Determinants of Pesticide Use in Cocoa Production in Nigeria

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ABSTRACT

Pesticide application in cocoa production is a widely adopted technology by cocoa farmers to combat pest attack which is a predominant phenomenon in cocoa production. This study examined the determinants of pesticide use in cocoa production in Nigeria. Specifically, it described the pesticide use pattern in cocoa production, determined the socio-economic factors influencing pesticide use in cocoa production and identified the problems associated with pesticide use in cocoa production in Nigeria. Multistage sampling technique was used to select 390 cocoa farmers for the study. Data were collected with the aid of questionnaire and analysed using descriptive statistics and OLS. Results showed that, the major pesticide used in the study area were fungicide, insecticide and herbicide with cocoa farmers using approximately 4,000gmai/l of pesticides per season. OLS regression analysis revealed that price of pesticide ($p<0.01$), farm size ($p<0.01$), income ($p<0.05$), extension visits ($p<0.01$) and cocoa variety ($p<0.05$) were the factors influencing pesticide use in cocoa production in Nigeria. Major problems associated with pesticide use in Nigeria were high cost of pesticides (100%), lack of subsidy by government (95.1%), adulteration of pesticides (86.3%), non-availability of pesticides at the right time (75.1%) and high cost of spraying equipment (65.1%). The study suggested that concerted efforts should be intensified by government and other stakeholders at making pesticide readily available and affordable to farmers especially at government designated centres.

Keywords: *Cocoa, Determinants, Pesticide use, Pattern, Nigeria, OLS.*

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Highlights of this paper

- This study examined the determinants of pesticide use in cocoa production in Nigeria.
- It described the pesticide use pattern in cocoa production, determined the socio-economic factors influencing pesticide use in cocoa production and identified the problems associated with pesticide use in cocoa production in Nigeria.
- The study suggested on the basis of results that combined efforts should be intensified by government and other stakeholders at making pesticide readily available and affordable to farmers especially at government designated centres.

1. INTRODUCTION

Cocoa (*Theobroma cacao L.*) is an enduring crop chiefly grown in Africa, the Caribbean, South America and Asia [1]. It is the foremost cash crop in West Africa with over 70% of world cocoa output grown in the region [2]. Cocoa is chiefly grown in the rainforest area of Nigeria, known as the cocoa belt owing to edaphic and climatic condition predominant in the area. The major cocoa growing states in Nigeria are Ondo, Cross River, Osun, Ekiti and Abia. Others are Edo, Oyo and Ogun states. Ondo State is considered as the largest cocoa producing state in Nigeria in terms of production outpu [3, 4]. The importance of cocoa in Nigerian agricultural production is seen from three major factors: the production opportunity possessed by cash crop farmers; the revenue and employment effects through provision of indigenous markets for both food and non-food commodities and the ability to earn foreign exchange to subsidize imports and various developmental projects in the country [5].

Cocoa production in Nigeria has witnessed a downward drift in spite of its significance to Nigerian economy. This decline could be ascribed to discovery of the petroleum which led to the bypass of agriculture; scarcity and high cost of input; aging trees; pests and diseases infestations, use of fake and substandard agrochemicals, poor planting materials, poor handling of produce and inadequate agricultural extension services [6-8] One of the major problems of cocoa production in Nigeria is pests and diseases infestation. The consequence of pests and diseases infestation are reduction in crop yield, losses in the value of foreign exchange, reduction in revenue and also have negative effect on the farmers' health. This problem of pest and disease outbreak has led to over reliance on pesticide to mitigate the losses. According to Damalas [9] "pesticides can be regarded as an economic, labour-saving, and efficient tool of pest management commonly use in most sectors of agricultural production." The main pesticide groups according to Bateman [10] include: Fungicides - for treating fungal diseases; Herbicides - kill weeds; Insecticides: control insect pests; Rodenticides - kill rats and mice and Molluscicides (that kill slugs and snails). Pesticides have imparted significantly in the control of vector-borne diseases, pests, increase crop yields and also enhance the nutritional value and safety of food [11]. Pesticides is widely used to control insect pest and disease of cocoa because of their prompt and impressive action Asogwa and Dongo [12]. Webster, et al. [13] stated that cocoa farmers would suffer great economic losses without the use of pesticide in its production. It is therefore imperative to examine the determinants of pesticide use in cocoa production in Nigeria. The study specifically described pesticide use pattern in cocoa production, analyse the determinants of pesticide use and identified the problems associated with pesticide use in cocoa production in Nigeria.

