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PESTICIDE USE AND HEALTH HAZARDS AMONG COCOA FARMERS: EVIDENCE FROM ONDO AND KWARA STATES OF NIGERIA

[1]Aminu, F.O., [2]Ladapo, H.L. and [1]Ojo, O.O.

[1]Department of Agricultural Technology, School of Technology,
Yaba College of Technology, Epe Campus, P. M. B. 2011, Yaba, Lagos State, Nigeria
[2]Department of Agricultural and Bio-Environmental Engineering, School of Engineering,
Yaba College of Technology, Epe Campus, P. M. B. 2011, Yaba, Lagos State, Nigeria
Corresponding Authors' email: folaafe02@gmail.com

Abstract
The study investigated the health implications of pesticide use by cocoa farmers in Ondo and Kwara States of Nigeria. Multistage sampling technique was adopted in the selection of 260 cocoa farmers in the study area. Data were collected with the aid of questionnaire and analysed using descriptive statistics and multivariate probit (MVP) regression model. Results from the study indicated that the cocoa farmers were getting aged with a mean age of 50 and 55 years and educational level of mainly primary school in Ondo and Kwara States, respectively. The predominant health effects experienced by the cocoa farmers resulting from pesticide exposure in the study areas were skin irritation (70.7%), breathing difficulty (69%) and eye irritation (65.9%). The results of the MVP revealed that total pesticide dose used increased the probability of the cocoa farmers experiencing eye irritation ($p<0.05$), skin irritation ($p<0.01$), dizziness ($p<0.05$), breathing difficulty ($p<0.05$) and stomach cramps ($p<0.01$), while reading and adherence to instructions on pesticide labels and manuals reduced the probability of the cocoa farmers experiencing eye irritation ($p<0.05$), dizziness ($p<0.05$), breathing difficulty ($p<0.01$) and stomach cramps ($p<0.05$). The study recommended that pesticide labels should be made comprehensible to farmers with little or no education through the use of pictorials on how to use and apply pesticides. This should accompany pesticide packages at the point of sales.

Keywords: Cocoa farmers, health, multivariate probit, and pesticide use

Introduction

Pesticides are important agricultural inputs that protect crops from diseases, pests and weeds (FAO, 2002). The use of pesticides contributes not only to healthy growth of crops but also to improved farm work efficiency and stable supply of agricultural produce (Kughur, 2012). Pesticides have substantially contributed to the control of pests, vector-borne diseases and increased crop yields (Coronado *et al.*, 2004). According to Damalas (2009), pesticides can be considered as an economic, labour-saving, and efficient tool of pest management with great popularity in most sectors of the agricultural production.

Pesticide application in cocoa production is a technology widely adopted by cocoa farmers to combat pests and diseases attack, which is a predominant phenomenon in cocoa production. Outbreaks of pests and diseases such as black pod disease, capsids and swollen shoot disease are some of the major problems militating against cocoa production in Nigeria. The effect of these pests and diseases include: reduced crop yield, foreign exchange earnings, farmer's income and government revenue (Fasina *et al.*, 2001; Ndubuaku and Asogwa, 2006). The role of pesticides in cocoa production in Nigeria has in the past been assessed in terms of their contribution to the output and quality of cocoa. According to CRIN (2000), the control of diseases and pests of cocoa in Nigeria is said to have increased cocoa output by about 40 to 50% in recent years. These chemicals play prominent roles in the effective control of cocoa diseases and pests, resulting in increased productivity and reduced effects of pests and diseases. Since cocoa constitutes raw materials for the beverage and chocolate industries, and its by-products such as; husks, fat extracted from husks and germ can be used to feed cattle, manufacture fertilizer, soap, cream, sweet, etc.. Therefore, there is the need to prevent cocoa from pests and diseases through the use of appropriate pesticide and dosage.

