHORT).

Cultural display

In addition to the exhibition, there was a cultural display by the Alasi Musi Bata cultural group, celebrating the rich cultural heritage of the Yoruba ethnic group and the roles play by agriculture in the nation's building.

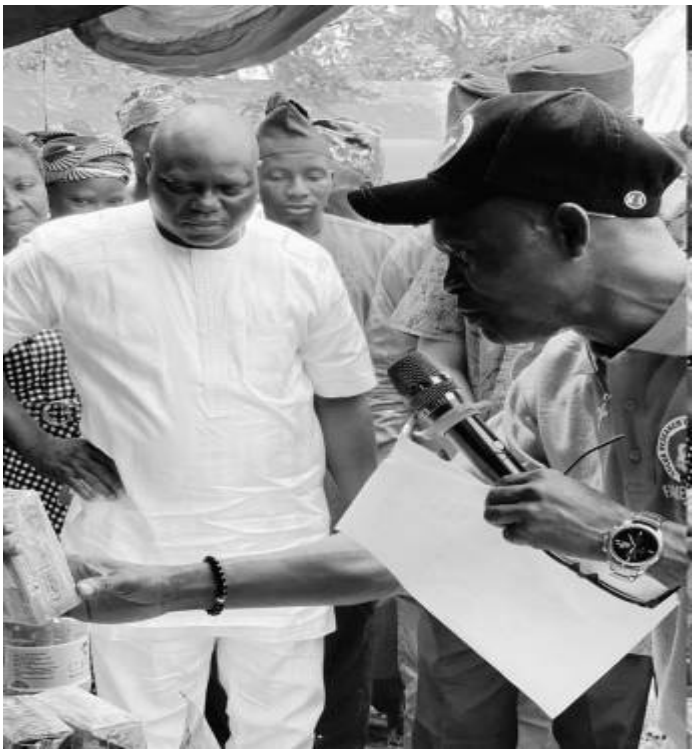
Interactive Sessions

The Master of Ceremony of the day, Mr. Anthony Agbongiarhoiyi hosted the attendees and gave them opportunity to engage with researchers and experts, seeking clarifications and discussing potential collaborations.

Closing Ceremony

Dr. Rahman Saheed Bayonle, from the Agricultural Extension Division of CRIN, delivered the vote of thanks. He expressed gratitude to all participants, organizers, and partners for their contributions to the event's success, emphasizing the collective effort required to transform Nigeria's agricultural landscape. The Farmers' Field Day successfully fostered knowledge exchange, promoted the

adoption of innovative technologies, and strengthened partnerships among stakeholders, all geared towards enhancing food security and driving economic growth in Nigeria.

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VALUE ADDITION RESEARCH

Experimental Title: Antiseptic Soaps from Cocoa Pod husk using local botanicals

Investigators: Yahaya, L.E., Jayeola, C.O., Okuande, A.F., Igbinadolor, R.O., Akinola, C.O.

Introduction: Soap remains a household product that finds uses on a daily basis. It is as anionic surfactants used in conjunction with water for washing and cleaning. It consists of sodium or potassium salts of fatty acids and is obtained by reacting common oils or fats with a strong alkaline solution in a process known as saponification (Lasio, 1978). The production of soaps creates no byproducts, and the minimal amount of energy is required for the saponification reaction, and it is less harmful to nature (Maotsela, *et al*., 2019, Sukeksi and Diana, 2020). They are also called natural soaps and are defined as alkali salts of fatty acids, mainly from vegetable origin (Prieto *et al*., 2018). Over the years, there has been a need to improve natural soaps to meet higher hygiene standards for the human population. For this reason, soaps with antiseptic properties were developed using synthetic additives. This, however is expensive and therefore uneconomical. The present study explored botanicals of natural origin with potent antiseptic properties.

Objectives: To develop CPH soaps for prophylactic purposes with increased disinfecting properties. ii. To characterize the developed soap products.

Materials and Method: Cocoa pod husk (CPH) was collected from the fermentary unit of CRIN, dried and ashed. Potash was extracted the ashed CPH. Selected botanicals (*Moringa oleifera* and and *Azadirachta indica*) were employed for this study. Soaps were produced through saponification process using these botanicals with antiseptic properties were formulated at varying concentration levels. The products were characterized and the antiseptic efficacy determined using the minimum inhibition concentrations (MIC). Variation of blends was made at 0, 2, 6, 12 % (w/w) which are coded MRG-0, MRG-2, MRG-6, MRG-12 and NEM-0, NEM-2, NEM-6, NEM-12 for *Moringa oleifera* and *Azadirachta indica* soaps respectively.

Results and Discussion

FTIR Analyses of Moringa oleifera and Azadirachta indica

Figures 1 and 2 shows the FTIR spectrum of *Moringa oleifera* and *Azadirachta indica* respectively while table 1 and 2 shows the peaks and their assignments. The functional group (C=O, C=H and CH stretch) identified in Tables 1 and 2 are typical of most organic compounds. For example, absorption at 3282.9 cm-1, 3292 cm-1 are characteristics of hydroxyl groups which are possibly from phenolic compounds or the glycosides. Absorption at 2918.5, 2851, 2918.5, 2851cm-1 indicates the presence of methyl (-CH3) and methylene (-CH2-) groups possibly from the fatty acids or terpenes. The absorption at 1598.6 cm-1 may likely indicate the presence of C= C, from unsaturated fatty acids. Peaks at 1607.9, 1367.8, 1318 cm-1 for *Azadirachta indica* may suggests the presence of alkaloids such as nimbin and nimbidin.

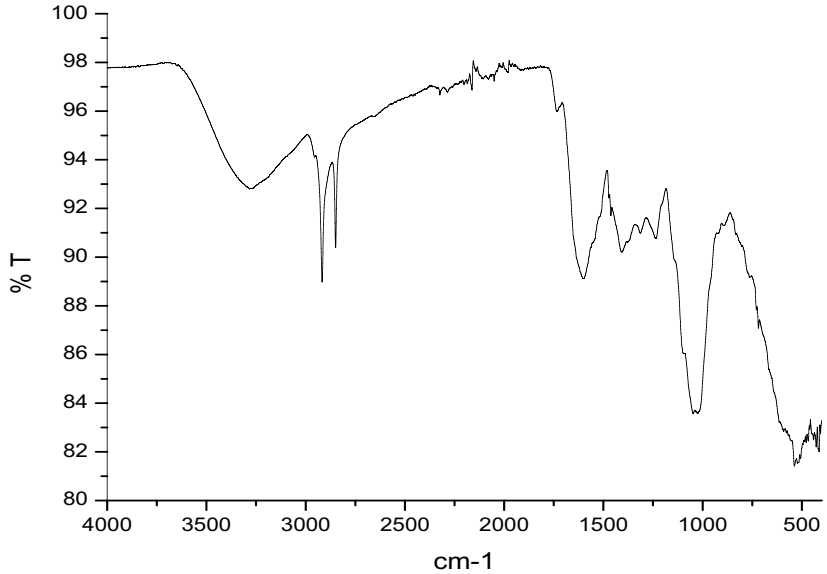

Fig. 1 FTIR Spectrum of *M. oleifera*

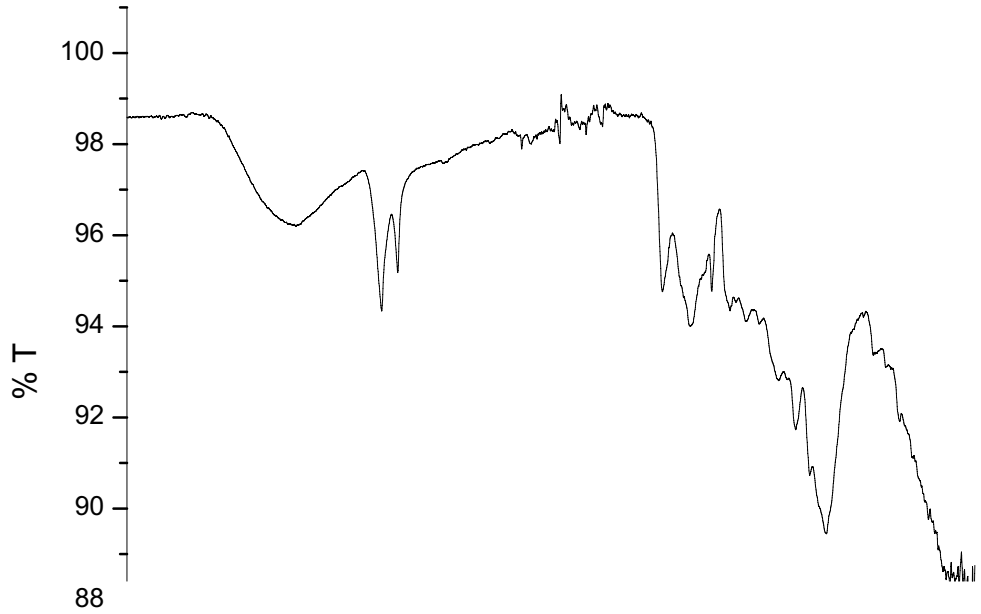

Fig. 2. FTIR Spectrum of *Azadirachta indica*

Table 1 shows the results of the MIC of the antiseptic soaps on the pathogens. According to the result, NEM soap exhibited more inhibitory action against *S. aureus* than MRG as evident with a zone of inhibition of 30.25 mm at 6% concentration. For *B. subtilis,* MRG soap proved to be more effective in inhibiting the pathogen at 12 % concentration as can be seen with a zone diameter of 26.50 mm. On the other hand, the effectiveness of MRG and NEM soaps to inhibit *E. coli* growth decreases with concentrations. While NEM soap showed the highest inhibition at 2 % concentration, MRG does at the same concentration with 26.50 mm zone diameter.

Table 1. Sensitivity of pathogens to soap concentrations after 18 hours

Test organism	Mean Zone of inhibition (mm)							
	MRG Concentration (%)				NEM Concentration (%)			
	0	2	6	12	0	2	6	12
S. aureus	13.0	17.5	17.5	18.5	15.75	15.75	17.70	29.0
B. subtilis	16.5	19.0	23.0	23.5	16.5	15.75	21.0	26.25
E.coli	18.5	26.50	18.75	18.5	18.5	36.5	34.0	18.5
T. rubrum	15.5	30.25	25.0	18.25	15.5	31.25	31.25	18.75
P. aeruginosa	23.5	26.75	19.0	25.0	23.5	23.5	18.0	17.75
C. albican	15.25	17.25	23.25	26.0	15.25	33.0	23.0	17.75

Recommendation and Conclusion: Antiseptic soaps were produced from the pod husk of cocoa using *Azadirachta indica* and *Moringa oleifera* herbs as antiseptic. The soaps exhibited effective inhibition against selected pathogens at low concentrations for both soap samples. It can therefore be concluded that *Azadirachta indica* and *Moringa oleifera* leaves can serve as substitute for antiseptic agents in soap formulations.

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Experimental Title: Physicochemical and Sensory Evaluation of Drinking Chocolate Sweetened with Date Powder

Investigators: Jayeola, C.O., Olalekan, M.A., Raji, M.O., Ajewole, A.O., Adesokan, M., Tolulope, O.S., Olorundare, B.O., Famaye, I.

Introduction

Chocolate consumption is a popular beverage globally, with a rich history dating back to ancient civilizations. However, traditional drinking chocolate production often involves adding refined sugars, which can be detrimental to health. Date powder, a natural sweetener derived from dates, offers a healthier alternative. This study evaluated the physicochemical and sensory properties of drinking chocolate sweetened with date powder.

Materials and Methods

Materials

- Cocoa powder, Date powder, Sugar, Milk powder, Cocoa butter, Vanilla powder

Equipment- Mixer, packaging materials, conching machine.

- Sensory evaluation panel.

Production Process

The different materials such as cocoa powder, date powderand vanilla are weighed in three different ratios and are mixed together. The mixture was conched for 2 hours to develop the flavor and texture. The final product was packaged in airtight containers for storage for further physicochemical analysis.

Experimental Design

The study employed a completely randomized design (CRD) with three treatments: 5%, 10%, and 15% date powder concentrations. Each treatment was replicated three times. The physicochemical analysis was carried out using AOAC 2000. The sensory analysis was performed by trained panelists using hedonic scale of 1 to 9. Ranging from 1-dislike extremely to 9- like Extremely.

Sensory Evaluation

The samples for organoleptic analysis are packaged differently. The products are reconstituted in water before serving to the panelists to assess. A sensory evaluation was conducted to assess the flavor, aroma, texture, and overall acceptability of the drinking chocolate. A panel of 10 judges evaluated the product, rating it on a scale of 1-9 ranging from 1-dislike extremely to 9-like Extremely

Results and Discussion

The results of the chemical analysis was indicated in table 1

The physicochemical analysis was carried out to determine the protein, fat, carbohydrate, and fiber content of the drinking chocolate. The results showed:

Table 1: Physicochemical Analysis of Drinking Chocolate

Nutrient	Unit	5% Date Powder	10% Date Powder	15% Date Powder
Energy	kcal/100g	542	557	572
Protein	g/100g	10.2	9.5	8.8
Fat	g/100g	30.5	29.2	27.9
Carbohydrate	g/100g	55.3	58.3	61.3
Fiber	g/100g	4.2	5.5	6.8
Sugar	g/100g	26.7	30.9	35.1
Sodium	mg/100g	50	45	40
Potassium	mg/100g	1200	1300	1400
Calcium	mg/100g	200	220	240
Iron	mg/100g	5	6	7
Vitamin A	[illegible]	10	15	20
Vitamin C	mg/100g	2	3	5

The results showed that the date powder concentration significantly improved the nutritional composition of the drinking chocolate except fat and protein with a slight decrease as the percentage of date inclusion increases, whereas the minerals especially iron, potassium and calciun and vitamin A content increases with increase in the percentage of date powder added.

The sensory evaluation revealed that the drinking chocolate with 10% date powder concentration had the highest overall acceptability score. The panelists described the flavor as "sweet and chocolatey" and the texture as "smooth and rich."

Conclusion

The production of drinking chocolate sweetened with date powder was successful, resulting in a unique and healthy beverage. The study demonstrated that the date powder concentration significantly affected the physicochemical and sensory properties of the drinking chocolate. The sensory evaluation showed that the product had a rich flavor, aroma, and texture, with an overall acceptability rating of 8.3/10. The nutritional analysis revealed that the product was high in carbohydrates and fat, but also contained a significant amount of protein, fiber, calcium, potassium, iron and vitamin A. This study demonstrated the potential of using date powder as a natural sweetener in chocolate production, offering a healthier alternative to traditional chocolate products.

Recommendations

This study can be scaled up to commercial production levels, with a focus on promoting local consumption of cocoa.

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Experimental Title: Microbial, Sensory and Shelf Studies of Cashew Juice Extracted Using A Motorized Small Scale Extractor

Investigators: A.O. Ajewole, C.O. Jayeola, S.A. Adeleke, M.O. Raji and R.A. Ekemube

Abstract

This study evaluated the microbial, sensory properties and the shelf stability of expelled cashew juice. The effects of manual machine extraction (MME), motorized machine extraction (MMT) and muslin tied extraction (MTE) on microbiological contamination, sensory perception and shelf stability of obtained cashew juice were investigated. The results showed that the methods of extraction significantly impact the microbial counts and stability of the juice. The sensory evaluation revealed that the MME ranked higher in terms of score, followed by the MTE. It also affected the physical attributes of the obtained cashew juice.

Keywords: Extraction, Microbial load, Sensory perception, Shelf stability, Cashew juice

Introduction: Continuous search for natural food products especially plant-based foods, has called for increased utilization of cashew apples in juice production. This effort, corroborated with attendant fabrication of locally made extraction machines calls for careful attention to safety of expelled cashew juice. Quest to develop sustainable mechanical extractor, especially for cottage juice production due to scarcity of such machines despite Nigeria high production capacity therefore required the need to monitor the wholesomeness and safety, that is microbial, sensory and shelf-life studies of produced cashew juice.

The objectives are to produce cashew juice using developed juice extractors and to carry out microbial, sensory and shelf-life studies on the produced cashew juice**.**

Materials and methods

Fresh cashew apples were picked from the cashew plot within the institute, washed with clean running tap water to remove adhering field soils, allowed to stand for about fifteen minutes for cleansing water to drain off. The apples were processed immediately as recommended by Ogunwolu (2017). The apples were first sorted to select those that were of quality, their nuts were removed as they were washed. Blanching of the apples was carried out in boiling water for 10 minutes as reported by Bolarinwa *et al*. (2020). and extracted using developed cashew juice extractors. Obtained cashew juice was pasteurized

and hermetically filled into already cleaned bottles and capped prior storage. The filled bottles were placed on the shelf at room temperature (27°C) alongside the control sample, and monitored for 8 weeks.

Sample plating and microbial analysis for bacteria and yeast counts was done using pour plate method, in line with the method described by Biocheminsider, (2021). Sensory evaluation of the extracted cashew juice was done. The juice samples were presented, in no particular order; to the panelists and it was ranked in accordance with the method described by Iwe (2009). A panel of 10 judges evaluated the product for colour, taste, flavor, smoothness, and overall acceptability; rating it on a scale of 1-9 ranging from 1- dislike extremely to 9- like Extremely. Shelf life of the expelled pasteurized cashew juice was determined by drawing samples from the produced cashew juice held on shelf at ambient temperature (27°C) on weekly basis for physical analysis using method described in AOAC, 2000. The cashew juice was stored for 8 weeks. After 8 weeks, the juice was analyzed for physical and chemical properties and sensory perception.

Experimental Design

The study employed a completely randomized design (CRD). Each treatment was replicated three times. The physical analysis was carried out using AOAC 2000. The sensory analysis was performed by trained panelists using hedonic scale of 1 to 9. Ranging from 1-dislike extremely to 9- like extremely.

Statistical Analysis

A one-way analysis of variance (ANOVA) was performed on the obtained data using Co-Stat statistical software. The mean of three replicates was separated using Duncan's test at a significance level of 5 percent.

Results and Discussion

Table 1: Microbial counts for cashew juice extracted using different methods

Cashew juice	MME				MHE				MTE			
	Wk 1	Wk 2	Wk 3	Wk 4	Wk 1	Wk 2	Wk 3	Wk 4	Wk 1	Wk 2	Wk 3	Wk 4
BC (Cfu/mL)	2	8	10	15	2	5	100	200	0	0	50	70
YC (Cfu/mL)	7	12	17	25	5	10	16	32	2	8	13	45

Legend: MME - manual machine, MHE - Manual Hand Expelled (Muslin cloth), MTE - Motorised Machined, BC - Bacteria count, YC- Yeast count, Cfu/mL - Colony forming unit per mL

Counts from Table 1 above showed bacteria counts and yeast count. The growth pattern for bacteria count and yeast count shows increase on weekly basis. Specifically, although bacteria count increased in all the methods of extraction yet, motorized machine appeared more stable followed by manual machine and manual hand expelled cashew juice had the highest bacterial count as the storage progresses. Higher number of colonies recorded with MHE could be traced to direct human contact during the extraction process. The surge in colonies as observed with yeast count of MTE extracted cashew juice could be a result of heavy sediment (pulverized cashew particles) generated from the motorized extractor providing medium for growth and multiplication.

Sensory Evaluation

The sensory evaluation report revealed that cashew juice obtained from manually driven cashew juice expeller (MME) compares well with the sample obtained from trade (control), and ranked better than the extract from motorized machine (MTE) and hand expelled sample (MHE) in terms of colour, taste, flavor, smoothness, and overall acceptability.

Effects of extraction methods on juice quality parameters

Table 2 showed the physical parameters monitored on the cashew juice extracted using different methods and this serves as the basis for comparison with the results obtained during storage. Results show slight deviation in parameters and on over all, with no significant difference, thus an indication that the cashew juice extracted was stable under the storage condition.

Table 2: Physical parameters of cashew juice extracted using different methods Parameters

Parameters	MHE	MME	MTE	Control
pH	3.8±0.11	3.9±0.13	3.9±0.18	3.7±0.04
Specific Gravity	1.046±0.02	1.048±0.05	1.062±0.20	1.038±0.05
Brix (%)	11.3±0.12	12.1±0.08	15.3±0.10	9.7±0.13
Colour (380/420nm)	1.309±0.15	1.696±0.20	1.114±0.07	0.989±0.04
Sediments (g)	10.63±0.5	12.50±0.3	13.48±0.88	1.02±0.06

Conclusion

Cashew juice has been expelled by manual hand extraction method viz-a-viz manually driven machines. The attempt made in this study at employing motorized machines compares well as it throw-up a huge positive. It was encouraging to note, the microbial stability reported at week one and week two. These feet can be sustained by improving on the machine' screen-size and thus help to reduce the sediment or particles present in the expelled juice.

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Experimental Title: Storage Quality and Sensory Properties of Coffee Pineapple Jam

Investigators: Raji, M.O., Jayeola, C.O., Ajewole, A.O., Atanda, J.F., Raji, Akeem Olayemi.

Introduction

Pineapple (*Ananas comosus*), a tropical fruit which belongs to the family of Bromeliaceae (Ayala-Zavala *et al*., 2010), is an essential source of importanc nutrients in the diet, such as carbohydrates, vitamins, bioactive components, and minerals. Pineapple (Smooth cayenne) which is known as the king of fruits has an alluring flavor and good nutritional value and is used as a source of vitamin C. Pineapple is ranked third in tropical fruit production, succeeding bananas and citrus fruits (Ali *et al*., 2020). In 2019, the annual production of pineapple is approximately 26 million tons (Hadidi et al., 2020), yet, more than 30% post-harvest losses are incurred within and after leaving the farm gate, hence, leading to high yearly economic losses. Invariably, to avoid postharvest losses and increase shelf life such as this, pineapple fruits are usually processed into more shelf-stable products such as juice, fruit bar, jelly, and jam. Pineapple is rich in sugar, especially sucrose, glucose and fructose, and other components such as minerals and vitamins which makes it an ideal raw material for jam preparation (JohAli *et al*., 2020; N et al., 2018).

Jam is an effective method of fruit preservation since it retains health and nutritional benefits of the raw material especially off seasonal products (Timothy *et al*., 2019). Fruits such as lemons, cranberries, apples and apricots were commonly used in the production of jams (Burkill, 2007). Fruit jam processing steps include juice extraction, clarification, concentration, and stabilization (Bhatnagar and Subramanyam, 2000). Jam is a likely source of several nutrients including fibers, proteins, vitamins, and antioxidant compounds (Dubey et al., 2021) However, it tends to have lower nutritional values (lower vitamin C content) when compared to fresh fruits. This is due to exposure to the heat generated during processing (Jawaheer *et al*., 2003).

Coffee is one of the most significant agricultural commodities in the world which possesses three main characteristic features, that is, acidity, aroma and taste. It is derived from over 1500 chemical substances, 850 volatile and 700 soluble. When

coffee is extracted in water, most of the hydrophobic compounds, including oils, lipids, triglycerides, and fatty acids remain in the grounds, as do insoluble carbohydrates like cellulose and various indigestible sugars. Structural lignin, protective phenolics and the wonderful aroma-producing essential oils are also present in coffee (Padmapriya *et al*., 2013). Coffee is a caffeine-containing beverage consumed daily worldwide to improve cognitive functions. Yearly, an approximate of about 3 billion cups of coffee are consumed every day, translating into an economic value of approximately US $ 200 billion per year (Mahmus *et al*., 2020; Samper *et al*., 2017). In 2022, coffee production was to be 170.5 billion of 60-kilogram bags, implying an increase of about 5.5 million regarding the global consumption of this beverage reported previously (Statista, 2023). Asides the economic importance of coffee, coffee has medical applications with health benefits. Previous studies have shown that the consumption of coffee for extended periods of time, reduces risk of the development of type two myelitis diabetes (Higdon & Frei, 2006). Some chemical compounds that are characteristic of coffee include caffeine and chlorogenic acids, among others. Caffeine-rich coffee was also found to show an apoptotic effect on cancer cells and function as a chemo preventive agent (Jabir *et al*., 2018). According to Boonchum *et al*., (2011), humans are exposed to free radicals virtually every day, from ultraviolet (UV) light, cigarette smoke, ionizing radiation, certain organic solvents, pollutants and industrial waste. Also, free radicals are harmful to health, negatively impacting several cellular damages (Pezzuto and Park, 2002).

Stability storage is the placement of samples into environmentally controlled chambers to determine how the quality of the substance or product varies with time under the influence of environmental factors such as temperature, humidity and light. Stability studies are a critical component in food and regulated product development. Storage studies determine whether any physical, chemical or microbiological changes affect the efficiency and integrity of the final product, thereby ensuring that a food or regulated product is safe and effective, irrespective of where it will be supplied in the world. Therefore, research effort should be geared towards establishing the safety of coffee - pineapple jam. The aim of this study is to determine physicochemical, storage stability and sensory properties of jam fortified with infused coffee beans powder.

