Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 24, Issue 4, 2024
PRINT ISSN 2284-7995, E-ISSN 2285-3952

EXPLORING THE DETERMINANTS OF ADOPTION BEHAVIOR IN COCOA PRODUCTION: A CASE STUDY OF INTEGRATED PEST MANAGEMENT IN CROSS RIVER STATE, NIGERIA

Eghosa Osas UWAGBOE, Adejoke Adebusola ADELUSI, Francis Adetunji ADESIDA

Cocoa Research Institute of Nigeria, P.M.B. 5244, Idi-Ayunre, Ibadan.Oyo state, Nigeria.
E-mails: eghosauwagboe1@gmail.com, aadelusi18@gmail.com, adesida2003@gmail.com

Corresponding author: eghosauwagboe1@gmail.com

Abstract

A comprehensive Integrated Pest Management (IPM) is an ecosystem approach to control insect and disease pests to minimize the use of pesticides. Cross River State was purposively selected based on training done by International Institute of Tropical Agriculture (IITA) through Sustainable Tree Crop Programme. The study explored the determinants of adoption behaviour. A systematic sampling technique was used to select a total of 108 IPM trained respondents. Structured questionnaire was used to gather information on farmers'socio-economic factors affecting IPM Adoption, determine the IPM adoption behaviour of farmers and ascertain the constraints experienced from IPM adoption. Male respondents were 81.5% while the females were 18.5%. Majority (65.1%), were between the age range of 41 and 60 years which is an indication that they were still in their prime age. Majority (94.4%), of the respondents were educated and majority (97.2%) of the farmers own small farms between 1 and 5 ha. Most of the respondents rated inaccessibility to market information as the highest constraint affecting IPM adoption with a Weighted Mean Score of 0.8. Majority (79.6%) had high level of intensity of IPM adoption while most of the respondents rated both pest monitoring and planting resistant varieties as the highest rate of adoption with a score of 2.9. A significant relationship exists between sex (X^2 =42.815, $p<0.05$), age (X^2 =65.148, $p<0.05$), education (X^2 = 40.426, $p<0.05$), years of experience (X^2 =110.333, $p<0.05$), and adoption behaviour. The contingency coefficient (CC) shows very strong relationship of sex 0.5328, age 0.6134, marital status 0.7758, education 0.5218 and years of experience 0.7108 with adoption behaviour. Farmers need to be encouraged in adopting IPM through marketing information that would reduce extortion of the farmers by local buying agents.

Key words**:** *exploring the determinants, adoption, cocoa, Integrated Pest Management training, marketing information*

INTRODUCTION

Cocoa was first located in Mexico and in other areas of centralAmerica thousands of years ago [38]. Cocoa was grown in many ancient south American cultures, the Aztecs and Mayans being the most well-known indigenes [42]. 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 [38]. 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 [39].

The foremost cocoa farms in Nigeria were in Bonny and Calabar in the 1870s but the area was not suitable for cocoa cultivation [29]. The relevance of cocoa to Nigeria can be examined based on its contribution to the economy of the nation.

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 due to huge investments in the oil sector and inadequate fund to acquire inputs [12, 32]. Also, the deterioration in cocoa production in Nigeria is mainly due to the incidences of insect pests and diseases along with other factors [6]. 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 tons. The main disease of cocoa is the 'Black pod' caused by *Phytophthora palmivora* and *Phytophthora megakarya* which results to 100% total loss [40].

According to the United States Department of Agriculture-Agricultural Research Service [35] Integrated Pests Management (IPM) is a sustainable, science-based, decision-making process that combines biological, cultural, physical, and chemical tools to identify, manage, and reduce risk from pests and pest management tools and strategies in a way that minimizes overall economic, health, and environmental risks.

The concept of integrated pest management (IPM), a sustainable strategy for managing pests, has been in practice for a long time. Although multiple sources define IPM in different ways, previous models primarily focused on the ecological, and to some extent on the evolutionary, aspects of pest management [28].

Integrated pest management is a complementary and necessary feature of sustainable agriculture, which aims to assure equitable, secure, sufficient and stable flows of both food and ecosystem services [34]. Agriculture will achieve sustainability only if the agro-ecosystem maintains stable productivity while resisting major disturbances including pest ravages [7].

A comprehensive IPM is an ecosystem approach to control insect pests that uses all available tools and combines different management strategies and practices to maintain the quality of stored products, enhance the sustainability (environmental, economic, and social) of stored product ecosystems, and minimize the use of pesticides in an effective, economical, and environmental way. There are usually six main elements in an IPM program [11] and any element of an IPM approach should use the knowledge of insect movement. Notwithstanding its low adoption rate in developing countries, IPM potentially offers the best route to economically efficient crop protection that increases and sustains farm productivity while minimizing threats to humans and the environment.

Even though insect controls are affected by macro-economics, business decisions, and policy factors, integrated pest management (IPM) has been gradually adapted to insect control decisions in most countries. The IPM is ecologically-based and the operational plan of an IPM has at least two key elements: monitoring-based decision making and applications of multiple pest control tactics [11]. If the foundation of an effective IPM program is to understand pest ecology, then understanding insect movement should be at the core of any IPM decision.