Although, pesticide use in cocoa production is usually for the basic aim of improving productivity through minimal or no pest attack. Evidence in the last few decades have shown that inappropriate use can be counterproductive and affect the farmers' health negatively (Ayinde *et al.,* 2006; Tadesse and Asferachew, 2008). Human exposure to pesticides is an important health and social issue as it can result in serious health problems such as: eye irritation, dizziness, body itching, epilepsy, stroke, respiratory disorders cancer, leukaemia, brain and liver tumours, convulsions etc. Death has been known to occur in some cases as a result of exposure to these pesticides (Ayinde *et al.,* 2006; Tijani 2006). Exposure to pesticides is thus one of the most important occupational challenges among farmers in developing countries (Konradsen *et al.,* 2003; Coronado *et al.,* 2004). Although developing countries use only 25% of the pesticides produced worldwide, they experience 99% of the deaths. This is because use of pesticides tends to be more intense, unsafe and regulatory, health and education systems are weaker in developing countries (WHO, 2008). This study therefore seeks to investigate the health implications of pesticide use by cocoa farmers in Ondo and Kwara States of Nigeria.

Methodology

Study Area

The study was carried out in two agro-ecologies (rain forest belt and humid guinea savannah), which covered two out of the five agro-ecologies where cocoa is produced in commercial quantities in Nigeria. The two agro-ecologies (South West and North Central) were purposively selected for the study. This is because they represent the two contrasting regions of high (South West) and low (North Central) cocoa producing areas (NBS, 2012; NSAEC, 2013).

Sampling Techniques

The respondents were selected through a multi-stage sampling technique. The first stage involved purposive selection of two out of five agro-ecological zones where cocoa is commercially grown in Nigeria. The second stage involved purposive selection (based on production intensity; the highest producing state was selected) of one state from each of the zones. These are Ondo (high) and Kwara (low). In the third stage, two agricultural zones were selected from each state through random sampling technique. One Local Government Area (LGA) was purposively selected based on the intensity of production and proximity from each agricultural zone in the fourth stage. In the fifth stage, five villages were randomly selected from each of the LGAs giving a total of 20 villages. The basis of selection was the intensity of cocoa production in these villages. Finally, in the sixth stage, a simple random sampling procedure was used to select 13 cocoa farmers from each of the 20 villages giving a total of 260 farmers for interview using the list of cocoa farmers from the agricultural zones as the sample frame. However, 232 questionnaires (122 for Ondo State and 110 for Kwara State) were used for the study. Other questionnaires were discarded due to incomplete information. Data were collected on the socio-economic characteristics of the cocoa farmers, personal protective equipment (PPE) used, and health symptoms experienced as a result of pesticide use for cocoa production in the study area.

Analytical Techniques

Descriptive statistics were employed to describe the socio-economic characteristics of the cocoa farmers and the major health symptoms experienced in the study areas. Multivariate probit regression model was used to determine the effect of pesticide and other socio-economic characteristics of the farmers on a set of health symptoms which include: eye irritation, skin irritation, headache, dizziness, breathing difficulty and stomach cramps.

The model is specified thus:

$$Y_{ij} = \beta_0 + \beta X_{ji} + \varepsilon \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where,

Y_{ij} is a binary dependent variable that takes the value of 1 if the ith farmer reports jth health symptom and 0 otherwise. Following Pingali *et al,* (1994) and Ayinde *et al., (*2006), the jth health symptom is as stated thus;

Y_1 = Eye irritation
Y_2 = Skin irritation
Y_3 = Headache
Y_4 = Dizziness
Y_5 = Breathing difficulty
Y_6 = Stomach cramp

X_{ji} is a vector of explanatory variables and is expressed as:

X_1 = Age of cocoa farmers (years)
X_2 = Education (years)
X_3 = Pesticide dose (grama.i./ha)
X_4 =Cocoa farming experience (years)
X_5 = Social habit* (Number of habits peculiar to a farmer)
X_6 = Pesticide application training (if trained = 1; 0 if otherwise)
X_7 = Weather condition (1 if windy during application; 0 if otherwise)
X_8 = Use of personal protective equipment; [X_{8a} = Use protective boot (1 if used; 0 if otherwise); X_{8b} = Use nose mask (1 if used; 0 otherwise); X_{8c} = Wear full protective garment (1 if used; 0 otherwise); X_{8d} = Use eye goggles (1 if used; 0 otherwise); X_{8e} = Use hand glove (1 if used; 0 otherwise)];
X_9 = Reading of pesticide labels (if read = 1; 0 otherwise)
X_{10} = Extension contact (frequency of visits/month)
ε = random error

* Operationaliation of Social Habits: Common social habits identified among cocoa farmers were: smoking, snuffing, kolanut consumption, consumption of alcohol and use of phone. The regular habits prevalent among the respondents out of the five listed were scored according to the level of occurrence. For instance, if it is only smoking that is a common social habit with a respondent, such a respondent gets 1, and if two habits are regularly engaged in, he/she gets 2. The maximum score per respondent is 5.

