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Perception and Adoption of Integrated Pest Management for the Enhancement of Cocoa Production and Income among Cocoa Farmers in Osun State, Nigeria.

Agulanna, F.T., Williams, O.A., Adebiyi, S., Rahman, S.B. and Uwagboe, E.O
Economics and Extension Department, Cocoa Research Institute of Nigeria (CRIN), PMB 5244, Ibadan, Nigeria
Corresponding author: foluagu@yahoo.com

ABSTRACT:
The study examined the perception of cocoa farmers on the adoption of Integrated Pest Management (IPM) and its impact on cocoa production and income. It described farmers' socio-economic characteristics, assessed their awareness and expenditures on IPM, and identified constraints to its adoption. A multistage sampling technique was used to select 150 farmers, and data were gathered through structured interviews. Descriptive statistics were used to analyze, including frequency counts, percentages, means, Weighted Mean Scores (WMS), and Pearson Product-Moment Correlation (PPMC). Results showed that 51.3% of the farmers were male, 84.7% were married, and the mean age was 49.8 years. Most farmers (87.3%) were aware of IPM, with 92.1% having up to nine years of training. Farmers' perceptions revealed that improved farming systems were considered challenging to adopt (WMS=2.55), and a common attitude was using any available insecticide (WMS=3.87). Constraints to IPM adoption included limited access to market information, which ranked highest (WMS=2.39). A significant relationship was found between farmers' age, farming experience, and perception of IPM. Older farmers with more experience showed a greater tendency to adopt IPM practices. The study concluded that farmers in their prime age had positive perceptions of IPM and were willing to learn and apply the techniques. It recommended awareness programmes and better access to market information, particularly targeting male farmers in their productive years to encourage sustainable IPM adoption in the study area.

KEYWORDS: *Adoption constraints, Attitude, Cocoa farmers, Farmers' perception, Integrated Pest Management.*

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INTRODUCTION

Originally, cocoa was mainly cultivated in the tropical rainforests in South America. Cocoa grows naturally in tropical rainforests. West and Central Africa produce about 70 percent of world cocoa. In the West African sub-region, cocoa is an important export crop in Ghana, Cote d'Ivoire, Nigeria, Cameroun, Togo and Sierra Leone. According to the International Cocoa Organization (ICCO 2023), approximately 90% of the world's cocoa is produced by 5 to 6 million smallholder farmers, with farm sizes ranging from two to five hectares (Ha).

Cocoa is one of the major cash crops in Nigeria, and it is primarily grown by smallholder farmers who rely on cocoa production for their livelihoods. Cocoa also plays a tremendous role in the health sector, as research has reported that consuming cocoa products prevents malaria, diabetes, and hypertension and reduces fatigue, among others (Ashton, 2013; Mandl, 2023).

Globally, cocoa production increased from 4,651 million metric tonnes in 2017/2018 to 4,745 million in 2019, with a production forecast of 4,824 million metric tonnes in 2020 (International Cocoa Organization

2020). Africa has remained the main cocoa producer, while in West Africa, Cote d'Ivoire, Ghana, Nigeria and Cameroon together account for about two-thirds of world cocoa production (Uwagboe & Agbongiarhuoyi, 2020). In West Africa, cocoa is mainly grown by smallholders who traditionally plant their cocoa at random under thinned forest shade. It is a low-input cultivation system that uses the forest soil fertility and the existing shade. This simple method explains that some six million ha of the West African forest zone are planted with cocoa, which provides about 70 percent of the total world production ((USAID ProLand, 2021; Kouassi et al., 2023).

In the 1970s, Nigeria was the second-largest cocoa producer in the world, but due to varied factors such as aging cocoa trees, limited access to fertilizers, unfavorable climatic conditions, pest and disease infestations, poor infrastructure, and farmers' inadequate funds to acquire inputs led to a decrease in cocoa production (Afolayan, 2023). Cocoa production is of great economic and social importance for the livelihoods of millions of small-scale farmers in tropical countries (Ardies, 2023). Insect pests are an important biotic stress factor for their cultivation. It has been shown that insect disease vectors greatly influence cocoa production costs and product quality (Adeniyi & Asogwa, 2023).

Globally, insects, pests, and diseases cause economic losses and yearly damage to crops such as cocoa. Despite the increasing demand for cocoa in the global market, pest infestations have severely limited production, affecting farmers' income. Nigeria's cocoa production has faced significant challenges in recent years due to various factors, including the prevalence of pests and diseases. A study by Olayemi et al. (2022) assessed the incidence and severity of major cocoa insect pests and diseases in the Southwest region of Nigeria, highlighting their impact on cocoa yields. The damage caused by the pests is up to an estimated loss of 100,000 tonnes. There are about 1,500 different species of insect pests attacking cocoa. However, less than two percent are of genuine economic importance (Wood & Lass, 1985).

Black pod disease, the main disease of cocoa, is primarily caused by Phytophthora megakarya and Phytophthora palmivora and continues to impact cocoa production in West Africa, including Nigeria significantly. Recent studies have highlighted the severity of this disease, with P. megakarya identified as the more aggressive pathogen, leading to substantial yield losses. In some cases, if left unmanaged, black pod disease can result in up to 100% loss of cocoa pods (Ali et al., 2024). So far in Nigeria, there is no organic cocoa, as synthetic pesticide spray application must be adopted to keep plantations productive. Nigerian cocoa farmers use many agro-chemicals (insecticides, herbicides, and fungicides) to increase production. However, they often do not consider the negative impacts of this on the cocoa beans. Recent studies have demonstrated that implementing Integrated Pest Management (IPM) strategies in cocoa cultivation can reduce pesticide applications. For instance, adopting IPM practices in cocoa farming has shown promising results in Indonesia, where farmers have reported improved yields and quality of cocoa beans, reduced pesticide use, and enhanced environmental sustainability (Ali et al., 2024).

The application of IPM helps monitor and target destructive pests and various cultural field operations, including sanitation, early harvest, and identification of disease symptoms. Using IPM leads to improved and safe yields from farmers' fields. The goal of IPM is to use research to investigate the right methodology that will assist farmers in minimizing the regular use of pesticides. Although pieces of evidence suggest that IPM practices promote crop quality (Frontiers in Sustainable Food Systems, 2024), protect the environment (American Chemical Society, 2023), and increase the profit potentials of stakeholders (Smith and Johnson. 2020), the perception of farmers towards it has been alarmingly low (Hossain et al., 2020).