Several reports indicated that IPM implementation depends on numerous factors including the level of education, economic and social conditions, environmental awareness, rational thinking, moral values, regulatory aspects, government policies, availability of IPM tools, extension education, consumer preference, and retail marketing [27, 17, 15 and 30]. Several other definitions also focus on minimizing or eliminating the reliance on chemical control options, adopting a number of other options with the emphasis on environmental and human health. However, some practitioners interpret IPM as rotating chemicals from different mode of action groups to maintain pest control efficacy and reduce pesticide resistance with an emphasis on reducing pest damage. These definitions and interpretations represent a variety of objectives and strategies for managing pests including vertebrate and invertebrate pests, diseases, and weeds. IPM is not a principle that strictly and uniformly applies to every situation, but a philosophy that can guide the practitioner to use it as appropriate for their situation. IPM is an approach to manage pests in an economically viable, socially acceptable, and environmentally safe manner.

Justification of the study

The Cocoa Transformation Agenda was introduced by the Federal government of Nigeria to revitalize cocoa production in the country. There is great need for the success of this programme, though a major hindering factor that could affect this transformation

programme is the incidence of pest and disease infestation of cocoa. This major problem could be reducedusing Integrated Pest Management. In view of the above, this study becomes appropriate in evaluating and examining Nigerian cocoa farmers' IPM adoption practices so as to provide a baseline information from which to assess advancement towards increasing IPM adoption.

Objectives of the research

The objectives of the study are to:

1. Identify socio-economic factors affecting the adoption of IPM by cocoa farmers in the study area,
2. Describe the enterprise characteristics of the farmer,
3. Determine the behavior of farmers towards IPM adoption,
4. Profile the constraints experienced from adoption of IPM.

MATERIALS AND METHODS

The Study Area

Cross River State is a coastal state in South-South geopolitical zone of Nigeria. Its capital is at Calabar, and it is named from the Cross River (Oyono), which passes through the State. Cross River is one of the 36 States of Nigeria and was formed from the eastern part of the Eastern Region on 27 May 1967. It borders to the north through Benue State, to the west through Ebonyi State and Abia State, and to the southwest through AkwaIbom State, while its eastern border forms part of the national border with Cameroon.

The present Cross River State is made up of parts of old Calabar and Ogoja Provinces divided into 18 administrative units called Local Government Areas. The Local Government Areas include Obanliku, Obudu, Bekwara, Ogoja and Yala in the North Senatorial District, Boki, Ikom, Etung, Obubra, Abi and Yakurr in the Central District and Biase, Akankpa, Odukpani, Calabar Municipality, Calabar South, Akpabuyo and Bakasi in the Southern Senatorial District. Ejagham and Efik are major languages of the State.

The State is situated within the tropics with total land area of 20,156 km^2. It lies between latitudes 5°32' and 4°27' North and longitudes 7°50' and 9°28' East. The Obudu and Obanliku Plateau with an altitude of 1,575.76 meters above sea level enjoys a climate typical of the temperate regions of the world.

Cross River State is an agricultural state and its economy relies partially on crops, such as cocoyam, rubber, oil palm, yam, cocoa, cashews and plantain, as well as fishing. Agriculture employs about 80% of the state's labor force, and contributes about 40% to the Gross Domestic Product (GDP). The state has modern agricultural estates and several smallholder farms in the local government areas. The climate allows the growing of a wide variety of crops. Export crops are the focus of agricultural production and research of the state with livestock, fishing and forestry as pillars of the economy.

Smallholder farmers account for a greater proportion of farm holdings in Cross River State. These farmers are the backbone of the agricultural sector in the state. Boki, Ikom and Etung are the three Local Government Areas known for the largest production of cocoa in the State.

Data collection and analysis

Sampling population and sample size

A purposive selection of Cross River State from the South-South zone,was based on the training centers of the STCP/IITA. A systematic random sampling technique was used in selecting a total of 108 IPM trained respondents from the list of STCP/IITA Farmers Field School (FFS) in the state.

Structured questions administered through questionnaire were used in collecting both quantitative and qualitative data from the selected cocoa farmers. Questions asked were categorized as: identify selected personal characteristics, identify enterprise characteristics, determine the behavior of farmers towards IPM adoption compared to their conventional practices, determine the constraints experienced from IPM adoption. The adoption of various practices was explained by the potential variables used and this included information in four broad categories: economic, social, management and

institutional factors. Some specific variables included farmer's age, education, farm size, farming experience, and farm yields.Descriptive statistics was used for data presentation while Chi-square was used to test hypothesis 1.

Hypotheses

HO_1: There is no significant relationship between the socio-economic characteristics and adoption behavior of the trained cocoa farmers.

RESULTS AND DISCUSSIONS

The socio-economic characteristics of the respondents

Sex of Respondents

The male respondents were 81.5% while the females were 18.5%. This is an indication that more males were involved in IPM adoption in cocoa farming than the females. In Nigeria, most agricultural culture limit women in acquiring land for tree crops cultivation which however affects gender issues in agricultural production and technology adoption. This finding is in line with [1], who opined that rural women farmers are constrained by adoption of modern technologies. Such factor could limit rural women's ability to improve agricultural production and the well-being of their families (Table 1).