Results and Discussion

Socio-economic characteristics of the respondents

Results in Table 1 reveal that the highest percentage of the sampled cocoa farmers in Ondo and Kwara States (37.7% and 64.5%, respectively), were within the age range of 51-60 years. Overall, the mean age of cocoa farmers in the study area was 51 years. This indicates that the cocoa farmers in the study area were aged and matured, implying low involvement of youths. Consequently, there is need to encourage youth involvement in cocoa production in the study areas. This finding corroborates the findings of Amos (2007) and Oseni and Adams (2013), that an average cocoa farmer in Ondo State was 50 years and above. This result also agrees with the findings of Adeniyi and Ogunsola, (2014), and that of Nmadu *et al.,* (2015), that most of the cocoa farmers generally in Nigeria were getting aged a nd might find it difficult to meet the demands which the intensive care of cocoa farms required.

Sex distribution of the respondents reveals that 77.9% and 89.1% of the sampled cocoa farmers in Ondo and Kwara States were male. On the average, 83.2% of cocoa farmers interviewed were male, while 16.8% were female. This implies that cocoa farming in the study areas was male dominated. Adesiji et al., (2007), had previously noted that females were more involved in the maintenance and processing of cocoa beans than production. Many (44.8%) respondents in the study area attained primary level of education, while 31.5% attained secondary level, implying that the sampled cocoa farmers in the study areas had basic literacy which could serve as an impetus in adopting innovations for cocoa production. Many (37.9%) of the cocoa farmers across the two states had 21-30 years of farming experience. The cocoa farmers in the study area can be said to have considerable years of farming experience, which could translate to increased productivity.

Table 1: Distribution of cocoa farmers by selected socio-economic characteristics

Description	Ondo State	Kwara State	Pooled sample
Age (years)			
Less or Equal to 30	11(9.0%)	0(0.0%)	11(4.7%)
31-40	15(12.3%)	10(9.1%)	25(10.8%)
41-50	39(32.0%)	22(20.0%)	61(26.3%)
51-60	46(37.7%)	71(64.5%)	117(50.4%)
Above 60	11(9.0%)	7(6.4%)	18(7.8%)
Sex			
Female	27(22.1%)	12(10.9%)	39(16.8%)
Male	95(77.9%)	98(89.1%)	193(83.2%)
Educational Status			
No formal Education	7(5.7%)	19(17.3%)	26(11.2%)
Primary	50(41.0%)	54(49.1%)	104(44.8%)
Secondary	36(29.5%)	37(33.6%)	73(31.5%)
Tertiary	29(23.8%)	0(0.0%)	29(12.5%)
Cocoa Farming Experience (years)			
Less or Equal to 10	20(16.4%)	0(0.0%)	20(8.6%)
11-20	32(26.2%)	50(45.5%)	82(35.3%)
21-30	42(34.4%)	46(41.8%)	88(37.9%)
31-40	19(15.6%)	12(10.9%)	31(13.4%)
Above 40	9(7.4%)	2(1.8%)	11(4.7%)
Trained on Pesticide Application			
No	24(19.7%)	57(51.8%)	81(34.9%)
Yes	98(80.3%)	53(48.2%)	151(65.1%)

Use of Pesticide			
Occasionally	58(47.5%)	12(10.9%)	70(30.2%)
Frequently	64(52.5%)	98(89.1%)	162(69.8%)
Use of Pesticides Cocktail			
No	76(62.3%)	36(32.7%)	112(48.3%)
Yes	46(37.7%)	74(67.3%)	120(51.7%)
Reading and Adherence to Instructions			
No	37(30.3%)	68(61.8%)	105(45.3%)
Yes	85(69.7%)	42(38.2%)	127(54.7%)
Wear Complete PPE			
No	45(36.9%)	74(67.3%)	119(51.3%)
Yes	77(63.1%)	36(32.7%)	113(48.7%)
Extension Contact			
No	12(9.8%)	44 (40.0%)	56 (24.1%)
Yes	110(90.2%)	66(60.0%)	176(75.9%)
Number of respondents (%)	**122(100%)**	**110 (100%)**	**232 (100%)**

