Journal of Agricultural Economics and Development Vol. 1(1), pp. 1-9, April 2012
Available online at http://www.academeresearchjournals.org/journal/jaed
ISSN 2327-3151 ©2012 Academe Research Journals

Full Length Research Paper

Factors determining the extent of pesticide use in Nigerian farms

Tijani[1], A. A. and Sofoluwe[1], N. A.

Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria

Accepted 29 March, 2012

This study analysed farmers' awareness of European Union (EU) ban on using some cocoa pesticides and factors determining use of pesticides by farmers. Tobit model was fitted to the cross sectional data collected from 100 sampled farmers across six (6) local governments' area of Osun State, Nigeria. Although majority (74%) of the respondents are aware of the EU Pronouncement, some of the banned chemicals are still being use by farmers. Results from Tobit estimates indicate that pesticide price is among the significant variables influencing the decision to use a particular pesticide or not. Major policy thrusts for devising pesticide use regulation, increasing farmers' awareness of the harmful effects of using banned pesticide and regulating pesticide prices to an affordable level are suggested to ensure appropriate use of pesticides by farmers.

Key words: Pesticides; Cocoa beans; Awareness; Pesticide use; Tobit model,

INTRODUCTION

Reliance on synthetic chemicals to control cocoa pests has given rise to a number of problems, which may affect the food chain and consequently impacting negatively on biological diversity. Some of the side effects of the use of these chemicals include the health hazards, undesirable side effects and environmental pollution (Asogwa and Dongo, 2007). Recently, National Agency for Food and Drug Administration and Control (NAFDAC) announced the ban on the use of 30 chemicals in Nigeria in line with the new European Union legislation on pesticide use (Auwal- Auwal-Ahmad and Awoyale, 2008). It has been established that farmers in Nigeria have poorly adopted much of the technical knowledge on cocoa pest management acquired from scientific research. The major factors responsible for inefficient application of pesticides are financial constraints, poor techniques, inappropriate equipment for applying the pesticide, ill timing of application, inadequate understanding of how to use and lack of concern for the consequences of careless use of pesticides (Oduwole, 2001).

The majority of cocoa farmers are often unaware that pesticides should be used in specific dosage to be cost effective and to minimize the quantity of the residues that the pesticide will leave on the crop. It has also been established that excessive use of these pesticides leaves residues on cocoa hence serving as a contaminant (Asogwa and dongo 2007).

In Europe, recent EU legislation has been approved banning the use of highly toxic pesticides including those that are carcinogenic, mutagenic or toxic to reproduction, those that are endocrine-disrupting, and those that are persistent, bio-accumulative and toxic (PBT) or very persistent and very bio-accumulative (vPvB). Measures were approved to improve the general safety of pesticides across all EU member states.

Although there are benefits to the use of pesticides, there are also drawbacks, such as potential toxicity to humans and other animals. Many pesticides can be grouped into chemical families. Prominent insecticide families include Organochlorines, Organophosphates, and carbamates. Organochlorine hydrocarbons (e.g. DDT) could be separated into dichlorodiphenylethanes, cyclodiene compounds, and other related compounds. They operate by disrupting the sodium/potassium balance of the nerve fiber, forcing the nerve to transmit continuously (Sosan et al. 2010). Their toxicities vary greatly, but they have been phased out because of their persistence and potential to bioaccumulate. Organophosphate and carbamates largely replaced organochlorines. Aside this toxic nature of this pesticide, some of the pesticides also deposits residues on the plant and these residues are dangerous to the consumption of the farmer and his environment.

*Corresponding author. E-mail: nasofoluwe@ gmail.com

The most commonly used pesticide is Lindane (Gamma BHC) on Kola-nuts *(cola nitida*) and cocoa (*Theobroma cacao*) for protection against kola-nut weevils *(Balanogastris Kolae).* It is also widely used by fishermen to kill fish for commercial purposes in Nigeria. Fenthion (an insecticide) is an effective avicide and is used mostly in northern part of Nigeria against bird pest. DDT and Gammalin-20 a rodenticide that has been outlawed but they are still illegally used in some parts of Nigeria (Pesticide action network October, 2007).