Materials and Methods

Pineapple was purchased from Oje market in Ibadan. Oyo State. Coffee beans were obtained from Cocoa Research Institute of Nigeria.

Preparation of roasted coffee beans

The dried coffee beans obtained from Cocoa Research of Nigeria were cleaned by removing foreign matter, the beams was then washed under running water and then air dried at room temperature for 2 hours. The beans were then roasted in an electric oven for two hours and ground to obtain the coffee powder.

Preparation of pineapple pulp

Figure 1: Pineapple fruit

The pineapples were sorted to obtain matured undamaged fruits, the crown of the pineapple was removed, the fruits were then peeled, cut into small pieces, crushed and blended to obtain the pulp.

Production of pineapple pulp

Sugar, roasted coffee powder in different proportions (to achieve different formulations) and pectin were added to the pineapple pulp.

Production of coffee pineapple jam

The pineapple pulp was then boiled until bubbles appear and the spoon test is passed. The coffee pineapple jam was transferred into clean sterilized bottles.

Figure 2: Coffee Beans

Plate 3: Coffee - Pineapple Jam.

Stability studies

The titratable acidity and brix of the food were analyzed according to the official method of analysis described by the Association of Official and Analytical Chemist (AOAC, 2012).

Microbial contents determination

The determination of the fungi counts was done by the method outlined in compendium methods for the microbiological examination of foods (APHA, 2012).

Sensory evaluation of samples

The sensory evaluation was carried out using 20 panelists who was randomly selected among the students and staff of Kwara State University, Malete, Kwara State, Nigeria. Hedonic scale of 1-extremely dislike and 9-extremely like was used for the sensory test.

Statistical Analysis

Each parameter was determined in duplicate and average values for each sample was expressed as mean ± SD. Data generated was subjected to statistical analysis (ANOVA) using a statistical package for the social sciences, (SPSS version 20.0) and mean separation was used to analyze the data.

Results and Discussions

The result of the physicochemical of the jam produced from coffee pineapple jam is given in Table 1. The physiochemical properties; Titratable acidity (0.08 – 0.08) was constant upon the inclusion of the coffee beans powder, Brix (13.20 – 16.00) decreased significantly upon the inclusion of coffee beans powder.

The constant titratable acidity shows that the inclusion of coffee powder had no effect on the acidity of the jam. The titratable acidity decreased insignificantly from 0.08 – 0.06 as the storage week increased from week 1 – 8 and the samples showed no significant difference ($p<0.05$). The reduction in the acidity of the jam samples during storage may be due acidic hydrolysis of polysaccharides where the acid present in the sample is utilized in the conversion of non-reducing sugars to reducing sugars (Bhardwaj and Pandey, 2011: Mgaya-Kilima *et al*., 2014). This result is similar to the result of Mgaya-Kilima *et al*., (2014) who evaluated the influence of storage temperature and time on the physicochemical and bioactive properties of roselle-fruit juice blends in plastic bottle.

The mean of the brix content reduced significantly from 14.88 – 11.23 as the storage week increased from week 1 – 8 and the samples were significantly different from each other ($p>0.05$).

Microbial Analysis of Coffee Pineapple Jam

The result of the microbiological analysis is shown in Table 2. Control sample had the highest growth of colony count ($14.5x10^3$ - $75.5x10^3$) and mold ($1.45x10^4$ - $7.55x10^4$). The colony count as well as the fungi count increased during storage of the jam (week 1 – 8). The colony count and the fungi count reduced with increased coffee inclusion (**(**$14.5x10^3$ to

$10x10^3$). while sample 90%PJ:10%C was least in supporting both colony ($10x10^3$ - $58.5x10^3$) and mold count ($1.00x10^4$ - $5.85x10^4$) which also increased from week 1 – 8. Generally, the colony count was higher than the mold count which indicates that the jam supported more of bacteria growth than mold growth.

Table 1: Storage Stability of the Physiochemical properties of Coffee Pineapple Jam

Parameters	Weeks	100%PJ:0%C	97.5%PJ:2.5%C	95%PJ:5%C	92.5%PJ:7.5%C	90%PJ:10%C	Mean	P-level
Titratable Acidty	1	0.08±0.00a	0.08±0.00a	0.08±0.00a	0.08±0.00a	0.08±0.00a	0.08	NS
(Mg/100g)	4	0.07±0.00a	0.07±0.00a	0.07±0.00a	0.08±0.00a	0.08±0.00a	0.08	NS
	6	0.07±0.00a	0.07±0.00a	0.07±0.00a	0.08±0.00a	0.07±0.00a	0.07	NS
	8	0.06±0.00a	0.06±0.00a	0.06±0.00a	0.07±0.00a	0.06±0.00a	0.06	NS
Brix	1	16.00±0.10a	13.40±0.10c	16.00±0.10a	15.80±0.10b	13.20±0.10d	14.88	***
	4	14.39±0.09b	12.05±0.09c	14.39±0.09b	15.61±0.10a	11.87±0.09d	13.66	***
	6	12.94±0.08b	10.84±0.08c	12.94±0.08b	15.43±0.10a	10.67±0.09d	12.56	***
	8	11.57±0.06	9.67±0.06	11.57±0.06	13.80±0.10	9.53±0.06	11.23	***

Table 2: Microbial Analysis of Coffee Pineapple Jam

Sample	week 0		week 2		week 4		week 8	
	CC	TFC (cfu/g)	CC	TFC (cfu/g)	CC	TFC (cfu/g)	CC	TFC (cfu/g)
100%PJ:0%C	$14.5x10^3$	$1.45x10^4$	$29x10^3$	$2.90x10^4$	$53x10^3$	$5.30x10^4$	$75.5x10^3$	$7.55x10^4$
97.5%PJ:2.5%C	$14x10^3$	$1.40x10^4$	$27.5x10^3$	$2.75x10^4$	$42.5x10^3$	$4.20x10^4$	$71.5x10^3$	$7.15x10^4$
95%PJ:5%C	$13x10^3$	$1.30x10^4$	$25x10^3$	$2.50x10^4$	$42x10^3$	$4.20x10^4$	$64x10^3$	$6.40x10^4$
92.5%PJ:7.5%C	$11.5x10^3$	$1.25x10^4$	$19x10^3$	$1.90x10^4$	$42x10^3$	$4.20x10^4$	$60x10^3$	$6.00x10^4$
90%PJ:10%C	$10x10^3$	$1.00x10^4$	$20x10^3$	$2.00x10^4$	$40x10^3$	$4.00x10^4$	$58.5x10^3$	$5.85x10^4$

CC: Colony Count, TFC: Total Fungi Count

Sensory attribute of Coffee infused Pineapple jam

Table 3 shows the sensory attributes of coffee infused pineapple jam. The taste, aroma, consistency, appearance and overall acceptability results of the samples ranged from 3.00-8.80, 2.85- 8.40, 3.05 – 8.10, 3.10 – 8.80, 3.45 – 8.85. This result showed that the overall mean of the taste, aroma, appearance and overall acceptability of the jam fall within the like slightly range except for consistency (5.82) which fall within the neither like nor dislike range. The range of result may be explained as being disliked moderately to liked very much in terms of taste (3.00 – 8.80), consistency (3.05 – 8.10), appearance (3.10 – 8.80), overall acceptability (3.45 – 8.85) except for aroma (2.85 – 8.40) which ranged between dislike very much to like very much. Sample 90%PJ:10%C which had the highest coffee value ranged between dislike very much to dislike moderately (2.85 – 3.45) while the sample 97.5%PJ:2.5%C with the lowest coffee fall within the range of like moderately (7.05 – 7.95) unlike the control which fall within the range of like very much (8.10 – 8.85).

Table 3: Sensory Evaluation Result of coffee Pineapple Jam

Sample	Taste	Aroma	Consistency	Appearance	Overall Acceptability
100%PJ:0%C	8.80±0.62a	8.40±0.60a	8.10±1.17a	8.80±0.41a	8.85±0.37a
97.5%PJ:2.5%C	7.75±0.72b	7.70±0.80b	7.05±1.47b	7.55±1.19b	7.95±0.51b
95%PJ:5%C	6.45±0.83c	6.40±1.19c	6.40±0.75b	6.55±1.43c	6.85±0.75c
92.5%PJ:7.5%C	4.95±0.83d	4.70±1.08d	4.50±1.00c	4.75±1.62d	5.20±1.36d
90%PJ:10%C	3.00±0.97e	2.85±1.18e	3.05±0.94d	3.10±0.97e	3.45±1.39e
Mean	6.19	6.01	5.82	6.15	6.46
P-level	***	***	***	***	***

Values with different letters within the same column are significantly different at $p<0.05$, *$p<0.05$, **$p<0.01$, ***$p<0.001$. PJ: Pineapple Jam, C: Coffee

Conclusion

The use of coffee inclusion in jam reduced the brix significantly, however, the reduction was not significant in the titratable acidity observed during the 8 weeks shelf-life study. It was also noted that the brix decreased with increased inclusion of the coffee powder. The same trend was noted in the sensory evaluation with the exception of the sample containing 2.5% coffee powder inclusion which had a higher acceptance next to the control (100% Pineapple jam). The result obtained from this study showed that the samples encouraged the growth of bacteria than mold, nonetheless, both were within safe limits.

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Experimental Title: Investigating Effects of Varied Wet Method on Quality of Robusta (*C. Canephora*) Coffee

Investigators: Adeleke, S. A., Jayeola, C. O., Adesokan, M. A. and Yusuf, T. I.

Introduction

The coffee drink is brewed by roasting coffee beans from coffee berries of a particular coffee species. Nigeria is regarded to have a good potential for coffee propagation in Africa (Ogunjirin, 2021). Over the years, it has contributed positively to the GDP and livelihood of Nigerians, though its potential has not been fully accessed (FAO, 2018). Globally, coffee is known as one of the most valuable commodity crops after rice due to its consumption as a beverage. Revenue realized from coffee in Nigeria is pretty low and below the minimum requirements of basic livelihood due to poor farming and processing practices (FAO, 2018). Recently, due to

government intervention in Agriculture, production of coffee has been increasing. The interventions include better policies that allow coffee farmers easy access to capital, credit facilities, subsidies, skills, machine and equipment, training and others to encourage coffee farmers to commercialize production.

Generally, coffee fruit consists of exocarp (pulp), mesocarp (mucilage), endocarp (parchment hull), spermoderm (testa or silver coat), endosperm (albumen) and embryo, made up of two cotyledons. In wet processing pulp is usually removed by pulpers (machines) or traditional mortar and pestle. Mechanical pulping may impact on the amount of mucilage left on the beans after pulping. Variation in soaking period and fermentation time may also impact on chemical composition and quality of coffee beans.

Furthermore, coffee Robusta exhibits 50% more caffeine composition than coffee Arabica, making it a low-cost alternative that is adopted mainly in blends (Belachew, 2003). Factors such as processing, harvesting techniques, nutritional properties, cultural treatments, genetics, environment, drying method, beverage extraction and roasting influence the chemical composition of coffee (Pinheiro *et al*., 2020). The characteristics of coffee that can be influenced by the chemical composition include taste, color, size, weight, brittleness, and flavour (Wulandari *et al*., 2021). Postharvest processing is the primary determinant of the quality of the final coffee produced. Information on the quality of mechanically pulped local coffee berries under various soaking and fermentation conditions are scarce. This study is to investigate Robusta coffee under varied soaking and fermentation period using mechanical pulper.

Materials and Methods

Robusta (*C. Canephora*) used in this study was obtained from the Cocoa Research Institute of Nigeria (CRIN) plantation, Idi Ayunre, Ibadan, in 2024. Selective method was used for harvesting the berries, followed by sorting to obtain good berries. Wet method was adopted to process the berries into green beans. A manually operated single-disc pulping machine was used to remove the pulp from the coffee berries after soaking for different times ranged from 24 to 72 hours.

Soaking and Fermentation

Seven samples of coffee berries were processed at different soaking and fermentation times. Soaking times was varied between 24 to 72 hours while fermentation times varied from 0 to 24 hours. Soaking is to facilitate softening of the pulp for effective removal. Fermentation is a critical step which influences the product's quality such as flavor development and nutritional profile. Avallone *et al*. (2005) explained that in wet processing, a fermentation process occurs to remove the mucus layer on the surface of the coffee bean horn skin. Fermentation is a valuable chemical event in forming compounds such as flavor: organic acids, amino acids, and reducing sugars.

Table 1: Pulping method, soaking time and fermentation time of samples.

Sample	Pulping Method	Soaking Time	Fermentation Time
A	Machine	24 hrs	24 hrs
B	Machine	24 hrs	14 hrs
C	Machine	48 hrs	14 hrs
D	Machine	48-72 hrs	13-14 hrs
E	Machine	48 hrs	24 hrs
F	Mortar and Pestle (Manual)	24 hrs	24 hrs
G	Machine	48 hrs	0 hrs

Chemical Analysis

The chemical testing for the different coffee samples was carried out using AOAC 1990 methods. The caffeine content was tested using the chromatography spectrophotometer method. Protein analysis was performed using the KJELDAHL method, fat analysis was performed using the SOXHLET method, and ash content was determined using the gravimetric method.

Brewed Coffee Cup Quality Methodology

The cupping quality test (taste test) was conducted at the Sensory Evaluation Unit of the Value Addition Research Department of CRIN. The coffee samples were roasted at 140°C and processed into powder using a high-power electric blender. An organoleptic test was conducted using a panel of 12 trained panelists, evaluating parameters such as aroma, taste, acidity, bitterness, uniformity, astringency, and overall acceptability. A 9-point hedonic scale was used to score the different attributes of the coffee samples, ranging from 9 - like significantly to 1 - dislike highly.

Results and Discussion

It was observed that all the chemical and nutritional parameters investigated: protein, fat, ash and caffeine were affected by the processing methods (Table 2). It can also be noted from Table 2 that most of these chemical and nutritional qualities were highly influenced by fermentation time: ash, protein and caffeine were specifically higher for 24 hours compared to 0 hours fermentation time. Comparing samples A and E also shows that soaking period affected the chemical composition. Table 3 indicates that cup quality of the samples was also influenced by the processing methods. The marginal differences between the values of cup quality parameters of samples E and G is an indication that fermentation time did not affect these parameters much. However, there was considerable difference in values of most cup parameters between samples A and F which shows that pulping method significantly affected these quality factors. Samples A and E. Samples A and E indicated that most of the cup profile factors were influenced by the soaking time. The results may be caused by the fact that pulping method, whether mechanical or manual, can influence the raw material's particle size distribution and texture which may enhance the soaking efficiency and subsequent fermentation process. Furthermore, different processing methods will produce different compositions of coffee, one of which is caffeine content that can create a distinctive taste for each coffee produced.

Table 2: Chemical and Nutritional Composition of Samples

Sample	ASH	FAT	Protein	Caffeine
A	5.20	12.41	12.11	0.049
B	4.51	13.62	13.64	0.061
C	4.62	13.42	12.02	0.042
D	4.84	13.12	13.22	0.053
E	4.88	12.84	13.34	0.058
F	4,72	12.76	13.12	0.064
G	4.68	13.12	12.22	0.046

Table 3: Cup Quality Test of Coffee Samples

Sample	Aroma	Taste	After Taste	Acidity	Body	Uniformity	Balance	Clean Cup	Sweetness	Overall	SCORE	AVERAGE
A	8.13a	8.02	7.94	8.19	7.88	8.00	7.94	7.00	8.00	8.13	86.08	8.61
B	7.83ab	7.75	7.75	7.44	8.00	8.02	7.75	7.21	8.00	7.88	84.45	8.45
C	7.24b	7.69	7.69	7.69	7.63	8.12	7.69	8.00	8.00	7.69	83.83	8.38
D	7.80a	7.81	7.56	7.75	7.69	8.00	7.56	7.80	8.00	7.69	83.94	8.39
E	7.75b	7.56	7.56	7.69	7.69	8.20	7.69	10.00	10.00	7.56	83.50	8.35
F	7.81ab	7.75	7.63	7.69	7.69	8.00	7.81	10.00	10.00	7.69	84.07	8.41
G	7.63	7.63	7.63	7.56	7.75	8.20	7.63	10.00	10.00	7.50	83.33	8.33

Conclusion

Chemical and cup profile properties of investigated Robusta samples were affected by the processing methods. The soaking time, fermentation time and the pulping method influenced most of the chemical and organoleptic factors investigated. It can be deduced that the optimal conditions for local coffee production needs to be established, since it has been noted that environmental factors affect quality of coffee produced.

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Training Department

The training department arm of the Institute is saddled with the responsibility of implementing the training policy and capacity building of staff in the Institute. Some of the achievements of the training department for the year 2024 are highlighted below:

Hand-on training on cashew milk production

In line with the national goal of youth empowerment, the Institute trained 20 Interns from 7 Institutions of Higher learning on cashew milk production. The hand-on training was organized by the Value Addition Research Department of the Institute.

Technical training on cashew: CRIN GIZ-MOVE Collaboration.

A two-phase partnership to provide technical support Cashew Technical Training was facilitated by CRIN-GIZ-MOVE. The first phase involved training on cashew production and processing which drew participants from Federal Ministry of Agriculture and Food Security, Federal Ministry of Trade & Investment, NEPC, CAPPAN, NCAN, Financial institutions, Regulatory agencies and CRIN amongst others. The training centred on Cashew Market and Value Chain Concept, Cashew Sector Organisation and Adult Training Principles, Improved Planting Material Development, Nursery and New Plantation Establishment and Pest The second phase involved developing an MoU with CRIN on cashew research in Nigeria.

TRACE Master Trainer Course on Climate-Smart Agriculture

CRIN in collaboration with the U. S. Department for Agriculture Lutheran (USDA), World Relief, International Institute of Tropical Agriculture (IITA) and Akwa Ibom State Government organized a training course on Climate-Smart Agriculture for extension workers. The goal of the training is to support farmers to improve cocoa production, using the climate-smart technique as well as expand the market access for Nigeria cocoa.

Safe environment for Safe Cocoa training program

The institute in collaboration with the Safe Environment Safe Amphibian Conservation Organization (SESACO) conducted a comprehensive five-day training program on organic cocoa farming, hand pollination, and cocoa value-added products. The training was aimed at equipping participants with practical skills and knowledge to enhance their farming practices and contribute to the sustainability of cocoa production in Nigeria.

Management Retreat

In a bid to build a management team with acumen and insightfulness needful to support the Institute in its drive to sustain its vision and mission, a 3-day

highly intensive management training was conducted. The theme of the retreat was: "Agribusiness and Financial Investment Opportunities for the Management Staff of CRIN". The objectives of the retreat were to build the capacity of CRIN management team on: (i) Business Opportunities Across Agricultural Value Chain, (ii) Steps to Establishing Profitable and Sustainable Agricultural Enterprises, (iii) Financial Investment Opportunity, (iv) Periodic Health and Medical Screenings: Preventive Care Essentials for Midlife and Beyond, (v) Guide to Staying Healthy, Happy, and Ahead of Potential Health Risks and (vi) Tips on Planning for Retirement.

International training

As part of the training effort of the Institute, the following staff have benefited from attending training at various locations as indicated below:

SN	Attendee	Conference/Workshop	Location	Date
1.	Mrs. E.A. Adeyemi,	Master Training Programme (MTP) African Cashew Alliance conference	Accra, Ghana	Feb. 26 to Mar 01, 2024 and 18 March 18-22
2.	Mr. Agbongiarhuoyi Anthony	Master Training Programme (MTP) African Cashew Alliance conference	Accra, Ghana	Feb. 26 to Mar 01, 2024 and 18 March 18-22
3.	Dr. Osita Ibe	Master Training Programme (MTP) African Cashew Alliance conference	Accra, Ghana	Feb. 26 to Mar 01, 2024 and 18 March 18-22
4	Dr. Akintobi Ogunsowo	Master Training Programme (MTP) African Cashew Alliance conference	Accra, Ghana	Feb. 26 to Mar 01, 2024 and 18 March 18-22
5	Mrs. Philo Orimoloye	Master Training Programme (MTP) African Cashew Alliance conference	Accra, Ghana	Feb. 26 to Mar 01, 2024 and 18 March 18-22

PhD Defense

SN	Name	Title of thesis	Institution	Date
1	Dr. Akintobi O.Ogunsowo	Anti hyperglycaemic activity and safety profile of fractions of aqueous extract of CAS (AECAS) in streptozotocin-induced hyperglycaemic rats.	University of Ilorin.	March 4, 2024.

PRODUCTION AND SUBSTATIONS DEPARTMENT

Plantation and Estate Management

The detailed analysis of the activities of the year under review are itemized below:

A. **Staff Strength/Staff Disposition**

B. **Farm Activities**

S/N	Unit	Effective Hectarage	No. of Staff	No. of PCW
1.	PEM	-	5	
2.	Zone 1	34.79	17	
3.	Zone 2	15.14	13	
4.	[illegible]	15.19	8	
5.	Zone 5	27.63	15	
6.	Zone 6	26.00	15	
7.	Zone 7	23.85	11	
8.	Zone 8	41.05	17	
9.	Zone 9	22.89	9	
10.	BCOO	6.00	2	2
11.	Fermentary	-	9	
12.	Ground Maintenance	-	33	15
13.	CFC/HPU	-	20	2
14.	Oil Mill	-	11	

All farm activities in various zones were faced with challenge of declined in the shortage of manpower, non-availability of farm input; farm tools and Agro-chemical as well as preparation for RIGAN and 60th Anniversary which was a huge success.

C. **Harvest Records**

Despite all the constraints, below were the harvesting record for the year 2024.

D. **Challenges and Constrains**

1. We have inadequate of everything, including

S/N	Units	Cocoa pods	Cashew (kg)	Kola	Plantain	Banana
1	Zone 1	1,895	57.4	-----	-----	304
2	Zone 2	2,357	-----	-----	-----	-----
3	Zone ¾	150	23.0	-----	-----	-----
4	Zone 5	9,793	-----	-----	-----	-----
5	Zone 6	3,206	-----	-----	-----	-----
6	Zone 7	-----	-----	250	-----	-----
7	Zone 8	23,339	-----	-----	12	137
8	Zone 9	292	-----	-----	-----	-----
9	BCOO	5,203	-----	-----	-----	-----
10	CFC/HPU	458 (hand pollinated) 8,444 (open pollinated)	-----	-----	-----	-----
	Total	55,137	80.4	250	12	441

chemicals, tools and manpower to handle the plots in the year ended. Nothing was given to us as a division that could make our work easy. We find it difficult to carry out activities in the zone due to Fulani invasion on our farm and nothing is being done to curb their activities.

2. Inadequate/shortage of manpower is another serious problem we are facing on the field
3. Non availability of offices for Agric. Superintendent.
4. Porosity of Zonal farm houses complex.
5. Late and inadequate supply of agro-chemicals.
6. Inadequate supply of farm tools and protectives clothing materials
7. Monitoring and supervision of our plots is difficult due to unavailability of functional motorcycles or utility vehicle.
8. Functional Bazuki tricycles are needed for evacuation of our farm produce
9. The oil mill unit needed total renovation
10. Illegal felling of wood.
11. Pilfering of our farm produce is still a menace in our various plots.

E. **Staff Exit from The Division due to Conversion**

Mr. Kunnuola Seun former field staff was converted to an executive officer and he was redeployed to Admin. & Supplies department, Miss Adesina Motunrayo former field staff was also converted to an executive officer and she was redeployed to Audit while Ologuunwa Temitope, Okoh Mercy, Matthew Samuel, Makinde Bunmi, Onuh Paulina, Patrick Emmanuel Ovie were formerly a field staff but got converted to a Supervisory level with additional qualification.

Retirement from Service

Mrs. Onwudi Maria and Mr. Agboluaje Ganiyu retired from active service while, Mr. Babalola Moshood and Azeez Kafayat also retired voluntarily in the year under review

Decease

Mr. Adebayo, Joel Adekunle and Akangbe, Folorunso died in the active service in year 2024. May the good Lord put permanent end to untimely death in our mist.

Conclusion

We appreciate the Almighty God for the opportunity given to us to be alive. We also appreciate the Executive Director and our immediate boss in person of Dr. Ogunlade M. O. for their fatherly role in Plantation & Estate Management and the Institute as a whole, we are using this medium to let him know that we still need more of his assistance in making our work go smoothly.

Thank you.

Adeyemo, R. F. (Mrs.)
Plantation Manager

NURSERY DEVELOPMENT AND Management Section

The Nursery section comprises of two units, Sexual propagation unit and Vegetative propagation unit. The activities of each unit in the year reported are as follows:

1. Sexual propagation unit (SPU): The following activities were carried out in this unit:

-Propagation of CRIN mandate crops through sexual means

-Maintenance of seedlings of CRIN mandate crops

-Maintenance of plantain orchard

-Supply of seedlings of CRIN 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 the World Cocoa Foundation (WCF) plot.