Source: Field survey, 2017. *PPE = Personal Protective Equipment

Results (Table 1) also indicate that majority of the cocoa farmers (80.3%) in Ondo State and only 48.2% in Kwara State had been trained on pesticide application. This implies that cocoa farmers in the study area were knowledgeable in pesticide application, though more trainings will be necessary in Kwara State. With majority (52.5% in Ondo and 89.1% in Kwara States) of the sampled cocoa farmers frequently using pesticides to control pests on their cocoa farms, the cocoa farmers had adequate expertise to curb pest and disease attacks to reduce yield losses on their farms. Majority (67.3%) of the sampled cocoa farmers in Kwara and Ondo (37.7%) States mixed two or more pesticides before application. These farmers believe that mixing different pesticides makes pest control more effective. This corroborates the findings of Oluwole and Cheke (2009), that mixing different pesticides increased the efficacy of the pesticide solution and ensured effective control of the target pests and diseases among farmers. However, Salameh *et al.,*(2004) have warned that the combined use of hazardous pesticides and the absence of appropriate precautions are detrimental to the farmers' health. All pesticides usually have instruction-bearing labels attached to it. Majority of cocoa farmers (69.7%) in Ondo State claimed to read and adhere to instructions on pesticide labels before use. This is contrary to the practice of farmers (61.8%) in Kwara State who don't read or adhere to pesticide instructions. According to Oluwole and Cheke (2009), majority of the farmers who attained either primary or no formal education often relied on information passed by other farmers and/or input suppliers. Furthermore, many (51.3%) cocoa farmers across both states don't usually wear full protective garments during pesticide application. This could expose them to health impairment associated with such pesticides (Ajayi and Akinnifesi, 2007). For close proximity to extension agents, this study (Table 1) further reveals that majority (90.2% and 60.0%) of the cocoa farmers in Ondo and Kwara States respectively, had contact with extension agents. This could have positive implication on innovation dissemination and adoption in the study area.

Common pesticides used in cocoa production in the study area

Pesticide use in cocoa production is a requisite for increased cocoa yield because almost all the stages of cocoa production cycle are affected by one pest or the other. Table 2 shows the common pesticides often used in cocoa farms in the study area, and the frequency of use among farmers. In Kwara State, Bounty (a combination of fertilizer and insecticide) is the most popular insecticide, which all the sampled cocoa farmers use in their cocoa farms. The two herbicides, paraquat dichloride (90.9%) and glyphosate (88.2%) are the common herbicides used by farmers. Copper (1) oxide + Metalaxy is the most popular fungicide used by 72.7% of the cocoa farmers in Kwara State. In Ondo State, Lindane was the most popular insecticide (71.3%), while Copper (1) oxide + Metalaxyl (66.4%) and Glyphosate (65.5%) are the most commonly used fungicide and herbicide respectively.

Table 2: Common pesticide used by cocoa farmers in the study area

State	Active Ingredient	Type	*WHO Class	Number (and percentage) of farmers
Kwara	Chloropyrifos	Insecticide	II	79(71.8%)
	LamdaCyhalothrin	Insecticide	II	29(26.4%)
	Bounty	Insecticide + Fertilizer		110(100.0%)
	Mancozeb,	Fungicide	III	18(16.4%)
	Copper (1) oxide + Metalaxy	Fungicide	II	80(72.7%)
	Paraquat dichloride	Herbicide	II	100(90.9%)
	Glyphosate	Herbicide	III	97(88.2%)
Ondo	Copper (1) oxide + Metalaxyl	Fungicide	II	81(66.4%)
	Copper hydroxide	Fungicide	II	34(27.9%)
	Lindane	Insecticide	II	87(71.3%)
	Thiamethoxam	Insecticide	II	77(63.1)
	Dichlorovinyl dimethyl phosphate	Insecticide	II	29(23.8%)
	Chlorpyrifos	Insecticide	II	75(61.5%)
	Glyphosate	Herbicide	III	80(65.6%)