Since cocoa serve as a major cash crop used in foreign exchange, non compliance with the stated rule by the foreign exchange market of cocoa would cause the isolation and rejection of any cocoa produced in Nigeria. This would in-turn lead to low returns on the part of cocoa farmers in Nigeria. There must be some underlining facts that hinder Nigeria cocoa producers from complying with this directive.

There are several studies on factors influencing the use of main inputs, such as fertilizer for crop production in Nigeria such as Bamire et al. (2002). However, similar studies on pesticide use, which also represent a crucial input in crop production due to continuous pest infestation, is not available. The present study, therefore, attempts to contribute to the existing body of literature by clearly examining the factors determining the extent of use of pesticides and farmers' awareness of beneficial and harmful effects of pesticides.

The objectives of this study are to determine the level of awareness of cocoa farmers in Osun state about the pesticides that has been banned by the European Union and to get the major determinants of the amount of pesticides currently in use by the farmers in Osun state. Nigeria was rated the second largest world producer of cocoa in the 1960's (Adegbola and Abe, 1983) and, for a long time the crop has been generating substantial foreign exchange for the country. The production of this important cash crop has suffered a major problem in Nigeria from pest and disease infestation. Pesticide use in Nigeria has been on the increase ever since its introduction in early fifties for cocoa production. Nigerian cocoa production is still dependent on pesticides to attain acceptable levels of crop production. The antimirid campaign, which followed the recommendation of Lindane in 1957, resulted in remarkable increase in cocoa production from an average of 103,000 tons per annum in 1961- 67 periods to 212,000 tons per annum in 1961-65 periods (Gerard, 1967). This shows to a large extent that the use of some pesticides is of significant importance to the production of cocoa. Increasing the productivity of cocoa is tantamount to an indication of economic development since cocoa is one of the major cash crops that contribute towards the Gross Domestic Product of Nigeria through foreign exchange.

Since cocoa produce that has its pesticide residue far above the minimum required level stated by EU are restrained in the foreign exchange market, this implies that those local farmers that are not aware of this legislation are only producing for themselves. Knowing fully well that the market of cocoa is not situated within the country but processed outside this country, hence farmers that are still using the banned chemicals will definitely be running at a loss.

EUROPEAN UNION PRONOUCEMENT AND COCOA PRODUCTION IN NIGERIA

The European Parrnership Agreement (EPA) is being negotiated between the European union (EU) and African, Caribbean and Pacific States (ACP). According to Mandelson (2007), the Economic Partnership provides a unique opportunity for trade integration between European Union and West Africa, by building on existing efforts to promote greater economic integration in the Sub region. European Partnership is a joint response to the challenges of globalisation and development . It aims to help west Africa become more competitive, diversify its export and build a regional market with uniform, transparent and stable rules needed to reinforce economic governance and attract investment. The eventual goal is to build a genuine partnership for development between European Union and West Africa, tailored to the regions of specific performances.

In the European Union (EU), as from 1 September 2008, a new legislative framework (Regulation (EC) No 396/2005 of the European Parliament and of the Council) on pesticide residues is applicable. This Regulation completes the harmonisation and simplification of pesticide Maximum Residue Levels (MRLs), whilst ensuring better consumer protection throughout the EU. With the new rules, MRLs undergo a common EU assessment to make sure that all classes of consumers, including the vulnerable ones, like babies and children, are sufficiently protected (EUROPA NEWS, 2008). It is necessary to ensure that such residues should not be found in food or feed at levels presenting an unacceptable risk to humans. Maximum residue levels (MRLs) are therefore set by the European Commission to protect consumers from exposure to unacceptable levels of pesticides residues in food and feed. Pesticides are used to protect crops before and after harvest from infestation by pests and plant diseases. A possible consequence of their use may be the presence of pesticide residues in the treated products.

