ADOPTION OF SAFETY MEASURES FOR PESTICIDE USE: THE CASE OF OIL PALM FARMS IN DELTA, EDO, AND ONDO STATES, NIGERIA

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Abstract: Human beings and environmental toxicity of chemical pesticides made the manufacturers of pesticides to specify before-during-after use safety precautions that users of pesticides should adhere to. The study assessed respondents' socioeconomic characteristics, pattern of use, experience in the use of pesticides, and to ascertain if there is significant difference between the states in terms of safety measures adoption. Respondents were selected through multistage sampling technique. Primary data were collected with questionnaire and analysed with percentage, mean and Kruskal-Wallis (H) test. Majority (75.4%) of the respondents were males, their average mean age, family size, and farming experience were 39 years, 5 persons and 16 years, respectively. Most (82.8%) of them were married, had formal education (96.6%), mix the pesticides (86.9%) that they spray and their years of experience in using pesticides was between 1 - 10 years (76.1%). Kruskal-Wallis test result (H= 50.79) indicated that there was significant difference between the surveyed States in terms of adoption of pesticide safety measures at 1%. It is established that pesticide mixers and sprayers are relatively young people and significant difference exists among mixers and sprayers in terms of adoption of pesticide safety measures in the surveyed States. It is recommended that agricultural extension agents and extension specialist should educate mixers and sprayers of pesticides on the importance of pesticide safety measures in the wellbeing of farmers, farm workers, environment, and on national food security.

Keywords: Adoption, mixers, oil palm, pesticides, sprayers, safety measures

Introduction

Oil palm is an important economic crop in coastal areas of West Africa especially in Nigeria where the crop once serves as main income source for the country. Pests have become a major problem of oil palm production (NIFOR, 2009; Dimelu&Ayaiwe, 2011; Kuwornu*et al*., 2012). The negative effects of pests on oil palm are most visible in the nurseries. Chemical pesticide was introduced to protect the crop against pests and its use has increased crop and livestock production. In Nigeria, over 50% of herbicides are used in plantation crops such as oil palm (Federal Ministry of Agriculture and Water Resources, FMAWR, 2007).

Pesticides have negative effects on all categories of humans particularly those who mix, load, spray, transport and use these pesticides (Golla*et al*., 2012). The extent of negative effects of pesticide on soil and water, food safety and human health are said to be unknown due to inadequate records of pesticide poisoning (Brown & Jacobson, 2005). Dangerous activities engaged in when using pesticides are eating, drinking, smoking especially during mixing or spraying even in very hot sun despite the products clearly stated precautions. It is argued that increasing human and environmental pesticide intoxication is due to misuse/mishandling of pesticides, ignorance and deliberate neglect of pesticide safety precautions (Ogunjimi&Farinde, 2012).

Objectives of this study were to describe the socioeconomic characteristics of respondents, ascertain their pattern of use, experience in the use, identify adopted and extent of adoption pesticide safety measures, and ascertain if there is significant difference between the surveyed States in terms of pesticide safety measures adoption.

Materials and Methods

This study was carried out in Delta, Edo and Ondo States in the oil-palm-rich Niger-Delta region of Nigeria. Edo State is bounded by Delta State in the south, and west Ondo State (Edo State, 2012). Edo and Ondo States has 18 Local Government Areas (LGAs) each. Delta State has 25 LGAs with a land area of 17 163km^{2}and temperature ranges of 18 and 35ºC to 30and 35ºC, approximately 122km of coastline bounded by the Bight of Benin and average annual rainfall is 120 to 260 cm. Ondo State has land area of 14788.723 km^2. Agriculture is the main occupation of the rural people in these States and oil palm is commonly grown and found in the wild (FPIND, 2011).

Multi-stage sampling technique was used in selecting 268 respondents. First, oil palm producing states were stratified into three based on delineated area under oil palm production. Second, simple random sampling was used to select Edo, Delta and Ondo States from the strata. Third, oil palm farms/plantations were grouped into 3 clusters (government, multinational and medium/small). Fourth, purposively selection of 1 government, 2 multinational, 5 and 6medium and small-scale plantations from the clusters respectively was carried out. Fifth, simple random sampling technique was used to select respondents. Primary data were obtained with questionnaire complemented by interview schedule and observation. Instrument for data collection was subjected to validity and reliability test. Reliability of questionnaire was estimated using the test-re-test technique. Instrument was confirmed reliable with reliability estimate of r = 0.74 as asserted by Mertens and McLaughlin (2004).