2. METHODOLOGY

Cocoa farmers in Nigeria were considered for the study. The respondents were selected through a multi-stage sampling technique. The first stage involved purposive selection of five from six geo-political zones where cocoa is commercially grown in Nigeria. In the second stage, stratified sampling technique was used to group the five cocoa producing geopolitical zones into high, medium and low zones. Following National Survey on Agricultural Exportable Commodities (NSAEC) [5] the zones are classified as high (South West), medium (South South) and

low (South East, North Central and North East). The third stage involved purposive selection (based on their production levels) of one state from each of the high, medium and low zones. These are Ondo (high), Edo (medium) and Kwara (low). In the fourth stage, two agricultural zones were selected from each State through random sampling technique. The fifth stage involved the use of simple random sampling technique to select one Local Government Area (LGA) from each agricultural zone using the list of LGAs available in the agricultural zone as sampling frame. In the sixth stage, five villages were randomly selected from each of the LGAs giving a total of 30 villages. The basis of selection was the dominance of cocoa production in these villages. Finally, in the seventh stage, a simple random sampling procedure was used in choosing 13 cocoa farmers from each of the 30 villages giving a total of 390 farmers for interview using the list of cocoa farmers from the agricultural zones as the sample frame.

A total of 350 questionnaires (110 for Kwara state; 118 for Edo state and 122 for Ondo state) were used for analysis as others were discarded due to incomplete information, outrageous data, etc. the total number of questionnaire used for analysis represented about 90 percent of the total number of sampled cocoa farming households. Data were collected on socio-economic characteristics of cocoa farmers, pattern of pesticide use and problems encountered in using pesticide in cocoa production in the study area.

2.1. Analytical Techniques

Descriptive statistics such as mean and standard deviation was employed to summarize the socio-economic characteristics of the cocoa farmers included in the regression model and identify the problems associated with pesticide use in cocoa production in the study area.

OLS was used to analyse quantitatively, the pertinent factors influencing pesticide use by cocoa.

Farmers in the study area. The model is expressed as:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, U) \quad (1)$$

Y = Pesticide used (gmai/ha).

X_1 = Price of pesticide used (₦/a.i./gram/ha), X_2 = Farm size (ha), X_3 = Farming experience (years), X_4 = Income of farmer (₦), X_5 = Education (years), X_6 = Extension contact (dummy).

X_7 = Cost of labour used (₦), X_8 = Cocoa variety (dummy), U = Error term.

Three functional forms (Cobb-Douglas, semi-log, and linear) were analysed. The best of the 3 functional forms was selected based on economic and statistical criteria such as a-priori expectation of signs of coefficient, R^2 value and F-test statistics.

3. RESULTS AND DISCUSSION

3.1. Pesticide Use Pattern in Cocoa Production in Nigeria

Pesticide use in cocoa production is a *sine qua non* to increased cocoa yield because almost all the stages of cocoa production cycle are affected by one pest or the other. Table 1 shows that all the sampled cocoa farmers use one form of pesticide or the other in their cocoa farms. All respondents in kwara State used bounty, a combination of fertilizer and insecticide in their cocoa farms. This was followed by herbicides, paraquat dichloride (90.9%) and glyphosate (88.2%). Fungicide was used by 72.7% of the cocoa farmers while chloropyrifos, an insecticide was the most used insecticide, used by 71.8% farmers in the state. Majority (75.5%) of the farmers used more than 4,000 gram active ingredients per litres of insecticide on their farm, while 32.7% of the farmers used less than 1,000 gram active ingredients per litres of fungicide and 60% used between 3,000 and 4,000 gram active ingredients per litres of herbicide in the state. Majority of the cocoa farmers used more than 4,000 gram active ingredients per litres of

pesticides in Edo State. Cypermethrin (90.7%) was the most used insecticide in the state, while fungicide was used by 82.2% of the sampled cocoa farmers, 80.9% used herbicide paraquat dichloride and 64.4% used glyphosate, also an herbicide in the state.