The EU legislation on Pesdticides (Regulation 149/2008/EEC) states that as from 1 September, 2008 all cocoa beans entering the European Union must conform to the provisions of the above EU Regulation. The Regulation establishes the Maximum Residue Levels (MRLs) of pesticides permitted in cocoa. MRLs are defined as the maximum concentration of pesticide residue (expressed as milligrammes of residue per kilogramme of food/animal feeding stuff) likely to occur in or on food and feeding stuffs after the use of pesticides

according to Good Agricultural Practice (GAP), i.e. when the pesticide has been applied in line with the product label recommendations and in keeping with local environmental and other conditions. List of pesticides and fungicides previously approved for use on cocoa farms in Nigeria are presented in Table 1 and Table 2.

In order to produce acceptable specification for Nigeria's cocoa industry to meet European Union Regulations on Maximum Residue limits (MRLs), the federal government has currently approved a list of pesticides for use on cocoa farms in Nigeria. These pesticides are given in Table 3:

Residue analysis by Sosan et al (2008) on the blood serum of cocoa farmers and their domestic water sources were analyzed for insecticide residues in selected cacao growing communities of south-western part of Nigeria. The farmers were grouped into five exposure periods based on their years of involvement in pesticide application, viz <5 years, 5-9 years, 10-14years,15-20years and >20 years. The blood and water samples of the farmers were collected. The insecticide residue level was determined in the selected states (Osun and Ondo) which are the major cocoa producing states in the southern areas. A survey of 150 farmers was made through the use of questionnaire and personal interview. The result of the analysis revealed that 42 out 76 farmers have residues of diazinon, endosulfan, propoxur and lindane in their blood: and 47 % out of these farmers are above 20 years exposure period. About 34% of the farmers had endosulfan (mean = .080mg/kg) in their blood. The residue of lindane, endosulfan and propoxur in the blood serum of cocoa farmers were found to be below the no observable effect level (NOAEL), which serve as the standard of measurement of residues in the blood serum of cocoa farmers.

METHODOLOGY

The study was carried out in Osun State, South Western part of Nigeria. Osun State was carved out of the old Oyo State on 27th August, 1991. It covers an area of approximately 14,875 square kilometres, lies between longitude 04 00E and 05 05" and latitude 05 558" and 08 07", and is bounded by Ogun, Kwara, Oyo and Ondo States in the South, North West and East respectively.

The 1991 census which is still in dispute and which obviously was an undercount put the population of the State at 2.2 million. The estimated population for year 2004 based on the 1991 census was 3.1 million. According to National Population Commission, the population of Osun state currently is 4,137,627. There are more than 200 towns, villages and other settlements in the State. Some of the major towns are: Osogbo, Ile Ife, Ilesa, Ikirun, Iwo, Ede, Ila-Orangun and Ikire. Others include Ipetumodu, Ejigbo, Ilobu, Gbongan, Inisa, Okuku, Ijebu-Jesha, Ipetu-Jesha, Ifon-osun, etc.

The State is divided into three senatorial districts namely, Osun I, Osun II and Osun III. Each of these districts is further divided into two zones. Osun I is made up of Ede and Iwo zones; Osun II consists if Osogbo and Ikirun zones while Osun III comprising Ife and Ilesa zones are the constituents of Ife/Ijesa district. In all, the State is divided into six zones.

The predominant ethnic group in the state is Yoruba, with others such as Ibo, Ebira and Fulani. The primary occupation of the people in the area is farming. They are engaged in production of both annual and tree crops. Annual crop produce are maize, cassava, yam, banana, while the major tree crops are cocoa, kola nut, citrus, oil palm etc. Osun State is regarded as one of the prominents states in Nigeria with highest cocoa producing capacity in Nigeria while Nigeria was rated the second largest world producer of cocoa in the 1960's (Adegbola and Abe, 1983) and, for a long time the crop has been generating substantial foreign exchange for the country.