Age of respondents

The result reveals that few (25.9%) of the respondents' ages were between age 21-40 years while 9.0% fall between age 61-80 and majority (65.1%) were between the age range of 41 and 60 years. This indicates that most of them are still in their prime age and would be ready to learn and apply the skill of IPM techniques in their farms. Few youths are involved in cocoa farming which could affect IPM techniques adoption negatively as some of the techniques are labor intensive. This study supports the findings of [36] who stated that most of the farmers trained on IPM were still in their prime age and would be ready to adopt IPM (Table 1). Also, [37] described the challenges of the adoption of IPM technology in cocoa production in Nigeria.

Marital Status of Respondents

The result reveals that most (77.7%) of the respondents were married while 13.9% were single. This implies that large family size will create labor for IPM adoption. The high proportion of married respondents shows that more members of the farm family are likely going to be available for IPM adoption in the study area. This also corroborates the age distribution result that few youths are involved in cocoa production. According to [24] most married cocoa farmers relied on family labor, reducing the requirement for hire labor to carry out some IPM activities and thereby reducing their financial obligations. According to [26] the implication of this similar study is that farmers in the study area were matured and could effectively take crucial decisions jointly with their spouses. Marital status is a crucial factor in shaping social rural participation and acceptance of innovation. Farmers need a large family to reduce the cost of adopting IPM labor and maintain good farming practices in their farm especially for tree crop like cocoa (Table 1).

Table 1. Distribution of respondents by socio-economic characteristic (n = 108)

Variables	Frequency	Percentage
Sex		
Male	88	81.5
Female	20	18.5
Age		
21-40	28	25.9
41-60	60	65.1
61-80	10	9.0
Marital status		
Single	15	13.9
Married	84	77.7
Divorced	3	2.8
Widowed	6	5.6
Years of Farming experience		
1-10	22	20.4
11-20	48	44.4
21-30	30	27.8
31-40	8	7.4

Source: Field survey, 2021.

Farming experience of the respondents

The result in Table 1 revealed that many (44.4%) of the respondents had between 11 and 20 years of experience in cocoa farming while only 7.4% had between 31 and 40 years. Farmers with longer farming experience are

expected to have higher inclination in adopting IPM technology.

[20] in his study ascertained that an increased farm productivity,farmers' education count less than farming experience while [21] opined that the tendency to adopt new innovations such as IPM depends on age of farmers, long time of farming business and access to capital (Table 1).

Educational qualification of respondents

The result shows that majority (94.4%) of the respondents were educated with primary (27.8%), adult education (4.6%), secondary (30.5%) and Tertiary (31.5%) while 5.6% had no formal education (Figure 1).

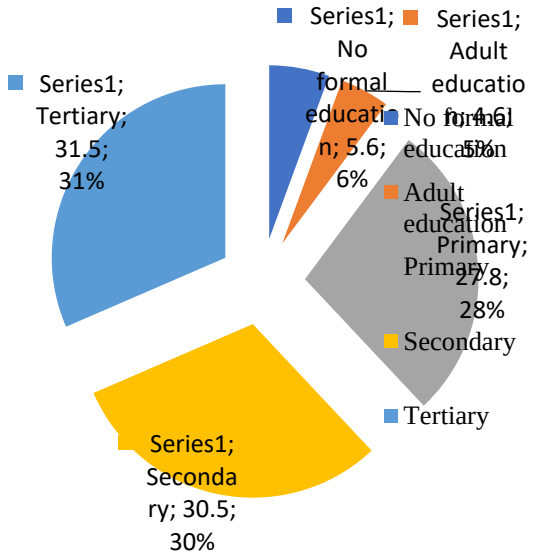

Fig. 1. Educational qualification of respondents
Source: Field survey, 2021.

The outcome of this study revealed that majority of the respondents were literate which has positive influence on adoption of IPM innovation and supports the findings of [25] who posited that highliteracy level will predispose farmers to adopt and use improved farm practices. Also, [19] opined that education empowers individual to be receptive of the modern technologies in terms of decision making, problem solving and adaptation to change. The formal education of farmers is very vital in technology adoption as it helps in quick assimilation of the innovation such as IPM technologies.

Farm size

Figure 2 shows that majority (97.2%) of the respondents had farm size between 1 and 5 ha, while only 2.8% had 6-10 ha. This implies that majority of the farmers own small farms, which could facilitate high adoption of IPM technologies based on less cost in adoption covering small areas. The farm size distribution of the cocoa farmers showed that most cocoa farmers were smallholders growing cocoa on less than 10 hectares of farmland. This could be ascribed to land tenure system in Nigeria which favors land disintegration through inheritance. Cocoa farm size is expected to have a positive effect on adoption since as the farmer devotes more of his total available land to IPM in cocoa cultivation, there is the likelihood that cocoa output and income would increase, enhancing the probability of technology adoption [22] posited that 75.5% of the cocoa farmers in Nigeria were either small or medium scale farmers which is in line with the findings of this study. [31] had a contrary view and resolved that size of farm is not a determinant of Integrated Pest Management (IPM) adoption regardless of farmers' scale of operation.