Fungicides (94.3%) was the most used pesticide in Ondo State. This is followed by lindane (71.3%), a banned insecticide while 65.6% used glyphosate, an herbicide in the state.

Lindane which was used by some of the sampled cocoa farmers in Ondo and Edo States belong to a group of pesticides popularly known as the 'dirty dozen' [14]. These pesticides have been prohibited or deregistered in some countries because of they are unsafe for humans and the environment. However, lindane was readily available in the open markets in Ngeria. This confirms the findings of Osibanjo [15] that pesticide regulation policy in Nigeria is poorly implemented.

3.2. Socio-Economic Factors Influencing Pesticide Use in Cocoa Production in Nigeria

Quantity of pesticide used (gmai/ha) was regressed on amount spent on pesticide (₦gma. i/ha), area grown to cocoa (ha), farming experience in cocoa production (years), income from cocoa production (₦), education level (number of years spent in school) extension contact (dummy) as well as labour cost (₦/ha) and cocoa variety (dummy). The Summary of the variables included in the regression model is presented in Table 2 while Table 3 presents the results of the regression analysis showing the socio-economic factors affecting the quantity of pesticide use in cocoa production in the study area. The analysis was done for each state and at the aggregate level.

3.2.1. Kwara State

The model adopted to explain the socio-economic factors influencing the quantity of pesticide use in cocoa production in Kwara State was the linear model. This was because the model had the highest R^2 value, highest F value and highest number of significant variables conforming to the a priori expectations in the state. The coefficient of determination value of about 0.823 implies that about 82% of the variation in quantity of pesticide used in Kwara State was jointly explained by the variables included in the model. The F value of 16.800 was significant at 1% alpha level attesting to the goodness of fit of the model. Results in Table 3 reveals that the significant variables influencing the quantity of pesticides used by cocoa farmers in Kwara State were price of the pesticide ($p<0.01$), area planted to cocoa ($p<0.01$), income from cocoa production ($p<0.05$), education ($p<0.01$), amount expended on labour ($p<0.05$) and cocoa variety ($p<0.05$).

Table-1. Pesticide use pattern in cocoa production in Nigeria.