The study was conducted in six (6), cocoa producing local governement area in Osun State. The six local governements areas are, Ilesa East, Ilesa West, Ife North, Ife Central, Atakumosa East and Atakumosa West. Primary data were collected from the cocoa farmers in the eight local governement area through the use of a structured questionnaire which was administered to randomly selected farmers in the chosen areas. The questionnaire was designed to obtain information on socio-economic characteristics of cocoa farmer, Output Level of Cocoa production of the farmers, other sources of income of the farmers and level of farmers' awareness of the European union pronouncement.

A multistage purposive sampling technique was used to obtain information from cocoa farmers based on the objective of the study. 100 respondents were targeted for the purpose of this research work, but 80 cocoa farmers responded thoroughly to the questionnaire. The first stage was the selection of the cocoa state, which is Osun State. The Second stage was the selection of the 4 local governments in Ilesa and 2 local governments in Ile-Ife. These 6 local governments are known for cacao production in Osun State. The third stage was the selection of 2 cocoa producing villages each from the Local Government Areas.

The data obtained were analyzed using the descriptive and Tobit regression analysis. The first three objective will be analyzed using the Descriptive Analytical tool while the last objective will be analyzed using the Tobit Regression technique.

The Tobit model was employed because of its advantage in specifying the intensity of use of the pesticide used and the functional relationtionship between the probabilities of the explanatory variables involved. The model expresses farmers pesticides adoption decision as a function of a linear combinaton of observable explanatory variables. The simple model can be presented as follows:

$$Y_i = \beta x_i + \mu_i \quad (1)$$

Table 1: List of Insecticides previously approved for use on cocoa farms in Nigeria

S/N	Trade Name	Active Ingredient	Chem. Class	Commercial Presentation form Test	Insect Name
1	Agrothion	Fenitrothion	Organophosphate	Emulsifiable Conc.	Termites
2	Basudin	Diazinon	Organophosphate	Emulsifiable Conc.	Mirid
3	Dursban	Chlorpyrifos	Organophosphate	Emulsifiable Conc.	Mirid
4	Elocron	Dioxacarb	Organophosphate	Wettable powder	Mirid
5	Mipcin	Isoprocarb	Carbamate	Wettable powder	Mirid
6	Unden	Propoxurr	Carbamate	Emulsifiable Conc.	Mirid
7	Thiodan	Endosulfan	Cyclic Sulphuric	Emulsifiable Conc.	Mirid
8	Decis-Dan/ Cracker 282 E.C	Endosulfan	Pyrethoid	Emulsifiable Conc.	Mirid

Source: Crop Production Division, Cocoa Research institute of Nigeria (CRIN), Ibadan Nigeria, 2009.

Table 2: List of fungicides previously approved for use on cocoa farms in Nigeria

S/N	Trade Name	Active Ingredient	Dosage	Rate/ha (kg/ha)
1	Caocobre-Sandoz	Copper Oxide	13.5 g/10L water	3.36
2	Ridomil Plus 72 WP	Metalaxyl+copper	33g/10L water	3.24
3	Brestan	Tin Triphenyl acetate	13.5g/10L water	2.33
4	Kocide 101	Copper hydroxide	40g/10 L water	2.5
5	Bordeaux mixture	Copper sulphate+Lime	40g/10L water	3.8
6	Perenox	Copperoxide	40g/10L water	3.4
7	Procida BBS	Copper Sulphate+5H20	40g/10L water	3.8
8	Orthodifolatan	4-Cyclohexane Dicarboxymide	45g/10 l water	1.9

Source: Crop Production Division, Cocoa Research institute of Nigeria (CRIN), Ibadan Nigeria, 2009.