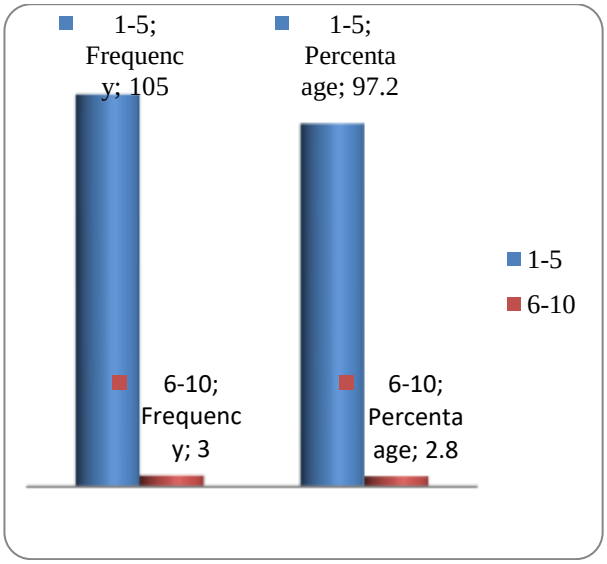

Fig. 2. Distribution of respondents based on farm size
Source: Field survey, 2021.

Cocoa yield in respondents' farms

The yield of cocoa beans is measured in terms of kilogrammes harvested in the last cropping season as presented in Table 2. The result shows that many (57.4%) of the respondents produced between 1-1,000kg while 32.4% produced 1,001-2,000kg, 7.4% produced

2,001-3,000kg, 1.9% produced 3,001-4,000kg while very few (0.9%) produced more than 4,000kg. The level of cocoa production in this study could be due to their small size of farm and moderate adoption of the IPM technology by the respondents.

Table 2 Distribution of respondents based on yield (kg/ha)

Yield	Frequency	Percentage
<1,000	62	57.4
1,001-2,000	35	32.4
2,001-3,000	8	7.4
3,001-4,000	2	1.9
>4,000	1	0.9
Total	108	100.0

Source: Field survey (2021).

The result corroborates the findings of [10] who posited in his study that most cocoa farmers don't produce at maximum level which could be as a result of farm age, insect pests and disease incidences and not adhering to recommended practices but controverts [8] whose report proved that yield of majority farmers was high with plots treated with IPM technology when compared with controls.
Adoption of IPM technology favors high yield and would have a multiplier effect on high revenue obtained by farmers.

Constraints of the respondents

Weighted mean score was used in ranking the constraints experienced in adoption of IPM technology as rated by the respondents. Most of the respondents rated inaccessibility to market information as the highest constraint affecting IPM adoption with a score of 0.8 followed by other off farm activities and inadequate labor which scored 0.7. Age of farm scored 0.6, inadequate credit facilities scored 0.5, Household size 0.4 while Contact with Extension agents and Membership of cooperative association scored the least with 0.3.
Inadequate marketing facilities and structure is a barrier to accessing marketing information. This problem can be solved by developing infrastructure of the existing market in the state and also by encouraging farmers in forming marketing co-operatives which will increase their capacity to negotiate with buyers. Farmers could also be trained on how to access market price information both locally and internationally.
Inadequate labor and other off farm activities were rated second in ranking with a score of 0.7 it is also a very severe constraints which could be as a result of rural urban drift of the youth in search for white collar jobs and riding motor bike and tricycle to earn daily income. Encouraging farm mechanization may be an option to overcome the problem of inadequate labor.
The third highest severe factor affecting IPM adoption is inadequate credit facilities with a score of 0.5. This could be as a result of inability of the farmers to obtain loan from financial institutions due to their inability to provide collateral (Table 3).

Table 3. Distribution of respondents based on constraints to IPM adoption

Constraints	Very severe		Severe		Not severe		Weighted Mean score
	Freq	%	Freq	%	Freq	%	
Age of farm	21	19.4	25	23.2	62	57.4	0.6
Other off farm activities	14	13.0	47	43.5	47	43.5	0.7
Access to Market Info	34	31.5	16	14.8	58	53.7	0.8
Inadequate labor	12	11.1	51	47.2	45	41.7	0.7
Household size	8	7.4	25	23.2	75	69.4	0.4
Inadequate credit facilities	23	21.3	12	11.1	73	67.6	0.5
Contact with Extension Agents	6	5.5	15	13.9	87	80.6	0.3
Membership of farmers/cooperative association	13	12.1	9	8.3	86	79.6	0.3

Source: Field survey, 2021.

Lack of capital due to seasonal liquidity and poor access to credit facilities makes technology utilization amongst poor farmers challenging thereby threatening sustainability of IPM adoption.

[9] opined that farmers' inaccessibility to credit contributes to lack of fund due to government inability to provide soft loan to farmers.