			Quantity of Pesticide (gmai/l)					
Active ingredient	**Type**	***WHO class**	**< or equal to 1000**	**1001-2000**	**2001-3000**	**3001-4000**	**Greater than 4000**	**Total**
Kwara State								
Chloropyrifos	Insecticide	11	0(0.0%)	38(34.5%)	22(20.0%)	14(12.7%)	5(4.5%)	79(71.8%)
Lamda Cyhalothrin	Insecticide	11	1(0.9%)	0(0.0%)	0(0.0%)	0(0.0%)	28(25.5%)	29(26.4%)
Bounty	Insecticide + Fertilizer		0(0.0%)	12(10.9%)	16(14.5%)	32(29.1%)	50(45.5%)	110(100.0%)
Mancozeb,	Fungicide	111	4(4.0%)	0(0.0%)	14(12.7%)	0(0.0%)	0(0.0%)	18(16.4%)
Copper (1) oxide + Metalaxy	Fungicide	11	36(32.7%)	17(15.5%)	5(4.5%)	12(10.9%)	10(9.1%)	80(72.7%)
Paraquat dichloride	Herbicide	11	12(10.9%)	10(9.1%)	24(21.8%)	32(29.1%)	22(20.0%)	100(90.9%)
Glyphosate	Herbicide	111	2(1.8%)	10(9.1%)	15(13.6%)	28(25.5%)	42(38.2%)	97(88.2%)
Edo State								
Cypermethrin	Insecticide	11	2(1.7%)	18(15.3%)	17(14.4%)	15(12.7%)	55(46.6%)	107(90.7%)
Metalaxy + Difenoconazoleþ + Thiamethoxam	Insecticide	11	1(0.8%)	0(0.0%)	5(4.2%)	4(3.4%)	28(23.7%)	37(31.4%)
Lindane	Insecticide		0(0.0%)	5(4.2%)	15(12.7%)	18(15.3%)	4(3.4%)	42(35.6%)
Metalaxy + Copper (1) oxide	Fungicide	11	0(0.0%)	2(1.7%)	7(5.9%)	30(25.4%)	58(49.2%)	97(82.2)
Paraquat dichloride	Herbicide	11	0(0.0%)	3(2.5%)	2(1.7%)	36(30.5%)	48(40.7%)	89(80.9%)
Glyphosate	Herbicide	111	0(0.0%)	2(1.7%)	6(5.1%)	23(19.5%)	45(38.1%)	76(64.4%)
Ondo State								
Copper (1) oxide + Metalaxyl	Fungicide	11	1(0.8%)	3(2.5%)	2(1.6%)	22(18.0%)	53(43.4%0	81(66.4%)
Copper hydroxide	Fungicide	11	0(0.0%)	4(3.3%)	7(5.7%)	6(4.9%)	17(13.9%)	34(27.9%)
Lindane	Insecticide	11	0(0.0%)	6(4.9%)	13(10.7%)	22(18.0%)	46(37.7%)	87(71.3%)
Thiamethoxam	Insecticide	11	6(4.9%)	1(0.8%)	2(1.6%)	8(6.6%)	60(49.2%)	77(63.1)
Dichlorovinyl dimethyl phosphate	Insecticide	11	2 (1.6%)	2(1.6%)	2(1.6%)	3(2.5%)	20(16.4%)	29(23.8%)
Chlorpyrifos	Insecticide	11	0(0.0%)	2(1.6%)	7(5.7%)	13(10.7%)	53(43.4%)	75(61.5%)
Glyphosate	Herbicide	111	0(0.0%)	5(4.1%)	24(19.7%)	18(14.8%)	33(27.0%)	80(65.6%)

Source: Field survey data, 2017.
***II** = moderately hazardous; III = slightly hazardous; NK = not known [16, 17].
Note: Active ingredients (gm.ai/litre) was obtained from the containers of pesticides used by the cocoa farmers.

Table-2. Summary statistics of variables included in the regression model.

States		Pesticide Price (₦/ha)	Age of farmers (Years)	Cocoa farming experience	Farm size (ha)	Labour cost (₦/ha)	Income (₦)
Kwara	Minimum	5268	42	3	0.4	0	120,000
	Maximum	192010	65	32	8.4	66,000	998,852
	Mean	47,225	54.52	19.94	3.62	21,477	686,549
	Std. dev.	35807.6	4.419	7.592	0.3291	3790.14	1784.723
Edo	Minimum	3350	25	2	0.4	0	211,200
	Maximum	368,000	70	40	12.6	122,665	2,430,000
	Mean	67,502	45.01	17.26	6.71	31,790	891,089
	Std. dev.	58646.3	11.373	7.378	1.3028	7759.08	5864.26
Ondo	Minimum	753	20	1	0.4	0	136,000
	Maximum	315,000	71	48	15.0	145,000	3,990,000
	Mean	22,571.4	48.57	19.89	10.13	41,930	924,930
	Std. dev.	37946.1	9.196	8.772	8.7824	5591.46	2389.977
Pooled	Minimum	753	20	1	0.4	0	120,000
	Maximum	368,000	71	48	15.0	145,000	3,990,000
	Mean	45,783.1	49.02	19.94	6.82	32,732	844,930
	Std. dev	48772.9	9.630	7.592	5.213	3976.91	5309.624

Source: Field survey data, 2017

Table-3. Socioeconomic factors influencing pesticide use in cocoa production in the study areas.