Furthermore, despite the growing recognition of IPM's effectiveness in pest control, many cocoa farmers still rely on traditional, less sustainable farming methods. While studies indicate that IPM can improve environmental sustainability and economic outcomes for farmers (Ali et al., 2024), farmers may lack sufficient knowledge about its practices, or the financial benefits associated with its adoption (Zhang et al., 2023). Despite the potential benefits of IPM in improving crop yield and sustainability, farmers often remain hesitant due to factors such as lack of awareness, inadequate training, limited access to resources, and cultural beliefs about new farming practices (Hossain et al., 2020; Smith & Johnson, 2020). This study seeks to address the limited understanding of how cocoa farmers in Osun State, Nigeria, perceive the adoption of Integrated Pest Management (IPM) practices and its impact on enhancing cocoa production and income by investigating the socio-economic characteristics of cocoa farmers, their awareness and spending on IPM, the level of IPM practice, their attitudes towards it, the constraints hindering IPM adoption, the barriers to and opportunities for IPM adoption in cocoa farming with a focus on its potential to increase both production efficiency and economic gains for farmers in the study area.

LITERATURE REVIEW

Perception, Knowledge, and Attitude of Farmers to Agricultural Innovations

The perception, knowledge, and attitude of farmers towards agricultural innovations play a vital role in determining the rate and extent of adoption, and this significantly affects the adoption of agricultural

innovations (Raza et al., 2023). Farmers' perceptions are shaped by prior experiences, cultural beliefs, and the local context of their farming activities. The complexity of these factors shows the interplay of personal, social, and institutional elements that either facilitate or hinder the uptake of new practices and technologies. Innovations perceived as complex or incompatible with traditional practices are less likely to be adopted. Conversely, those perceived as providing immediate and clear benefits, such as increased yields or reduced labour requirements, tend to gain quicker acceptance (Raza et al., 2024). Another critical factor is risk perception; innovations perceived as risky or requiring substantial initial investments may face resistance unless accompanied by risk mitigation strategies like insurance or subsidies. Knowledge levels among farmers significantly influence adoption.

Socio-economic and demographic factors significantly influence the adoption of agricultural innovations. The education level plays a critical role, as educated farmers tend to have better analytical skills and a greater capacity to evaluate and implement new practices. Similarly, farm size and wealth are pivotal; larger or wealthier farmers often possess more resources to experiment with innovations. Access to credit greatly affects adoption rates since financial constraints can prevent farmers from investing in capital-intensive innovations. Furthermore, age and gender can influence adoption: younger farmers are typically more open to new ideas, while female farmers often face unique barriers due to socio-cultural constraints. Addressing these demographic dimensions is essential for fostering inclusive and widespread adoption of agricultural innovations.

Studies indicate that farmers with access to higher education levels, extension services, and exposure to training programs are more likely to understand and appreciate the benefits of these agricultural innovations, thereby adopting the new techniques (Raza et al., 2023). Access to accurate and timely information about innovations, including their application and potential benefits, is critical. Poor knowledge often results in misconceptions or partial adoption, leading to suboptimal outcomes and disillusionment with innovation. Attitudes of farmers are shaped by their cultural and social environments as well as personal experiences with past innovations. Positive attitudes often arise when farmers observe successful applications of an innovation in similar settings. However, traditional beliefs, limited understanding of the benefits, and skepticism about the practicality of innovations often hinder adoption (Raza et al., 2023, 2024).

Social norms and endorsements by community leaders can reinforce positive attitudes, while skepticism and resistance may arise from perceived failures or lack of trust in the sources promoting the innovation (Zhang et al., 2022). Social networks and peer influence also play crucial roles. Farmers are more likely to adopt innovations or practices endorsed by trusted individuals within their community, such as successful peers, local leaders, or extension agents (Achukwu et al., 2023). Demonstration plots and peer-led training sessions are particularly effective in fostering trust and showcasing tangible benefits.

Institutional factors such as government policies, availability of extension services, and market access also play a significant role in adopting innovations. Policies incentivizing adoption, such as subsidies, tax breaks, or guaranteed markets, can significantly enhance uptake. Contrariwise, inconsistent policies, bureaucratic hurdles, or lack of institutional support can undermine efforts to promote agricultural innovations. Hence, a robust understanding of farmers' perceptions, knowledge, and attitudes alongside consideration of socio-economic, cultural, and institutional variables is essential for designing and implementing effective strategies to promote the adoption of agricultural innovations.

Challenges militating against the adoption of IPM in Africa

The adoption of Integrated Pest Management (IPM) in Africa faces numerous challenges that hinder its widespread implementation. These challenges emanate from a combination of factors, including limited awareness and training, inadequate extension services, cultural resistance, climate change, cost and accessibility barriers, and institutional gaps. Overcoming these obstacles requires a comprehensive, multi-pronged approach to promote the sustainable adoption of IPM practices across the continent. One of the primary barriers to adopting IPM in Africa is farmers' limited awareness and knowledge about the concept and its potential benefits.

Many farmers, particularly smallholders, lack an understanding of the long-term advantages of IPM compared to conventional pest control methods. This knowledge gap is aggravated by the lack of targeted education and training programmes, leaving farmers ill-equipped to apply IPM techniques effectively. Without proper training, farmers may perceive IPM as complicated or ineffective. Thus, they may opt for the more familiar, often less sustainable, chemical pesticides. Inadequate training and awareness significantly hinder the widespread use of IPM across the continent (Raza et al., 2023).

Another critical barrier is the lack of adequate agricultural extension services. In many African countries, extension services are understaffed, underfunded, and often disconnected from the needs of farmers. Extension workers who should ideally serve as intermediaries between researchers and farmers are often insufficiently trained in IPM and lack the resources to provide effective guidance. The absence of consistent,

practical support from extension workers means that farmers often have limited exposure to IPM strategies and cannot properly implement them. As a result, the lack of strong and well-resourced extension services impedes IPM adoption (Wossen et al., 2017; Raza et al., 2023).

Cultural resistance and the persistence of traditional pest control practices also play a significant role in preventing the adoption of IPM. Many farmers in Africa rely on traditional pest control methods such as burning fields or using chemical pesticides, which have been passed down through generations. Changing these indigenous practices requires overcoming resistance to new technologies and methods. Farmers may perceive IPM as foreign or too complicated, which limits their willingness to embrace it even when it may be more effective and sustainable. Addressing cultural persistence requires engaging local communities through participatory learning and community-based approaches that demonstrate the benefits and usefulness of IPM (Akinmoladun et al., 2019; Halbleib et al., 2021).