2. Vegetative propagation unit (VPU): The activities performed by this unit are as listed below:

-Vegetative propagation of CRIN mandate crops through grafting, budding and stem cutting.

--Maintenance of 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

3. Other activities carried out include:

-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

4. Staff strength: The staff strength of the section is 30 (7 supervisors and 23 Staffers)

5. Achievement: The following achievements were recorded within the period reported upon:

-Propagation of 100,000 cocoa seedlings for commercial and research purposes

- Propagation of 1,000 cashew seedlings for commercial purposes

- Propagation of 1,000 Kola seedlings for research and commercial purposes

- Propagation of 500 coffee seedlings

-Production of cocoa, coffee, cashew and kola Clonal materials for field establishment and research purposes

6. Challenges: The nursery section is being faced with some challenges despite the achievements which include:

-Dilapidation of some shade nets

-Irregular transportation of staff to and fro Nursery

-Lack of security personnel in the nursery

-Lack of office equipment/facilities and sufficient farm tools and equipment for effective work and enhanced productivity

7. Recommendation: More attention should be given to Nursery section to improve the production of healthy seedlings and clones.

Babalola E. A. (Mrs)
Head/ NDM

Hybrid Production Unit (HPU)

The mandate of the unit is to generate cocoa hybrid pods for Nigerian farmers under Federal and State Government programs, stake holders, nursery Development management (NDM) to raise seedlings for sale and for research purposes.

Staff Deposition/Strength

The unit has two (2) supervisory level staff and eighteen (18) field staff.

1	ACAS	1
2	HAS	1
3	AS	1
4	AAS	2
5	CAFO	14
6	SAFO	1

The area of land covered includes;

1	International clone	2ha
2	Hybrid plots	2ha
3	Uhonmora plot	0.5ha
4	Local clone plot	ha
6	RVT plot	2ha

Operation Carried Out

This includes the following

1) weeding of coca plots
2) spraying of cocoa trees with fungicides and insecticides
3) pruning of cocoa trees
4) removal of chuppons
5) removal of mistletoes
6) harvesting of hybrid pods
7) Removal of termitarium.
8) Weeding and spraying of herbicides of road path

Achievements

Eight thousand nine hundred and two (8,902) pods were harvested from January to December 2024

1) Hand pollinated pods (458)
2) Open pollinated pods (8444)

Pollination Materials/ Chemical Received

Hillforce	250ml by12 pieces
Ultimax plus	50g by 100 pieces
Renova	250wdg 10 sachet
1 pack of force up	1l by12
2 jubali agrotech pulse	2
Knap sack Sprayer	2
Masthanne m-80	1kg by 2

constraints

1. Inadequate manpower
2. Untimely supply of herbicides
3. Damaged/unrepaired field implement e.g. wheel barrow, sprayers
4. No means of mobility: ground motorbike
5. Theft of cocoa pods

Recommendations

1. Repairs of damaged field implement e.g. wheel barrow, knap sack sprayer e.tc.
2. Hiring of male field contract workers to join the staff in combating weeding of overgrown plots.
3. Security patrol around the plots during the week days /on weekends.
4. Exchange of supervisors with lower cadre field workers for the unit.

E-signed

Iyadunni, kolawole
Head CFC/HPU

SUBSTATIONS

Ajassor Substation

Head of Station: Dr. A.O. Akinpelu

Preamble

Cocoa Research Institute of Nigeria (CRIN), Ajassor substation is one of the substations of the Institute. It was founded in the year 1965 and will be 60 years in 2025. CRIN Ajassor is located in Etung Local Government Area of Cross River State of Nigeria along Border Road near Cameroun Border. It is bounded in the West by Ikom Township, South by Effraya town, and North by Ajassor plantations (Etigefe) and East by Ajassor Mission town. The substation is predominantly cultivated with Cocoa and other mandate crops of the Institute prominent among them are Kola, Tea because of its soil fertility and ability to sustain most tree crops. Some handful of plantations of Kola, Coffee and Tea are also located at the station. In fact, it is well established that Cashew can also thrive in CRIN Ajassor. Consequently, all the five mandate crops of CRIN can be grown on CRIN Ajassor soil.

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.

Staff Disposition

S/N	Designation	Number
1	Chief Research Officer/Head of Station	1
2	Assistant Chief Agricultural Superintendent	1
3	Accountant 1	1
4	Assistant Chief Matron	1
5	Senior Statistical Assistant	1
6	Executive Officer	2
7	Chief Secretariat Assistant	1
8	Chief Health Assistant	1
9	Chief Agricultural Field Overseer	12
10	Assistant Chief Agricultural Field Overseer	3
11	Senior Driver/Mechanic	1
12	Assistant Field Assistant	2
	Total	27

The staff strength as at the year under review and as shown in the table above stands at twenty-seven (27) and four (4) Project Contract Workers (PCWs) who are engaged as security personnel. It is pertinent to inform CRIN Management that most staff of CRIN Ajassor especially those on the field and in the Security, Unit are very few and are ageing. Hence, there is an urgent need to recruit more young and vibrant people into the system.

Participation in Junior Staff Promotion Exercises: Four (4) staff members were involved and participated in the Promotion exercises conducted during the year under review. We sincerely appreciate the Management of the Institute for approving both promotion and conversion for the staff concerned as seen in the table below.

S/N	Names	Former Post	Present Post	Mode
1	Mrs Pauline Ugi	Senior Secretarial Assistant	Chief Secretarial Assistant	Promotion
2	Mr Anthony David	Senior Agricultural Field Overseer	Assistant Chief Agricultural Field Overseer	Promotion
3	Mr Edim Okpokam	Assistant Executive Officer	Executive Officer	Conversion
4	Mrs Ekama Blessing Isong	Chief Clerical Officer	Assistant Executive Officer	Conversion

Retirement from Service:

Two (2) staff of the Substation retired from service. They are:

S/N	Names	Designation	Date of Retirement
1	Mr Mmeregini Uwadiaru	Accountant 1	July 4, 2024
2	Mr Azogor Isong Echeng	Chief Agricultural Field Overseer	January 11, 2025

Redeployment:
The erstwhile Plantation and Estate Manager, Mr. Ajayi Kelvin Segun (Assistant Chief Agricultural Superintendent) was redeployed back to the headquarters effective March 17, 2025.

Plantation Management:
Despite visible challenges such as diminishing strength of the field staff, inadequate man power and farm inputs, the station was able to maintain and open up some abandoned plantations and improved the aesthetic values of the environment. Cocoa, Kola and Tea plots in CRIN Ajassor were maintained throughout the period under review.

In addition, establishment/survival count was carried out on the National Cocoa Seed Garden plot with a view to ascertaining the total number of surviving cocoa trees available on the plot since it was established. Similarly, sign posts describing each clone were erected to distinguish the clones from each other

Establishment count of National Cocoa Seed Garden Plot

S/N	Cocoa Varieties	Stand Count	Plot Size (Ha)
1	C77	195	0.27
2	C67	34	0.05
3	T57/22	43	0.05
4	T65/7	184	0.27

Remark: The effective hectarage for the crops in other plots is not certain as proper survey has not been carried out to determine the number of surviving trees. Meanwhile, some of the abandoned cocoa plots were put under share cropping, to discourage encroachment and to enhance increase in revenue and prevent spread of pests and diseases. In a bid to increase the plant population on our plots, the station has been able to raise seedlings to rehabilitate and supply missing stands in some of the cocoa and kola plots to replace the empty or dead space in 2025/2026 cropping season.

Infrastructure/Capital Project: The station has not benefitted from any infrastructural facilities and or capital project. We appeal to the Institute's Management to put this station in focus with respect to infrastructural projects in the coming year.

Research Experiments: Few numbers of research experiments were carried out at CRIN Ajassor Substation in the year under review as indicated in the table below..

Research experimental work carried out at Ajassor Sub-station in 2024

S/N	Year of Establishment	Treatment	Researcher (s)	Remarks
1	2024	Fertilizer Trial	Dr. Ayegboyin K.	Completed
2	2024	Agrochemicals and Botanicals	Dr Henry Otunoye *et al*	Completed
3	2024	Tea Nursery Establishment	Dr. Okeniyi *et al*	On-Going

Training of pollinators: In order to generate and produce true to type hybrid cocoa varieties; the station benefitted from the training organized for selected members of the community. The 2-Day training was facilitated by resource persons from the headquarters. Many stakeholders in cocoa production were part of the training held in the Exhibition Hall of the substation. The participants were taken through theory with the use of PowerPoint presentations and practical demonstrations on some selected cocoa plots. However, the Seed Garden cocoa plot was chosen as plot where the hybrid cocoa materials will be generated.

Organisations that participated in the Training

1. CRIN, Ibadan, Oyo State
2. CRIN Ajassor Substation, Cross River State
3. Lutheran World Relief (LWR), Ikom, Cross River State
4. Export Training Group (ETG), Ikom, Cross

River State
5. JB Cocoa, Ikom, Cross River State
6. Sunbeth, Ikom, Cross River State
7. Beyond Beans, Ikom, Cross River State
8. Johnvent Cocoa, Ikom, Cross River State

Eight pollinators were thereafter retained at the substation and they carried out the exercises for six (6) months (May-October, 2025).

Disbursement of fund

Consequent upon the directives from the Executive Director to raise twelve thousand seedlings from the hand pollinated cocoa pods. The station successfully raised the seedlings and also distributed two hundred and one (201) hand pollinated cocoa pods to farmers in Ikom and its environs. This was made possible through the fund and assistance received from the Traceability and Resilience in Agriculture and Cocoa Ecosystems (TRACE) Project.

The table below shows the crosses where the hand pollinated cocoa pods were derived based on the number of successfully pollinated flowers. However, some challenges experienced from pollinated flowers that developed into Cherelles were abortion, diseases and rodent attacks. These challenges were overcome through effective use of recommended measures.

Factors	Crosses		Total
	T 65/7 X T 57/22	C67 X C77	
No of Pollinated flowers	2939	4105	7044
No of Success	1015	1763	2778
No of Matured Hybrid Pods Harvested	402	424	**826**
No of Pods used for Seedling Production	280	345	625
No of Pods Distributed to Farmers	122	79	**201**

Shade Nets:

The three (3) shade nets for propagating seedlings were in deplorable conditions. The station was able to repair the shade nets in preparation for nursery establishment for cocoa seedlings as could be seen in the pictures below. In addition, iron scaffolds were erected and water tanks were placed close to each of the nets in order to reduce time and stress in watering the seedlings. Furthermore, with the repairs of the shade nets the station, based on staff motivation was able to raise more than twenty thousand (20,000) open pollinated cocoa seedlings with pods from the Seed Garden. Nevertheless, there is an urgent need to repair them so as to serve as models to visitors and farmers that come to the station for research needs.

Visit of the Executive Director (Dr P.O. Adebola)

It is with great pleasure and gladness I write the report of our Executive Director's (Dr P.O. Adebola) visit to CRIN, Ajassor Substation on Tuesday 28th February, 2025.

The Executive Director (ED) arrived the station in company of Dr M. Ogunlade (Director, Production and Substations), Dr F. Olasupo and Mr Abel Adegbindi at exactly 10am. They were received and ushered into the exhibition Hall by the Head of Station (Dr A.O. Akinpelu)

The Head of Station (HoS) in his welcome address congratulated and appreciated the ED for the successes recorded during the 60th Anniversary and hosting of the RIGAN Games by the Institute. He highlighted some of the achievements at the substation to the admiration and applaud of the ED and his team.

The HoS reported that the station has been able to raise about twelve thousand (12000) seedlings of Hand Pollinated (**T65/7 X T57/22 and C67 X C77**) materials in order to meet up with the Directives of the ED. In addition, the dilapidated shade nets and the collapsed fence of the structures housing the station's 50Kva generator have been repaired. Similarly, the aesthetic value of the station has improved through the motivation and supports being received from the ED and the Internal Management Committee (IMC) of the Institute.

In his characteristic manner of getting the job done without wasting precious time, the ED demanded he

be taken to the Seed Garden plots where hand pollination exercises were carried out earlier in 2024. At the plots, he commended the efforts of the station in keeping the plots clean and prepared for the generation of crosses for the TRACE Project. Some of the cocoa trees where the exercises were performed were shown to the team and pictures of the tagged cocoa trees were taken. However, he commented on the signpost that was erected on the plot. He advised it should have more information than what was inscribed. He showed a sample of what should be on the signpost.

Thereafter, he returned to the office to have an interactive session with the staff. During the session which he made very accommodating, members of staff were allowed to bare their minds on things bordering on their welfare and challenges being experienced at the station. Some of the challenges include:

1. Lack of basic infrastructures (Water, Electricity, Internet facilities)
2. Lack of Toilet at the Gate House for the Security Personnel
3. Inadequate and untimely remittances of contributions and dividends from the CI&CS at the headquarters
4. Lack of perimeter fence
5. Incidences of encroachment on the Institute's lands
6. Redemption of the promise made to the staff of the station during the last verification exercises at the headquarters

The ED assured the staff that the challenges raised will be addressed in due time. It is important to state here that the wages of the Project Casual Workers (PCWs) has been improved upward as at the time of writing this report.

A tour of the facilities of the station was made where the ED gave an order to immediately invite an expert in drilling borehole to assess the suitable location where another borehole will be drilled to replace the collapsed one. While at the nursery, he was impressed with the performance of the cocoa seedlings (Hand and Open Pollinated) being raised. Furthermore, the HoS led the team to the Palace of the Paramount Ruler and the Clan Head of Ajassor Community (HRM Anthony Ntui Etta). The ED was well received by the Clan Head and his subjects.

In his speech, the ED appreciated the visit of the Clan Head to the headquarters during the 60th Anniversary of the Institute and the heart-to-heart discussions they had together; the constant supports being received by the staff of the Institute at the Substation. He assured them that he will address some of the issues raised by the community and promised to repeat the visit before the end of the year.

Group photographs were thereafter taken to keep the memories of the events.

Participation in stakeholders' meeting for the establishment of Coffee and Tea Nurseries: The station represented the Institute in a programme organized by the Nigerian Export Promotion Council (NEPC), Calabar Coordinating Office, Cross River State. The broad objective of the programme was the identification and selection of suitable locations for the establishment of both Coffee and Tea nurseries in Cross River North Senatorial District. Suitable sites were selected in Ogoja and Obudu, respectively. The exercise was jointly carried out by The Ministry of Agriculture, Cross River State and Cross River Basin Development Authority (CRBDA).

List of the Representatives and their Organisations

S/N	NAMES	ORGANISATION
1	Dr Osas 'Damian **OMOROGBE**	NEPC, Cross River State Coordinator
2	Dr Ayodele Oladipo **AKINPELU**	Head, CRIN, Ajassor Substation
3	Mr William **IFERE**	Director of Crop, Cross River State Ministry of Agr iculture
4	Dr Elvis **UDEY**	Deputy Director Crops, CRBDA
5	Dr Assam **ASSAM**	President, National Association of Coffee and Tea Farmers, Cross River State

It will be recalled that the Institute (Cocoa Research Institute of Nigeria) through her substation at Ajassor, Cross River State was invited by the Nigerian Export Promotion Council (NEPC), Cross River State Coordinating Office to join other stakeholders in the Coffee and Tea value chain to attend a Stakeholders' Meeting of Coffee and Tea. This is as part of the roadmap towards the

development of Coffee and Tea for export in Cross River State in particular and Nigeria in general.

Consequently, a working group to achieve this broad objective was set up by NEPC. This comprises representatives of the following organisations:

1. Cocoa Research Institute of Nigeria
2. Cross River State Ministry of Agriculture and Irrigation
3. Cross River State Ministry of Commerce
4. Cross River Basin Development Authority (CRBDA)
5. National Association of Coffee and Tea Farmers

At the end of the visit, it was concluded that CRBDA has facilities (Land and Water resources) that can conveniently serve the intended purposes. In addition, Obudu Cattle Ranch was chosen as a site for the establishment of nurseries and demonstration farms for *Coffee arabica* and Tea because of the climatic condition. In all it was agreed that all the chosen locations should be prepared to accommodate one hectare each for the crops.

Participation in the 3rd National Cocoa Festival:

The Institute was represented at the annual Cocoa Festival tagged CALABAR 2024 held at the Metropolitan Hotel, Calabar, Cross River State. The festival had a twain theme: **'Roles of the National Cocoa Management Committee (NCMC) and Others in Mobilizing Stakeholders into European Union Regulations (EUDR) Compliance'** and **'Cocoa Value Addition and Youth Entrepreneurship: Key to Nigeria Cocoa Sustainability'.** The event was from 23-24 October, 2024.

There were two (2) sessions in the first day where each of the participating organisations was invited to share their views on the subjects for discussions while the second day was just one session.

It is pertinent to note that CRIN was well represented in all the sessions allotted for participation. At the end of the 2-day event, a communiqué was drafted, ratified and presented to the President of Cocoa Farmers Association of Nigeria (CFAN). It was unanimously agreed that the political will of the government is a crucial factor to drive the implementations of these recommendations to achieve the desired outcomes.

Participation in the 60th Anniversary of the Institute:

The station was involved in the celebration of the 60th Anniversary activities of the Institute which was simultaneously held with the Research Institute Games Association of Nigeria (RIGAN). Though the twain events were held at the headquarters in Ibadan. Staff and members of the substation actively participated. Mr AJAYI, Kelvin Segun won a medal at the RIGAN Games. Thanks to the supports received from the Executive Director.

Visit of the Honourable Commissioner, Ministry of Agriculture and Irrigation Development, Cross River State, Nigeria

The Honourable Commissioner of Agriculture and Irrigation, Cross River State, Nigeria (Hon. Johnson A. Ebokpo) paid an unscheduled visit to CRIN, Ajassor Substation on Saturday, September 28, 2024. The visit was a fall-out of the meeting of the Cross River State Committee on Cocoa, Coffee and Oil Palm Strategic Plan Development.

Coincidentally, the team was received by Dr S.O. Agbeniyi (Director, Research Operations) who was in the substation having taken a break from the training programme himself and other scientists came to execute in Ikom, Cross River State. He thereafter gave goodwill messages on behalf of the Executive Director.

In addition, the readiness of the Institute and the Substation to key into the Strategic Plan Development of the state government was greatly emphasised. Consequent upon this, the Head of Station (HoS) was instructed to serve as the representative of the Institute in the team.

In his responses, the Honourable Commissioner appreciated the contributions of the Institute to the economy of Cross River State through various ways among which is the introduction of hybrid and improved varieties of cocoa. He expressed the readiness of His Excellency (Senator Prince Bassey Otu) to strengthen the cord of collaboration with the Institute.

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(Senator Prince Bassey Otu) to strengthen the cord of collaboration with the Institute.

Moreover, he promised to send a team from the State Government to visit and assess the statuses of the road leading to the substation and other infrastructures such as the official residential buildings and office blocks. This will make for a proper recommendation to the Executive Governor for interventions in the constructions of the roads and renovation of the existing infrastructures in the Substation. The Commissioner could not hide his approval of the conditions of our cocoa plots.

Members of CRIN team present were:

1. Dr S.O. Agbeniyi (Director, Research Operations)
2. Dr M. Ogunlade (Director, Production and Substations)
3. Dr A.O. Akinpelu (Head, CRIN Ajassor Substation)
4. Dr. F. Olasupo (Plant Breeder)
5. Mr. A. Agbogiarhuoyi (Agricultural Extensionist)

Members on the Honourable Commissioner's team

1. Hon. Johnson A. Ebokpo (Honourable Commissioner, Ministry of Agriculture and Irrigation)
2. Professor Susan Ohen (Chairman, Cross River State Committee on Cocoa, Coffee and Oil Palm Strategic Plan Development)
3. Professor Damian Agom (Member)
4. Dr Assam Assam (Member)
5. Mr Williams O. Ifere (Director/Desk Officer, Cocoa and Coffee; Cross River State Ministry of Agriculture and Irrigation)
6. Mr Kenneth Asim Ittah (Member)
7. Mr Ubana Ubi Bassey (Member)

Handling over of cocoa seedlings raised for an organization (ETG, Beyond Beans):

The station was instructed to raise some number of cocoa seedlings for ETG, Beyond Beans. It is with pleasure I write that twenty thousand (20,000) hybrid cocoa seedlings were supplied to this organization.

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).

2. 404 Pick-Up with registration number FG 2326 B034.

3. Mercedes 911 Water Tanker with registration number FG 237 B02 (Need to repair the Power steering as soon as possible).

4. The Eicher Truck with registration number FG 740 B03 (Not functioning).

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.

7. Tractor 1 (serviceable) with registration number FG 239 B03 MF 265.

8. Tractor 2 (unserviceable).

9. Motorcycles 2: 1 Daylong Wolf 150; 1 TVS (Both Functioning); however, the 2 Suzuki 185 motor bikes with registration numbers FG 334 B03 and FG 335 B03 are old and not functioning.

10. 1 Tricycle Bazuki 200 TRC (Functioning)

11. Generators: 50 KVA Generator plant 1 (Functioning), 1 Elepaq 10KVA Petrol generator (Functioning), 1 Tiger 2700 (Functioning), 1 Sumec SPG 2500 (Functioning) and 1 Tiger T 950 (Functioning)

12. Farm/Field equipment: 3 Jacto Knapsack Sprayers (Functioning) Hand driven mowers; 2 Water pumps (1 Functioning, 1 Non- Functioning), 1 Harrow, 1 Plough (Not Functioning);

13. Visual equipment: 1 Overhead projector DLP LG,

14. Laboratory Equipment: 1 Autoclave, 1 Microscope

15. Electronic machines: 1 HP Scanner G4010 (Functioning), 1 HP Printer P1006 (Faulty), 1 HP Laptops, 3 HP Laserjet printer (2 Faulty, 1 Functioning), 1 Desktop computer (Samsung) (Faulty).

Challenges and Prospects:

Some of the challenges and prospects in CRIN Ajassor Substation are as follows:

Internally Generated Revenue (IGR):

It was observed that outstanding revenue increase was recorded in the period under review. This was due to motivation, dedication, commitment and ability to administer and supervise the few field staff and engagement of hired labour to work on different plots within the station.

Internally Generated Revenue Analysis for 2024 (May 2024-February 2025)

S/n	Description of Products	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Total
1	Cocoa Beans		29,750	110,000		361,950		210,000			325,000	1,036,700
2	Cocoa Pods	34500	79,000	36,000		898,000	185,000	450,000	45,000	300,000	922,000	2,949,500
3	Cocoa Seedlings						705,000					705,000
4	Kolanuts					34,000	84,500	87,000	30,000			235,500
5	Palm Oil	30,000										30,000
6	House Rents	7,000				42,500		127,600	85,000		33,600	295,700
7	Drugs	5,000	10,000			20,300		10,000			10,000	55,300
	Total	**76,500**	**118,750**	**146,000**		**1,356,750**	**974,500**	**884,600**	**160,000**	**300,000**	**1,290,600**	**5,307,700**

Inadequate workforce:

The station needs 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 persistence pilfering of our farm produce, more encroachment and much lower productivity.

Based on the size of the substation in terms of land mass, it is suggested that not less than 60 field staff and 3 Agricultural Superintendents be added to cope with the weeding, spraying, harvesting, pruning and other cultural practices on our plots dedicated to our mandate crops. Therefore, there is a need to employ additional Field Attendants to complement the existing 15 Field Staff. In addition, we need additional 10 Watchmen to complement our 7 current Watchmen (3 staff and 4 contract staff) at the moment.

Funds:

There is paucity of funds which has affected most of our activities at the station. However, the funds released to us through TRACE Project has helped us in achieving some results. The fund was judiciously spent for the maintenance of the seed garden plots where hand pollinated pods were generated and raising of seedlings from the pods as directed by the Management. We plead with the Management for adequate and timely release of Capital Votes to CRIN Ajassor Sub-Station as soon as possible to enhance efficiency. Weeding is done more than six times in Ajassor Substation due to high fertility of the soils, persistence rainfall among other factors. We need to repair and fuel our Toyota Hilux, Tractor, Water Tanker as well as Tricycle (Bazuki), machines, equipments and generators especially as we mobilize our field men to go into different plots and experimental sites within Cross River State.

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 still not been properly addressed holistically. The Head of Station has had different meetings with the Clan Head and Paramount ruler (HRM Anthony Ntui Etta) and his subjects on this issue. We were assured of their cooperation in dissuading the indigenes from engaging in such acts. Meanwhile, efforts were made internally by CRIN land allocation committee to remove all permanent crops planted by some recalcitrant. However, permission was temporarily

given to only those who are ready to cultivate arable crops at the boundaries of the research reserves. We suggest a GIS survey project to determine the extent of CRIN land.