Household size which is the fifth constraint with a score of 0.4 could be due to large family size and inability to cope with little revenue to feed many mouths and maintain the family upkeep. The provision of adequate financial support to cocoa farmers will increase credit facilities that will assist the farmers in coping with their household expenditure. This could also encourage the farmers toaccess more communal land for cocoa production.

[41] also reported that Ghana reduced rural poverty by 24% between 1990 and 2005, principally as a result of empowering small-scale farmers through adoption of improved technologies. This could be encouraged in Nigeria through the use of Farmers Field School (FFS) in training cocoa farmers on IPM throughout the cocoa producing States in order to empower the small-scale farmers and reduce poverty.

Adoption behavior

Intensity of adoption

Intensity of adoption is a measure of the percentage of total land on which the cocoa farmers implemented IPM practices in their cocoa farms as compared with the total area of land they used for cocoa growing. It refers to the level of use of a given technology in any time period.

Table 4 revealed that majority (79.6%) had high level of intensity of adoption, 17.6% had medium while 2.8% had low level. This implies that the respondents implemented IPM in high proportion of their total cocoa farm land.

[13] defined intensity of adoption as the level of adoption of a given technology (for instance the number of hectares planted with improved seed or the amount of fertilizer applied per hectare). Intensity of adoption has been measured in several ways in literature. [18] defined intensity as the number of technologies adopted.

Other researchers such as [5] defined intensity of adoption as the proportion of area under the improved varieties.

Table 4. Distribution of respondents based on intensity of adoption

Intensity Categories (Ha)	Frequency	Percentage
1-2	86	79.6
3-4	19	17.6
5-6	3	2.8
Total	108	100.0

Source: Field survey, 2021.

Rate of adoption

Rate of adoption refers to the relative speed with which farmers adopt an innovation. It is usually measured by the length of time required for a certain percentage of members of a system to adopt an innovation.

The rate of adoption was ranked using Weighted Mean Score as rated by the respondents. Most of the respondents rated both pest monitoring and planting resistant varieties as the highest rate of adoption with a score of 2.9. Weeding 2-3 times a year and appropriate use of recommended pesticide scored 2.8, followed by pruning of basal chupons and routine sanitation of farm (such as removal of mistletoe, climbers, lichen, moss) which both scored 2.7.

Also, water management androutine destruction of infected cherelles scored 2.6 each while fertilizerand soil management scored 1.9 and biological control scored 0.7. Pest monitoring and planting resistant varieties are the highest adopted IPM technology which may be due to the training received from Cocoa Research Institute of Nigeria (CRIN) on improved cocoa varieties, accessibility to the varieties and pest management.

According to [3] Integrated pest management (IPM) is a potentially effective method that makes use of many non-chemical means to control pests, but its adoption is low. Biological control scored the lowest due to its complexity in IPM technology. Despite the expected benefits of many agricultural technologies, farmers often adopt them at a

slower pace than might be expected in developing countries [33].

Table 5. Respondents' rate of IPM adoption n=108

	Year 1		Year 2		Year 3		Year 4		Year 5		WMS
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	
Pruning of basal chupons	15	13.9	9	8.3	31	28.7	33	30.6	20	18.5	2.7
Fertilizer and soil management	13	12.0	22	20.4	23	21.3	19	17.6	31	28.7	1.9
Water management	26	24.1	9	8.3	35	32.4	24	22.2	14	13.0	2.6
Weeding 2-3 times a year	17	15.7	17	15.7	24	22.2	27	25.1	23	21.3	2.8
Routine destruction of infected cherelles	17	15.7	12	11.1	27	25.0	25	23.2	27	25.0	2.6
Routine sanitation of farm such as removal of mistletoe, climbers, lichen, moss	12	11.0	14	13.0	26	24.0	28	26.0	28	26.0	2.7
Biological control	20	18.5	19	17.6	20	18.5	21	19.5	28	25.9	0.7
Pest monitoring	19	17.59	12	11.1	30	27.8	35	32.4	12	11.1	2.9
Planting resistant varieties	13	12.0	18	16.7	33	30.6	28	25.9	16	14.8	2.9
Appropriate use of recommended pesticide	7	6.5	16	14.8	25	23.1	34	31.5	26	24.1	2.8

Source: Field Survey, 2021
WMS: Weighted Mean Score
Grand Mean Score: 2.5

Scale of adoption

Findings presented in Table 6 concern the scale of adoption which had some implications for the future direction of IPM practices. The study measured the number of technological components that were tried after the respondents were trained. The result revealed the Weighted Mean Score of all the IPM techniques that were tried by the respondents as follows: pruning of basal chupons 1.9, weeding 2-3 times a year 1.9, routine destruction of infected cherelles 1.8.