Climate change presents another challenge to the adoption of IPM in Africa. Unpredictable weather patterns, including floods, droughts, and temperature shifts, can disrupt pest management strategies. IPM often relies on specific timing for pest monitoring and the release of biological control agents, which becomes less predictable under changing weather conditions. This unpredictability can lead farmers to question the reliability of IPM and, in many cases, choose chemical pesticides, which are more adaptable to varying climatic conditions. As climate change intensifies, it will be crucial to adapt IPM strategies to ensure they remain effective under increasingly variable weather patterns (Vega et al., 2020).

The cost of implementing IPM also poses a significant barrier, particularly for smallholder farmers who often operate with limited resources. Biological control agents, pest monitoring tools, and other inputs for IPM can be expensive. Moreover, the availability of these inputs is often limited in remote areas, making it difficult for farmers to access the resources needed to adopt IPM practices. The high initial costs and limited input access make IPM seem financially infeasible for many farmers. Without subsidies or access to credit, the transition to IPM can be a significant financial burden (Pretty et al., 2018). Institutional and policy gaps further aggravate the challenges faced in promoting IPM. In many African countries, policies that support sustainable agricultural practices, including IPM, are either absent or poorly enforced. Subsidies for chemical pesticides often make these inputs more affordable and accessible than IPM alternatives, creating a market preference for chemicals over sustainable pest management methods. Additionally, weak enforcement of regulations related to pesticide use and the lack of incentives for farmers to adopt IPM discourage the widespread use of integrated pest management. Strengthening policies that support sustainable agricultural practices and providing incentives for IPM adoption will be essential in overcoming these institutional barriers (Tambo et al., 2020).

Moreover, a lack of comprehensive research on pest ecology in Africa makes it difficult for farmers to implement IPM strategies effectively. IPM requires a deep understanding of pest species and their life cycles, but this knowledge is lacking in many regions. Effective pest monitoring and control depend on accurate data about pest behavior and their natural enemies, which is often unavailable. Strengthening pest monitoring systems and conducting research on pest ecology will be crucial in enabling farmers to make informed decisions about pest management and improve the effectiveness of IPM (DeLannoy & Barros, 2024). Finally, the challenges to adopting Integrated Pest Management in Africa are multi-faceted and require a coordinated, comprehensive approach to address them. Improving awareness through education and training, strengthening agricultural extension services, addressing cultural resistance, adapting to climate variability, making IPM inputs more accessible and affordable, and creating supportive policies are necessary to promote the widespread adoption of IPM. By tackling these challenges comprehensively, African countries can move toward more sustainable, resilient, and environmentally friendly pest management practices that support long-term agricultural productivity and food security.

Attitude of cocoa farmers towards the practice of IPM

Attitudes of cocoa farmers toward IPM are formed by their understanding of its benefits, such as reduced pesticide use, lower production costs, and environmental sustainability. Positive attitudes are often observed and developed in farmers who have participated in IPM training programmes or witnessed successful implementation within their communities (Hossain et al., 2020; Zhang et al., 2022). This exposure builds confidence in IPM and highlights its practical benefits, motivating its adoption. However, negative attitudes persist among farmers due to several misconceptions about IPM. Many perceive IPM as labor-intensive, time-consuming, risky, or less effective than conventional pest control methods (Hossain et al., 2020; Zhang et al., 2022).

Others doubt its effectiveness, particularly in managing severe pest outbreaks, leading to hesitancy in transitioning away from chemical-based solutions. The challenges are further exacerbated by social norms and a lack of trust in the promoters of IPM, such as extension agents and agricultural organizations (Parsa et al., 2014; Zhang et al., 2023). Farmers with greater access to education and support services are generally

more receptive to IPM practices (Oluwatusin, 2014; Hossain et al., 2020; Zhang et al., 2022). Educational attainment plays a critical role in shaping the attitudes of farmers. Farmers with higher levels of education often exhibit a greater willingness to adopt IPM practices due to their enhanced capacity for understanding the scientific principles underpinning the approach (Achukwu et al., 2023). Access to robust support services, including extension services and farmer-based organizations, contributes significantly to positive attitudes by providing technical assistance and reinforcing the perceived reliability of IPM methods (Eryanto et al., 2023).

Social influences such as peer recommendations and endorsements by community leaders are also instrumental in shaping attitudes. When key figures in farming communities endorse IPM, other farmers are more likely to adopt it. Demonstration plots and participatory learning programmes are particularly effective, providing tangible evidence of IPM's efficacy and encouraging broader acceptance (Zhang et al., 2023). In conclusion, promoting positive attitudes toward IPM among cocoa farmers involves correcting misconceptions through targeted education, building trust in extension services, and utilizing social networks to share success stories. Understanding these attitudes is crucial for designing effective interventions that encourage sustainable pest management practices.

Constraints militating against adoption of IPM

Several critical constraints hinder the adoption of Integrated Pest Management (IPM). One of the foremost barriers is the knowledge gap among farmers. Inadequate training and limited access to information impede farmers' understanding and implementation of IPM practices, leaving them reliant on conventional pest control methods (Akinmoladun et al., 2023; Hossain et al., 2020). Economic constraints also play a significant role. The high upfront costs associated with IPM, coupled with a lack of financial support or credit facilities, limit the ability of farmers to invest in these practices. Many smallholder farmers face significant resource constraints, which makes it difficult to prioritize sustainable pest management over immediate needs (Akinmoladun et al., 2023; Hossain et al., 2020). Infrastructure deficiencies also limit the adoption of IPM. Limited access to markets and necessary inputs such as biopesticides and extension services reduces the capacity of farmers to implement and sustain IPM strategies. Inadequate infrastructure often isolates farmers in remote areas, depriving them of crucial support systems and resources (Turley & Uzsoki, 2019; Ayim et al., 2020).

Social and cultural barriers also impede IPM adoption, with resistance to change and a strong reliance on traditional farming practices fostering skepticism toward new methods. Additionally, a lack of trust in the efficacy of IPM among farmers further affects its acceptance and adoption within communities (Ali et al., 2024; Zhang et al., 2023). Environmental factors, including pest resurgence and the unpredictability of climate patterns, contribute to the uncertainty surrounding IPM. Climate variability often disrupts the effectiveness of pest control measures, leading to inconsistent results and reducing farmers' confidence in these practices (Ali et al., 2024; Zhang et al., 2023). Addressing these constraints requires a comprehensive approach that includes targeted training programmes, financial support mechanisms, improved infrastructure, community engagement to overcome cultural resistance and adaptive strategies to cope with environmental challenges. Such efforts are essential to ensure the sustainable adoption of IPM practices across diverse agricultural contexts.