Staff Quarters Renovation:
Virtually all the staff quarters need renovation, most of the existing buildings are now dilapidated, there is the need for urgent attention for renovation of these quarters to avoid total damage. The recent rainstorms this February affected some buildings making them almost uninhabitable as seen in the pictures below.

Water Supplies Challenges:
Water supplies have been a major problem in Ajassor substation despite persistence efforts been made by CRIN Management. The two bore holes (Solar and Electric Powered) that supply water for nursery/plantation irrigation and domestic usage are in bad condition. Thanks to our Executive Director who during his official visit to the station has promised to drill another borehole for the station.

Another means of water supplies is by the use of the Substation Water tanker truck (Mercedes 911) to fetch water from the village streams. The vehicle has been refurbished minimally. However, proper refurbishment is suggested to enhance optimal usage most especially during dry season which incidentally is the most useful period for the Water tanker. The Power steering needs to be repaired to reduce the stress on the driver.

Electricity Supply
It has been observed that the service line that comes to the station has been vandalized along Ikom-Mfum Border Road. Consequently, there has not been electricity supply from the Port Harcourt Electricity Distribution Company (PHEDC), Ikom, Cross River State.

Bad State of the Entrance Road
The only access road (2killometers) linking the substation from the international border road is in a very bad state up till now and this has affected movement of vehicles in and out of the station.

Poor Communication Network Provision
The Global Satellite Mobile (GSM) Communication network system at this part of Cross River State is epileptic. However, the presence of a mast (2G) within the station has made communication easy, though internet facilities are nothing to write home about within the substation. These affect research communications and interaction as and when due.

Persistent Pilfering
We constantly experience pilfering because our plots are been troubled by intruders illegally harvesting our mandate crops, mostly at night. The youths and the security men made all effort to combat this problem but we are not satisfied yet. The available security men who are not armed are few and ageing and likewise there's no perimeter fence to prevent the intruders from escaping.

Environmental Sanitation
Efforts are ongoing for staff and residents within the quarters to renovate toilet facilities in their various blocks to guide against open defecation and unhygienic ways of disposing both liquid and solid wastes within the quarters. Hence, the usual Monthly Environmental Sanitation exercises have been strengthened every last Saturday of the month throughout the year under review. This will go a long way to reducing incidences of communicable and non-communicable diseases that may result from these unwholesome acts.

Other achievements
The under listed are some of the achievements in the year 2024:

Internal training and re-training of both field and non-field workers on maintenance of plantations to enhance sustainability and productivity. This was done through provision of calendar of operations.

Introduction of recreational activities and fun fare to ease tension and to calm down fatigue/high blood pressure such as football competition,

Training on management and maintenance of health status of workers and tenants to avoid sickness and untimely death.

Provision of solar street lights to boost security activities around our quarters and shade nets, these were made possible by some concern citizens.

Control of security treat by the encroachers and re-acquisition of CRIN land through the involvement of DSS, Nigeria Army and the Nigeria Police force to chase and arrest the notorious perpetrators.

Fosterling of peace and order among the occupants

by the creation of quarter's Chief Councils within the estate by enacting and executing the tenancy policies formulated by the Ajassor substation management. This had yielded excellent results up till this moment. Violators have been required to pay some fines whenever any of the policies were abused.

Staff welfare has improved holistically as against the previous years; staff and tenants are granted assistance adequately when the need arises. Especially on health ground through access to the Health Center based on the approval of the Executive Director.

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 erection of perimeter 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. Tarring or grading of 1.5km road from Border Road to CRIN Ajassor main gate which is becoming un-motorable.
6. 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.
7. 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 tenants and staff will move out of the quarters and that will spell doom for the safety of all farm produce at the station.
8. Renovation of the existing and construction of more nursery seedling shade nets which are in very bad state.
9. Installation of inverter at the station to bring down the running cost on gasoline/diesel operated generator.
10. Repairs of meteorological station. This may assist in weather predictions and generate funds for the Institute from same.
11. Renovation of the fermentation house, purchase of tarpaulin for drying of cocoa beans, drying oven shed and construction of raised platforms for drying cocoa.
12. Provision of a modern and better equipped laboratory for CRIN Ajassor.
13. Completion of Cocoa bread bakery in the station.
14. Repairs of leaking roof of the administrative block building

OWENA SUBSTATION

Head of Station: Dr. O.S.O., Akanbi

1.0. Introduction

The 2024 Annual Report of the Owena Substation of the Cocoa Research Institute of Nigeria (CRIN) provides a comprehensive overview of the activities carried out between May 2023 and April 2024. This report highlights key achievements, challenges, and recommendations across various operational areas, including the nursery, field operations, finance, and other administrative activities. During the year under review, the substation remained committed to its core mandate of advancing cocoa research and development, ensuring the sustainable production of cocoa and other mandate crops. Efforts were directed towards improving nursery management, enhancing field productivity, maintaining financial accountability, and facilitating other research and extension activities. The dedication of the station's personnel, collaboration with stakeholders, and support from CRIN headquarters played crucial roles in achieving these milestones.

The subsequent sections of this report will provide a detailed account of the substation's progress in nursery operations, field activities, financial management, and other engagements that contributed to the overall success of the station in 2024.

Overview of Owena CRIN Substation

Owena Substation has a cultivable land area of 17.95 hectares, of which approximately 10.4 hectares are currently under cultivation. The Alade field is 0.5 hectares, of which 0.3 hectares are cultivated, while at Onisere Station the total cultivated area is 1.0 hectares out of 2.5 hectares.

Staff Disposition List

The disposition staff lists of the station during the period under review is presented in the table below

CRIN Owena Substation Staff Disposition as at March, 2024

S/N	NAMES	FILE NO	DESIGNATION	CONRAIS/ STEP	QUALIFICATION	DATE OF FIRST APPOINTMENT
1	Dr. Akanbi O.S.O.	330	AD	14/2	PhD	09/04/2008
2	Enosegbe Kelly	357	ACAS	12/5	HND	06/02/2009
3	Ojewale Ezekiel	359	ACAS	12/5	HND	06/02/2009
4	Akinrinola Akeem	1513	PEOII (Account)	9/3	HND	02/06/2003
5	Ajinisi Mary Oluwaponmile	1723	SEO (Account)	8/3	HND	10/08/2009
6	Arobieke Sunday	1721	SEO (Admin)	8/3	BSc.	02/07/2009
7	Alexander Yemi	1564	SAS	8/3	HND	08/09/2008
8	Adeoye Abosede Stella	1650	AAS	5/15	ND	02/01/2009
9	Ajayi Abiodun Adeleke	1525	CAFO	6/7	SSCE	02/06/2003
10	Thomas James	1526	CAFO	6/6	SSCE	02/06/2003
11	Mallam Dada	1719	CAFO	6/5	SSCE	30/06/2009
12	Oyekunle Emmanuel	1895	CMD	6/4	SSCE	05/12/2011
13	Ibrahim Tajudeen	1672	CAFO	6/3	SSCE	02/01/2009
14	Okujuwa Idowu	1812	CAFO	6/3	SSCE	29/04/2011
15	Okojie Peter	1905	CAFO	6/2	SSCE	19/12/2011
16	Chukwu Nweke Paul	1887	CAFO	6/2	SSCE	01/12/2011
17	Sanni Ibrahim	1916	CAFO	6/2	SSCE	26/01/2012
18	Oni Nike	1801	ACAFO	5/7	SSCE	29/04/2011
19	Shaibu Muhammed	1617	SAFO	4/12	SSCE	02/01/2009
20	John Mary	1813	SAFO	4/10	SSCE	29/04/2011
21	Bolarinwa Felix	1674	AFA1	3/15	PRY 6	02/01/2009
22	Oguntade Dolapo	1983	AFA1	3/6	SSCE	05/03/2020
23	Yusuf Jimoh	1984	AFA1	3/6	SSCE	05/03/2020

NB:

i). There are two outstations (2) under the Substation and two of our staff are attached to work at the outstations which are located at Alade and Onisere. The staff are Mr. Bolarinwa Felix and Mr. Ajayi Abiodun

1.0. Field Activities

During the periods under review, the following activities were carried out within the scope of the list below.

a). **Field Maintenance and Pest Control**

Despite the shortage of field staff during the review period, significant progress was made in maintaining all plots. Regular weeding was carried out on schedule to ensure optimal field conditions, with the following plots receiving consistent attention:

- Two-hectare plot
- Rehabilitation plot
- Seed garden plot
- Dr. Ayegboyin's plot
- Demonstration plot

A major achievement during this period was the successful rehabilitation of the 10-hectare plot, which had been largely abandoned in the previous year due to staff shortages. To address this challenge, the plot was released to an experienced cocoa farmer under an agreed management arrangement. This decision proved highly beneficial, as the farmer provided prompt and continuous maintenance, including:

- Regular clearing of the plot, ensuring weeds were kept under control.
- Timely removal of parasitic plants, such as mistletoe, to enhance plant health.
- Implementation of good agricultural practices, including adequate shade management, pruning, and soil fertility enhancement—practices that were previously lacking.

This arrangement not only ensured that the 10-hectare plot was well-managed but also alleviated the burden on the station's limited field staff, allowing them to focus on other essential tasks. In addition to routine field maintenance, periodic pesticide spraying was conducted to control black pod disease and insect pests such as capsid bugs and mirids. These efforts contributed significantly to improving the overall health and productivity of the cocoa trees across the station.

b). Head quarter's fungicide screening trials

During the review period, the Headquarters selected Owena as one of the key locations for its fungicide screening trials, demonstrating confidence in the station's suitability for such research. Two trials were sited: one at the Demonstration Plot and the other at the Seed Garden Plot.

Despite the challenge of limited staff, the station actively participated in both trials, ensuring the successful execution of all required activities. This included:

- Regular monitoring and data collection to assess the efficacy of the fungicides.
- Ensuring proper application protocols to maintain the integrity of the trial results.
- Providing logistical support and field management to facilitate smooth implementation.

The station's commitment to these trials underscores its dedication to advancing cocoa disease management strategies and contributing valuable data that can inform national recommendations for effective fungicide use. This participation not only strengthened the station's research profile but also provided an opportunity for capacity building and knowledge transfer, which will enhance future field management practices.

Achievements

1. Cocoa Plot Establishment

Three cocoa plots were established during the period under review. These include:

- A 1.5-acre plot beside the office.
- A 0.5-acre plot located towards the main gate.
- The gapping-up of cocoa stands behind the germplasm plot.

In total, approximately 2 acres of new cocoa plots were established and maintained during the dry season with adequate watering provisions, which continued even until now due to the delayed rainfall. These plots have been planted with cocoa seedlings and plantain suckers to enhance soil moisture conservation and provide shade for the young cocoa plants.

1. Opening of Moribund Plots

Two previously abandoned and moribund plots on the verge of extinction were successfully revived. Mature, ripe pods were harvested, processed, and sold during this period. Additionally, new seedlings were planted to replace dead and missing stands. These revived plots include:

- A 10-hectare plot.
- A 2-hectare plot.

3. Nursery Establishment

During the period under review, approximately 100,000 cocoa seedlings were raised. These include:

- 60,000 seedlings raised for Beyond Beans, which were paid for at the Headquarters.
- Over 40,000 seedlings raised for the Cocoa Farmers Association of Nigeria (CFAN), Ondo State.
- In November 2024, 102 cocoa clonal pods were sent to the station, which were separately raised for the Trace Project. Currently, there are over 3,000 clonal cocoa seedlings growing in our nursery.

4. Removal of Mistletoes

A key focus of this administration has been ensuring the removal of mistletoes from all cocoa plots between November and February to promote healthy cocoa stands. Mistletoe removal was carried out in the following plots:

- Demonstration Plot.
- Dr. Ayegbonyin's Plot.
- Seed Garden Plot.
- Rehabilitation Plot.

Additionally, mistletoes have been removed from all other plots within the estate.

5. Infrastructural Improvements

For many decades, the CRIN quarters at Owena Substation lacked adequate street lighting, resulting in security concerns. During the period under review, this problem was addressed by installation of seven (7) 400-watt automatic sensor solar panel floodlights on electric poles within the quarters.

The project was funded using recovered outstanding electricity bill payments from tenants within the estate. The streetlights installed have significantly improved security and the quality of life for residents.

6. Renovation of Signboards: The two station signboards, located at:

- The entrance along the Ondo-Akure expressway.
- The CRIN staff quarters' main gate.

Both signboards had faded and deteriorated but were successfully repaired, repainted, and rebranded with clearer inscriptions. The project was sponsored by one of our clients who buys our dry cocoa beans.

7. Social Events: A Befitting Send-Forth Ceremony Was Organized In Honor Of The following retired staff members:

- Dr. Oluyole (Immediate Past Head of Station).
- Mr. Segun Okunade (Agricultural Technologist).
- Mr. Ogbugburu (Agricultural Technologist).
- Mr. Adeolu (Station Chief Driver).
- Mr. Agaji (Field Staff).

Gifts were presented to all honorees in appreciation of their service.

8. Financial Performance

The financial standing of the station improved significantly, increasing from **₦1,769,678.61** in 2023 to **₦8,074,629.89** in 2024, representing a nearly eightfold growth. Below is a summary of the income generated:

- Income sources and financial breakdown to be detailed separately.

Summary of the 2023/2024 IGR

		Year 2023	Year 2024
S/N	**Produce/Services**	**Amount (#)**	**Amount (#)**
1	Cocoa Beans	627,090	833,500:00
2	Cocoa Pods	75,000:00	270,000:00
3	Cocoa Seedlings	170,000:00	210,000:00
4	Rent	265,750:00	208,500:00
5	Access Fee	75,000:00	44,000:00
6	Guest house	65,000:00	27,000:00
7	Palm Oil	45,000:00	45,000:00
8	Rent (IPPIS deduction)	235,338.61	442,829.89
9	Cocoa seedlings sold@ #300/seedling (Paid directly into Hq)	-	6,000,000:00
10	Cherry	13,000:00	-
11	Vehicle Hiring	50,000:00	-
12	Land Loan	148,500:00	-
	Total	**#1,769,678.61**	**#8,074,629.89**

Challenges, Constraints and Suggestions

The major challenge bedeviling the station is the acute shortage of labour, as only few successes can be achieved with our present number of field staff strength i.e. Presently, there are three (3) males and two (2) females' field staff actively working on the plots at Owena station, the two other field staff are working at the outstations. With the enormous land size under our care, very little success can be achieved.

We implore the management to look into this direction and provide us with alternatives by funding the substations to engage casuals mostly the male folks to work on our plots during the four or five months that are crucial for cocoa farms.

Other challenges faced by the station which require urgent attention are listed below:

1) Provision of long aluminum ladder for the station to combat mistotletoes menace in some of our plots, the exact specification distributed to all the zones at the headquarters.
2) Provision of inputs like cutlasses, files, rain boots, field coats, herbicide, wheelbarrows, pesticide e.t.c.
3) Provision of 2 (50m) hoses to be used by our water pump machine at the nursery, the one currently in use is leaking out water excessively.
4) Provision of 2 (2000L) Storex tanks to store water, one at the nursery while the other will be placed at the office.
5) Stoppage of the activities of land excavators in our plot at 10 hectares: The continuous activities of the land excavators are endangering our plots at the 10 hectares as the indiscriminate removal of topsoil and the subsoil had degraded some portions of our plots thereby predisposing our farmland to severe erosion. We enjoin the management to please look into this issue holistically and promptly. Many letters have been submitted to the management on the issue. CRIN may lose the land in Owena to encroachers who dubiously go through the back door to take authority from state Government for excavation and other purposes on the supposed CRIN land.

   Though several letters had already been written to the headquarters in that regard but the excesses and menace of these land excavators remain unabated, even till now.

Conclusion

The period from January 2024 to Dec. 2024 has been marked by substantial progress across various operational, research, and infrastructural areas of the Owena CRIN Substation. The achievements recorded demonstrate the commitment and dedication of the station's staff, coupled with strategic management and stakeholder support.

To sustain and build upon these accomplishments, it is imperative to continue prioritizing research, infrastructure, and staff development. Addressing the highlighted recommendations will further enhance productivity, operational efficiency, and the station's overall impact on cocoa research and development in Nigeria.

I express my sincere appreciation to all staff, CRIN management, research partners, and stakeholders, for their invaluable contributions toward the station's progress. Together, we will continue to advance CRIN's mandate and strengthen cocoa research for the benefit of the industry and the nation.

Ochaja Substation

Head of Station: Dr. Ugioro, Osasogie

1. Location of Substation

The Ochaja Substation, Cocoa Research Institute of Nigeria, Ochaja, PMB 1005 Egume, via Anyigba, Kogi State, Nigeria. The station is situated in the North Central Nigeria. Primary crop of research is cashew and the plantation crops are cashew and oil palm.

The GPS Coordinate of the substation is 7.431050^{0}N, 7.278390^{0}E.

1. Staff Disposition/Human Resource

The staff members in the substation are 28, comprising of both senior and junior cadre staff. The designation and responsibilities are given in the table below.

S/N	Names	PF. No.	Date of 1st Appointment	Designation	Responsibility
1	Dr. Ugioro Osasogie	435	10/10/2010	Chief Research Officer	Head of Station
2	Mr. Uloko B.A.	307	18/09/2003	Chief Agric. Sup.	Agric. Sup
3	Mr. Wada, Sunday	327	08/04/2008	Chief Agric. Sup	Agric. Sup
4	Mr. Magaji, M.	455	21/02/2011	Principal Agric. Sup.	Agric. Sup.
5	Mr. Ibrahim Wasiu A.	1718	02/06/2009	Senior Accountant	Account
6	Mr. Ogbechie, C.	1169	01/06/1992	Prin. Work Supt.	Office
7	Mrs. Samuel Ladi E.	1532	02/06/2003	Chief Secretariat Asst.	Office/Secretary
8	Mr. Owemidu, Martins	5860	17/01/2023	Executive Officer	Office
9	Mr. Meliga, Kashim	627	10/10/2023	Executive Officer	Office
10	Mr. Ibrahim Noah	1555	01/04/2008	Chief/ Driver Mechanic	Office/Driver
11	Mr. Oguche Nathaniel	1530	02/06/2003	Chief AFO	Field
12	Mr. Opaluwa Pius	1534	02/06/2003	Chief AFO	Field
13	Mrs. Aye Fatima	1748	20/12/2010	Higher Agric. Sup	Field
14	Mr. Musa Abdullahi	1531	02/06/2003	Chief AFO	Field
15	Mrs. Yahaya M. Adishetu	1552	22/09/2005	Chief AFO	Field
16	Mrs. Abah Janet	1567	02/12/2008	Senior Health Asst.	Office
17	Mr. Alih Muhammed	1687	02/01/2009	Chief AFO	Field
18	Mr. Nda Okpanachi	1689	02/01/2009	Chief AFO	Field
19	Mr. Alfa Ndah	1787	20/04/2011	Chief AFO	Field
20	Mr. Alu Friday	1536	27/06/2003	Driver/Mechanic	Field
21	Mr. Unubi	1533	02/06/2003	Agric. Field Attendant	Field
22	Mr. Otanwa John	1691	02/01/2009	Senior watchman	Watchman
23	Mr. Nifu Yahaya	1688	02/01/2009	Agric. FA.	Field
24	Mr. Husseni Yahaya	1892	15/12/2011	Agric. FA.	Field
25	Mr. Abubakar Yahaya	1893	15/12/2011	Agric. FA.	Field
26	Mr. Simon Sunday	1981	05/03/2020	Agric. FA.	Watchman
27	Mr. Umoru James	1982	05/03/2020	Agric. FA.	Watchman
	Casual Security Staff				
1	Peter Job				
2	Uyola Dede				
3	Nathaniel Olije Eikwu				
4	Noah Husseini				
5	Abdullai Jubrin				
6	Sule Shaibu				

1. Land Resources/Assets

The Substation has a total land mass of 351 hectares, out of this land mass, about 80 hectares had been cropped mainly with cashew and some other crops like kola, oil palm and arable crops. The resources comprised of trial plots, experimental plots, demonstration plots, germ plasm, commercial plot, small scale cashew nut processing factory (can be upgraded) etc. more than 30 hectares of this land had been encroached upon by the indigenes from different communities in the neighbourhood.

Land Utilization

Total land coverage of the Substation - 351 Hectares
Total land area already cropped with cashew -71.2 Hectares
Total land area encroached upon by indigenes -30 Hectares
Newly cultivated Cashew Plot in 2021 and 2022-10 Hectares
Total land area under permanent crops cultivation-81.2 Hectares.

Table 1: Details of the established plots in CRIN Ochaja Substation, Kogi State.

Name	Spacing	Pedigree	Year planted	Purpose	Size (Ha)
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	Cashew Nut Size Trial/Oro Collection	1999	Expt. Trial	7.0
5. Plot SW1	6.2M X 6.2M	Small Nut Cashew	1976	Commercial	3.2
6. Plot NW1	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	Medium and Small Nut Cashew	1977	Fertilizer Trial Expt.	4.2
9. Plot NW/9	3.2M X 3.2M	Verified 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 9.1	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	Verified Nut Cashew	2011	Commercial	2.0
15. Higher Density Plot	9M X 9M 8M X 8M 6M X 6M	Verified Nut Cashew	2001	Experimental Trial	5.0
16. Germplasm Plot	6M X 6M	Oro Collection	2009	Germplasm	5.0
17. Plot NW/3	4M X 4M	Verified 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. Un-named cashew plot		Cashew plot	2017 & 2018	Commercial	12.0
20. Polyclonal seed plot	9M X 9M	Polyclonal cashew	2021	Experimental	2.2
21. Polyclonal seed plot	12M X 12M	Polyclonal cashew	2021	Experimental	0.5
22. Local material trial	9M X 9M	Brazilian large	2021	Comparative	0.75
23. Scion Garden	6M X 6M	Germplasm	2022	Germplasm collection	2.2
24. Clonal plot	9M X 9M	Germplasm	2022	Germplasm collection	0.5

4. Research Plots

S/N	Project/Experiment Title	Responsibility
	Physical effects o f intercropping cashew with some arable crops (completed her PhD work on the plot)	Dr. Nduka, B.A.
	Growth and yield of cashew as influenced by leguminous cover crops	Dr. Iloyanomon, C.J.
	Preliminary studies on yield differential and soil nutrient stat us of cashew plantations of different nut sizes in Ochaja Substation, Kogi State	Dr. Iloyanomon, C.J.
	Leaf litter fall and soil nutrient dynamics of cashew plantations of different ages in Ochaja Substation, Kogi State.	Mrs. Iloyanomon, C.J.
	Field establishment of cashew as influenced by shade plants and phosphate fertilizers	Dr. Ibiremo O.S.
	Effects of coppicing period and height on cashew rehabilitation	Mrs. Adeyemi E.
	Cashew hybrid trials	Dr. Festus Olasupo
	Setting up of beehives to enhance cashew productivity project	Dr. Ibiremo O.S. *et al*
	Polyclonal seed field trial: 9m by 9m and 12m by 12m	Dr. Adeniyi, D.O.
	Large nut size field trial: 9m by 9m	Dr. Adeniyi, D.O.

5. Infrastructure

Details of the Substation Infrastructure

S/N	TYPE	QUANTITY	DESCRIPTION	REMARK
1.	Office Complex	7 Office Rooms 1 Waiting Room 1 Store 1Lab./Library space	Administrative Block of Substation	The offices require renovation, rest rooms are out of use. Upholsteries, Periodical termite control is required for health of the facility.
2.	Residential Quarters			
	A	1	4 Bedroom Flat	Some toilets and bathrooms are out of use. Periodical termite control is required.
3.	B	3	3 Bedroom Flat	Requires facelifts and periodical termite control
4.	C	1	3 Bedroom Flat	Requires facelifts and periodical termite control
5.	D	7	2 Bedroom Flat	Requires serious renovations and periodic termite control
6.	E	5	4 Units of 1 Bedroom	In a very bad state and require serious renovation and periodic termite control
7.	Rest House	1	2 Bedroom Flat	Require regular maintenance, facelifts, leaking ceilings need replacement and periodic termite control. The beddings, mattress need to be replaced.
8.	Security light	2	Solar panel street light	Donated for security of staff quarters

Other facilities include

a. Central Toilet: 4 room central toilet for staff quarters' general use; Requires facelifts.

b. The Stores (Technical, Research and Stationeries materials)

c. The Cashew Juice Processing Factory has manually operated equipment that is moribund, can be refurbished for operations.

d. Cashew Nut Processing Factory also has manually operated equipment that is moribund and obsolete. It can be resuscitated with serious total overhauling of the processes and stages in order to meet the standard processing factory.