Table 6. Distribution of respondents based on scale n=108

IPM Technologies	Full trial		Some trial		Never tried		WMS
	Freq	%	Freq	%	Freq	%	
Pruning of basal chupons	-	-	98	90.7	10	9.3	1.9
Fertilizer and soil management	15	13.9	32	29.6	61	56.5	1.2
Water management	1	0.9	71	65.7	36	33.3	1.6
Weeding 2-3 times a year	-	-	101	93.5	7	6.5	1.9
Routine destruction of infected cherelles	-	-	86	79.6	22	20.4	1.8
Routine sanitation of farm such as removal of mistletoe, climbers, lichen, moss	-	-	101	93.5	7	6.5	1.9
Biological control	23	21.3	21	19.4	64	59.3	0.8
Pest monitoring	-	-	84	77.8	24	22.2	1.8
Planting resistant varieties	-	-	88	81.5	20	18.5	1.8
Appropriate use of recommended pesticide	-	-	93	86.1	15	13.9	1.9

Source: Field survey, 2021.
WMS-Weighted Mean Score
Grand Mean=1.6

Routine sanitation of farm such as removal of mistletoe, climbers, lichen, moss 1.9, pest monitoring 1.8, planting resistant varieties 1.8 and appropriate use of approved and recommended pesticides 1.9 which are higher than the grand mean of 1.6 and are regarded as high trials while water management had 1.6, fertilizer and soil management had 1.2and Biological control had 0.8 which are equal or below the grand mean score of 1.6 and are regarded as low trials. The result indicates that the respondents had higher trials of the IPM technologies.

This finding is similar to the findings of [16] who reported that durian growers had high level of IPM trial. According to [2] certain research technologies, which are deemed to improve farm production, may be beyond the understanding of rural farmers, even with the interpretation of extension agents especially when it is more costly than their local techniques.

Association of socio-economic relationship and IPM adoption

Table 7 reveals that significant relationship exists between sex (X^2 =42.815, p<0.05), age (X^2 =65.148, p<0.05), marital status (X^2 =163.333, p<0.05), education (X^2 =40.426, p<0.05), years of experience (X^2 =110.333, p<0.05), and adoption behavior. The null hypothesis is rejected as all variables show significant relationship. The contingency coefficient (CC) shows strong relationship of the variables with adoption behavior; sex 0.5328, Age 0.6134, marital status 0.7758, education 0.5218 and years of experience 0.7108.

Table 7. Association of socio-economic relationship and IPM adoption

Variables	Df	X^2	P	CC	Decision
Sex	1	42.815	0.000	0.5328	S
Age	33	65.148	0.001	0.6134	
Marital status	3	163.333	0.000	0.7758	S
Education	4	40.426	0.000	0.5218	S
Years of experience	29	110.333	0.000	0.7108	S

Source: Field survey, 2021.

This finding is supported by the study of [14] who posited that Education expands individual scope of inference and paradigm, whereas training re-enforces individual's experience and up-grade the skills for effective implementation of any novel technology. Education enhances individual farmer's ability to access and process agricultural information, and the application of information in improving on-farm activities. Educational status is assumed to influence cocoa production technologies positively because with higher level of education the farmers would be in a position to technically and economically assess the new crop or technology to clear doubts and uncertainties associated with it and enhance its adoption. The significant relationship of sex implies that men and women have roles to play in the adoption of IPM in cocoa farms. However, cocoa farming is labor intensive which is confirmed by [23] findings that men are more decisive, aggressive, logically ambitious and have strength to withstand the rigors of farming.

According to [4] since cocoa farming is dominated by male farmers, it is expected that more male cocoa farmers would adopt technologies than their female counterparts, other things being equal. This is because women have less access to credit and land as collateral when compared with men,as well as relying mostly on hired labor which is scarce due to migration of the rural youth to the urban areas to seek for jobs with relatively better remuneration.

Adoption of IPM by cocoa farmers have economically impacted farmers in a number of ways including increase in cocoa yield which invariably translates to increased income and profit. Also, increased yield encourages the creation of more efficient market and export opportunities. In addition, there is a substantial reduction in the quantity of pesticides applied to cocoa farms which leads to reduced input cost and lowering of

hazards that are associated with food poisoning through gradual intake of chemically produced cocoa beans. Other economic benefits of IPM adoption are reduction of insects and disease pests attack and improved cocoa beans quality.

CONCLUSIONS

The findings of this study inferred that majority of the respondents were literate which has positive influence on adoption of IPM innovation which is very vital in technology adoption as it helps in quick assimilation of the innovation. Majority of the farmers own farm size less than 10 hectares which showed that the cocoa farmers were smallholders who could be ascribed to land tenure system in Nigeria which favors land disintegration through inheritance. This is also reflected in their cocoa yield. Marketing information is a problem which can be solved by developing structure of the existing market in the state and also by encouraging farmers in forming marketing co-operatives which will increase their capacity to negotiate with buyers.

Farmers could also be trained on how to access market price information both locally and internationally.

The result on adoption behavior of intensity, rate and scale revealed that most of the respondents were early adopters and had a higher scale of adoption.

More youth should be encouraged by the government to take up cocoa farming to enhance sustainability of IPM adoption.

The farmers are constrained financially, so they need to be supported with soft loan to enhance increase in their hectare of cocoa farms.

Yield improvement programme such as rehabilitation programme in agronomic practices should be initiated in order to increase cocoa yield of farmers.