Source: Field survey, 2017

***II = moderately hazardous; III = slightly hazardous (WHO, 2009; PAN, 2009).**

Note: Active ingredients (gm.ai/litre) was obtained from the containers of pesticides used by the cocoa farmers

Personal Protective Equipment (PPE) used by Cocoa Farmers in the Study Area

Table 3 indicates that the prominent personal protective equipment (PPE) worn by majority of the sampled cocoa farmers in Kwara State were nose guard (80.9%), boot (83.6%) and cap (60.9%). However, in Ondo State, the prominent PPE used were face mask (85.2%), boot (79.5%), hand gloves (77.0%), goggles (74.6%), nose guard (73.0%), cap (65.6%) and overall coat (63.1%). Generally, the pooled data for all farmers shows that majority of the sampled cocoa farmers commonly used boot (81.5%), nose guard (76.7%), face mask (64.2%), cap (63.4%) and hand gloves (55.2%) as their personal protective equipment during pesticide application in cocoa farms. This result is an indication that cocoa farmers do not wear full PPE, and therefore, expose themselves to health impairments occasioned by pesticide application in the study area.

Table 3: Common personal protective equipment and the proportion of cocoa farmers that use them in the study area

PPE	Kwara State	Ondo State	Pooled sample
Cap	67(60.9%)	80(65.6%)	147(63.4%)
Hand Gloves	34(30.9%)	94(77.0%)	128(55.2%)
Nose Guard	89(80.9%)	89(73.0%)	178(76.7%)
Face Mask	45(40.9%)	104(85.2%)	149(64.2%)
Goggles	20(18.2%)	91(74.6%)	111(47.8%)
Overall Coat	36(32.7%)	77(63.1%)	113(48.7%)
Boot	92(83.6%)	97(79.5%)	189(81.5%)
Long Sleeve Cloth	44(40.0%)	37(30.3%)	81(34.9%)
Ordinary Eye Glasses	18(16.4%)	27(22.1%)	45(19.4%)

Source: Field survey, 2017

Health symptoms associated with pesticide use in cocoa production among farmers in the study area

Table 4 presents the results of the major health symptoms suffered by cocoa farmers as a result of their exposure to pesticides in the study area. Medical examination of a sample of the cocoa farmers was beyond the scope of this study. The study only relied on self-identified health issues by asking the farmers if they experienced any health impairment after handling/spaying pesticides in their farms. Generally, 79.3% (73.8% in Ondo and 85.5% in Kwara) of the cocoa farmers interviewed observed at least two pesticide-related health symptom during or after application of pesticides. The health-related symptoms suffered by the cocoa farmers include: eye irritation, skin irritation, headache, dizziness, breathing difficulty and stomach cramps, with farmers reporting a minimum of two and a maximum of six symptoms of illness. Skin

irritation after exposure to pesticide was the most predominant health symptom suffered by 70.7% of the cocoa farmers, while those who suffered breathing difficulty and eye irritation were 69% and 65.9% respectively. In Ondo State however, eye irritation and breathing difficulty were the most predominant health symptoms, while in Kwara State, eye irritation was the next most predominant ailment suffered after skin irritation. It follows therefore, that the predominant health effects resulting from pesticide exposure in the study area were skin irritation, eye irritation and breathing difficulty. Ritter and Arbuckle, (2007), reported that continuous exposure to pesticides can lead to an array of health effects, depending on the pesticide's toxicity and the dose absorbed by the body.

Table 4: Major health symptoms associated with pesticide use in the study area among farmers

Variable	Ondo State	Kwara State	Pooled Sample
Suffered health symptoms	90(73.8%)	94(85.5%)	184(79.3%)
***Symptoms**			
Eye Irritation	86(70.5%)	77(70.0%)	153(65.9%)
Skin Irritation	75(61.5%)	89(80.9%)	164(70.7%)
Headache	73(59.8%)	75(68.2%)	148(63.8%)
Breathing Difficulty	85(69.7%)	74(67.3%)	160(69.0%)
Dizziness	76(62.3%)	44(40.0%)	129(55.6%)
Stomach Cramp	78(63.9%)	33(30.0%)	111(47.8%)