Table 3. Pesticides Currently Approved for Use on Cocoa Farms in Nigeria

S/N	Trade Name Insecticide	Active Ingredient	Commercial Presentation form Test	Pests
1	Dursban48EC	Chlorpyrifos	Emulsifiable Concentrate	Mirid
2	Actara25WG	Thiamethoxan	Wettable granule	Mirid
3	Proteus 170 O-TEQ	Deltamethrin 20g/L +Thiacloprid 150g/L	Oil Dispersion	Mirid
Fungicide				
4	Funguran^{-OH}	Copper hydroxide	Wettable powder	Black pod
5	Champ DP	Copper hydroxide	Dustable powder	Black pod
6	Ridomil gold 66WP	Cuprous Oxide + metalaxyl-M	Wettable powder	Black pod
7	Nordox 75WP	Cuprous Oxide	Wettable powder	Black pod
8	Kocide	Cuprous Oxide	Wettable powder	Black pod
Herbicides				
9	Touch down	Glyphosate	Soluble concentrate	Weed
10	Round up	Glyphosate	Soluble concentrate	Weed

Source: Crop Production Division, Cocoa Research institute of Nigeria (CRIN), Ibadan Nigeria, 2009.

Algebraically expressed for the ith farm operator:

$$Y^*_i = \beta_0 + \beta_i x_{1i} + ,... + \beta_N X_N \quad i=1,...,N \qquad (2)$$

Such that

$$Y_i = \begin{cases} 1 \text{ if } Y_i^* > T \\ Y_i^* \text{ if } 0 < Y_i^* < 1 (i = 1,...,n) \\ 0 \text{ if } Y_i^* \leq T \end{cases} \qquad (3)$$

Where Y_i is the observed dependent variable, e.g. amonut of pesticide applied; Y_i* is the non-observable latent variable representing the use of pesticide in cocoa production; *T is* the critical (cut off) value, n is the number ofobservations.

From equation 2,

Y= amount of pesticidde use (ml)
x_1 = Pesticide price (₦/ 100ml or g)
x_2 = Labour price(₦)
x_3= Previous year output price (₦)
x_4= Previous year output (ton)
x_5 = Farm size (ha)
x_6 = Age (years)
x_7 = Marital status
x_8 = Education
x_9 = Household size
x_{10} = Religion
x_{11} = Major Occupation

Tobit analysis was used to estimate the likelihood of pesticide use and the intensity of its use (interms of its quantity). Tobit is prefered to Ordinary Least Square (OLS) estimation because it allows for the inclusion of observation with non use of approved pesticides. The use of maximum likelihood estimation guarantees that the parameter estimates will be consistent and the appropriate statistical tests performed (Pindyck and Rubinfeld 1997). Unlike the OLS case, the value of a Tobit coefficient does not directly correspond to the expected change in an explanatory variable, rather the tobit model estimates a vector or normalised coefficients which can be transformed into the vector of first derivatives.

The emprical model (Eqn 1) was examined to determine the effect of those factors that affect the amount of pesticide use among cocoa farmers in the study area. The input prices (pesticide price, labor price), lagged output price and social economic characteristics constitute the variables that determine the amount of pesticide use by the cocoa farmers. Amount of pesticide per farm in 100ml or g was specified as the dependent variable. The independent variables include the following: pesticide price, Labor price, previous year output price, farm size, age, marital status, education, household size, religion, major occupation (operation) and access to loan. The Tobit regression analysis shows that the independent variables (Pesticide price, Labor price and Major Occupation) have a significant effect on the amount of pesticides used per farm.

RESULTS AND DISCUSSION

TYPES OF PESTICIDE USE BY COCOA FARMERS IN OSUN STATE

The data obtained from the farmers in Osun state shows that most of the farmers do not limit themselves to the use of just one pesticide on their cocoa farm but they combine these chemicals together depending on the purpose in which they are meant for. The study revealed that some of the farmers are still using the banned chemical alongside with the approved chemicals on their cocoa farm. In order to present a true picture of what was found on the field, the farmers are grouped on the basis of the chemicals that they use on their fields after which the farmers that are using banned ones are isolated from the others. This was done because very few farmers were using just one chemical; most of them combine the chemicals together.

Table 4 gives the list of the chemicals (approved and banned) that are been used by cocoa farmers in Osun State. The predominant chemical been used by cocoa farmers in Osun state is Ridomil which is used by 92.3% of the total respondents.

Proportion of the Banned and Approved Cocoa Pesticides Used

The number of respondents that changed from banned to approved chemicals, depicts the level of awareness of the farmers to the harmful effects of the banned chemicals.