Parameters	Kwara State	Edo State	Ondo State	Pooled sample
Constant	327.303***	-1.469**	-44.72**	3.243***
	-4.566	(-2.274)	(-2.046)	-2.664
Price of pesticide (₦)	0.111***	0.533***	0.721***	0.755***
	-3.792	-4.783	-7.91	-5.597
Age (Years)	-167.796	0.728	-1.168**	0.543
	(-1.012)	-1.125	(-2.312)	-1.431
Sex (Dummy)	131.224	0.006	0.225	-0.199
	-1.311	-0.751	-1.315	(-1.563)
Farm size (Ha)	1334.9***	0.287***	0.351**	0.246***
	-6.626	-3.035	-2.086	-4.324
Experience (Years)	192.809	0.101**	-0.020**	0.061
	-0.159	-2.106	(-2.226)	-1.378
Income (₦)	0.002**	0.008	0.029**	0.109**
	-2.024	-0.078	-2.065	-2.047
Educations (Years)	-550.65***	0.135**	-0.165**	0.046
	(-3.483)	-2.097	(-2.176)	-1.056
Extension visit (Frequency)	-116.015	-0.151***	-0.128**	-0.419***
	(-0.155)	(-2.757)	(-2.375)	(-9.095)
Labour type (Dummy)	-132.64	0.153***	0.009***	0.019
	-0.066	-3.214	-2.911	-1.4398
Labour cost (₦)	0.079**	0.242**	0.194**	0.027
	-2.035	-2.445	-2.061	-0.603
Cocoa variety (Dummy)	104.019**	-0.321**	0.003**	0.102**
	-2.241	(-2.134)	-2.258	-2.301
R^2	0.823	0.928	0.899	0.883
Adjusted R^2	0.678	0.772	0.756	0.694
F-value	16.800***	10.767***	18.276***	21.825***

Source: Computed from field survey, 2017 ***, ** and * indicate significance at 1%, 5% and 10% levels respectively. Figures in parentheses are t-values.

Price of pesticide had a direct relationship with quantity of pesticide used in Kwara State at 1% alpha levels. This result is however, contrary to the a-priori expectation. The positive significant influence is an indication that pesticide is a major input in cocoa production. So, irrespective of the price at which it is being sold, the cocoa farmers would still purchase to curb the incidence of pest and disease infestation as well as guarantee increase output in the study area. This result however, disagrees with Ayinde, et al. [18] that price of insecticide reduced

the quantity of insecticide used. Farm size was also positive and significant at 1%. This implies that the unit of pesticide used increase with farm size in the study area. In the same vein, income of farmers had a positive significant influence on quantity of pesticide used at 5% alpha level suggesting that as income realised from cocoa production increases, the quantity of pesticide used by cocoa farmers in the state increases. A ₦1 increase in income will increase the quantity of pesticide used in cocoa by 0.167gm./ai. This report agrees with those of Dung and Dung [19]; Ayinde, et al. [20] that quantity of pesticide used increases with income. Labour cost was also positive and significant at 1%. This implies that the cocoa farmers tend to substitute pesticide for labour as labour cost increases, especially in the area of using herbicides to kill weeds. Furthermore, the variety of cocoa grown by the cocoa farmers had a positive significant influence on quantity of pesticide used in cocoa production in the state. This implies that cocoa farmers who planted local variety used more pesticide than the hybrid variety in the state. A negative relationship however, existed between pesticide use and cocoa farmers educational level at 1% alpha level in the state. This is an indication that cocoa farmers with little or no education used more pesticide on their cocoa farms and vice versa. This could be due to their inability to read, understand and adhere to the instructions on the pesticide labels and manuals.