*** Multiple Responses recorded**
Source: Field survey, 2017

Effect of Pesticide Use on the Health of Cocoa Farmers in the Study Area

The multivariate probit model was estimated jointly for six health symptoms: eye irritation, skin irritation, headache, dizziness, breathing difficulty and stomach cramps. The empirical results of the analysis are presented in Tables 5 and 6. Table 5 presents the Wald test that farmers experience of one health symptom is correlated with another (or other) health symptom (that is, the symptoms are not mutually exclusive). The p-value of the Wald test statistic for the overall significance of the model is 0.000, indicating that the multivariate probit regression is highly significant. The likelihood ratio test of rho (ρ) is also highly significant (p-value=0.000), further indicating that a multivariate probit specification fits the data well.

Rho refers to the correlation coefficient among the error terms of the health symptoms. Rho21, for instance, is the correlation coefficient among the error terms of symptoms (1) and (2). Another important result is that the correlation coefficients among the error terms are significant, indicating that the health symptoms are interdependent. The simultaneous modelling was also justified with the highly significant off-diagonal values of the error covariance matrix (/atrhoij). Apart from the model justification, the significance of the off-diagonal elements of the covariance matrix shows that there are unobserved heterogeneities that influence farmers experiencing the health symptoms besides pesticide use in their farms. The correlation coefficient between majority of the health symptoms were positive and significant. On the other hand, the correlation coefficients between dizziness and eye irritation; breathing difficulty and eye irritation; stomach cramp and eye irritation; dizziness and skin irritation and breathing difficulty and headache were negative. These results point to the cross-equation correlation of the error terms and hence interdependence of the health symptoms. This also indicates that farmers who experienced one health symptom were also likely to experience another. These diagnostic tests further support the use of multivariate probit regression and indicate that use of simple probit or multinomial logit will result in inconsistent estimates.

Table 5: Results of Wald Test of simultaneity of the effect of pesticide use on the health of cocoa farmers in the study area

	Coefficients	P-value		Coefficients	P-value
/atrho21	0.709	0.000	rho21	0.610	0.000
/atrho31	0.218	0.022	rho31	0.214	0.018
/atrho41	-0.021	0.835	rho41	-0.021	0.835
/atrho51	-0.027	0.773	rho51	0.027	0.773
/atrho61	-0.065	0.584	rho61	-0.065	0.083
/atrho32	0.119	0.231	rho32	0.119	0.226
/atrho42	-0.005	0.967	rho42	-0.005	0.967
/atrho52	0.086	0.367	rho52	0.085	0.365
/atrho62	0.171	0.187	rho62	0.170	0.178
/atrho43	0.183	0.085	rho43	0.182	0.078
/atrho53	-0.004	0.965	rho53	-0.04	0.965
/atrho63	0.209	0.036	rho63	0.206	0.031
/atrho54	0.471	0.008	rho54	0.438	0.000
/atrho64	0.508	0.000	rho64	0.469	0.000
/atrho65	0.643	0.000	rho65	0.567	0.000

Source: Computed from MVP Result

Likelihood ratio test of rho21 = rho31 = rho41 = rho51 = rho61 = rho32 = rho42 = rho52 = rho62 = rho43 = rho53 = rho63 = rho54 = rho64 = rho65 = 0: $chi^2(21) = 120.316$ Prob> $chi^2 = 0.0000$

The estimates of the effect of pesticide use on the health of the cocoa farmers are presented in Table 6. Results of the six health symptoms are presented in the following order, eye irritation, skin irritation, headache, dizziness, breathing difficulty and stomach cramps.

Eye irritation

Table 6 indicates that probability of cocoa farmers experiencing eye irritation increases with increase in total pesticide dose used ($p<0.05$), while it decreases with increase in the age of farmers ($p< 0.05$), use of eye goggle ($p<0.01$), use of ordinary glasses ($p<0.01$) and reading and adherence to instructions on pesticide labels ($p<0.05$). This implies that cocoa farmers who used high dosage of pesticide and without eye protective gear were prone to experiencing eye irritation which could be in form of inflammation, itching or redness of the eye. The result also implies that younger farmers were more involved in pesticide application and therefore more liable to experience eye irritation than older farmers in the study area. This could be as a result of nonchalant attitude of the younger farmers during pesticide application. This result corroborates the findings of Ayinde *et al.*(2006), that farmers acquire more experience in the use and application of insecticide as they grow older in age. Also, farmers who wore personal protective equipment (PPE) like eye goggles, ordinary eye glasses, and read and adhere to the instructions on pesticide labels and manuals were less exposed to eye irritation problems than those who did not take any of these precautions. This result is in accordance with the findings of Oluwole and Cheke (2009).