Table 5 shows that 74% of the respondents are using approved chemicals while about 26% are still using the banned chemicals. But none of the farmers are solely using banned chemical, those that are even using banned chemical are using it in combination with the approved ones. This shows that majority of the farmers are aware of the European Union pronouncement on cocoa chemicals and they have changed from banned to the approved chemical.

Awareness of the European Union Pronouncement

Table 6 shows that 71.4 per cent of the respondents are aware of the European Union pronouncement on the banned and approved cocoa pesticides while just 28.6 per cent are not aware of the E.U. pronouncement. Table 6 also shows that 55.8 per cent of the respondents know between 1 and 2 approved pesticides, 27.3 percent know between 3 and 4 approved pesticides and 16.9 per cent of the respondents know above 5 approved pesticides.

Harmful and Beneficial effects of the pesticide

The pesticides used by the farmer (Table 7) constitute both positively and negatively to the output level of cocoa produce by the respondents. Table 7 shows that the cocoa pesticides that the respondents use on their farm have beneficial effects on the cocoa beans. 92.2% of the respondents attest to the fact that pesticides destroys insect on the field. All the respondents acknowledged that pesticides use increases production, prevents disease infestation and enhances the growth of the cacao tree. Most of the respondents do not use fertilizer on their cocoa plot been a perennial crop, this account for the

Table 4. Distribution of Respondents on the types of Pesticide used in Osun State

Pesticides	Frequency	Percentage (%)	Cum. Percentage (%)
*Actara, Cocobre-Sandox	2	2.5	2.5
*Actara, Ridomil	3	3.9	6.4
*Chloropyrils, Actara, Ridomil	4	5.2	11.6
*Cypercot, Termitex, Ridomil	8	10.4	22.0
*Ridomil, Perenox	33	42.9	64.9
*Ridomil, Cypercot	2	2.6	67.5
*Ridomil, termitex	5	6.5	74.0
**Actara, Ridomil, Coppersulphate	4	5.2	79.2
**Ridomil, Termitcot, CuSO4, Unden	2	2.6	81.8
**Ridomil and Gamalin 20	3	3.9	85.7
**Ridomil, Unden	4	5.2	90.9
**CuSo4, Unden	4	5.2	96.1
**Ridomil, Basuden	3	3.9	100

Source: field survey 2011
Note: ** indicate the category of farmers using banned chemical alongside with approved ones
* indicate the category of farmers that are using the approved chemicals

Table 5: Distribution of Respondents on the type of Pesticide used in Osun State

Pesticides	Frequency	Percentage (%)
Approved	57	74
Banned	20	26

Source: Field Survey, 2010

Table 6: Distribution of respondents by awareness of European Union pronouncement, awareness of banned pesticides and awareness of approved pesticide

Variable	Frequency	Percentage (%)
Awareness of European Union pronouncement		
Yes	55	71.4
No	22	28.6
Awareness of banned pesticide		
1-2	43	55.8
3-4	34	44.2
Awareness of approved pesticide		
1-2	43	55.8
3-4	21	27.3
5 and above	13	16.9

Source: field survey, 2010

reason why 46.7% said the use of pesticides reduces the level of fertilizer usage on the farm while majority of the respondents (53.3%) said it does not reduce fertilizer usage.

Table 8 shows that the cocoa pesticides used by the respondents on their farm also pose some detrimental effect on the farmers' life, other property and the cocoa plant. It shows that excessive use of the pesticide could even damage the cacao tree which will eventually lead to loss on the part of the farmer. About 84.4% of the respondent attested to the fact that pesticide usage affects their health while just 15.6% disagreed. The use

Table 7: Distribution of respondent on beneficial effect of pesticide

Variable	Frequency	Percentage (%)
Beneficial effects		
Destroy insect	71	92.2
Destroy insect	71	100
Increase production	77	100
Prevent disease	77	100
Promote growth	77	100
Requires less Fertilizer	36	46.8