3.2.2. Edo State

The double-log model was adopted to explain the socio-economic variables influencing quantity of pesticide used by the respondents in Edo State. The double-log function was chosen as a lead equation because it best fits the model in terms of criteria considered. The model had a R^2 value of 0.928. This shows that about 93% of variation observed in the quantity of pesticide used in cocoa farms in Edo State was explained by the independent variables included in the model. The model revealed that price of pesticide ($p<0.01$), farm size ($p<0.01$), experience ($p< 0.05$), education ($p< 0.05$), extension visits ($p<0.01$), type of labour used ($p<0.01$), labour cost ($p<0.05$) and variety of cocoa grown ($p<0.05$) were the variables influencing the quantity of pesticide used in the state.

Price of pesticide ($p<0.01$) had a direct significant relationship with quantity of pesticide used by cocoa farmers in Edo State. This implies that the quantity of pesticide used increased with increase in the price of pesticide used in the state. Farm size ($p<0.01$) also had a direct relationship with quantity of pesticides used in the state. This indicates that the quantity of pesticide used in the state increases with the area of land cultivated to cocoa. Furthermore, cocoa farming experience ($p<0.05$) was also positive and significant implying that quantity of pesticides used in the state increases with the experience of the farmers in cocoa production. Experience helps the farmers to understand the risk of not using adequate pesticides in their cocoa farms. A year increase in the experiences of farmers increases pesticide use by 0.101gm./ai. A positive relationship also existed between quantity of pesticide use and education at 5% alpha level. This indicates that increase in education level will further assist the cocoa farmers in Edo State to know the advantages of using Pesticide in cocoa production. The result is in congruence with Oluyole [3] that high literacy level predisposes farmers to adopt innovations and use improved farm practices. Type of labour employed was also positive and significant at 1% alpha level. This implies that cocoa farmers who hired labour used more pesticides on their cocoa farms. This was confirmed by the result on labour cost ($p<0.05$) which had a direct relationship with the quantity of pesticide used in the state.

However, extension visit ($p<0.10$) and cocoa variety ($p<0.05$) were found to have inverse relationship with the quantity of pesticide used in Edo State. The negative significant relationship of extension visits connotes that the more frequently the visits, the less the quantity of pesticide used. This could be because the extension agents constantly train the farmers on good agricultural practices as alternative to pesticide. In the same vein, the

negative significant relationship of cocoa variety in the state was probably because majority of the cocoa farmers in the state cultivated hybrid variety of cocoa which requires less application of pesticide relative to the local ones.

3.2.3. Ondo State

The semi-log model was adopted as the lead equation for determining the socio-economic variables influencing pesticide use in Ondo State. The significance of F value at 1% attests to the goodness of fit of the model. The value of R^2 is 0.899. This implies that the regressors included in the model jointly explained about 90% of the deviation in the quantity of pesticide used in the state. The model also had the highest of significant variables that conformed to the a priori expectations in terms of magnitude. The model reveals that the price of pesticide ($p<0.01$), farm size ($p<0.05$), income ($p<0.05$) labour type (0.01), labour cost ($p<0.05$) and cocoa variety ($p<0.05$) had positive significant influence on quantity of pesticides used while age of farmers ($p<0.05$), experience ($p<0.05$), education ($p< 0.10$) and extension visit ($p<0.05$) had negative significant influence on quantity of pesticides used in cocoa production in the state.

The positive significant relationship of price of pesticide, farm size, income, labour type and labour cost indicate that the higher the price of pesticide, the larger the farm size, the higher the labour cost and income realised from cocoa production, the more the quantity of pesticide used in cocoa production in the state. The positive influence of cocoa variety signifies that pesticide usage increases with local variety of cocoa. However, the negative significant influence of age of farmers, cocoa farming experience, education and extension visits imply that younger cocoa farmers with little cocoa farming experience, less education and less visits from extension agents used more pesticides in their cocoa farms and vice versa in the state.

3.2.4. All Locations

The result for all locations was obtained from the double-log model. The model had a significant F value of 21.825 which attests to the goodness of fit of the model. The highest R^2 value of 0.883 implies that about 88% of variations in the quantity of pesticide used in all the study areas was jointly explained by the predictor variables included in the model. The model revealed that the socio-economic variables influencing the use of pesticide in Nigeria were price of pesticide ($p<0.01$), farm size ($p<0.01$), income ($p<0.05$), extension visits ($p<0.01$) and cocoa variety ($p<0.05$).