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. It is currently out of use.

f. Water Borehole: A functional borehole is within the premises of the Substation with

4000 liters capacity storage tank in-place. The storage can be doubled for ease of period of incessant pumping.

g. Power Generating Sets:
   i. A 50 KVA Electricity Generating Plant (Not functional, no battery to start and no fund to power the set- 5 liter/hour consumption rate of Diesel)
   ii. 2.5 KVA Electricity Generating Set for Office Complex Use: Very old, tattered.
   iii. Sumec 3800 Electricity Generator- for borehole use: Functional
   iv. Portable Generator for Rest House Use: Non-functional
   v. ELEPAQ 2.5 KVA Electricity Generating Set: Functional

h. 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.

i. 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.

j. The Security Post at the main entrance of the Substation needs urgent renovation and total change of the seriously leaking roof.

k. All the roads leading to and within the Substation require urgent attention.

6. Vehicles

Table: Details of the vehicles in the Substation

Vehicle	Condition	Remarks
Toyota Hilux (Petrol Engine)	Functional	Roadworthy and in good state, maintained regularly with servicing and changing of parts. The interior upholstery need to be refurbished. Maintenance cost bored by head of station.
Motorcycle – TVS	Functional	Roadworthy and in good state, maintained with regular servicing, maintenance cost bored by head of station.
Motorcycle - DAYLONG	Functional	Need repairs
Bazuki Tricycle	Non-functional	General servicing required and gear need to be changed.
Motorcycle CG 125	Not functional	Use for field work and minor runs of the Substation
Toyota Hilux (Diesel Engine)	Not functional	Off – road (listed for boarding)
Bedford Lorry (Water Tanker)	Grounded for years	Listed for Boarding by the team of Auditors from Headquarters
Peugeot 504 Station Wagon	Grounded for years	Listed for Boarding by the team of Auditors from Headquarters
Peugeot Pick-up Van	Grounded for years	Listed for Boarding by the team of Auditors from Headquarters
MF Tractor with Trailer	Grounded for years	Listed for Boarding by the team of Auditors from Headquarters
Motorcycle TX 185	Not functional	Off – road (listed for boarding)
Toyota Hilux – ARCN (Petrol Engine)	Grounded to due accident, tyres with realm inside store	Tolled to Ochaja substation from accident scene involving Researchers from Ibadan on their way returning from Mambila, Taraba state.

7. Store Materials as at December 2023

The table below show the store materials (Technical, Stationaries and Research Store Materials) and Station's Dispensary.

Table 8.1: Technical Store materials

Particulars	LG Folio	Physical Figure	Bin Card Figure	Diff	Unit Price	Total	Remarks
Glass for Ever Cool Fridge	L8/81	1	1	-	-	HQ	Obsolete
Rotor	L8/23	3	3	-	-	HQ	Obsolete
Kick brush	L8/7	1	1	-	-	HQ	Obsolete
Brake Light Bulb	L8/23	2	2	-	-	HQ	Obsolete
Contact point	L8/49	1	1	-	-	HQ	Obsolete
Florescent Starter	L8/87	2	2	-	-	HQ	Obsolete
Fuse	L8/23	75	75	-	-	HQ	Obsolete
Lamp holder	L8/63	1	1	-	-	HQ	Obsolete
Big hammer	L8/26	1	1	-	-	HQ	Good
Alternator	L8/31	1	1	-	-	HQ	Bad
Sprocket Ring	L8/57	1	1	-	-	HQ	Bad
Fuel filter for Gen. set	L8/63	2	2	-	-	HQ	Good
Terminal head	L8/115	1	1	-	-	HQ	Good
Fuel filter for HATZ Eng.	L8/18	2	2	-	-	HQ	Good
Spade	L818	1	1	-	-	HQ	Good
Front Shock Absorber Shaft	L8/102	1	1	-	-	HQ	Good
Fuel syphoning Tube	L8/115	1	1	-	-	HQ	Bad
Diodes for Gen. Set	L8/57	6	6	-	-	HQ	Obsolete
Digger	L8/63	1	1	-	-	HQ	Good
Clamp	L8/132	1	1	-	-	HQ	Good
Hack Saw	L8/162	1	1	-	-	HQ	Good
Shovel	L8/101	4	4	-	-	HQ	Good
Finner Fan Belt	L8/42	1	1	-	-	HQ	Good
Soil Huger	L8/162	1	1	-	-	HQ	Good
[illegible]	L8/102	1	1	-	-	HQ	Good
1½" Union	L8/102	3	3	-	-	HQ	Good
¾" Tees	L8/102	1	1	-	-	HQ	Good
Hand Trowel	L8/63	1	1	-	-	HQ	Good
Rake (FDA)	L8/63	2	2	-	-	HQ	Good
Chain Saw	L8/102	2	2	-	-	HQ	Good
Set of Zink	L8/101	1	1	-	-	HQ	Good
3" Clips	L8/81	5	5	-	-	HQ	Good
6" Clips	L8/89	2	2	-	-	HQ	Good
4" Clips	L8/89	6	6	-	-	HQ	Good
Injector for Gen Set	L8/103	2	2	-	-	HQ	Obsolete
Regulator	L8/18	2	2	-	-	HQ	Obsolete
Radio Phone	L8/32	1	1	-	-	HQ	Obsolete
India hoe	L8/62	2	2	-	-	HQ	Good
Pruning shares	L8/132	2	2	-	-	HQ	Good
Vernier Caliper	L8/132	1	1	-	-	HQ	Good
Original Chain	L8/157	1 pkt	1 pkt	-	-	HQ	Good
Rakes	L8/101	4	4	-	-	HQ	Good
¾"Stop Cock	L8/102	2	2	-	-	HQ	Good

½"Tap (Hand Basin)	L8/102	1	1	-	-	HQ	Good
¾" Elbow	L8/102	8	8	-	-	HQ	Good
Garden Tools	L8/2	2 Sets	2 Sets	-	-	HQ	Good
Wash hand Basin	L8/102	1	1	-	-	HQ	Good
Fire Extinguisher	L8/102	1	1	-	-	HQ	Good
Original Bar	L8/161	2	2	-	-	HQ	Good
Rain Coat	L8/161	1	1	-	-	HQ	Good
100mm Wooden Ruler	L8/140	2	2	-	-	HQ	Good
Hand Mower	L8/140	3	3	-	-	HQ	Good
Head pan	L8/140	2	2	-	-	HQ	Good
100m Metal Tape	L8/140	1	1	-	-	HQ	Good
Syphonic Ball	L8/20	1	1	-	-	HQ	Bad
½" Stop Cock	L8/20	4	4	-	-	HQ	Good
½" Elbow	L8/20	7	7	-	-	HQ	Good
Fan Belt A-50	L8/27	1	1	-	-	HQ	Good
Standing Vice	L8/2	1	1	-	-	HQ	Good
WFB – ISAC Motorized Sprayer	L8/161	1	1	-	-	HQ	Good
Knapsack sprayer	CP15	1	1	-	-	HQ	Good

8.2: Stationaries Store materials

Particulars	LG Folio	Physical Figure	Bin Card Figure	Diff	Unit Price	Total	Remarks
File Box	L8/101	2	2	-	-	HQ	Obsolete
File Box Spring	L8/101	2	2	-	-	HQ	Obsolete
Staff Advance Register	L8/101	1	1	-	-	HQ	Obsolete
Loan/Register Book	L8/101	1	1	-	-	HQ	Obsolete
Cash/Analysis Book	L8/101	1	1	-	-	HQ	Good
Big Stencil	L8/101	1	1	-	-	HQ	Bad
Correction Fluid	L8/23	4	4	-	-	HQ	Bad
Requisition Book	L8/101	3	3	-	-	HQ	Obsolete
Store Receipt Voucher	L9/001	4	4	-	-	HQ	Good
Store Issue Note	L9/001	2	2	-	-	HQ	Good
Store Ledger	L9/001	1	1	-	-	HQ	Good

Table 8.3: Research Store materials

Particulars	LG Folio	Physical Figure	Bin Car d Figure	Diff	Unit Price	Total	Remarks
Perenox	L^{11}/2002	12	12 tins	-	-	HQ	Expired
Ultimax plus	L^{11}/2002	2 cartons	2 cartons	-	-	HQ	Good
Actara	L^{11}/2002	2 cartons	2 cartons	-	-	HQ	Good
Tree Killer	L^{11}/2002	1	1 tin	-	-	HQ	Good
Coabre Sandox	L^{11}/2002	4	4 tins	-	-	HQ	Expired
Benlate	L8/161	5	5 tins	-	-	HQ	Expired
Difolatan	L8/95	8	8 tins	-	-	HQ	Expired
Nose Spray cover	L8/161	2	2	-	-	HQ	Good
Sterilline Petri Dishes	L8/95	349	349 pcs	-	-	HQ	Good

Table 8.4: Materials in the Substation's Dispensary

S/N	Items	Quantity	Remarks
1.	Wooden Trolley	1	Obsolete
2.	Wooden cupboard with drawers	1	Obsolete
3.	Steel Trolley	2	Obsolete
4.	Drug Case	2	Obsolete
5.	Baby Weighing Scale	1	Obsolete
6.	Wooden chair	2	Obsolete
7.	Sterilizer	1	Obsolete
8.	Bed pan	1	Obsolete
9.	Basins	2	Obsolete
10.	Big Tray	1	Obsolete
11.	Small Tray	2	Obsolete
12.	2½ X 6 padded bed	1	Obsolete
13	Kerosene Sanyo Fridge	1	Bad
14	Tab Vit. C white		Bad
15.	Tab Amodaquine		Bad

Table 8.5: Materials for Cashew Juice Processing Facility

S/N	Items	Quantity	Remarks
1.	Electrical Extractor	1	Obsolete
2.	Manual Extractor	1	Small
3.	Pasteurizer	2	1 bad
4.	Water filter candle	2	Bad
5.	160 ltrs. Plastic Drum	2	Good
6.	3 Legs pot	1	Good
7.	Plastic Bottles with cover	-	Over 2,500 pcs remaining
8.	Long spoon	2	Bad
9.	Plastic Bowl	2	Big
10	Plastic Bowl	1	Medium
11.	Funnel (Plastic)	1	Good
12.	Plastic Basket	2	Medium
13	Plain Table	1	Bad
14.	Wooden Bench	1	Bad

Table 8.6: Materials in the Substation's Dispensary

S/N	Items	Quantity	Remarks
1.	Dryer	1	Obsolete
2.	Boiler for Cashew nuts	1 set	Obsolete
3.	Cashew Nut Sheller	6	Non-functional
4.	Vacuum Storage Tank	1	Obsolete
5.	Weighing balance	1	Non-functional
6.	Hermetic sealed tin	4	Obsolete
7.	Stainless bowl	1	Bad
8.	Sealing machine	1	Bad
9.	Stainless bowl	1	Good
10.	Stainless tray	4	Good
11.	Plastic bowl	4	Good
12.	Plastic bucket with cover	4	Medium
13.	Plastic bucket with cover	4	Small
14.	Big CO_2 Cylinder	2	Risky to use
15.	Iron Stool	8	Bad
16.	Formica Table	2	Bad
17.	Soldering gas	1	Risky to use

8. Financial Status Of Substation As At May 2024

- A total of two hundred and twenty-five thousand and five hundred naira (N225,500) in cash have been remitted by the substation to Headquarters account from January 2024 to date
- Raw cashew nut valued at two hundred and twenty-eight thousand and six hundred naira (N228, 600) have been delivered to headquarter office in Ibadan.
- Oil palm valued at N20,000 (twenty thousand naira) was sold at the rate of N250 (two hundred and fifty naira) per bunch in December, 2024.

IBEKU SUBSTATION

HOS: Dr. Olaniyi, O.O.

A. Staff Disposition:

The staff strength as at December 31, 2024 stood at nineteen (19). This comprises of 9 senior staff, that is, the HOS, Station Accountant, 1 research officer, five (5) Agric Superintendents, and 1 driver. Ten junior staff, that is, 1 motor mechanic/driver, 1 watchman, 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, 2023

S/N	Name	G.L.	P.F.	Design	Date Of Birth	Date Of 1st Appt
1	Dr. Olaniyi O. O.	13/3	410	HoS (AD)	9/11/71	28/09/2010
2	Nduka Clara	7/1		RO2	30/10/1992	21/03/2024
3	Mr. Enagu Victor	13/4	275	CAS	30/03/73	31/05/2002
4	Mrs.U.N. Nmeregini	13/4	281	CAS	21/10/68	25/09/2002
5	Mr. Borokini O.	11/4	367	ACAS	27/03/79	08/02/2009
6	Mr. Agbor Charles	8/6	432	PAS 1	27/05/78	13/10/2010
7	Mr. Ojelabi A. A.	8/4	1746	SEO	03/12/82	30/08/2010
8	Miss Nya Emem	7/3	534	HAS	17/12/90	03/03/2020
9	Oladipo Kayode D.	8/3	1263	TO	31/1/1971	6/08/1997
10	Mr. Onyemuwa J.C.	5/2	1736	SMD/MI	15/05/66	17/03/2010
11	Mr. Eze Joseph	5/3	1680	ACAFO	13/06/67	02/01/2009
12	Mr. Nwachukwu B.	3/12	1678	HW	10/06/67	02/01/2009
13	Mrs. Chibuo Oluchi	4/2	1679	AFA 1	02/01/70	02/01/2009
14	Mrs Ihueze Chinedu	3/12	1681	AFA 1	15/08/68	02/01/2009
15	Mr. Chimaobi E. I	4/3	1683	AFA 1	15/03/68	02/01/2009
16	Mr. Nwachukwu A.	4/2	1890	AFA 1	12/12/75	14/12/2011
17	Mr. Uwakwe I.	2/10	1892	AFA 1	14/03/65	14/12/2011
18	Mr. John Muo	1/3	1976	FA	05/05/77	05/03/2020
19	Mr. Uwakwe C.	1/3	1977	FA	6/11/76	05/03/2020

Transfer: Mrs. Nduka Clara was transferred to Ibeku Substation from CRIN headquarters Ibadan and resumed on 2nd October, 2024 as a Research Officer 2 (R.O.2).

B. Land Area:

Please find below the landmass 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

C. 2024 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.

D. 2024 Achievement

1. Maintenance of two hectares of newly established cashew scion project at Ibeku Sub Station
2. Maintenance of 1 hectare of cocoa (WCF Project)
3. Raising and supplying of 100,000 cocoa seedlings

Plate1. Raising of 100,000 cocoa seedlings Nursery establishment early stage

4. Supplying of 2,800 cocoa pods supplied to Trace Project in January 2025 worth (N2,800,000)
5. Tea germplasm maintenance in Ibeku Substation. It was planted in the year 2024

Plate 2: maintenance of tea plot

6. Construction of sign boards

Plate3a: Old signboard

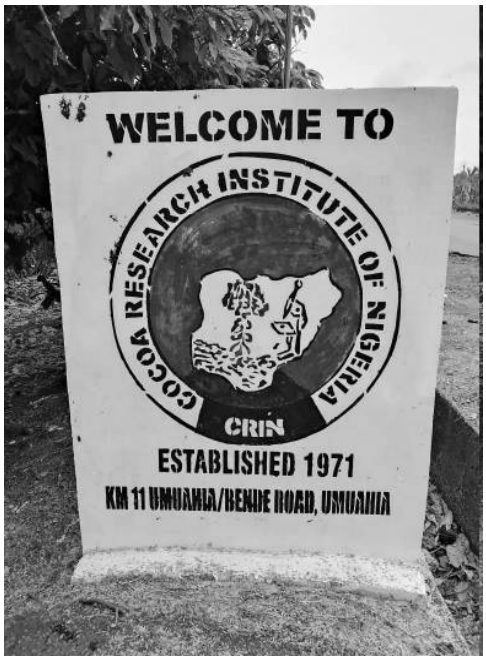

Plate 3b: New signboard

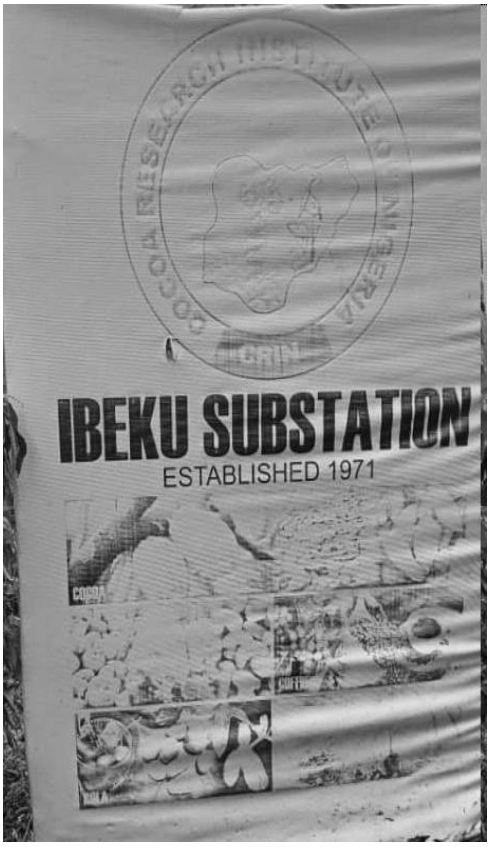

Plate2a: Admin block board (Before)

Plate2b Admin block board (After)

7. Visitation of Nigeria Export Promotion Council Aba, Abia State

Plate3: The team was led by Mr Okechukwu second left and Dr. Olaniyi O.O. third from right

8. Visitation of the CRIN NASU executives from the headquarters to NASU staff at the station

Plate4: From the left was Mr Enagu, Mrs Kuforiji, Mr Emeka, Dr O.O. Olaniyi, Mrs. Nmeregini U.N., Mr Adeyanju and Mr. Borokinni

1. Visitation to farmer's field at Ikot Obuk Akwa Ibom State

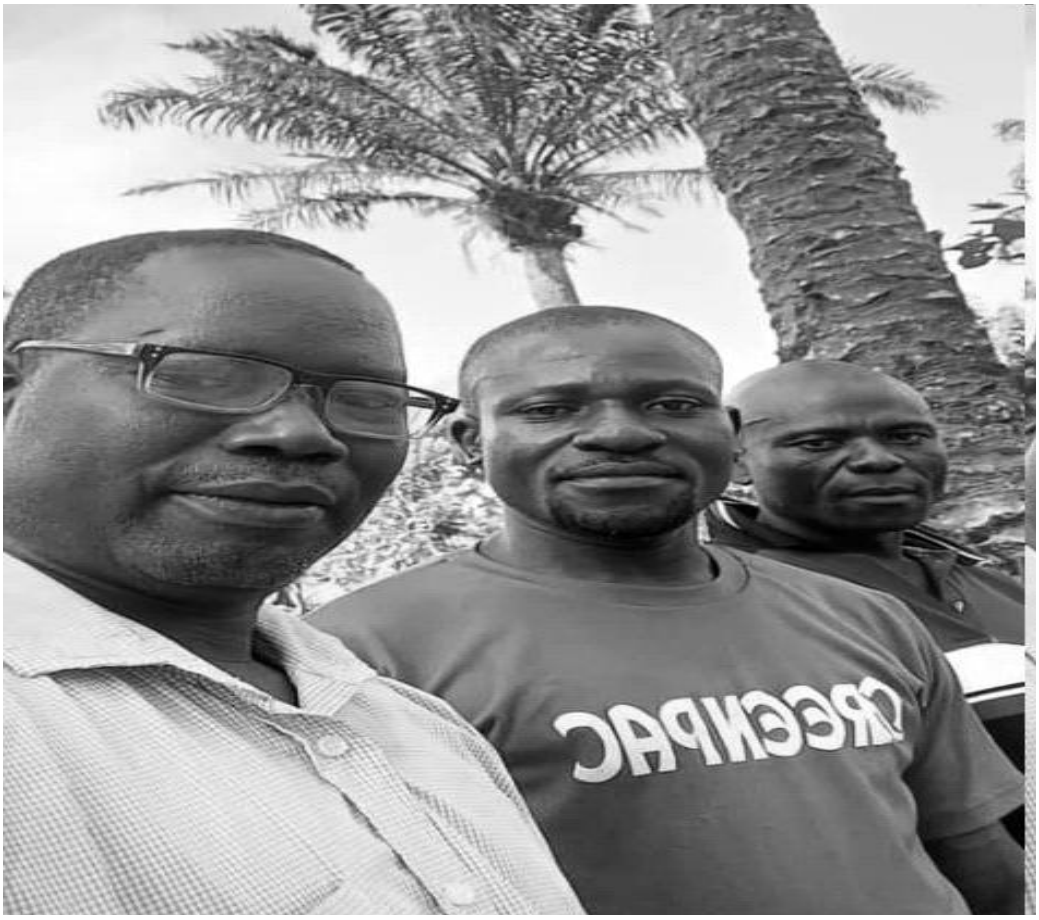

Plate5: Dr. Olaniyi O.O. the H.O.S from the left followed by Mr Nicodemous and John Visitation to farmer's field at Ikuanu Local Govt, Abia State

Plate6: Dr. Olaniyi from the left followed by Mr Oluwa followed by Mr. Achanti and Mr. Agbor to the extreme right

1. Rehabilitation of commercial 2 cocoa plot

2 . Rehabilitation of commercial 3 cocoa plot

3. Maintenance of pro cashew project plot

Plate8: Cashew scion project

Procurement of 5000-litre Gee Pee tank for nursery operations

Plate 9: Gee Pee water tank building

Solar street light in front of admin

Plate: supplying of cocoa seedlings to the farmers

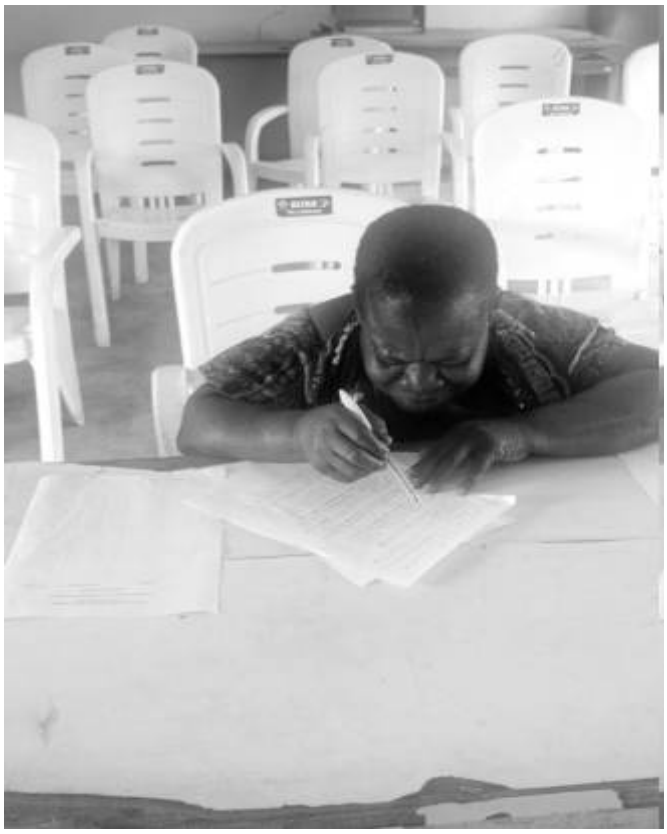

Plate10: Mrs. Ihueze Chinedu during 2024 junior staff promotion examination exercise

The condition of the office complex at Ibeku Substation

Plate9: The main office building needs an urgent intervention for rehabilitation

Plate11: Group photograph with Tea Programme Scientists at Ibeku substation during a research trip

Plate12: Group photograph of staff during CRIN 60th anniversary at Ibeku sub station

Plate13: Group photograph with the Executive Director CRIN and staff during his working visit to Ibeku Substation

From the right Mrs Nmeregini U. followed by the Executive Director CRIN DR. P.O. Adebola followed by the HOS Dr. Olaniyi O.O and lastly Mr. Enagu V.O. during E.D. visit to the station

1. Internally Generated Revenue: A total sum of two million. nine hundred and forty-eight thousand, nine hundred and thirty-seven naira five kobo only (**N2, 948,937.5**) was realized in the year 2024. In addition to this, **2800** pods were supplied to **TRACE PROJECT** amounted to **(N 2,800,000)** in the cropping season.

Below is the breakdown.

Crin Ibeku Substation IGR Summary for Year 2024

SN	ITEM	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	Total
1	Cocoa Beans		-					-		-			1,800,453.75	2800000	1,800,453.75
2	Cocoa Pods	-	-		-		-	-		-			500,000		500,000
3	Agbalumo	-	-		-	-	-	-	-	-	-	-	-		-
4	Ogbono	-	-		-	-	-	-	-	-	-	-	-		-
5	Plantain	-	-	-	-	-	-	-	-	-	-		-		-
6	Banana	-	-		-	-	-	-	-	-	-	-	-		-
7	Cashew Nut	-	-	-	-			-		-	-	-	93,161.25		93,161.25
8	Firewood	-			-	-	-	-	-	-	-	-	-		-
9	Cocoa Seedlings	-	-	-		-		-	-	-	-	-	300,161.25		300,161.25
10	Palm Fruit	-	-	-	-	-		-	-	-	-	-	255,161.25		255,161.25
	TOTAL							**-**	**-**	**-**	**-**	**-**			**5,748,937.5**

1. Peace: We were able to maintain peace in the station and the hosting communities.

4. 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 labourers available.