MATERIALS AND METHODS

Pre-Survey

The pre-data survey was conducted in Ayeoba in Ife-South LGAs of Osun State. The survey, which also represented an advocacy visit, was conducted in order to familiarize the farmers with the culture, norms, and traditions in the study area.

Unequivocally, during the pre-survey activities, we determined the applicability of the questionnaire and got legitimization for the proposed survey work.

Study Area

The study was carried out in Osun State. Two Local Government Areas (LGAs), Ife South and Ife Central, were selected for the study. The main survey was carried out in Aye Oba and Olode in Ife-South LGAs of Osun State. Eighty cocoa farmers were sampled for the survey work and drawn from Aye Oba and Olode in Ife South. In comparison, seventy cocoa farmers were drawn from Aye Koka and Iyanfoworogi in Ife-Central LGAs.

A structured interview was used to collect information from the sampled farmers assembled in Aye Oba, which is in the center of the communities around the area. The programme was organized using a participatory approach. The farmers comprise both male and female cocoa farmers. A total of one hundred and fifty (150) cocoa farmers were used for the study.

Instrument for Data Collection

A structured questionnaire elicited information about the study objectives from the cocoa farmers. The questionnaire was divided into five sections as follows: (A) socio-economic characteristics, (B) Perception of the use of IPM, (C) Constraints experienced in adopting IPM, (D) Attitude of respondents towards adoption of IPM, (E) Adoption behavior rate of IPM usage.

Analytical Tools

Descriptive and inferential statistics: frequency counts, percentages, mean, standard deviation, and weighted mean scores.

RESULTS AND DISCUSSION

The socio-economic characteristics of the respondents, as shown in Table 1 below, reveal the factors that influence the adoption of Integrated Pest Management (IPM) techniques among cocoa farmers in the study area. These findings show farmers' socio-economic characteristics, including sex, marital status, educational status, and religion. The table reveals that about 51.3% of the respondents were males, while 48.7% were females. This is crucial as both genders are actively involved in agricultural practices, and any initiative to promote IPM adoption should consider gender-specific roles and challenges. For instance, while male farmers have better access to resources and decision-making autonomy, female farmers could benefit from targeted training to bridge potential gaps in access to inputs and knowledge. Most (84.7%) were married, which gave the respondents a sense of responsibility. The high proportion of married respondents implies that the farmers are likely to have stable family structures, which could foster a sense of responsibility toward adopting innovations like IPM. Married individuals may also have access to family labor, which could support the labor-intensive aspects of IPM practices, such as monitoring and manual pest control.

Regarding education, 84% of the respondents had one form of formal education ranging from adult to tertiary education. The finding that 84% of respondents had some level of formal education highlights the potential for effective dissemination of IPM knowledge. Education is a key determinant in adopting agricultural innovations as it enhances the ability of farmers to understand and implement complex techniques. Farmers with higher education levels are better positioned to appreciate the long-term benefits of IPM, including reduced pesticide use, improved yields, and environmental sustainability. This result aligns with existing literature, such as Adebiyi et al. (2021), which links educational attainment with the willingness to embrace innovative agricultural practices.

Respondents within the age brackets of 56-63 years were 22.1%, with a mean age of 49.8 years. This indicates that most are still in their prime age and would be ready to learn and apply IPM techniques on their farms. The mean age of 49.8 years, with the largest age group being 56-63 years (22.1%), indicates that most cocoa farmers are in their productive years. Despite not being "young," they are experienced and active enough to adopt new technologies. The willingness to learn and adopt IPM techniques varies, with older farmers potentially being more resistant due to entrenched traditional practices. Targeted training programmes tailored to their needs and experiences could address this challenge effectively. The result supports the findings of Adebiyi et al. (2021) in a study of cocoa farmers who practiced cocoa rehabilitation techniques on cocoa beans, revealing that farmers are still in their active farm age.

The high level of farming experience (mean of 5.6 years, with 68.7% having 20-31 years of experience) reflects a strong knowledge base in cocoa cultivation. Experienced farmers are more likely to recognize the limitations of conventional pest control methods and the potential benefits of IPM, making them key stakeholders in its adoption. This finding supports the assertion that experience in farming enhances decision-making capabilities related to adopting innovative practices. Nearly half (46.0%) of the respondents had a farm size of 3-5 hectares, indicating relatively small-scale cocoa farming. The predominance of small-scale farming, with 46% owning farms of 3-5 hectares, aligns with previous studies, such as Ojelade et al. (2005); ICCO (2023); Ojo and Adebayo (2024), which reported that most cocoa farmers in Nigeria operate on small to medium-scale farms. The smallholder nature of cocoa farming has implications for IPM adoption. Smaller farm sizes may limit the farmers' financial capacity to invest in IPM inputs. However, these farmers can benefit from cooperative arrangements or subsidies to make IPM practices more accessible. Additionally, larger farms have greater income potential, which could enhance farmers' ability to adopt IPM technologies. Farmers with larger plots may also have more flexibility to allocate portions of their land for experimenting with new practices, thereby increasing the likelihood of adoption. Addressing land tenure challenges, such as fragmentation through inheritance, could encourage farmers to consolidate their farms, enhancing the scalability of IPM practices.

The socio-economic characteristics of cocoa farmers significantly influence the adoption of IPM techniques. Education and experience are critical enablers, while constraints such as small farm sizes and traditional practices pose challenges. Efforts to promote IPM adoption should focus on leveraging the strengths

identified, such as the educational background of farmers and farming experience, while addressing barriers through tailored training, financial incentives, and policies that support smallholder farmers.