A positive relationship was found to exist between the pesticide used in cocoa production in Nigeria and price of pesticide. This implies that quantity of pesticide used increased with price of pesticide, an unusual situation that point to the importance of pesticide in cocoa production. Likewise, farm size and income had positive significant influence with quantity of pesticide used in the study area. These imply that the more the hectares of land cultivated to cocoa, the higher the income realized, the more the quantity of pesticides used. Frequency of extension visits was however found to have a negative relationship with the quantity of pesticide used in the study areas. This implies that the quantity of pesticide used decrease with frequency of extension visits and vice versa in the study area.

3.3. Problems Associated with Pesticide Use in Cocoa Production in the Study Areas

Farmers were asked to rank these problems in order of importance and the breakdown of responses are presented in Table 4. Generally, the major problem faced by the respondents was high cost of pesticide. All (100%) the respondents indicated that cost of pesticide were too high. This was closely followed by lack of subsidy by government. About 95% of the respondents indicated lack of subsidy as a pressing problem in the study areas. The

respondents wanted government to make pesticide available to them at reduced prices as government's contribution to their farming enterprise.

The next most pressing problem is adulteration of pesticide. Farmers claimed that some middlemen who sold pesticide to them were engaged in this sharp practice. Farmers were able to overcome this by buying at the ADP's office, Agro-services centres and other government designated centres close to them. But the problem with this arrangement was that these pesticides were often times not available at the designated centres when needed which ranked as the next problem. High cost of spraying equipment was ranked as the next challenge by 65.1% of the respondents. About 60% of the respondents reported that pesticide used in cocoa production did not produce the desired effect of combating pest and diseases infestation on their cocoa farm. This problem may largely be due to the fact that these pesticides may be adulterated ones or inappropriate application by the farmers. The last ranked problem was shortage of farm labour. This increases the cost invested in pesticide especially herbicides due to unavailability of labour to help in weeding cocoa farm lands.

Table-4. Problems of pesticide use in cocoa production in the study areas.

Problems	Kwara	Edo	Ondo	Pooled
High cost of pesticide	110(100.0%)	118(100.0%)	122(100.0%)	350(100.0%)
Adulteration of pesticide	101(91.8%)	99(83.9%)	102(83.6%)	302(86.3%)
Non availability of pesticide at the right time	72(65.5%)	104(88.1%)	89(73.0%)	265(75.7%)
Pesticide does not have the desired effect	50(45.5%)	67(56.8%)	92(75.4%)	209(59.7%)
High cost of spraying equipment	56(50.9%)	96(81.4%)	76(62.3%)	228(65.1%)
Shortage of farm labour	38(34.5%)	79(66.9%)	88(72.1%)	205(58.6%)
Lack of subsidy by government	106(96.4%)	115(97.5%)	112(91.8%)	333(95.1%)

Source: Field survey data, 2017.

4. CONCLUSION AND RECOMMENDATIONS

The study provided information about the categories of pesticide use in cocoa production, the pattern of its use and determinants as well as problems associated with pesticide use in cocoa production in the study area. The major pesticide used in the study area were fungicide, insecticide and herbicide with cocoa farmers using approximately 4,000gmai/l of pesticides per season. The socio-economic variables influencing the use of pesticide in Nigeria were price of pesticide, farm size, income, extension visits, and cocoa variety. Therefore, it is recommended that efforts should be intensified at making pesticide readily available and affordable to farmers especially at government designated centres. Cocoa Research Institute of Nigeria (CRIN) should be adequately funded by the federal government to undertake research that will produce high yielding and disease resistant varieties of cocoa at affordable prices in order to minimize costs and increase returns to cocoa production. Cocoa farmers should also be constantly trained on good agricultural practices by extension agents, they should also be encouraged to form and join viable cocoa farmers' group so that they can purchase farm inputs such as pesticide and spraying equipment at subsidized rate.

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