5. Field Activities: General maintenance of research and commercial plots - slashing, pruning, spraying, 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.

6. Cocoa Seedlings: Seedlings were raised to boost our IGR and for replacing dead cocoa trees in some of our plots.

E. Visitors: The following persons visited our office over the year, CFAN Chairman in Abia State Elder Kalu and her members, Dr. Ogunlade, M., Dr. Famaye, A., Dr. Olasupo, F., Dr Okeniyi, Michael, Dr. Oluyole, Mr. Obatolu, Mr. Olayinka, Taiwo, Mr. Oloyede, Mr. Ayanwole, Mr. Ibrahim, Dr Sobowale, Mr. Kuforiji , Mr Oluwa, Mr Nicodemous and Mrs Olubiyi

F. Challenges/Constraints:

1. Lack of portable water**,** both Ibeku substation and Ugbenu experimental station lack portable water. The station depends fully on the use of generator for official work. Generating electricity through solar inverter is required.

2. Inadequate Work Force: Both Ibeku and Ugbenu have inadequate work force. Presently, only one security officer is available for the entire Ibeku Substation.

3. Our hilux vehicles lack tyres and engine needs replacement

3. Chemical Spraying: The substation is in need of fungicides, herbicides, insecticides and sprayers 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.

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 need for Nurse or Health attendants in an isolated place like CRIN Ibeku Substation.

7. Ugbenu Experimental Station: The outstation has only one staff since No security staff 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 floor needs serious renovation.

G. Additional Staffers Request by Cadre:

Security 8 (5 in Ibeku and 3 in Ugbenu)

Field Staff 48 (Following the standard set at the headquarters, CRIN Ibeku

Substation will require nothing less than 51 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
Clerk	
Total	60

H. Suggestions/Way Forward:

1. Impress: Impress should be given on monthly basis. This impress will be highly appreciated.

2. Furniture: We are in need of furniture in all offices of the station. The furniture we have are mostly bad and obsolete, most of them have been the ones available since inception of the station.

3. 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 are in need of reams of A4 printing papers, toners, staplers and other stationery for the smooth administrative running of the substation.

4. Borehole should be dug in the station and Ugbenu to prevent water related disease.

5. More field staff needed in Ibeku and Ugbenu as well as Secretariat staff are needed.

Mambilla Substation Kusuku

Head Of Station: Dr. S.A. Adeosun

Staff Strength

The station started the year 2024 with a staff strength of 25, but ended the year with a staff strength of 23. This is because, during the year, one of our staff members retired while one died in service. Out of the 23 staffers, 20 were stationed in the Main Station, at Kussuku, while 3 were stationed at the Experimental Station at Mayo-Selbe. Table 1 below shows the staff strength of the Station as at 31st December 2024.

Table 1: Staff strength of CRIN Mambilla Substation as at December 2024

S/N	Name	Designation
1	Dr. S. A. Adeosun	Head of Station
2	Mr. Fredrick Njwe Chila	Chief Agric Superintendent (Station's Plantation Manager)
3	Mr. Augustine Mari	Chief Agric Superintendent
4	Mr. Cletus Ayere	
5	Mr. Saheed Abass	Principal Executive Officer
6	Mr. Peter Numfor	Principal Data Processing Officer 11
7	Mr. Francis Wakaps	Principal Technical Officer
8	Mr. Usman Huseini	Chief Health Assistant
9	Mr. Ibrahim Nganjiwa	Higher Agric. Supt.
10	Mr. Albert Mamza	Research Officer II
11	Mr. Alim Muhammed	Agric. Field Attendant
12	Mr. Dahiru Adamu T.	Chief Driver/Mechanic
13	Mrs. Regina Isaiah Joseph	Chief Field Agric. Overseer
14	Mr. Philipian Moses	Chief Field Agric. Overseer
15	Mr. Ahmed S. Buba	Agric. Field Attendant
16	Mr. Zubairu Ahmed	Chief Driver/Mechanic
17	Mrs. Anester Lawal	Chief Field Agric. Overseer
18	Mr. James Musa	Chief Field Agric. Overseer
19	Mr. Joshua Paul	Chief Field Agric. Overseer
20	Mr. Manasses Andriya Bebe	Agric. Field Attendant
21	Mr. Ephesian Clement	Agric. Field Attendant
22	Mr. Genesis Miku	Agric. Field Attendant
23	Mrs. Philina Stephen	Agric. Field Attendant

Change of Station's Leadership

Dr. O.O. Adenuga, the head of station of CRIN Mambilla substation was redeployed (transferred) to CRIN Headquarters Ibadan; while Dr. S.A. Adeosun from CRIN Headquarters Ibadan was deployed to CRIN, Mambilla Substation to take over as Head of Station of CRIN Mambilla in May, 2024.

Retirement

Mr. Zephaniah Numfat retired from CRIN Service with effect from 3 March 2024 due to age 60 years. Before his retirement, he was a security staff of the station.

Death: The Station recorded the loss of one of its staff by death. This was Mrs. Satu Musa, an Agric. Field Attendant, who died on Saturday 12 October 2024 after a brief period of illness.

Plantation Activities

Weed Control

At Kusuku Main Station, weed control was one of the major activities on the plantation of *Coffee arabica* and Tea plots using manual method of weed control since there were no herbicides to use in reducing the weed density on the field. General weeding activities at Mayo-selbe was carried out on the mandate crops (cocoa, cashew, tea and Robusta coffee manually as there was no available herbicides to use. Also, the few cocoa stands on the plantation at Mayo- Selbe Experimentation were ring weeded during this report. The few available field staff were kept into good use and controlled the weed on the field to a great extent.

Boundaries Maintenance

The Arabica coffee boundary fence at Kusuku Main Station that was destroyed by termites was rehabilitated by replacing the damaged wooden poles with new ones. At Mayo-selbe Experimental Station, boundaries were maintained by planting life trees on the boundaries as hedge plants. Generally, CRIN Mambilla Substation's boundaries, both the plantation and the quarters were well maintained and there was no land encroachment.

Harvests

A total of 43 banana bunches were harvested, 21 kg of Arabica coffee, and 8 basins of avocado pear were harvested. A total of 2,435.94 kgs of fresh tea leaves was harvested. Cocoa did not bear well due to lack of fungicides to spray against black pod disease. A total of 72 kg of cocoa was harvested and processed into dry cocoa beans between October, November and December 2024. Another factor that caused low cocoa production was the drought that occurred during the year which led to the severe abortion of flowering

Tea Processing

Out of the harvested tea leaves, 150 kg was processed into 6 kg and 5 kg of black and green tea, respectively. The processed tea was transferred to CRIN Headquarters and used at the CRIN 60th anniversary celebration.

Pruning

Part of the tea plot was pruned to boost fresh leaves yield and this was carried out on over grown tea bushes in the field.

Cutting of Fire Traces

Cutting of fire traces round the plantations at the main and experimental Stations started during the last month of the quarter, December 2024. This was aimed at checking fire encroachment on the plantation as the dry season was setting in. Some portions of the field areas were covered with cutting of fire traces during the period under review and shall continue the next quarter which is 1st quarter of 2025.

Pest/Diseases Control

Various insect's pests were controlled at the tea nursery on tea cuttings that were set in the nursery using Termix insecticide. Besides, Rocket 20E insecticide (a termicide) was sprayed on tea bushes on the field which were affected by termites and on tea and coffee seedlings in the station's nursery to control termites and other leaf eating insect pests However, no control measures were provided for the control of coffee berry diseases (CBD) and this drastically reduced Arabica coffee yield in the station. This was as a result of dearth of pesticides in the Station.

There was watering and overall maintenance of Arabica coffee and tea seedlings which were established by Dr. Adepujo, Abigail and Dr. Olaniyi, O.O. The tea plants cuttings were set in the station's nursery for their research work. Also, the 2500 tea cuttings which were set for Dr. S.A. Adeosun were well maintained by regular watering, weeding and controlling the nursery shade. The cuttings hardening off was done during the period under review. The cuttings had about 95% survival due to good management. Beside these, a total of 3000 Arabica coffee berries was planted on a primary bed and shade constructed to provide canopy for the nursed berries. Watering of cocoa and tea seedlings in the nursery at Mayo-selbe experimental Station was carried out. The few seedlings of cocoa, coffee Robusta and tea in the Experimental Station were well maintained.

Research Activities

The station maintained 9 experiments sited on the station. The experimental plots were kept tidy and data were collected as and when due.

Table 2: On-going Experiments in the Station

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) 1-5 Tea clone C15 cutting each		2012		
4	Simultaneous 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	Simultaneous 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
9	Dr. Idong Mokwunye		2023	Dr. Idong M.	In progress.

Office and Rest House Premises
The premises of both office and rest house were kept tidy using hoes and cutlasses for hoeing and slashing.

Maintenance of Station's Equipment
The Toyota hilux vehicle, the motor cycle and Tricycle in the station were well maintained

Internally Generated Revenue (IGR)
The total sum of two hundred and forty-six thousand, twenty-three naira, seventy-five kobo (**₦246,023.75**) was generated during the year and the breakdown is as stated below.

Table 3: Internally Generated Revenue (IGR) for the year 2024

S/No.	Items	Jan (₦)	Feb (₦)	March (₦)	April (₦)	May (₦)	June (₦)	Aug (₦)	Sep (₦)	Oct (₦)	Nov (₦)	Dec (₦)	Total (₦)
1	Cocoa beans	124,985	-	-	-	-	-	-	-	-	-	-	**124,985.00**
2	Banana	**2,000**	2,400	1,350	1,200	-	-	-	-	1,788.75	-	3000	**11,738.75**
3	Coffee berries	-	8,400	-	-	-	-	-	-	-	-	-	**8,400.00**
4	Pear avocado	-	5,200	700	3,000	-	-	-	-	-	-	-	**8,900.00**
5	Tea leaves	-	-	30,000	-	-	-	-	-	50,000	-	-	**80,000.00**
6	Rented quarters	-	8,000	-	-	-	-	-	-	-	-	-	**8,000.00**
7	Staff ID card					4,000	-	-	-	-	-	-	**4,000.00**
	Total	**126,985**	**24000**	**32,050**	**4,200**	**4,000.00**	**-**	**-**	**-**	**51,788.75**	**-**	**3,000**	**246,023.75**

Remark: A total of 150 kg of tea leaves was harvested from the tea plot and processed into 5kg and 6kg of green and black tea, respectively for CRIN at 60th year celebration

Library

The library of the station remained functional during the year 2024; although new and modern text books are needed to update the library.

Security

The security guards of the station performed their duties well as there was no record of theft or any security breaches in the Station. However, the extremely inadequate number of security guards in the Mayo-Selbe Experimental Station has left the Station vulnerable to burglary.

Engagement of Casual Security Guards

In response to dearth of manpower in the Station, approval was obtained from the Headquarters and four casual security guards were recruited to compliment the service of the only remaining security staff in the Station. The casual security guards currently on ground are as follows:

1. Haruna Isa
2. Huseini Umar
3. Francis Boben
4. Garba Elisha

Three (3) of them are working in Kusuku and one (1) is working at Mayo-selbe experimental station.

Visitors In the Station

A total of 21 individuals visited the Station during the period under review and their records are stated below in Table 5.

Table 4: Detail of individuals that visited the Station in 2024

Date	Name	Address	Purpose
19/01/2024	Alh. Danladi R	Gembu Sardauna L.G.A.	Official to collect ground rent
27/01/2024	Alh. Danladi R	Gembu Sardauna L.G.A.	Official to collect ground rent
27/05/2024	Hassan Usman	Kakara	Official
9/7/2024	Usman Hassan	Kakara	Official
9/7/2024	Fatima Usman	Kakara	Official
7/8/2024	Ismaila Ahmadu	Kakara	Official
14/8/2024	Suleman Yahya Lawal	Gembu	Official
4/9/2024	Soloman Oluremi	CRIN Headquters, Ibadan	Official assignment
7/9/2024	Kahya S.S.	Jos	Official
7/9/2024	Awalu Sani Usman	Jos	Official
23/10/2024	John James B	Agala kusuku village	Official
01/11/2024	Sakinat Danjuma	Gembu	Health talk knowledge
12/11/2024	Oluwaseyi Daniel		Inquiries
19/11/2024	John James Agala		Official
28/11/2024	Chimse Christian		Health Gembu
28/11/2024	Dr Hassan Usman	Kakara	Official
06/12/2024	Nuhu Beta Kallastone		FCT experimental layout
06/12/2024	Charles Lama		FCT experimental layout
17/12/2024	Abdulmumin Umar	Nguroje	Official
17/12/2024	Hassan Usaman	Kakara	GH care

Dispensary

A total of 36 ailments were diagnosed in the Station's Dispensary; and due to non -availability of medication, they were referred to hospitals for treatment.

Table 5: Report of sickness diagnosis in the Station's Dispensary for the year 2024

Diseases	Jan		Feb		March		April		May		June		July		Aug		Sep		Oct		Nov		Dec	
	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C		C	A	C	A
Dizziness catarrh	-	7	-	10	-	5							4	-	8	-	4	-	-	-	3	-	1	-
Cold	12	8	4	9	6	3							7	8	-	-	9	-	-	-	-	-	-	-
Tooth pains	7	6	2	3	1	13							1	-	-	2	-	-	5	-	2	-	-	-
Loss of apt	-	12	-	6	-	6							4	2	6	3	10	11	3	6	1	-	5	7
Stomach pain	10	5	11	7	4	5							6	10	3	2	11	5	8	4	4	18	-	6
Eye pain	14	7	4	-	-	-							2	1	-	-	2	1	-	-	-	-	-	-
Headaches	6	1	2	-	5	1							10	-	7	-	4	-	4	-	3	-	7	-
Chill	-	-	-	8	-	12							8	6	1	3	2	-	1	-	-	-	1	-
Diarrhea	-	9	-	-	-	8							2	1	-	1	4	-	4	3	-	1	1	-
Sore mouth	7	4	2	1	-	-							3	2	1	-	-	-	6	-	-	5	2	4
Vomiting	4	11	-	-	2	-							5	13	4	6	-	8	8	4	1	8	-	3
Leg pain	8	-	5	4	-	-							2	-	3	-	5	1	2	-	1	-	2	-
Oedema	-	2	-	5	-	4							4	-	7	2	-	-	1	-	1	-	-	-
Backaches	-	10	-	2	-	3							11	-	3	-	8	-	6	-	-	-	8	-
Hypertension	-	14	-	11	-	7							4	-	1	-	1	-	8	-	2	-	1	-
Cough	13	6	4	8	-	9							4	3	2	-	4	-	10	3	7	8	-	6
Stress	-	3	-	3	8	4							-	-	-	-	-	-	-	-	-	-	-	-
Chest pain	-	10	-	2	-	3							-	-	-	-	-		-	-	3	-	1	-
Accident	1	1	2	4	-	6							2	1	2	-	4	-	-	4	1	1	-	-
Malaria	14	11	6	-	1	-							15	8	8	9	8	7	12	6	2	10	-	1
Joint pain	-	6	1	4	2	3							-	-	-	-	-	-	-	-	4	-	-	-
Typhoid fever	1	5	1	7	5	-							9	-	-	-	1	-	-	5	-	-	3	-
Side pain	-	3	-	1	-	-							-	-	-	-	-	-	-	-	6	-	-	-
Thrust	4	-	3	3	-	-							3	1	1	-	1	1						
Body pain	-	15	-	-	-	-							6	-	9	-	5	-	10	-	6	-	11	-
Delivery													-	-	1	-	-	-						
Sleepless night	5	3	1	8	2	12							6	8	7	3	5	9		2	-	-	4	-7
Neck pain													-	-	-	-	-	-	-	-	-	-	2	-
Abdominal pain													-	2	2	-	1	-	-	1	-	-	9	7
Stiff neck													1	-	-	3	1	-	-	-	-	-	-	-
Pile													2	-	-	-	2	-	-	-	-	-	-	-
Ear pain													-	-	-	-	-	-	-	1	-	-	1	-
Heart burn													5	-	-	-	3	-	-	-	-	-	-	-
Ulcer													-	-	-	-	-	-	-	-	9	-	1	-
TOTAL	**101**	**166**	**48**	**110**	**36**	**116**							**126**	**66**	**76**	**34**	**95**	**43**	**88**	**39**	**56**	**51**	**60**	**27**

Key: C: Children, A: Adults

Weather Record

Table 6: Annual Rainf all record at CRIN Mambilla Station in 2024

Month	Rainfall (mm)	Rainy Days	Mean Rainfall (mm)
January	-	-	-
February	-	-	-
March	208.0	6	34.66
April	185.9	10	18.59
May	224.4	10	22.44
June	467,8	16	29.23
July	504.1	18	28.00
August 2024	450.2	16	28.10
September 2024	710.1	22	32.80
October	481.1	13	37.00
November	-		-
December	-	-	-
Total	**3,068.6**	**105**	**230.82**
Mean monthly rainfall	**255.72**		

Constraints

1. Inadequate field staff

Currently, the Station is battling with gross shortage of manpower. As a result, regular weed management in the plots and office environments suffers greatly making weed control in the plantation an uphill task. Moreover, general nursery and field activities in the plantation as well as general maintenance of office premises and the research plots have been greatly hindered.

2. Inadequate inputs

The general condition of the mandate crops, especially Arabica Coffee and tea on the plantation is not encouraging in terms of yield due to lack of fertilizer application which has not been done for many years. And this has led to reduction in the yield of the crops drastically. It has also caused the extinction of some the crops on the field due to nutrient deficiency.

Moreover, the Station did not receive any pesticide from the Headquarters in the year under review. This has made weed control very difficult. Lack of pesticide in the Station has made pest and disease control an impossible task, and this has reduced the quantity of harvest we got from our plantations.

3. Fire incident

Some unknown person set part of the Arabica coffee plot on fire on two occasions in January. During these periods of the disasters, most of the staff and other youth in the community came out to fight the fire but the fire was too high to be controlled, thus making much of the coffee and tea bushes to be badly affected. The tea stems that were burned or affected were pruned and successfully resuscitated.

The Station Needs

1. The office building in Kusuku is dilapidated seriously and need urgent renovation. The HoS quarters and the rest house are in an extremely deplorable state of disrepair. They urgently need to be renovated. The office building of mayo-selbe Experimental station is at the verge of collapsing and need urgent attention for renovation.
2. There are inadequate staff both in the field and in the offices, and this call for need for employment or engagement of casual labour on the field for maintenance of the mandate crops in the Station.
3. Pesticides, especially fungicides are needed to control and minimize the deleterious effect of black pod disease and other pests of the mandate crops.
4. The field staffs are inadequate and no available herbicides to reduce weed density on the field plots.

5. There is need for simple farm inputs such as cutlasses, rain boots, and rain coats for the field staff in order to enhance their performance on the field.

6. There is need to replace the wooden poles of the fence of Kusuku Station with iron poles for durability of the poles.

Uhonmora Substation

Head of Station: Dr. Adebiyi, S

Staff Strenght

The Station started with 24 staff but ended with 21 as a result of the retirement of 3 members of staff from CRIN service.

Table1: Staff Strength of CRIN Uhonmora Substation as at December, 2024

S/N	NAME OF STAFF	DESIGNATION
1	Dr. Adebiyi Solomon	HOS Uhonmora
2	Ogiugo Philip	Chief Agric. Superintendent
3	Arene Sunday	Accountant
4	Asein Oyakhire. J.	PEO11
5	Oaikhena Lydia	HEO
6	Ifidon Ikhuoso.T.	Chief Health Assistant
7	Alaba Umahoin	CAFO
8	Onaja Joseph	Work Superintendent
9	Anijese Funmilayo	CAFO
10	Ojimah Dennis	CAFO
11	Amedu Achonu	CAFO
12	Ebiale Benjamen	CAFO
13	Augustine Amaize	CAFO
14	Nwagala Charles	CAFO
15	Edeh Simon Tochukwu	CAFO
16	Ehidiamen Joseph	ACAFO
17	Kokori Paul	Field Attendant 1
18	Imumolen Jeffery	Field Attendant
19	Jamgbadi Imoudu	Field Attendant
20	Ketu Ehimika	Field Attendant
21	Okedion Friday	Motor Driver/Mechanic

Change of the Head of Station

Dr. Famuyiwa, B.S the Head of Station was transferred to CRIN Headquarters Ibadan; while I Dr. Adebiyi, S was deployed to CRIN Uhonmora Substation to take over as the Head of Station and resumed on the 5th of May, 2024.

Retirement

Mr. Edibo Gabriel, Mrs. Okpaise Idowu and Mr. Okesola Amos retired from CRIN service.

Mr. Edibo retired in January in January, 2024 as Assistant Chief Agric. Superintendent and was promoted to Chief Agric. Superintendent in the 2024 promotion exercise. Mrs. Okpaise Idowu and Mr. Okesola Amos both retired in March, 2024 due to age 60 year.

Name of plot and sizes with the plantation

S/N	Plot Name	Crop	Size	Remark
1	A1	cashew	1Ha	fruiting
2	A2	cashew	1Ha	fruiting
3	B1	Cashew	1Ha	Fruiting
4	B2	Oil palm	1Ha	Fruiting
5	D1	Cocoa TC	1Ha	Fruiting
6	E1	Germplasm	0.5 Ha	Abandoned
7	E1	Cocoa TC	2Ha	Poor performance
8	E1	Cocoa F3	1.5Ha	Poor performance
9	G1	Cocoa	1Ha	Poor performance
10	G2	Cocoa	1Ha	Poor performance
11	G3	Cocoa	1Ha	Poor performance
12	Opposite Nursery	Oil palm	2.7 Ha	Fruiting
13	Back of office	CocoaTc5	1.2Ha	Fire razed 0-2Ha
14	Along the road	Tc4 and Tc6		Excellent performance
15	Coffee Plot	Coffee/ plantain	1Ha	Moribund
16	Cocoa	Hybrid Cocoa	0.5Ha	Moribund
	Tea Exp. Plot	Tea	0.25Ha	On-going
17	Nursery		0.5Ha	About 10000 capacity
	Total		15.75Ha	

Funds received from Headquarters between January and December 2024

Date	Amount	Reference	Purpose
22/01/24	85.000.00	Raising of Cashew seedling	Purchase of Top Soil
02/09/24	296,000.00	Repairs and other logistics	Repairs of Transformer
Total	381,000.00		

Achievements

Restoration of Electricity

Sequel to the information available on the situation of the electricity in Uhonmora Substation, the transformer had been faulty since October 2022 and thereafter a great storm destroyed the entire electric pole. My predecessor, Dr. Famuyiwa reported the matter to the management.

Efforts to repair the transformer was initiated and with kind supports of some staff of Benin Electricity Distribution Company, coupled with intervention of Eng. Adeyemi, the repairs were achieved and electricity was fully restored on the 1st July, 2024.

Regarding the damaged electric poles within the quarters, we engaged a chain saw operator who cut some useful poles within our plantation. These were erected to replace the bad poles and thereafter, service cable was fixed with the help of one of our staff Mr. Friday (Ex NEPA staff).

Rehabilitation of moribund cocoa plots

Some missing stands of cocoa were gapped up with early bearing variety raised in the Substation nursery. This task was achieved in A1, C1 and the plot at the back of office.

Pruning, removal of chupon/ mistletoes

This Good Agricultural Practices were achieved as an occasional routine practice in all cocoa plots in the station. This practice has improved production and performance.

Expansion of Nursery

Capacity of the nursery was expanded to accommodate at least 25,000 cocoa seedlings and other mandate crops. Pumping machines were repaired and water hole was procured.

Maintenance of plots/plantation

Efforts were made to maintain some experimental plots with little available manpower.

Staff welfare

Five members of staff were promoted to senior staff in 2024.

Production of Cashew seedlings on request

About 2,900 cashew seedlings were supplied on request to a farm in Uzea, Urome Edo State.

Improvement on IGR

A total sum of one million and sixty-one thousand, seven hundred and thirty-seven naira, eighty kobo only (#1,061,737.80) was realized from sales farm produce and other services. This doubled the amount realized in 2023.