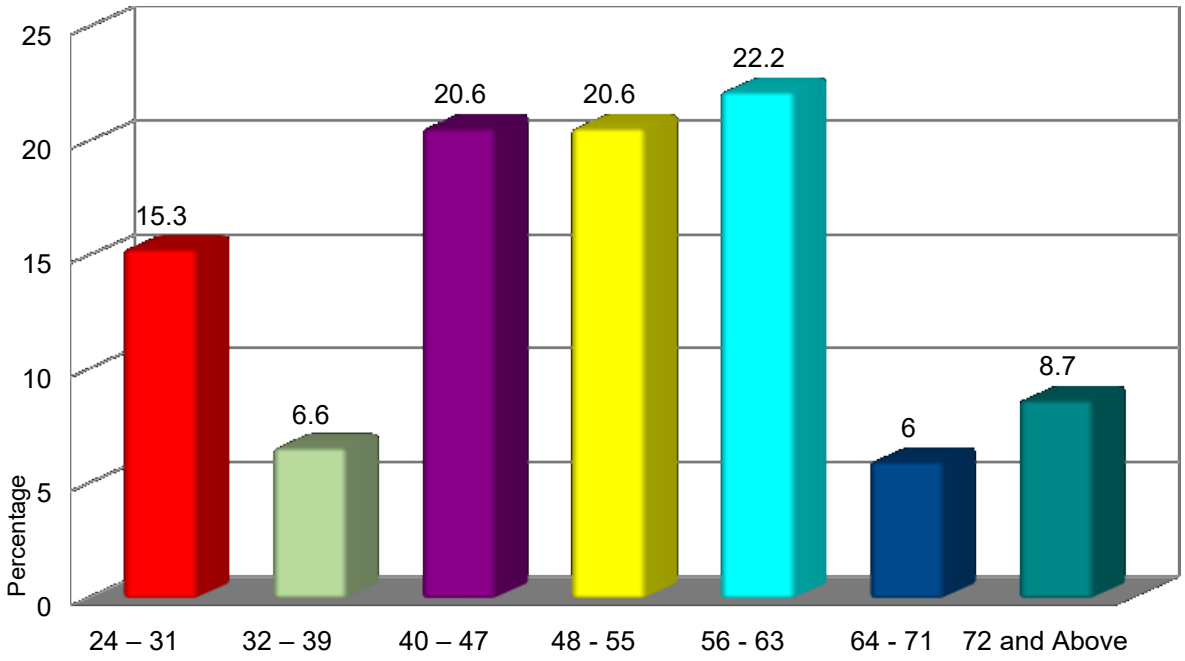

Figure 1: Diagram showing the age of the respondents in years
Source: Field survey

The data presented in Table 2 below provides important insights into the awareness, training, and economic impact of Integrated Pest Management (IPM) practices among cocoa farmers. These findings underscore the potential of IPM to enhance productivity and profitability in cocoa farming even as the adoption process is still maturing in the study area. A high percentage of farmers (87.3%) were aware of IPM, while (92.1%) had 0-9 years of training in IPM, indicating that this is a recent innovation in cocoa farming. The high level of awareness (87.3%) indicates that IPM is gaining recognition among cocoa farmers. Awareness is a critical precursor to adoption, as farmers need to understand what IPM entails and its potential benefits before they can consider incorporating it into their farming practices. This result suggests that dissemination efforts through extension services, farmer organizations, or community outreach programs have been somewhat effective. However, awareness alone does not guarantee adoption. Practical training and support are necessary to translate awareness into action. The finding that 92.1% of farmers have had 0-9 years of IPM training shows that IPM is a relatively recent innovation in cocoa farming in the study area. This aligns with the global trend of promoting sustainable agricultural practices to address environmental concerns and reduce reliance on chemical pesticides. While the short duration of training may limit the depth of knowledge and confidence in applying IPM, it also reflects a growing interest in equipping farmers with sustainable pest management skills. Continuous and comprehensive training programmes are essential to deepen farmers' understanding of IPM and ensure effective implementation.

The fact that 63.3% of the respondents realized more than ₦500,000 per annum from cocoa sales demonstrates the economic viability of cocoa farming in the study area. This income level is significant, particularly for smallholder farmers. It underscores the potential of cocoa farming as a source of livelihood. The correlation between IPM adoption and improved yields, as seen in the data, suggests that integrating IPM into cocoa farming could further enhance productivity and profitability. By improving soil health and reducing pest-related losses, IPM contributes to higher yields and better-quality cocoa beans, which can command premium prices in the market. About 42.7% of respondents spent less than ₦42,000 per annum on IPM, which suggests that the cost of implementing IPM is relatively low compared to conventional chemical-based pest control methods. This affordability could make IPM a viable option for smallholder farmers, who often face financial constraints. However, the low expenditure may also indicate that farmers are not fully implementing all components of IPM, potentially limiting its effectiveness.

Table 1: Socio-economic characteristics of farmers **n=150**

Variable	Frequency	Percentage
Sex		
Male	77	51.3
Female	73	48.7
Marital status		
Single	19	12.7
Married	127	84.7
Divorce	-	-
Widowed	4	2.7
Educational status		
Non formal	24	16.0
Adult	12	8.0
Primary	48	32.0
Secondary	50	33.3
Tertiary	16	10.7
Religion		
Christianity	104	69.3
Islam	44	29.3
Traditionalist	2	1.3

Source: Field survey.