Women should be encouraged to grow cocoa and they should be given access to farm land for tree crops.

Way forward

There is need to bring up policies that will enhance sustainability of continuous use of IPM to boost production among farmers in the study area. The time of paradigm shift from the farmers' primitive ways of controlling insect pest and diseases to a more effective and efficient methods of control is now.

ACKNOWLEDGEMENTS

Special thanks to the Executive Director (Dr. P. O. Adebola) and his management team for the time given to carry out this work.

REFERENCES

[1]Adeogun, S.O., Olawoye, J.E., Akinbile, L.A., 2010, Information sources to cocoa farmers on cocoa rehabilitation techniques (CRTs) in selected states of Nigeria. Journal Media and CommunicationStudies2: 9-15.

[2]Agbamu,J.U, 2006, Essential of Agricultural Communication in Nigeria.Lagos:Malthouse Press Ltd.

[3]Ahsanuzzaman, A., Norton, G.W., 2015, Social Exchanges, Attitudes toward Uncertainty and Technology Adoption by Bangladesh Farmers: Experimental Evidence. AEA Annual meeting, Boston, MA.USA.

[4]Aneani, F., Anchirinah, V.M., Owusu-Ansah, F., Asamoah, M., 2012, Adoption of Some Cocoa Production Technologies by Cocoa Farmers in Ghana. Sustainable Agriculture Research1: 103-117.

[5]Asfaw, S., Bekele, S., Franklin, S., Mekbib, G.H., 2011, Agricultural technology adoption, seed access constraints and commercialization in Ethiopia. Journal of Development and Agricultural Economics 3: 436-447.

[6]Asogwa, E.U., Anikwe, J.C., Ndubuaku, T. C. N., Reports and Recommendations on the Evaluation of Kizan KJ–16 Knapsack Sprayer for Protection of Cocoa Farms in Nigeria.Tech.Rep. CRIN, Ibadan, Nigeria, pp.4.

[7]Conway, G.R., 1993, Sustainable agriculture: the trade-offs with productivity, stability and equitability. In Barbier EB (ed), Economics and Ecology. Dordrecht, the Netherlands: Springer, pp. 46–65.

[8]Dormon, E. N. A., Van Huis, A., Leeuwis, C., 2007. Effectiveness and profitability of integrated pest management for improving yield on smallholder cocoa farms in Ghana.International Journal of Tropical Insect Science27: 27–39.

[9]Eze, S. O., Olorunfemi, O. E.,, 2010, Farmers' perception on cocoa production constraints in Akure South local government area of OndoState: implications for political economies and food security in Nigeria. Nigerian Journal of Rural Sociology10: 40-48.

[10]Famuyiwa, B.S., Torimiro, D.O., Obatolu, B.O., Uwagboe, E.O., 2014, Preventive Measures Adopted by Nigerian Farmers for the Environmental Hazards in