Other Achievement includes

1. Conducting on-the-spot-assessment to farmer's farm on invitation in order to give useful advice on how to improve such a farm.
2. Promotion of cultivation of mandate crops such as cocoa and cashew among investors so as to encourage diversification in to agricultural sector. Investor such as SKAAF Construction Company based in Edo state wishes to diversify into cocoa sector through the establishment of a big cocoa plantation in Edo state. The Chairman of the company, Eng. Scaaf seeks for the support of CRIN in the areas of supply of improved planting materials, field establishment, Good Agricultural Practices including on-farm processing and drying of cocoa beans.
3. Participation in the training and empowerment of cocoa farmers in order to improve production and socio-economic life of the people in Edo State. Such as, a world Food Day 2024 organized by the Ministry of Agriculture Edo state and Empowerment programme through training on cocoa cultivation and distribution of plantain suckers and cocoa seedlings to cocoa farmers in Edo South Senatorial District, Edo State
4. Integration of mandate crops into cropping system of farmers and Stakeholder where such mandate crops can be successfully grown. This was achieved in Uzea, Urome Edo State where cashew was established to encourage its cultivation in the area. A farm land of 10ha was established in July 2024 with the population of about 2,600 cashew seedlings in the geometry of 6m x 6m.
5. Training of cocoa farmers on implementation of Good Agricultural Practices in conjunction with Tree crops Unit, Edo State.

Challenges/ Constraints

1. Poor funding was a major barrier in 2024 because there was no fund released to sustain any of the station task and activity. This has a negative effect on the station because this fund is responsible for day-to-day running of the station.
2. Inadequate field workers was also a major constraint, this made many of our experimental plots busy and consequently unproductive. Presently, there are just 13 field staff to do the field work.
3. Inadequate farm Implements and Tools affected the field works and other tasks negatively. Farm implements such as cutlasses, rain boots, rain coats, files and watering cans are key for field workers.
4. Inadequate inputs/chemicals affected production and productivity of our experimental plots. Pesticides and herbicides were not available to reduce effects of Black Pod diseases and weed control respectively.
5. Incessant felling of trees by the youths in the neigbouring community was a great disturb to our experimental plots.
6. Fire outbreak was occurred in January, 2024. This affected the cocoa plot near office complex and the surrounding of HOS building. The source of the fire was traced to unknown Filani herd men who in many cases move in the night.

2024 Internally Generated Revenue

Month	Land Rent	Access Fees	Palm Oil	Dry Cocoa Beans	Cocoa Seedling	Oil Palm Seedling	Plantain	Fire Wood	Total
Jan									
Feb									
Mar	45,000.00	10,400.00							55,400.00
April	47,000.00		125,000.00	21,212.80					193,212.80
May	55,000.00		37,500.00		90,000.00	90,000.00			272,500.00
June	63,000.00				150,000.00				213,000.00
July									
Aug					50,100.00		25,000.00		75,100.00
Sept							15,000.00	20,000.00	35,000.00
Oct									
Nov									
Dec		17,500.00		200,025.00					217,525.00
TOTAL	**210,000.00**	**27,900.00**	**162,500.00**	**221,237.80**	**290,100.00**	**90,000.00**	**40,000.00**	**20,000.00**	**1,061,737.80**

The Substation needs

1. There is shortage of manpower most especially field workers. Field staff should be recruited to complement the efforts of the existing few hands. Project Contract workers should also be given priority.
2. Provision of Inputs such as pesticides and herbicides for insect pest and control of weeds respectively.
3. Simple farm implements such as cutlasses, rain coats, and rain boots should be provided to enhance efficiencies.
4. Rehabilitation of office complex and residential quarters.
5. Provision of mattress and window curtain in the Rest House.
6. Provision of ceiling fans in office complex and in the Rest House.

Dr. Adebiyi, S

Head of Station

Uhonmora

INFORMATION AND DOCUMENTATION RESEARCH

Experimental Title: Media Resources Availability and Utilisation as Correlates Job Satisfaction of Agricultural Researchers in Southwestern Nigeria

Investigators: Ogunjobi Taiwo E. and Aboderin Ayokunnu

Introduction

Media resources mean anything that can provide intellectual support to the users. It includes books, periodicals, newspapers, pamphlets and ephemera, audio and video recording stored in computer memory, on magnetic tape, film materials, graphic computers, CD-ROM and others according to Elaturoti (1977) as cited by Adeoye and Popoola (2011). It is a collection of different forms of communication, such as television, computer, printer, modem and video disk recorder, connected to allow information to be presented in any combination of media, such as textual, audio, video, or electronically (The World Book Encyclopedia, 2008). Agricultural researchers need various kinds of media resources for research in research institutions and teaching in colleges of agriculture, for the purpose of self-development, research breakthrough, impacting knowledge in students and dissemination of technologies and innovation. To achieve this, the right media resources must be available for the right person at the right time in its appropriate format. According to Gregorio and Sison (1989) as cited by Oladele (2010), modern agricultural efforts must be supported by media resources which will, not only keep researchers informed of the advances in their specialization but also provide exhaustive coverage of publications related to their work and those of their colleagues. Media resources are very vital to the overall performance of researchers in agricultural research institutes in developing and developed countries.

As submitted by Chimanikire *et al*. (2007), job satisfaction leads to high job productivity or performance by workers. When an agricultural researcher is satisfied with what he does, he will in turn give his best toward the attainment of the general goal of the institute. Consequently, when the agricultural researcher is satisfied, the question of poor performance and inefficiency will be a forgotten issue in agricultural research institutes. According to Droussiotis (2004), managers who are successful in motivating employees often provide an environment in which appropriate or adequate incentives are made available for the needed satisfaction of the employee. It is the duty of the institute's management to create and develop an effective environment in which agricultural researchers will be satisfied to become productive members of the institute. The satisfaction that an agricultural researcher gains from his job in a formal organisation is paramount to the worker however; the definition of job satisfaction has visibly evolved through the decades. Most versions share the belief that job satisfaction is a work-related positive emotional reaction. Job satisfaction describes how contented an individual is with his job. According to the Cambridge Advanced Learners'Dictionary (2003), job satisfaction refers to the feeling of pleasure and achievement which one experiences in the job when one knows that his work is worth doing, or the degree to which work gives the feeling of pleasure and achievement. Spector (1997) suggested that job satisfaction is helpful in evaluating the emotional wellness and mental fitness of agricultural researchers and that agricultural research institutes can use the information gained from the use of media resources to improve departmental policies and practices where dissatisfaction is expressed. Significantly, job satisfaction is very essential to the continuing growth of agricultural systems around the world and they rank alongside professional knowledge, skills, competencies, as well as strategies, in determining agricultural success and performance. In other words, professional knowledge, skills and competencies can be observed when one is taking on and mastering challenging tasks directed at agricultural success and performance (Filak and Sheldon, 2003).

There are five aspects that make up an individuals' level of job satisfaction. These include pay, promotion, supervision, the work itself and co-workers (Hanisch, 1992). Each person has different reasons for liking or disliking his/her job, therefore, job satisfaction is an evaluative statement of how one feels about his or her job (Robbins, 2003). Some aspects of the job may increase or decrease satisfaction according to the degree of challenge experienced on the job, how interesting it is, the extent of physical demands, working conditions,

types of rewards available, extent of support one receives from colleagues, and so on. On an individual basis, satisfaction is a moderating variable related to productivity; however, organisations with more satisfied employees tend to be more effective than those with less satisfied employees (Ostroff, 1992). When employees are satisfied, they have fewer absences and there is less failure (Robbins 2003; Hellriegel, Slocum and Woodman, 1998). In addition, satisfaction to work is essential in the lives of researchers because it forms the fundamental reason for working in life. Almost every researcher works in order to satisfy his or her needs in life, which he or she constantly agitates for. Job satisfaction in this context is the ability of the job to meet researchers' needs and improve their job performance. Job satisfaction has been the most frequently investigated variable in organisational behaviour (Spector, 1997). It is an area of particular interest to organisational managers and those who work for them (Cranny, Smith, and Stone, 1992). In the academia, individuals such as, directors, deans, and others involved in the administration and supervision of members should be concerned with the job satisfaction of employees. Organisations' measure job satisfaction because of the relationship with the organisations' short-term goals of increasing individual productivity, reducing absences, lethargy, and other related issues (Smith, 1992). The level of individuals' job satisfaction can lead to behaviours that affect the functioning of the organization (Spector, 1997).

Individuals with a greater sense of job satisfaction tend to be happier and have a greater sense of trust with management (Smith, 1992). Unfortunately, there is not one organization where all workers will be completely and consistently satisfied with all facets of job satisfaction (Judge, Hanisch and Drankoski, 1995). Therefore, it is imperative to continuously measure the level of job satisfaction among employees for managers to know what can and should change in the work environment in order to improve employee job satisfaction (Cranny, et al 1992). Employees possessing a greater sense of job satisfaction are likely to have a better quality of life, greater physical and mental health, more job stability, and exhibit greater cooperativeness with supervisors and managers (Cranny, et al 1992). Job satisfaction varies among researchers. For example, Peretomode (1991) and Whawo (1993), have suggested that the higher the prestige of the job, the greater the job satisfaction. In addition, job satisfaction is individualistic and it affects one's feelings or state of mind. When agricultural researchers feel satisfied, they will be less likely to leave the job. Keeping agricultural researchers productive and satisfied can limit costly turnover and increase an institute's overall productivity (Davis and Newstron 2003).

Researchers in agricultural research institutes are saddled with the responsibility of conducting research in various areas of agriculture to enhance agricultural production, boost agricultural output and thus provide adequate food for the nation and raw materials for industries in Nigeria. Preliminary research has shown that researchers rarely go to the library to use media resources and this is due to insufficient media resources needed to carry out the responsibilities given to them in most agricultural research institutes in Nigeria. Consequently, this situation has caused dissatisfaction in the job performance of the agricultural researchers. The present economic situation in Nigeria also limits the amount of media resources provided to researchers thereby affecting their use of relevant media resources to carry out their research activities and this has led to dissatisfaction on the job. As agricultural researchers continue to turn their attention toward what would make them satisfied, it is important that the influence of media resources availability and utilisation on job satisfaction in agricultural research institutes be studied in detail. Research findings could help in discovering change which could enhance job satisfaction among researchers especially when media resources are available and utilised in agricultural research institutes. The aim of this study therefore, is to investigate the influence of media resources availability and utilisation on job satisfaction of researchers in agricultural research institutes in Southwestern Nigeria.

Objectives of the study

The main objective of the study is to examine media resources availability and utilisation as correlates job satisfaction of researchers in agricultural research institutes in Southwestern Nigeria.

The specific objectives of this study were to:

1. identify the types of media resources available for utilisation by researchers in agricultural research institutes in Southwestern Nigeria;
2. identify the most preferred media resources used by researchers in agricultural research institutes in Southwestern Nigeria;
3. investigate the relationship between media resources availability and job satisfaction of researchers in agricultural research institutes in Southwestern Nigeria;
4. find out the relationship between media resources utilisation and job satisfaction of researchers in agricultural research institutes in Southwestern Nigeria;
5. examine the influence of media resources availability and utilisation of media resources on job satisfaction of researchers in agricultural research institutes in Southwestern Nigeria and
6. identify constraints to the utilisation of media resources by researchers in agricultural research institutes in Southwestern Nigeria.

Research Methodology

The research design adopted for this study is a descriptive survey research design of the correlational type. The independent variables in this study were media resources utilisation and media resources availability while the dependent variable is job satisfaction. The population of this study consisted all researchers in Agricultural Research Institutes (ARI) in Southwestern Nigeria. These agricultural research institutes have either their headquarters or sub-stations located in this region. As at the time of writing this study), there were eight agricultural research institutes in Southwestern Nigeria comprising five headquarters and three substations. The headquarters of the Research Institutes were purposively selected for this study because the substations lacked the provision of media resources for the use of agricultural researchers. The researchers were chosen using the total enumeration of researchers in headquarters.

Results and Discussion

RQ1: What are the types of media resources available for use in agricultural research institutes?

The result as shown in Table1 revealed that the most available print resources were newspapers (newspapers ($\bar{\times}$=2.96), journals ($\bar{\times}$=2.77) and conference proceedings ($\bar{\times}$=2.72) whereas, posters ($\bar{\times}$= 1.97) were rarely available. On electronic media, E-mail ($\bar{\times}$= 2.32) and the Internet ($\bar{\times}$= 2.31) were mainly available although Ipad ($\bar{\times}$= 1.51) was scarcely available. AGORA ($\bar{\times}$= 1.54), LanTEEAL ($\bar{\times}$= 1.28) and FAO publications were agricultural databases which were often available for use by agricultural researchers but TROPAC ($\bar{\times}$= 0.97) was almost not available This is in line with Popoola (2008) who reported that journal top the list of the major source of information in the academia and research Institutes in Nigeria. Asemi (2005), Rajput and Motiyani (2007) as cited by Egberongbe (2011) reported that researchers use electronic resources such as internet and e-mail.

Table 1: Media resources available for use of agricultural researchers

Print Resources	4	3	2	1.	0	Mean	S.D
Newspapers	148	80	63	32	11	2.96	1.15
	44.3%	24.0%	18.9%	9.6%	3.3%		
Journals	126	77	71	48	12	2.77	1.20
	37.7%	23.1%	21.3%	14.4%	3.6%		
Conference	110	95	74	35	20	2.72	1.20
Proceedings	32.9%	28.4%	22.2%	10.5%	6.0%		
Textbooks	82	110	88	41	13	2.62	1.10
	24.6%	32.9%	26.3%	12.3%	3.9%		
Newsletters	93	94	79	50	18	2.58	1.19
	27.8%	28.1%	23.7%	15.0%	5.4%		
Theses and	98	84	81	46	25	2.55	1.25
Dissertation	29.3%	25.1%	24.3%	13.8%	7.5%		
Book of	76	97	89	57	15	2.49	1.15
Abstracts	22.8%	29.0%	26.6%	17.1%	4.5%		
Encyclopedia	78	84	92	59	21	2.42	1.20
and Dictionary	23.4%	25.1%	27.5%	17.7%	6.3%		
Bulletins	43	107	90	71	23	2.23	1.13
	12.9%	32.0%	26.9%	21.3%	6.9%		
Posters	33	93	81	86	41	1.97	1.19
	9.9%	27.8%	24.3%	25.7%	12.3%		

Key: Very highly available = 4 Highly available = 3 Moderately available = 2
Fairly available = 1 Not available = 0

Table 2: Media resources available for use of agricultural researchers con't

Electronic Media Resources	**4**	**3**	**2**	**1**	**0**	**Mean**	**S.D.**
Electronic Mail	76	97	67	46	48	2.32	1.35
	22.8%	29.0%	20.1%	13.8%	14.4%		
Internet	71	107	57	52	47	2.31	1.34
	21.3%	32.0%	17.1%	15.6%	14.1%		
E-books	80	63	72	54	65	2.12	1.44
	24.0%	18.9%	21.6%	16.2%	19.5%		
E-journals	64	79	46	95	50	2.04	1.37
	19.2%	23.7%	13.8%	28.4%	15.0%		
E-theses	43	100	70	64	57	2.02	1.30
	12.9%	29.9%	21.0%	19.2%	17.1%		
E-conference proceedings	59	71	72	81	51	2.02	1.33
	17.7%	21.3%	21.6%	24.3%	15.3%		
E-newspapers	41	102	57	65	69	1.94	1.35
	12.3%	30.5%	17.1%	19.5%	20.7%		
Teleconferencing	54	77	68	58	77	1.92	1.40
	16.2%	23.1%	20.4%	17.4%	23.1%		
Ipad	32	50	79	70	103	1.51	1.32
	9.6%	15.0%	23.7%	21.0%	30.8%		

Agricultural Databases	**4**	**3**	**2**	**1.**	**0**	**Mean**	**S.D**
AGORA	29	49	76	99	81	1.54	1.25
	8.7%	14.7%	22.8%	29.6%	24.3%		
LanTEEAL	19	37	75	90	113	1.28	1.20
	5.7%	11.1%	22.5%	26.9%	33.8%		
FAO publications	14	34	88	88	110	1.26	1.15
	4.2%	10.2%	26.3%	26.3%	32.9%		
CAB Abstract	16	36	53	106	123	1.15	1.17
	4.8%	10.8%	15.9%	31.7%	36.8%		
PROTA	17	24	54	130	109	1.13	1.10
	5.1%	7.2%	16.2%	38.9%	32.6%		
HINARI	10	32	60	102	130	1.07	1.10
	3.0%	9.6%	18.0%	30.5%	38.9%		
AGRICOLA	9	27	63	111	124	1.06	1.06
	2.7%	8.1%	18.9%	33.2%	37.1%		
CARIS	9	17	84	96	128	1.05	1.04
	2.7%	5.1%	25.1%	28.7%	38.3%		
AGRIS	13	12	69	112	128	1.01	1.04
	3.9%	3.6%	20.7%	33.5%	38.3%		
TROPAC	6	12	74	115	127	.97	.95
	1.8%	3.6%	22.2%	34.4%	38.0%		

Key: Very highly available = 4Highly available = 3 Moderately available = 2
Fairly available = 1 Not available = 0

RQ2: What are the most preference media resources used by researchers in agricultural research institute?

The results of the findings revealed that journals ($\bar{x}$ =3.19) and textbooks ($\bar{x}$=2.88) were the favourite among print resources while posters ($\bar{x}$=1.71) was least preferred. Electronic resources like the internet ($\bar{x}$=3.28), electronic mail ($\bar{x}$=3.11) were mostly preferred among electronic resources by agricultural researchers whereas E-newspapers ($\bar{x}$= 2.69) was the least preferred. Lastly, agricultural databases like AGORA ($\bar{x}$=2.20), FAO publications ($\bar{x}$= 2.08), OARE ($\bar{x}$=1.96) and CAB Abstract ($\bar{x}$=1.90) were preferred to TROPAC ($\bar{x}$= 1.51) by agricultural researchers. This agreed with the study carried out by Zawai and Majid (2001), Swain, and Panda, (2009) that researchers prefer using journals, theses, dissertations and some other online databases for their research work

Table 3: Degree of preference of media resources by Researchers

Print Resources	4	3	2	1	0	Mean	S.D
Journals	186	76	33	26	13	3.19	1.13
	55.7%	22.8%	9.9%	7.8%	3.9%		
Textbooks	118	117	56	27	16	2.88	1.12
	35.3%	35.0%	16.8%	8.1%	4.8%		
Theses and	116	116	50	35	17	2.84	1.16
Dissertation	34.7%	34.7%	15.0%	10.5%	5.1%		
Conference	112	129	34	41	18	2.83	1.18
Proceedings	33.5%	38.6%	10.2%	12.3%	5.4%		
Book of Abstracts	80	105	73	56	20	2.51	1.19
	24.0%	31.4%	21.9%	16.8%	6.0%		
Encyclopedia and	70	82	92	63	27	2.31	1.23
Dictionary	21.0%	24.6%	27.5%	18.9%	8.1%		
Newsletters	51	94	121	39	29	2.30	1.13
	15.3%	28.1%	36.2%	11.7%	8.7%		
Bulletin	30	50	94	114	46	1.71	1.15
	9.0%	15.0%	28.1%	34.1%	13.8%		
Posters	40	44	88	102	60	1.71	1.25
	12.0%	13.2%	26.3%	30.5%	18.0%		

Table 4: Degree of preference of media resources by Researchers cont.

Electronic Media Resources							
Internet	205	69	21	25	14	3.28	1.13
	61.4%	20.7%	6.3%	7.5%	4.2%		
Electronic mail	193	59	30	31	21	3.11	1.26
	57.8%	17.7%	9.0%	9.3%	6.3%		
E-journals	154	65	51	42	22	2.86	1.30
	46.1%	19.5%	15.3%	12.6%	6.6%		
E-books	157	61	47	42	27	2.84	1.35
	47.0%	18.3%	14.1%	12.6%	8.1%		
E-theses	126	80	61	42	25	2.72	1.29
	37.7%	24.0%	18.3%	12.6%	7.5%		
E-conference	141	62	57	46	28	2.72	1.35
proceedings	42.2%	18.6%	17.1%	13.8%	8.4%		
E-newspapers	118	88	58	47	23	2.69	1.27
	35.3%	26.3%	17.4%	14.1%	6.9%		
Agricultural Databases							
AGORA	88	52	84	58	52	2.20	1.40
	26.3%	15.6%	25.1%	17.4%	15.6%		
FAO	71	68	72	64	59	2.08	1.40
publications	21.3%	20.4%	21.6%	19.2%	17.7%		
OARE	76	41	79	68	70	1.96	1.44
	22.8%	12.3%	23.7%	20.4%	21.0%		
CAB Abstract	68	45	75	78	68	1.90	1.41
	20.4%	13.5%	22.5%	23.4%	20.4%		
PROTA	68	43	80	71	72	1.89	1.42
	20.4%	12.9%	24.0%	21.3%	21.6%		
HINARI	53	55	85	73	68	1.86	1.35
	15.9%	16.5%	25.4%	21.9%	20.4%		
LanTEEAL	54	49	79	85	67	1.81	1.35
	16.2%	14.7%	23.7%	25.4%	20.1%		
AGRICOLA	55	40	85	74	80	1.75	1.38
	16.5%	12.0%	25.4%	22.2%	24.0%		
AGRIS	40	64	72	73	85	1.70	1.35
	12.0%	19.2%	21.6%	21.9%	25.4%		
TROPAC	34	38	83	87	92	1.51	1.28
	10.2%	11.4%	24.9%	26.0%	27.5%		

Key: Very highly available = 4 Highly available = 3 Moderately available = 2
Fairly available = 1 Not available = 0

Research Question 3: What are the constraints to the use of media resources by researchers in Agricultural Research Institutes?

This section aimed to elicit information on the constraints to media resources utilisation in agricultural research institutes. The result of the finding as shown in figure 1 revealed that poor funding of research institutes (86.8%), irregular electricity supply (81.4%), inadequate media resources (71.3%), infrastructure breakdown (64.4%), poor maintenance of media resources (57.2%) and obsolete equipment (57.2%) were the major constraints to the use of media resources in agricultural research institutes. Others were inadequate access to media resources (54.8%), inadequacy of trained media specialists (46.1%), unfavourable organisational policies (44.0%), poor management (48.5%) and lack of knowledge in the use of some of the existing media resources (28.1%). This finding is in consonance with Fatoki (2004) who stated that poor funding constitutes a major problem against the use of media resources.

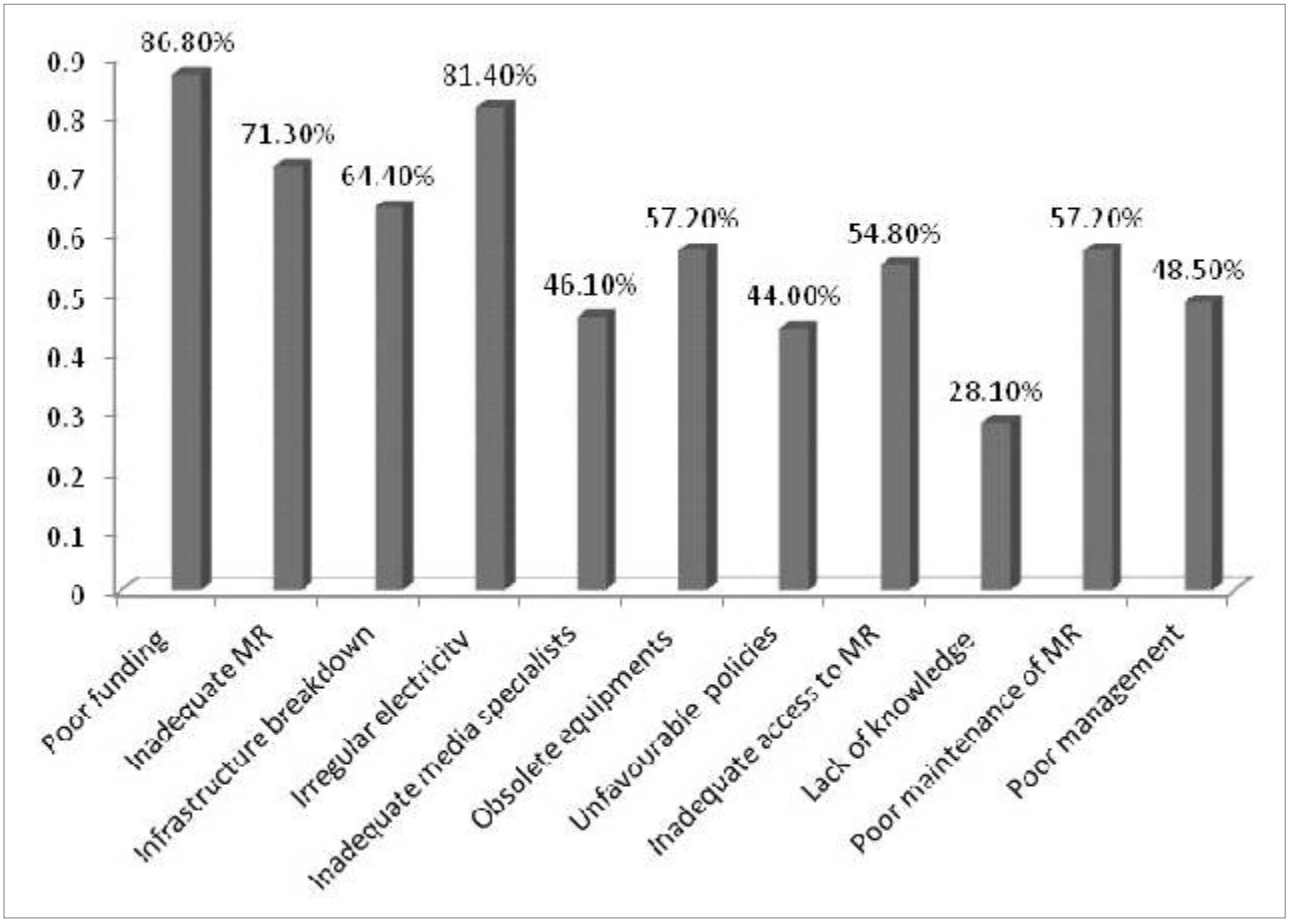

Figure1. Constraints to media resources utilization by Agricultural researchers

Hypotheses 1: There is no significant relationship between Media Resources Utilisation and Job Satisfaction of researchers in Agricultural Research Institutes in Southwestern Nigeria.