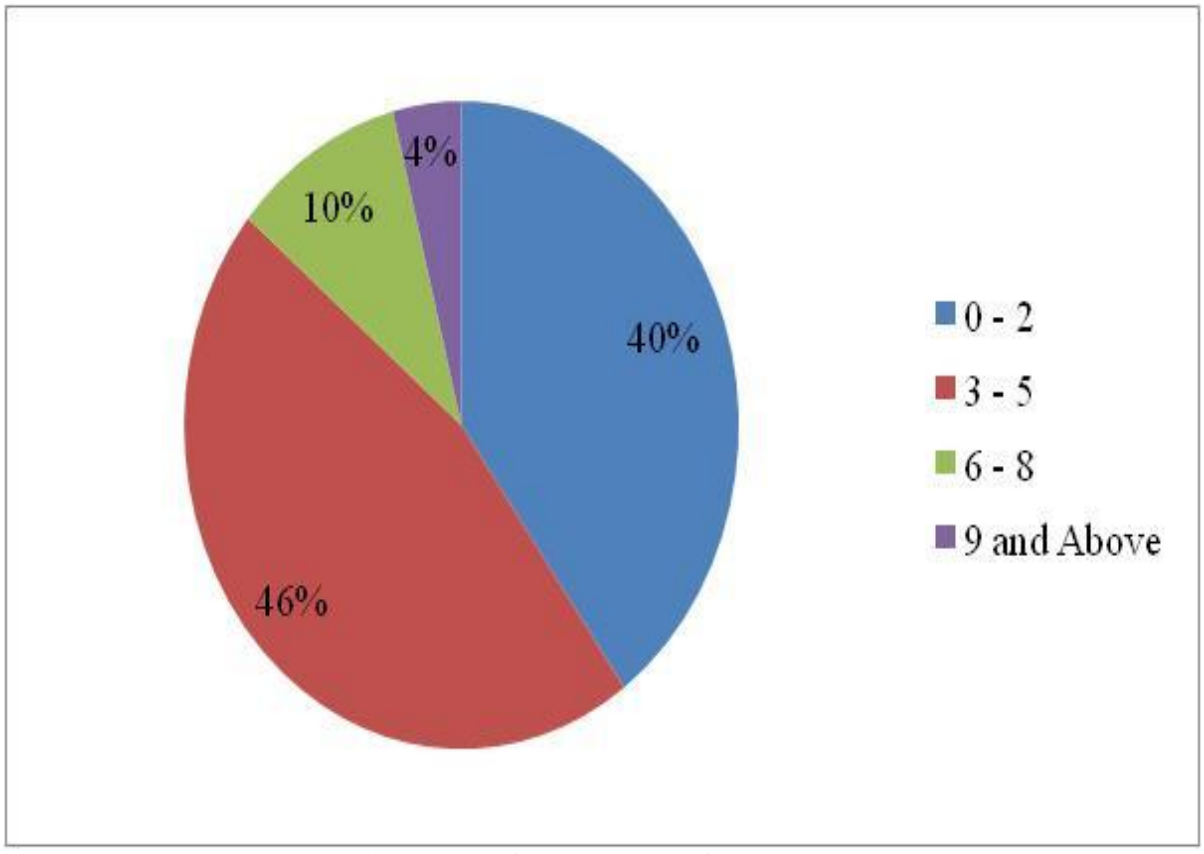

Figure 2: Diagram showing the distribution of respondents by farm size in Hectares
Source: Field survey.

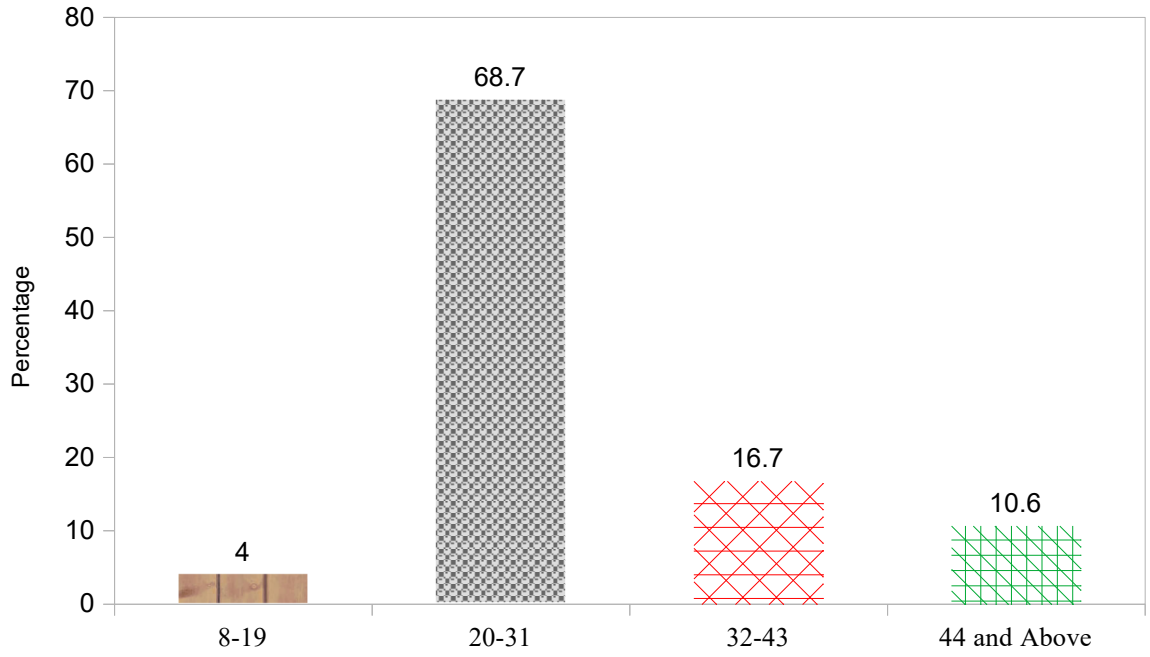

Figure 3: Diagram showing the distribution of respondents by farming experience (years)
Source: Field survey.

Additional subsidies or access to affordable IPM inputs could encourage broader and more effective adoption. The results indicate that IPM can boost production levels by improving soil nutrients and promoting sustainable farming practices. Unlike chemical pesticides, which can degrade soil quality over time, IPM emphasizes ecological balance and long-term productivity. Farmers who adopt IPM will likely see cumulative benefits, including reduced input costs, healthier crops, and increased resilience to pests and diseases. The findings demonstrate that cocoa farmers are increasingly aware of IPM and recognize its potential to improve productivity and income. However, the relatively recent introduction of IPM and limited training duration indicate the need for sustained efforts to deepen adoption. With targeted interventions and support, IPM can become a cornerstone of sustainable cocoa farming, driving economic growth and environmental conservation.

Table 3 below shows the perceptions of cocoa farmers toward adopting Integrated Pest Management (IPM) practices. Perception is critical in determining farmers' willingness to adopt agricultural innovations. The rankings derived from the weighted mean scores (WMS) provide valuable insights into the barriers and opportunities related to IPM adoption in the study area. Respondents who perceived that improved farming systems are not easily adaptable, so they did not adopt them had the highest weighted mean score (WMS) of 2.55 and were ranked 1st, while those who indicated that they adopt new practices based on information about them from those who have adopted (WMS=2.19) and those that responded that since new farm practices are not profitable, they are not interested in any of them (WMS=1.43) were ranked 2nd and 3rd respectively. Those who perceived they were very interested in adopting new practices that help conserve input, soil, and water had the lowest WMS of 1.04 and were ranked 6th. The highest-ranked perception indicating that farmers find improved farming systems difficult to adopt underscores a significant barrier to the uptake of IPM. This resistance could stem from factors such as the complexity of innovations, resource constraints, and lack of tailored support. This finding aligns with earlier studies, such as Alam et al. (2024) and Gizachew et al. (2024), which attribute low yields and adoption rates to the failure of research and extension systems to deliver accessible and relevant services to farmers.
The ranking of peer influence as the second highest perception reflects the importance of social networks in shaping adoption behavior. Farmers often rely on the experiences of their peers when deciding whether to adopt new practices. This is particularly true in rural communities, where trust and social proof significantly influence decision-making. Leveraging this dynamic through farmer-led demonstration plots and peer-led training programmes could enhance IPM adoption rates. Extension services should prioritize creating platforms for successful adopters to share their experiences with others. The lowest-ranked perception highlights a lack of interest in practices related to conserving inputs, soil, and water. This could be attributed

to inadequate extension delivery on the importance of these conservation practices. Farmers may not prioritize such practices if they are not perceived as directly improving yields or profits. Strengthening extension efforts to emphasize the long-term benefits of sustainable farming practices, such as increased soil fertility and reduced input costs, is critical.