Source: Field survey, 2010

Table 8: Distribution of respondent on harmful effect of pesticide

Variable	Response	Frequency	Percentage (%)	Central tendency
Harmful effects				
Damages plants in excess	Yes	60	77.9	Mean = 1.19
	No	70	22.1	S.E =0.05
Affects human health	Yes	65	84.4	Mean=1.15
	No	12	15.6	S.E=0.04
Pollutes water body	Yes	58	75.3	Mean=1.26
	No	19	24.7	S.E=0.05
Causes death of livestock	Yes	65	84.4	Mean=1.16
	No	12	15.6	Mean =1
Production falls				
if used in excess	Yes	41	53.2	Mean= 1.45
	No	33	46.7	S.E = 0.06
Destroys farm fertility	Yes	15	19.5	Mean=1.8
	No	62	80.5	S.E=0.05
Reduces yield	Yes	20	26.0	Mean=1.8
	No	57	74.0	S.E=0.05

Source: Field survey, 2010

of pesticide also contaminates water body thus killing the aquatic animals if it runs into the river. About 75.3 percent of the respondent are currently experience this water pollution on their farm. About 84% of the respondents were of the opinion that the use of pesticide causes the death of their livestock while the 15.6% that responded no might not even be raising any livestock, hence might not know if it could kill their animal. Of all the harmful effect enumerated in the questionnaire, it was only the reduce yield that is in opposition to the view of the farmer. Most of the farmers (74%) of the farmers responded that the use of pesticide does not reduce their cocoa yield rather it boost the production of the cocoa.

Tobit Test Result of the determinants of pesticides type used by cocoa farmers

The analysis of the extent of pesticide use by farmers ais presented in Table 9. The diagnostics tests such as Pseudo R^2, Likelihood Ratio, are reported in Table 9. All the explanatory variables accounted for about 47 per cent of the variations in the dependent variable.

The results suggest that Pesticide price is significantly positively associated with pesticide use indicating that with increase in price farmers also use more of the pesticide. Increase in pesticide price does not reduce the amount of pesticide used by the farmer rather as price increases the amount of pesticide used also increases. The result is contrary to what Rahman (2003) obtained in Bangladesh. This shows that cocoa pesticides price and quantity relationship is an exception to the law of demand. The amount of pesticide use for cocoa production in Osun State is independent of the price. In Osun State, black pod disease is a major cocoa disease which could cause a loss of up to 90% of cocoa beans if not combated with pesticides, in order to avoid this, farmers need to use adequate amount pesticides necessary to negate the effect of the disease regardless of the price of the pesticides.

Labour price is also significantly negatively associated with pesticide use indicating that as more labour is employed on the farm, lesser amount of pesticide is

Table 9: Distribution of Respondents on Determinants of Pesticides used

Variable	Dependent variable: amount of pesticides used per farm		
	Coeff	**Standard Error**	**t-value**
Constant	-2799.606	3549.164	0.434
Input Prices			
Pesticide price	34.859	11.359	3.07*
Labor Price	-0.018	0.006	-2.80*
Output prices			
Output Price	-0.000	0.109	-0.04
Output Previous Year	-4.051	5.136	-0.79
Socio-Economic Characteristics			
Farm size	-199.267	279.326	-0.71
Age	-4.933	32.908	-0.15
Marital Status	-498.998	501.184	-1.00
Education	92.137	265.753	0.35
Household Size	-122.261	100.609	-1.22
Religion	1657.933	939.9065	1.76*
Major Occupation			
Access to Loan	-098.252	1117.927	-0.98
R^2 = 0.473			
Log-likelihood	-529.0276		

Source: Field Survey, 2010
- Significant at 5% level ($p<0.05$)

required on the farm. Employing enough workers result to adequate and efficient management of the cocoa plot. When the cocoa plot is effectively taken care of, disease outbreak will be reduced hence the need for pesticide use will consequently be reduced. Hence increase in labour requirement leads to decrease in the pesticide use.