Skin irritation

The probability of the cocoa farmers having skin irritation increases with increase in total pesticide dose used ($p<0.01$), and weather condition at the time of pesticide application ($p<0.05$). This implies that farmers that used high dosage of pesticide and sprayed when the weather is windy stand the risk of experiencing skin irritation in the study area. This result conforms with the report of Pingali *et al.* (1994), that skin irritation increases with rate of herbicide application. Moreover, incidence of skin irritation decrease with extension agents' visits ($p<0.05$), and the use of PPE such as; boot ($p<0.05$), hand gloves ($p<0.05$), and wearing of long sleeve clothes ($p<0.05$).

Headaches

This was found to be positively related with increase in the number of social habits ($p<0.05$), and training on pesticide application ($p<0.05$). Indulgence in social habits like smoking, kolanut and alcohol consumption, chatting or receiving phone calls among others, especially during pesticide application, predispose the cocoa farmers to headache. Also, training increase the probability of cocoa farmers experiencing headache. This result, although against *a priori* expectation could imply that information obtained from the trainers may not be in accordance with the information needs, or that the training sessions may be ineffective. On the other hand, there is a possibility that farmers ignored recommendations of the trainers or become recalcitrant to training received due to their own personal or psychological preferences, feelings of adequacy and knowledge of pesticide application among others. Probability of experiencing headache was however, found to decrease with age of the farmers ($p<0.05$), and wearing of protective garments such as boots ($p<0.05$), and ordinary eye glasses ($p<0.05$).

Dizziness

Table 6 further indicates that probability of farmers experiencing dizziness increases with increase in total

pesticide dose used ($p<0.05$), wearing of protective garments such as nose guard ($p<0.01$) and wearing of long sleeve clothes ($p<0.05$). It is possible that the cocoa farmers in the study area may not have used the right nose guard or usually wear the nose guards for too long before removing it to breath properly. Most nose guards restrict proper breathing in of oxygen, and when worn continuously for too long may lead to low oxygen content in the blood and brain which can cause dizziness. The long sleeve clothes may be such that absorb excess heat which can alter physiological processes in the body and cause dizziness. In contrast, dizziness decreases with reading and adherence to instructions on pesticide labels and manuals.

Breathing difficulty

Total pesticide dose ($p<0.05$), wearing of complete PPE ($p<0.01$) and nose guard ($p<0.05$) were found to increase the cocoa farmers' probability of experiencing difficulty in breathing as a result of pesticide application in the study area. Most common nose guards often impair oxygen inflow which can cause breathing difficulty and lead to dizziness as explained earlier. It could also be that the farmers were not wearing the appropriate PPE recommended for pesticide application. Breathing difficulty decrease with increase in the age ($p<0.01$), pesticide application training ($p<0.05$) and reading of pesticide labels ($p<0.01$). Older and well trained cocoa farmers are more knowledgeable about the prospects and problems of pesticide application.

Stomach cramps

The determinants of farmers experiencing stomach cramps as a result of pesticide application on their cocoa farms were related to total pesticide dose used ($p<0.01$), social habits ($p<0.01$) and reading and adherence to instructions on pesticide labels ($p<0.10$). The probability of cocoa farmers experiencing stomach cramps increase with total pesticide dose used and number of social habits they indulged in during pesticide spraying, while it decreases with reading and adherence to instructions on pesticide labels and manuals.