Table 2: Awareness and amount spent on IPM **n=150**

Variables	Frequency	Percentage
Awareness of IPM		
Yes	131	87.3
No	19	12.7
Years in IPM Training		
0 – 9	138	92.1
10 – 20	2	1.3
21 – 31	10	6.6
Mean ± Standard deviation	5.63 ± 6.81	
Bags of cocoa produced (65kg=1 bag)		
2 – 10	63	42.0
11 – 19	43	28.7
20 – 28	19	12.6
29 – 37	14	9.4
38 and above	11	7.3
Amount realized on the sale of cocoa(₦)		
50,000 – 643,000	55	36.7
643,001 – 1,236,001	71	47.3
1,236,002 – 1,829 002	17	11.3
1,829,003 – 2,422,003	3	2.0
2,422,004 – 3,015,004	4	2.7
Mean ± Standard deviation	₦861,946.3 ± 542,761	
Amount spent on IPM per year (₦)		
41,400	64	42.7
41,401 – 82,801	38	25.3
82,802 – 124,202	43	28.7
124,203 and above	5	3.3
Mean ± Standard deviation	₦59,725.6 ±41423.115	

Source: Field Survey

The study reveals a significant gap between awareness and adoption of IPM driven by perceptions of complexity, profitability, and inadequate extension support. Addressing these perceptions through robust training, farmer engagement, and economic incentives can bridge the gap and foster the widespread adoption of sustainable farming practices like IPM.

The attitudes of cocoa farmers toward Integrated Pest Management (IPM), as presented in Table 4 below, offer critical insights into their practices, beliefs, and areas where interventions are required. These attitudes reveal both the opportunities and challenges for promoting the adoption of IPM. While some attitudes reflect entrenched cultural and economic constraints, others emphasize the need for better awareness and support systems. The highest-ranked attitude (WMS = 3.87) reflects farmers' widespread reliance on readily available insecticides to combat pest infestations. The second-ranked attitude highlights a cultural barrier to adopting recommended agronomic practices. Removal of chupon (WMS=3.80) (the pruning of unproductive branches or suckers) is essential for improving cocoa tree productivity. However, farmers' belief that this practice conflicts with cultural traditions reflects a deep-seated resistance to change. Supplying water to young cocoa trees is very expensive and was ranked 3rd (WMS= 2.35). The belief that watering young cocoa trees is expensive reveals a practical challenge for farmers. Water is critical for young seedlings' survival and growth, especially during dry seasons when they are vulnerable to drought stress. However, farmers' reluctance to invest in water management can jeopardize seedling establishment, leading to higher mortality rates and reduced productivity. The lower-ranked attitudes, such as planting resistant varieties (WMS = 1.71), Ranked 4th; monitoring pests to save money (WMS = 1.31) ranked 5th; while applying fertilizer to increase yields (WMS = 1.15), ranked 9th, indicate that farmers may lack adequate knowledge about these effective practices. The attitudes of cocoa farmers toward IPM reveal a mix of embedded cultural beliefs, economic constraints, and knowledge gaps. Addressing these issues through targeted interventions can

significantly enhance the adoption of IPM practices, improving productivity, profitability, and environmental sustainability in cocoa farming.

Table 3: Perception on the use of Integrated Pest Management n=150

Perception of the use of Integrated Pest Management	A	U	D	WMS	Rank order
I am very much interested in adopting new practices that help conserve input, soil, and water	0(0.0)	6(4.0)	144(96.0)	1.04	6th
Since I am not sure of the success of new practices, I would like to wait till others adopt it	22(14.7)	5(3.3)	123(82.0)	1.33	4th
Since new farm practices are not profitable, I am not interested in any of them	30(20.0)	4(2.7)	116(77.3)	1.43	3rd
I try to keep myself informed about improved farming practices to adopt them as early as possible	17(11.3)	0(0.0	133(88.7)	1.23	5th
Improved farming systems are not easily adaptable, so I do not adopt them	113(75.3)	6(4.0)	31(20.7)	2.55	1st
I adopt new practices based on information from those who have adopted them	88(58.7)	2((1.3)	60(40.0)	2.19	2nd

Source: Field survey. A= Agree U= Undecided D= Disagree

Table 4: Attitudinal Statements on the Use of Integrated Pest Management N=150

Attitudinal Statements	SA	A	U	D	SD	WMS	Rank order
Pruning of cocoa is done to prevent black pod disease.	0(0.0)	0(0.0)	0(0.0)	15(10.0)	135(90.0)	1.10	10th
Weeding on my farm can prevent insect attack	0(0.0)	0(0.0)	0(0.0)	26(17.3)	124(82.7)	1.17	7th
Application of fertilizer can increase the yield of cocoa	3(2.0)	0(0.0)	0(0.0)	10(6.7)	137(91.3)	1.15	9th
Removal of mistletoe could increase the fruiting	0(0.0)	0(0.0)	0(0.0)	26(17.3)	124(82.7)	1.17	7th
I use any insecticides available in the market	87(58.0)	22(14.7)	4(2.7)	8(5.3)	29(19.3)	3.87	1st
Removal of chupon is against our cultural beliefs	97(64.7)	5(3.3)	3(2.0)	11(7.3)	34(22.7)	3.80	2nd
Water management is necessary to prevent drying up of young cocoa plant	0(0.0)	0(0.0)	0(0.0)	28(18.7)	122(81.3)	1.19	6th
Monitoring of pest saves money	0(0.0)	2(1.3)	11(7.3)	18(12.0)	119(79.3)	1.31	5th
Planting of resistant varieties controls pest	0(0.0)	0(0.0)	0(0.0)	31(21.2)	115(78.8)	1.71	4th
Supplying water to young cocoa trees is very expensive	43(28.7)	4(2.7)	0(0.0)	18(12.0)	85(56.7)	2.35	3rd

Source: Field survey.