Major occupation is also significantly positively associated with the pesticide use. This indicates people that have their major occupation to be cocoa farming use more of pesticide on their cocoa farm that those who take cocoa farming as a secondary profession. Cocoa farmers use more pesticides with the expectation of increased output since it is the major source of their income. Farmers that specialize in the production of cocoa use more pesticides than those who cultivate cocoa as additional income source.

As size of the farm increases, the amount of pesticide used also increases but in a decreasing manner due to economy of scale on the amount of pesticides that will be used on large farms. The amount of pesticide use is negatively associated with age, marital status, household size and access to loan. Education is positively associated with pesticide use indicating that highly educated people use more pesticides, consistent with high expectation. Religion is another factor that is positively associated with the amount of pesticide use.

CONCLUSION

This study attempts to contribute to the existing body of literature by explicitly examining the factors determining the extent of use of pesticides and farmers' awareness of beneficial and harmful effects of pesticides. The objectives of this study are to determine the level of awareness of cocoa farmers in Osun state about the pesticides that has been banned by the European Union and to get the major determinants of the amount of pesticides currently in use by the farmers in Osun state.

Pesticide use has become an important factor in cocoa production. Result of the study has revealed that farmers in Osun State use different types of pesticides to manage the incidence of pest and disease on the farm. Most of the farmers in Osun State have considerably changed from banned pesticides (chemicals) to the approved pesticides for controlling the incidence of black pod disease. This however depends on socio-economic and demographic factors. Nevertheless, few farmers are still using the banned chemicals on their cocoa farm. Farmers' awareness of the harmful effects of pesticides is not very strong as revealed in the study. They believe the beneficial effects of the pesticides outweigh the harmful ones. As revealed in the study, pesticide price, labor price (wages) and the major occupation (Crop specialization) of the farmer are the major determinant of the amount of pesticide use by cocoa farmers in Osun State. Findings from this study reveal that policy makers, government and agrochemical companies should ensure the constant availability in the market of those active ingredients that are within the new class of pesticide at reasonable cost. Also, pesticide regulatory policies and program to farmers' awareness of the harmful effects of pesticides should be made by the government to safeguard cocoa farmers in

the use of pesticides.

REFERENCES

Adegbola MOK, Abe JO (1983). Cocoa Development Programme, Nigeria. Research Bulletin No 9. Cocoa Research Institute of Nigeria Printing Unit, pp. 3-5.

Asogwa EU, Dongo L N (2009). Problems associated with pesticide usage and application in Nigerian cocoa production: A review. Afri. J. Agric. Res., 4 (8): 675-683.

Auwal-Ahmad G, Awoyale F (2008). NAFDAC warns against use of banned chemicals in food storage. The Guardian, Wed. May 14, 2008. pp. 3.

Bamire AS, Fabiyi YL, Manyong VM (2002). Adoption pattern of fertilizer technology among farmers in the ecological zones of south-western Nigeria; a tobit analysis. Aust. J. Agric. Res., 53: 901-910.

Gerard BMA (1967). A comparison of climatic observations in a cacao plantation and in the open in Ghana, In: CONFERENCE INTERNATIONALE SUR LES RECHERCHES AGRONOMIQUES CACAOYERES, I., 1965, Abidjan. Proceedings, Paris: IFCC, 1967. P.94-100.

Oduwole OO (2001). Sustainable cocoa production in Nigeria: Farmers perception of technology characteristics and socio economic factors in adoption decision. Proc. 13th Int. Cocoa Res. Conf., pp. 1147 – 1152.

Pesticide action network October (2007).

Sosan MB, Akingbohungbe AE, Ojo IAO, Durosinmi MA (2008) Insecticide residues in the blood serum and domestic water source of cacao farmers in South-western Nigeria. Chemosphere 72 (2008) 781–784.

Sosan MB, Akingbohungbe AE, Durosimi MA, Ojo AO (2010). Erythrocyte Cholinesteras Enzyme Activity and Hemoglobin Values in Cacao Farmers of Southwestern Nigeria as Related to Insecticide Exposure. Archives of Environmerntal and Occupational Health, Vol. 65, No. 1.