It is shown in Table 5 that there was a positive significant relationship between Media Resources Utilization and Job Satisfaction of researchers in Agricultural Research Institutes in Southwestern Nigeria ($r = .292^{**}$, $N = 334$, $P < .05$). Findings from the study indicated that utilisation of media resources had positive, weak and significant relationship on Job Satisfaction of researchers in Agricultural Research Institutes in Southwest Nigeria ($r = .292^{**}$, $N = 334$, $P < .01$). Therefore, the null hypothesis 1 is rejected meaning that without utilisation of media resources in agricultural research institutes, researchers may not be satisfied. This means that as independent variable increases, dependent variable also increases. The more researchers utilise media resources to obtain relevant information for

agricultural research, preparation for seminar presentation and communication purposes, the more their satisfaction on the job. This agreed with the work of Ajayi (2001), Ogunsola (2004) and Oduwole (2005), who perceived that utilisation of media resources as necessary tools that increase job satisfaction of researchers. The findings of this research was also corroborated by Edward et al. (1995) who studied the impact of electronic resources from libraries on the job performance and satisfaction of researchers and reported that many researchers agreed with the use of media resources because it reduced their workload and brings satisfaction on the job.

Table 5: Relationship between media resources utilisation and job satisfaction

Variables	Mean	Std. Dev.	N	R	P	Remark
Job Satisfaction	154.0719	36.9514	334	.292**	.000	Sig.
Media Resources Utilization	119.6976	35.0930				

** 0.05 level of Sig

Hypotheses 2: There is no significant relationship between Media Resources Availability and Job satisfaction of researchers in Agricultural Research Institutes in Southwestern Nigeria.

It is shown in Table 6 that there was a positive significant relationship between Job Satisfaction and Media Resources Availability of researchers in Agricultural Research Institutes in Southwestern Nigeria (r = .266**, N= 334, P < .01). The null hypothesis 3 was rejected connoting that there was a positive relationship between media resources availability and job satisfaction. It also meant that increase in the availability of media resources, will lead to increase in job satisfaction.

Table 6: Relationship between media resources availability and job satisfaction

Variables	Mean	Std. Dev.	N	R	P	Remark
Job Satisfaction	154.0719	36.9514	334	.266**	.000	Sig.
Media Resources Availability	87.8563	34.8497				

** 0.01 level of Sig

Hypotheses 3: There is no joint influence of Media Resources Availability and Media Resources Utilisation on Job Satisfaction of Researchers in Agricultural Research Institutes.

The result in Table 7 revealed that the joint effect of independent variables (Media Resources Availability and Media Resources Utilisation) on Job Satisfaction was significant R = .332, this shows joint relationship, Adj. R^2 = .105 shows coefficient of determination, (F(2,331) = 20.521; R^2 = 110; P < .05) shows significance. This method of analysis was used to test the joint contribution of the independent variables on the dependent variable that is job satisfaction. It was shown from the finding that the independent variables had significant joint influence on job satisfaction. This signifies that both independent variables had a strong bearing on job satisfaction; that is, both were quite pertinent to researchers job satisfaction. The null hypothesis was rejected meaning that utilisation of media resources and availability of media resources had joint significant influence on job satisfaction of agricultural researchers. Therefore, the independent variables had significant joint influence on researchers' job satisfaction.

Table 7: Regression analysis showing joint influence of media resources availability and media resources utilisation on job satisfaction

Model	Sum of Squares	DF	Mean Square	F	Sig.
Regression	50159.291	2	25079.646	20.521	.000
Residual	404520.98	331	1222.118		
Total	454680.28	333			

R = .332, R^2 = .110, Adj R^2 = .105

Conclusion and Recommendations

The study identified media resources that were available and utilised by agricultural researchers, the study also revealed those that were not utilised and those that were under utilised. In comparison with other groups of media resources mentioned in this study, agricultural databases are still the lowest media resources in terms of availability, use and preference. The study had found that media resources availability and media resources utilisation had a significant influence on job satisfaction of agricultural researchers. This is in line with global literature (Okiki 2013, Oduwole 2005 and Ogunsola 2004). In other words, researchers that use media resources in research will be more satisfied than those who do not. Therefore, the result of this study served as eye opener to the management of agricultural research institutes to understand the importance of media resources in research activities and it would also help them to realise the need to allocate more funds for the purchase of media resources; this should be done to enhance availability of media resources for the use of agricultural researchers and hence, their job satisfaction would be guaranteed. The result of the finding also revealed that there were constraints to the use of media resources; these were poor funding of research institutes, irregular electricity supply, inadequate media resources, infrastructure breakdown, obsolete equipment, poor maintenance of media resources, inadequate access to media resources, poor management and unfavourable organisational policies.

Finally, from the result generated from the study, media resources are important to the overall success, goals and achievement of agricultural researchers and research institutes at large, once there is awareness on media resources needed by the researchers, management of research institutes should endeavour to provide needed media resources to the institutes libraries and ICT centers in the institutes. Also, for a nation to achieve maximum development, all the available media resources would have to be carefully utilised by agricultural researchers. Based on the findings of this study, the following were recommended:

1 Some media resources such as agricultural databases were lacking in agricultural research institutes; therefore, management of agricultural research institutes should allocate more funds for the purchase of media resources.

2 Some media resources that were available were not properly utilized; librarians and media specialists should create more awareness and enlightenment to researchers on the use of those media by organising seminars, workshops and training. This will increase researchers' level of awareness of media resources that are provided in the library as this will enhance their research activities.

3 There should be regular orientation by media specialists and librarians on the available media resources to newly employed researchers.

4 More current journals, conference proceedings, books and other resources should be provided in the institute library for researchers' usage.

5 Researchers in agricultural research institutes should endeavour to use media resources regularly in support of their research activities.

6 Library management should organise information literacy programmes for agricultural researchers to improve their information searching and retrieval skills.

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INFORMATION AND DOCUMENTATION DEPARTMENT (Dr Mrs Taiwo E. Ogunjobi - Head of Directorate)

Objective

Information and Documentation department comprises of three (3) divisions which are library, information communication technology (ICT) and documentation divisions. These three divisions support the research activities of the institute by providing information and services to all people who seek it irrespective of their location.

Personnel: There are twenty-one (21) staff working in the information and documentation department. These include two Librarians, eight Programme Analysts, three Library Officers, three Data Processing Officers, one Chief Agricultural Field Overseer, two Photographers, one Secretariat Assistance and one Clerical Officer.

Library Division – (Aboderin Ayokunnu K. – Head, Library Division)

Introduction:

The Library Division of CRIN serves as a critical knowledge hub, providing essential support for the institute's research endeavours. The library's core mission is to collect, organize, preserve, and disseminate pertinent information resources to its diverse user community. This report provides an overview of the library's accomplishments, challenges, and strategic plans for the year 2024.

Achievements:

The Library Division achieved the following milestones in 2024:

1. **Renovation of the Library:** The library underwent a major renovation, which improved the overall reading environment and provided a more conducive space for research and study.

2. **Services Rendered:** The library provided various services to its users, including:

- Attending to users' inquiries and requests
- Compiling the 2023 Annual Report
- Purchasing newspapers and other relevant materials
- Carrying out research work to support the institute's research activities
- Rearranging the renovated library to ensure

optimal use of space and resources

3. **Training and Development:** The library provided training and development opportunities for:

- Corp members: The library trained 3 Corp members in library operations and services.
- Industrial training students: The library trained 27 Industrial training students in library operations and services.

Challenges:

Despite the library's achievements, several challenges were encountered in 2024, including:

1. **Electricity:** The library experienced frequent power outages, which disrupted library operations and services.

2. **Lack of On-the-Job Training:** The library staff did not receive adequate on-the-job training, which limited their ability to provide effective services.

3. **Infrastructure:** The library's infrastructure, including furniture and equipment, was inadequate and required upgrading.

4. **Equipment:** The library lacked essential equipment, including:

- Desktop and laptop computers
- Printers, scanners and photocopiers
- Internet connectivity and Wi-Fi
- Library software and databases

5. **Funding:** The library faced funding constraints, which limited its ability to acquire new materials and provide adequate services.

6. **Staffing:** The library had inadequate staffing, which limited its ability to provide effective services.

Future Plans:

To address the challenges faced in 2024, the library has outlined the following future plans:

1. **Seek Additional Funding:** The library will seek additional funding from the institute's management and external donors to support its operations and services.

2. **Upgrade Infrastructure and Equipment:** The library will prioritize the upgrade of its infrastructure and equipment to provide a more conducive reading environment and effective services.

3. **Provide On-the-Job Training:** The library will provide on-the-job training for its staff to enhance their skills and knowledge.

4. **Improve Services:** The library will improve its services, including attending to users' inquiries and requests, compiling reports, and carrying out research work.

Conclusion:

The Library Division of CRIN played a crucial role in supporting the research activities of the institute in 2024. Despite the challenges faced, the library remains committed to providing excellent services to its users. The library's future plans are designed to address the challenges faced in 2024 and to improve the overall quality of library services.

Recommendations:

Based on the library's achievements and challenges, the following recommendations are made:

1. Provide Additional Funding: The institute's management should provide additional funding to support the library's operations and services.

2. Upgrade Infrastructure and Equipment: The library's infrastructure and equipment should be upgraded to provide a more conducive reading environment and effective services.

3. Provide On-the-Job Training: The library staff should receive on-the-job training to enhance their skills and knowledge.

INFORMATION COMMUNICATION TECHNOLOGY (ICT) DIVISION (Babafemi, Ibitope B. – Head, ICT Division)

Introduction

The ICT Division is pleased to present its annual report for 2024, highlighting our Functions achievements and challenges. Our mission is to provide reliable technology services and infrastructure to support the institution's operations

Personnel

ICT Division has Six (9) personnel.

Functions

The division is saddled with the following functions:

- Internet Service Management: Ensuring stable and secure internet connectivity across

- Technical Support: Providing timely and effective technical assistance to users.
- Website Management: Maintaining and updating the institutional website and email services.
- Infrastructure Maintenance: Ensuring the upkeep and upgrade of ICT infrastructure.
- Procurement of Tools: Sourcing and acquiring ICT tools and equipment.
- In-house ICT Training: Providing training and development opportunities for interns and staff.
- Backup and Disaster Recovery: Ensuring the backup and recoverability of critical systems, including the website, User Manager, and Mikrotik RouterBOARD.

Activities and Achievement

1 Managed over 80 active users via the Mikrotik User Manager system
2 Created 14 institutional for scientists
3 Updated the Institute's website; linked CRIN Social media platforms (Facebook, YouTube, Flikr and X) on the website for visibility
4 Deployed monthly backup solutions for Mikrotik RouterBOARD and core network configurations
5 Deployed monthly backup solutions for CRIN Website to ensure website continuity and security
6 Procurement of Network and crimping Tools for smooth Network connectivity.
7 Training of interns

Challenges

- Inadequate power supply to departments, thereby limiting network coverage extension to other departments with limited or no internet access
- Unavailability of office spaces

Conclusion

The ICT Division continues to evolve in meeting the technological demands of the institution. Through strategic investments and committed service delivery, we aim to build a more robust, secure, and user-centric ICT environment in the coming year.

DOCUMENTATION DIVISION: (Ogunbanjo Olajide O. – Head, Documentation Division)

The Documentation division of Information and documentation department of cocoa research institute of Nigeria (CRIN) has been actively involved in various activities, including production and issuance of staff Identity Cards and management of social media platforms.

ID Card Production

The Documentation Department oversees the production and issuance of staff Identity Cards as part of its administrative functions. The details are as follows:

- Total registered staff: 107
- Total card collected: 103
- Cards distributed: Over 103, with more in process

The production of staff Identity Cards is an ongoing activity, ensuring that all staff members are provided with proper identification.

Social Media Management

The department also manages CRIN's social media presence, promoting the institute's events and activities. Key highlights include:

- Coverage of seminars from February 2024 to November 2024, showcasing the institute's research and expertise.
- Extensive coverage of the 60th Anniversary celebrations, including roadwork preparations and the grand event.
- Successful hosting of the RIGAN games as part of the 60th anniversary celebrations, which received great social media engagement.
- Significant increase in engagement across all social media platforms.
- 80% increase in visibility during the 60th anniversary festivities, highlighting the institute's achievements and activities.

Current Status

Both ID card production and social media management are ongoing activities, aimed at enhancing staff identification and promoting the institute's research and achievements. The Documentation Department will continue to ensure that staff members are properly identified and that the institute's activities are well-promoted through various social media platforms.

ENGINEERING DIVISION

Preamble

During the year 2024, the Engineering Works and Services Division was as usual organized into three (3) technical sections and fourteen (14) operational units.

This became imperative in order to effectively utilize the available manpower and to deliver maximally in all front of the official responsibility of the engineering division of the institute.

Sections

The three (3) technical sections in Engineering are arrange below:

1. Civil Engineering
2. Electrical Engineering
3. Mechanical Engineering

Units

We have fourteen (14) operational units, which are herein listed below:-

1. Civil:
- Mansory and Bricklaying
- Road
- Carpentary

2. Electrical
- Generator and Protection
- Networking and Installation
- Billing and Metering
- Electronic and Solar Energy

3. Mechanical
- Agricultural and Equipment
- Fabrication and Welding
- Plumbing and Water supply
- Generation, Refrigeration and Air Conditioner
- Machine shop
- Automobile and Motor Vehicle
- Special Duties (Maintenance, Planning & Monitoring)

Staff

The Engineering Division has a total of seventy-six (76) staff under this 2024 reporting year their various functional units in the Division. With five (5) Registered Engineers with Council for the Regulation of Engineering in Nigeria Professionals and Other professional Technical Staff and Drivers.

Overall Functions Of The Engineering Division

As a service division, our main function is in the technical support to the Research mandate goal of the institute. Some of such supports are:

- Daily maintenance of vehicle fleets, building, machinery, electrical lines and equipment that drives the Research mandate goals.
- Preparation of BEME for major projects and tender reports. To prepare tender document to facilitate execution of capital project.
- Inspecting and verification of projects along side some others Carrying out details of projects
- Technical advisory role to the Executive Director/Management on the tenets of the ethics of engineering.

Challenges

- Delays in request approval: This in most cases leads to manufacturing setbacks.
- Non availability of tools: Craftsmen and technical units have no tools to work or carryout their assignment. They work with their individual acquired tools for their day-to-day assignment in the institute.
- No electricity: No simple source of electricity to the division as at this year of report. The Solar system broke down and it has not been repaired till date.
- Bulk Parts Purchase: This would cater for prompt maintenance of our institute vehicles and others. This eradicates long down time delays in maintenance.
- Lack of training of staff and retraining of staff to meet up with the goal trends in maintenance techniques.

Scope For Future

1. Training of staff and retraining to meet up with the recent global technology.
2. Provision of daily needed maintenance items in bulk in the Inventory Store to eradicate delay in the execution of maintenance plans and avoid high cost of parts/item over time especially as cost fluctuates.
3. Provision of upgrade tools/equipment for the staff day to day running of the division workshops.
4. Provision of upgrade source of electricity for the division even to the workshops for effective results.

INTERNALAUDIT

Introduction and Objectives

In line with the provision of Section 1701(i) of the Financial Regulations, the Internal Audit Unit is a managerial control mechanism that measures and evaluate the effectiveness of internal control in the organization. This is no different with us at CRIN. The Division play crucial roles to ensuring that the Institute operate efficiently, comply with regulations, and achieve its research objectives.

Specifically, the role and objectives of Internal Audit in CRIN includes:

1. Evaluate the effectiveness of internal control system in the Institute and report as appropriate.
2. Ensure compliance with due process and other extant rules in all transactions and financial dealings involving government fund
3. Carry out 100% pre-payment audit
4. Carry out value-for-money assessment to ensure government funds are used effectively, efficiently and economically.
5. Bring to the notice of the Executive Director from time to time any observation on financial and operational matters and advise appropriately.
6. Provide valuable support for end-of-year statutory audit.

On a general note, Internal Audit help maintain transparency, accountability, and financial integrity. This to a great extent provide assurance and secure the confidence of our many collaborators, partners and other stakeholders toward continuous impactful contributions to agricultural research and the nation's economy. For the financial year ended 31st December 2024, in my opinion, the Division in its roles impacted the system positively. Research scientists, laboratory technologies, and agricultural superintendents constitute about 70% of the Institute's staff strength. Focus is given mostly to research and other technical activities showing tendencies to jettison administrative and other essential rules. Internal Audit has from time to time provide the much-needed education and guide to all staff towards compliance with Financial Regulations and other extant rules.

Personnel

As at 2024-year end, staff strength was fifteen (15) comprising of five (5) Accountants, eight (8) Executive Officers, one (1) Data Processing Officer and a driver attached to the Division's official vehicle.

I provide leadership and staff supervision as Head of Division.

Activities for the year were duly reported to the Executive Director as appropriate.

Major Challenge And Suggested Solution

What I consider as the major challenge of internal audit in the Institute is not peculiar to CRIN. It is something that cut across other government Research and Development Institutes.

Research is dynamic and distinct from administrative setup. Some requirements as stipulated in the Financial Regulations (FR) are considered not in tandem with research operations, bringing Research Officers (ROs) to compliance in the cause of duty is becoming a recurring challenge.

A review in part or in whole of the Financial Regulations (FR) and other relevant extant rules or at least some form of exemptions for research Institutions based on research peculiarities are suggested to tackle the identified challenge.

Conclusion and Recommendation

Research is pivotal to the development of any nation the world over, Nigeria, not an exception.

The government is advised to further provide enabling environment and as a matter of legislation, encourage Public-Private Partnership. This will facilitate the much-needed collaborations between Universities, Research Institutions, and the Private Sector.

I thank the Executive Director, Dr. Patrick Adebola for the opportunity and his landmark achievements since he assumed office four years ago.

HUMAN RESOURCES AND ADMINISTRATION DIRECTORATE

The Human Resources and Administration Directorate 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.

A. Structure Of the Department

To facilitate the activities of the Directorate, the Directorate is structured into three (3) Divisions, viz Human Resources Management Division, Legal and Corporate Matters 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

Health Service Division - Dispensary and Maternity

B. Staff Strength

The department has a total number of 118 staff. They are summarized as follows:

26 Professional in Administration, 26 Executive Officers; 1 Confidential Secretary, 1 Data Processing Officer, 8 Secretarial Assistants; 6 Clerical Officer; 8 Nurses, 1 Higher Environmental Health Officer, 1 Health Information Record Officer, 1 Health Assistant, 2 Health Attendants; 1 Data Processing Assistant, 2 Catering Offices; 3 Catering Assistants; 1 Storekeeper and 7 Field Attendants.

C. Functions/Activities of The Directorate

Detailed reports of 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:

D. Achievement/Progress of The Directorate

Total staff strength: Year 2024 the total strength of the Institute's staff is 900 i.e. Male: 593 and Female: 307.

Promotions: Junior staff promotions done in year 2024, 6 junior staff were promoted while 11 were given inter-cadre transfer/conversion. Senior staff promotions done in year 2024, 237 Senior Staff were promoted while 12 staff were given inter-cadre transfer/conversion.

Training: As at 31 December, 2024, there was no training.

Left The Service

Total number of thirty-two (32) staff 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 2024 while three (3) staffs on maternity leave, four (4) paternity leave, one (1) staff on leave of absence, one (1) sabbatical leave, four (4) staff on study leave without pay, fourteen (14) staffs on compassionate leave and eighteen (18) staffs on exam leave.

Internal Management Committee Meetings

In year 2024, the Internal Management held meetings six times.

Corporate Visits

Thirty-four (34) people and three (3) corporate organizations pay courtesy visit to the Institute.

INSTITUTE'S REST HOUSE

Activities of Institute's Rest House

1. Generation of reasonable IGR through the sales of accommodation to private and corporate organizations or person(s).
2. Regular accommodation of CRIN Management official guests during RIGAN games held at CRIN Headquarters, Ibadan.
3. Accommodation of CRIN official guests from Accountant General Officer, Abuja.
4. Catering and provision of function refreshment during CRIN 60th year anniversary at Ibadan.
5. Catering and Accommodation of new staffs on first 28 days at the Headquarters, Ibadan.
6. Accommodation of CRIN official guests during CRIN 2024 in house review.
7. General cleanly and maintenance of CRIN Rest House interior and exterior environment.

Challenges/Constraints

1. Plumbing system: - The whole Rest House plumbing system requires total repair and over hauling (new connection).
2. Purchase of 50kva petrol electric generator, the solar energy is getting weaker and needed to be back-up with this alternate power machine.
3. Purchase of cooking equipment plates and cutlery due to regular damages.
4. Purchase of window curtains and bed spreads due to regular usage and old age.
5. Renovation of chalet 1^A and 1^B.
6. Refurbishing of chalet 2^A and 2^B which had been re-roofed.
7. The two damaged flat screen TV set at the reception require replacement.
8. Need for the recruitment of two more catering staff in order to effectively cover the three shift duties.
9. Motor cycle for the Section's operation

HEALTH SERVICE

8 Qualified Nurses
2 Health Information Officer
3 Executive Officers
1 Store Officer
1 Chief Secretarial Assistant
7 Health Assistant
3 Gardeners

Dispensary

Between January – December, 2024, total number of 4,019 patients were seen.

Maternity

From January – December, 2024, total number of 1,187 patients were seen.

Delivery

Twenty-seven (27) babies delivered normally by Spontaneous vaginal delivery without any complications.

Family Planning

Eighty-five (85) clients were attended to.

Death

No death was recorded.

Sick Off

Two (2) patients were given sick off.

Referrals

Twenty-four (24) patients were referred to higher centre for expert care.

Imprest

About one hundred and twenty thousand (**N**120,000.00) was received for the reporting year.

Immunization

Eight hundred and seven (807) babies were immunized against preventable diseases while ninety-five (95) pregnant mothers were immunized against tetanus infections.

Staff Education

None of the Nurses or subordinate staff was sponsored for any seminar/workshop in the reporting year.

Babies Party

The Management released an amount of two hundred thousand naira (**N**200,000.00) only for the babies' party in December, 2024.

Income Generated

Total income generated from both the dispensary and maternity was seven hundred and forty-four thousand naira (**N**744,000.00) only.

Dispensary	**N**410,000.00
Maternity	**N**344,000.00
Total	**N**744,000.00
Profit on drugs	**N** 17,000.00
Payment on medical test in March, 2024 for new staff.	**N**220,000.00
Total	**N237,000.00**

Cash Advance

Nil grant received for drug purchase

Achievements Within The Year

1. Promotion of both senior and junior staff.
2. Payment of uniform allowance to both Nurses and Health Attendants.
3. Babies party held this year due to support from Management.

Challenges

1. Full implementation of NHIS programming by providing functioning laboratory, a resident Doctor and equipment for use.
2. Lack of seminal workshop for staff.
3. Lack of computer and internet facility.
4. Shortage of Nursing personnel.
5. Leaking roof of the garage.
6. Termite infestation of the building.
7. Lack of stable light due to non-repair of solar inverter for the past two years.
8. Water shortage due to non-functioning of generator to pump water.
9. No laptop to perform administrative work.

CHALLENGES OF THE DIRECTORATE

1. Harmful and obsolete chemical 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 toilet at technical store.
5. Provision of working materials e.g. stationery, furniture, computer and office equipment.
6. Store personnel training is highly required for more effective 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 equipments i.e complete sets of computers, laptops, refrigerators and air conditioners.
- Provision of imprest regularly.