The constraints in Table 5 below indicate cocoa farmers' challenges in adopting Integrated Pest Management (IPM). These constraints highlight systemic issues such as limited access to market information and economic and social factors like household size and labor availability that must be addressed to enhance the uptake of sustainable farming practices. Access to market information has the highest WMS of 2.39 and was ranked 1st while household size (WMS=2.22), inadequate labor (WMS= 2.16), other off-farm activities (WMS=2.10), membership of farmers/ cooperative association (WMS=2.00), contact with extension agents (WMS= 1.56), age of farms (WMS=1.55) and inadequate credit facilities (WMS=1.26) were ranked 2nd, 3rd, 4th, 5th, 6th, 7th and 8th respectively. This aligns with Oduwole et al. (2017), Saerem (2021), and Sciendo. (2021) that farmers with fewer constraints are likely to adopt.

Access to timely and accurate market information is pivotal for adopting agricultural innovations such as IPM. Farmers rely on market intelligence to decide the cost-effectiveness and potential returns of adopting new practices. The influence of household size on IPM adoption reflects the dual role of family members as both resource consumers and labor providers. Larger households may face competing demands for income and labor, diverting resources away from farm activities. On the other hand, smaller households may struggle to meet labor demands for implementing IPM practices such as pest monitoring and manual weeding. Labor shortages are a significant constraint, particularly as IPM requires regular monitoring, timely interventions, and consistent farm maintenance. Cocoa farming in many regions depends on aging farmer populations, with younger individuals often pursuing off-farm employment. Engagement in off-farm activities diverts time and resources from farm management, reducing the capacity of farmers to adopt labor-intensive practices like IPM. These activities are often necessary for income diversification, especially in households with limited farm productivity or market access.

The constraints militating against adopting IPM among cocoa farmers are multi-faceted, with market access, labor availability, and household size emerging as key barriers. Addressing these challenges requires concerted efforts by stakeholders, including government agencies, extension services, cooperatives, and financial institutions. Tailored interventions focusing on education, resource provision, and economic incentives are critical to fostering widespread adoption of IPM practices, thereby improving productivity, sustainability, and farmer livelihoods.

Table 5: Constraints militating against the Adoption of Integrated Pest Management n=150

S/N	Constraints experienced in the adoption of Integrated Pest Management	Very Severe	Severe	Not severe	WMS	Rank order
1	Age of farms	8(5.3)	66(44.0)	75(50.7)	1.55	7th
2	Other off-farm activities	42(28.0)	81(54.0)	27(18.0)	2.10	4th
3	Access to market information.	74(49.3)	61(40.7)	15(10.0)	2.39	1st
4	Inadequate Labour	50(33.3)	74(49.3)	26(17.3)	2.16	3rd
5	Household Size	71(47.3)	41(27.3)	38(25.3)	2.22	2nd
6	Inadequate credit facilities	14(9.3)	11(7.3)	125(83.3)	1.26	8th
7	Contact with Extension agents	37(24.7)	9(6.0)	104(69.3)	1.56	6th
8	Membership of farmers/ cooperative Association	45(30.0)	60(40.0)	45(30.0)	2.00	5th

Source: Field survey.

The results from Table 6 below show significant relationships between the socio-economic characteristics of the farmers and their perception of Integrated Pest Management (IPM) in the study area. These findings reveal the factors that influence IPM adoption. A strong and positive relationship was observed between farm experience and the perception of IPM ($r = 0.780$, $p = 0.000$). This suggests that farmers with more years of experience are more likely to understand IPM practices better and appreciate them. Experienced farmers are likely to have encountered various pest challenges and understand the value of sustainable pest management practices. Therefore, they may be more open to adopting IPM techniques that promise better long-term yield and pest control results. This highlights the importance of leveraging the knowledge and experience of older, more seasoned farmers in adopting and spreading IPM practices. Extension programmes should focus on these farmers as they can act as key influencers or champions to encourage younger, less experienced farmers to adopt IPM.

The negative but weak relationship between age and perception of IPM (r = -0.032, p = 0.005) indicates that younger farmers tend to have a more favorable view of IPM practices. Younger farmers are often more receptive to innovation and are likely to be more adaptable to new technologies like IPM. This finding suggests that the future sustainability of IPM adoption may depend heavily on engaging younger generations more open to experimenting with and adopting new farming practices. To ensure the long-term adoption of IPM, efforts should be made to target younger farmers with tailored training programs and technologies that resonate with their preferences and learning styles. Youth-focused interventions could facilitate the widespread adoption of IPM practices in the study area. The findings emphasize the importance of experience and age in shaping farmers' perceptions of IPM. A strong farm experience is positively associated with better perception and potential adoption of IPM, while younger farmers show more openness to adopting such practices. Therefore, strategies that combine the wisdom of experienced farmers with the innovation-driven mindset of younger farmers will likely enhance the adoption of IPM in the long run.

Table 6:Hypothesis: There is no significant relationship between farmers' socio-economic characteristics and the perception of the practice of IPM.

Variables	Correlation Coefficient (r)	p-value	Remark	Decision
Age	-0.032	0.005	Significant	Reject Ho
Farm size	0.460	0.175	Not significant	Accept Ho
Farm experience	0.780	0.000	Significant	Reject Ho

Source: Data Computation.

CONCLUSIONS AND RECOMMENDATION

In conclusion, most of the farmers were in their prime age and ready to learn and apply the skill of IPM techniques in their farms. Most of the small-scale farmers were males with long farming histories. Government should encourage youths to be involved in cocoa production to enhance sustainability. The farmer's farm size is relatively small; they need to be supported probably with soft loans to ease the increase in the hectares of their cocoa farms. Also, yield improvement programmes such as good agricultural practices and rehabilitation programmes in agronomic practices should be initiated and taught to increase farmers' yield. Women should also be encouraged to grow cocoa and given access to farmland for tree crops. There is a need to examine the constraints militating against the adoption of IPM in order to design and implement proper policy measures that can promote the adoption of IPM. This will lead to a paradigm shift from the primitive natural control practices previously used by the farmers.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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