Cocoa Plantations. Journal of Agricultural Extension18: 99-111.
[11]FAO, 2017, Integrated Pest Management of Major Pests and Diseases in Eastern Europe and the Caucasus, Food and Agriculture Organization of the United Nations: Budapest, Hungary, pp. 110.
[12]FAOSTAT, Food and Agriculture Organization of the United Nations, 2018, www.fao.org/faostat/en/#data/QC, Accessed on 21 May 2021.
[13]Feder, G., Jus, R.E., Zilberman, D., 1985, Adoption of agricultural innovations in developing countries: A survey.Chicago: The University of Chicago, pp. 1-80.
[14]Huffman, W.E., 1999, Human capital: Education and agriculture, in Handbook of Agricultural Economics,ed.by Gardner GL and Rausser GC. Elsevier Science Publishers Amsterdam, The Netherland, pp. 1-55.
[15]Jayasooriya, H. J. C., Aheeyar, M.M.M., 2916, Adoption and factors affecting on adoption of integrated pest management among vegetable farmers in Sri Lanka. Procedia Food Sci. 6: 208–212.
[16]Kittipong, S., 2000, Factors influencing the adoption of integrated pest management: a case study of durian growers in the Eastern region of Thailand Unpublished M.phil. thesis. University of South Australia.The International Graduate School of Management Division of Business and Enterprise, pp. 66.
[17]Lefebvre, M., Langrell, S.R.H., Gomez-y-Paloma, S., 2015, Incentives and policies for integrated pest management in Europe: a review. Agron. Sustainable Dev35: 27–45.
[18]Masuki, K.F.G., Mowo, J.G., Kamugisha, R., Opondo, C., Tanui, J., 2011, Improving smallholder farmers' access to information for enhanced decision making in natural resource management: Experiences from South Western Uganda. Conference on Innovations as key to the Green Revolution in Africa: Exploring the scientific facts.Springer Netherlands, pp. 1145-1159.
[19]Mohanty, A.K., Lepch, B., Kumar, A., 2013, Constraints Analysis in Adoption of Vegetable Production Technologies for Livelihood Perspective of Tribal Farmers in North Sikkim Indian. Research Journal of Extension Education 13: 51-56.
[20]Nwaru, J.C., 2004, Rural Credit Market and Arable Crop Production in Imo State of Nigeria.UnpublishedPh.D Dissertation, Michael Okpara University of Agriculture, Umudike, Nigeria.
[21]Ogungbile, A.O., Tabo, R., Rahman, S.A., 2002, Factors affecting adoption of ICSV111 and ICSV 400 Sorghum variaties in Guinea and Sudan Savanna of Nigeria. The plant Scientists 3:21-2.
[22]Ogunlade, M.O., Oluyole, K. A., Aikpokpodion, P.O., 2009, An Evaluation of the Level of Fertilizer Utilization for Cocoa Production in Nigeria. Journal of Human Ecology 25:175-178.
[23]Oladipupo, F.O., Kareem, O.W., Adereti, F.O., Abubakar, H. N., 2011, Gender discrimination among the rural household in Edu Local Government Area of Kwara State, Nigeria. Journal of Agriculture and Rural Development.6: 82-90.
[24]Olujide, M.G., Adeogun, S.O., 2006, Assessment of cocoa growers' farm management practices in Ondo State, Nigeria. Spanish Journal of Agricultural Research4: 173-179.
[25]Oluyole, K.A.,2005, Evaluation of the Economics of post harvest processing of cocoa in Cross River state Nigeria. Journal of Agriculture, Forestry and the social sciences3: 58-64.
[26]Osarenren, C.O., Emokaro, C.O., 2015, Profitability of cocoa production under different management systems in Edo State, Nigeria. Nigerian Journal of Agriculture, Food and Environment 11:38-43.
[27]Parsa, S., Morse, S.,Bonifacio, A., Chancellor, T.C.B.,Condori, B., CrespoPérez, V., Hobbs, S.L.A., Kroschel, J., Ba, M. N., Rebaudo, F., 2014, Obstacles to integrated pest management adoption in developing countries. Proc. Natl. Acad. Sci. U.S.A. 11: 3889–3894.
[28]Peterson, R. K. D., Higley, L.G., Pedigo, L.P., 2018, Whatever happened to IPM? Am Entomol64: 146–150.
[29]Punch Newspaper, 2017, Idanre tells the sad story of Nigeria's Cocoa Industry. https://www.punchnewspaper.com, Accessed on 21 May 2021.
[30]Rezaei, R., Safa, L., Damalas, C.A.,Ganjkhanloo, M.M., 2019, Drivers of farmers' intention to use Integrated Pest Management: integrating theory of planned behavior and norm activation model. J. Environ. Manage 236: 328-339.
[31]Samiee, A., Rezvanfar, A., Faham, E., 2009, Factors affecting adoption of integrated pest management by wheat growers in Varamin County, Iran.African Journal of Agricultural Research 4: 491-497.
[32]Sanusi, R.A., Lawal, J.O., 2008, A Comparative Analysis of Agricultural Credit to Tree Crop Projects and Other Agricultural Projects in Nigeria: A case Study of Nigerian Agricultural Cooperative and Rural Development Bank (NAC&RDB). Footprint. 6. pp. 21-27.
[33]Suri, T., 2007, Selection and comparative advantage in technology adoption.Yale University Economic Growth Center Discussion Paper No. 944. New Haven, Conn., USA: Yale University.
[34]Tilman, D., Downing, J.A., 2002, Biodiversity and stability in grasslands. Nature 367: 363–365.
[35]USDA-ARS (United States Department of Agriculture-Agricultural Research Service).2018, A national road map for integrated pest management.https://www.ars.usda.gov/ARSU, Accessed on 21 July 2023.
[36]Uwagboe, E.O., 2011, Effect of integrated Pest Management (IPM) utilisation on cocoa farmers' yield in selected states of Nigeria. Unpublished M.philthesis.University of Ibadan, Faculty of Agriculture and Forestry.Pp.1-188.

[37]Uwagboe, E. O., Agbongiarhuoyi, A.E., 2020, Adoption challenges of integrated pest management (IPM) technology and cocoa production in cross river state, Nigeria: the elucidation and way forward, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.20(4), 575-581.
https://managementjournal.usamv.ro/pdf/vol.20_4/Art67.pdf, Accessed on August 30, 2024.
[38]Vulcanotec, 2020, Do you know the origin of cocoa?https://vulcanotec.com/en/news/doyouknow-the-origin-of-cocoa, Accessed on 9 April 2021.
[39]Wikipedia, 2010, Cocoa Bean.https://en.wikipedia.org/wiki/cocoa_bean, Accessed on 9 April 2021.
[40]Wood, G.A.R., Lass, R.A., 1985, Cocoa4th Ed. Longman,https://www.scrip.org, Accessed on 29 September 2019.
[41]World Bank, 2007, World Development Report: Agriculture for Development.The World Bank, Washington, D.C.https://doi.org/10.1596/978-0-8213-6807-7, Accessed on 1 November 2023.
[42]World Cocoa Foundation, 2018, History ofCocoa. https://wwwWorldcocoafoundation.org/blog/history-of-cocoa, Accessed on 9 April, 2021.