Table 6: Effect of pesticide use on the health of cocoa farmers in the study area

Variable	Eye Irritation	Skin Irritation	Headache	Dizziness	Breathing Difficulty	Stomach Cramp
Age (years)	-0.01**(-2.072)	-0.015(-1.05)	-0.25**(-2.48)	-0.008(-0.62)	-0.27***(-2.72)	0.005(0.29)
Education (years)	-0.096(-0.56)	-0.011(-0.66)	-0.004(-0.24)	-0.007(-0.37)	-0.010(-0.52)	0.004(0.14)
Pesticide dose used (gm.ai./ha)	0.024**(2.12)	0.341***(3.92)	0.007(1.28)	0.40**(2.08)	0.18**(2.36)	0.131***(4.86)
Social Habit (No of habits)	0.179(0.50)	0.007(0.19)	0.087**(2.30)	-0.033(-0.77)	-0.017(-0.39)	0.14***(2.72)
Pesticide application training (dummy)	-0.045(-0.17)	-0.128(-0.060)	0.446**(2.291)	-0.026(-0.11)	-0.455**(-2.19)	-0.251(-0.77)
Weather condition (dummy)	0.090(0.90)	0.150**(2.195)	0.058(0.58)	-0.023(-0.22)	-0.115(-1.000)	-0.217(-1.39)
Boot	0.163(0.75)	-0.47**(-2.36)	-0.44**(-2.02)	-0.009(-0.04)	0.194(0.75)	-0.015(-0.04)
Nose guard	-0.018(-0.09)	-0.162(-0.82)	0.050(0.25)	0.66***(2.96)	0.222**(2.072)	0.377(1.16)
Complete PPE	0.074(0.39)	0.198(1.04)	0.226(1.06)	0.149(0.74)	0.638***(2.77))	0.455(-1.60)
Eye goggle	-0.49***(-2.65)	0.218(1.07)	-0.115(-0.56)	-0.301(-1.49)	0.001(0.01)	-0.203(-0.70)
Hand gloves	-0.208(-1.13)	-0.483**(2.47)	0.236(1.58)	0.035(0.21)	0.028(-0.12)	0.231(1.19)
Cap	-0.053(-0.28)	0.163(0.87)	-0.136(-0.70)	-0.149(-0.75)	-0.097(-0.47)	0.279(0.89)
Long sleeve cloth	-0.495(-0.38)	-0.26**(-2.28)	0.392(0.19)	0.39**(2.09)	-0.118(0.51)	0.168(0.60)
Ordinary eye glasses	-0.38***(-2.76)	-0.028(-0.10)	-0.78**(-2.03)	-0.206(-0.60)	0.032(1.39)	0.470(1.48)
Read and adhere to pesticide label	-0.28**(-2.092)	-0.215(-1.17)	0.104(0.55)	-0.29**(-2.17)	-0.61***(-3.01)	-0.65**(-2.41)
Extension contact (frequency)	0.002(0.04)	-0.16**(-2.18)	0.034(0.68)	-0.087(-1.49)	0.086(0.130)	0.029(0.41)
Constant	0.343**(2.270)	1.571***(3.28)	0.647***(2.82)	1.926***(2.96)	-0.324**(2.195)	-0.65**(-2.48)

Source: Field survey, 2017

Note: N= 349; Log pseudo likelihood= -888.73336; Wald chi2 (169) = 463.51; Prob. > chi2 = 0.0000 * and ** indicate significance at 1% and 5% levels respectively. Figures in parentheses are z-values**

Conclusion

The study concludes that cocoa farmers were getting older, implying low youth involvement in cocoa production in the study area. Cocoa farmers were undoubtedly exposed to pesticide which predisposes them towards pesticide-induced health impairments such as eye irritation, skin irritation, breathing difficulty, headache, dizziness and stomach cramps. The study recommends that cocoa farmers should be trained regularly on right handling and safe use of pesticide, appropriate use of personal protective equipment, to reduce exposure to pesticide and the risks involved in the misuse and abuse of pesticide. In addition, training in integrated pest management (IPM) methods which are environment friendly and could reduce the potential exposure to pesticides, is recommended. Pesticide labels should be made comprehensible farmers with little or no education. Pictorial representation on how to use and apply pesticide should accompany pesticide packaging at the point of sales. This is expected to reduce pesticide toxicity amongst cocoa farmers to the barest minimum. More so, there is need for a reorientation and training of extension agents to enhance their effect on the cocoa farmer's decision making especially in the area of pesticide application. Information diffused to farmers through the extension agents should include safety and health information, and emphasis should be laid on the need for cocoa farmers to read, understand and adhere to instruction on pesticide labels and manuals.

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