Data were coded and entered for analysis by using SPSS software version 16. Descriptive statistics such as frequency counts, percentages, means and standard deviation were used to summarize and describe the data while Kruskal-Wallis test f there is significant difference between the surveyed States in terms of pesticide safety measures adoption

The Kruskal-Wallis standard model is:

$$H = \frac{12}{N(N+1)}\sum_{i=1}^{c}\frac{R_1^2}{n_i} - 3(N+1)$$

Where

H = Kruskal-Wallis test
N = Sum of all observations in all samples combined
n_i = number of observations in the ith grouping
C = Total number of samples in the study
R^2 = Sum of ranks
i = Sample number in the study

Results and Discussion

Socio-economic characteristics of respondents

The analyses show that a majority (75.4%) of the pesticides mixers and sprayers in the sampled States were males. This is different from that of Ondo State (79.9%) and Edo state (87.1%) and higher than that of Delta State (64.0%). Women are likely to be more involved in palm oil processing and marketing. This finding has clearly indicated that females could also be an active participant in pesticide mixing and spraying, given by the remaining 23%. The grand mean age of the respondents was 39 years similar to that obtained at the states with Edo respondents having least grand age mean of 37 years. This is an indication that pesticide mixers and sprayers in oil palm farms/plantations were relatively young and were within the economically active age as previously noted by Ibitoye*et al.* (2011) and Gaber& Abdul-Latif (2012). The prevalence of young people in pesticide mixing and spraying may be because the application of pesticide is energy demanding and could be tedious for older people.

Furthermore, the majority (82.8%) of the mixers and sprayers were married and had formal education (96.6%). The dominance of married people as pesticide mixers and sprayers may likely have positive effects on pesticide safety measures adoption and keeping family safe. When the percentage of those who completed primary, secondary and higher schools were taken, Ondo State respondents (95.5%) had the highest number of formal education background than Delta State (92.2%) and Edo State (74.7%). Consequent upon this result, it is expected that adoption of pesticide safety measures may likely be higher in Ondo State than Delta and Edo States. It is expected that respondents with basic education should be able to interpret and understand pesticide safety measures messages in whichever form they are presented.

The grand household size mean (5 persons) suggests that more family labour would be readily available for pesticides mixing and spraying and grand monthly income mean of ₦15,062.00 would be inadequate for a fairly large household size. Consequently, some of the mixers and sprayers may undermine safety precautions to fend for their households. The situation would be worse for hired workers (29.1%) as management of farms/plantations are likely to pay less attention to their safety. The aggregate farming experience mean of respondents was 16 years. This corroborates the finding of Dimelu&Anyaiwe (2011) on smallholder oil palm producers in Ika local government area of Delta State.

Pesticide use pattern and experience

The majority (86.9%) of the respondents mix and spray pesticides (Table 2). This is similar to results obtained from Edo (83.5%), Delta (97.4%) and Ondo (73.9%) states. Therefore, there is the likelihood that incidences of pesticides poison would likely be higher among these respondents since incidences of human toxicity is likely to be higher among users who mix and spray pesticides (Nagenthiararajah and Thiruchelvan, 2008). Based on this result, Ondo State pesticide mixers and sprayers with least score percentage (73.9%) are likely to be less exposed to pesticide poison than respondents in the other two states.

Comparatively, 44.9% of respondents in Ondo State had a higher pesticide use experience and higher mean of 8 years closely followed by those in Delta State (43%) with mean of 7 years and least by Edo State (23.5%) with mean of 6 years, respectively. Ondo States respondents' pesticide use pattern and experience may have been influenced by their higher formal education background (Table 1) in which they were above the other 2 States.

Table 1: Socioeconomic characteristics of respondents

Parameters		Edo State		Delta State		Ondo State		Grand	
		Freq	%	Freq	%	Freq	%	Freq	%
Sex	Male	74	87.1	73	64.0	55	79.7	202	75.4
	Female	11	12.9	41	36.0	14	20.3	66	24.6
Age	16-40	55	64.7	68	59.6	30	43.4	153	57.0
	41-60	30	35.3	46	40.3	36	52.1	112	41.8
	Above 60	-	-	-	-	03	04.3	03	01.1
	$\bar{X}$	37		40		41		39	
Marital status	Married	63	74.1	104	91.2	55	79.7	222	82.8
	Single	22	25.9	10	8.8	14	20.3	46	17.2
Education	No formal	03	3.5	04	3.5	02	2.9	09	03.4
	Incomplete Pry Sch.	06	7.1	02	1.8	-	-	08	03.0
	Complete Pry sch.	09	10.6	14	12.3	06	8.7	29	10.8
	Incomplete Sec. Sch.	04	4.7	03	2.6	01	1.4	08	03.0
	Complete Second. Sch.	36	42.4	71	62.3	45	65.2	152	56.7
	Higher	27	31.7	20	17.6	15	21.7	62	23.1
House size	1-4	31	36.5	18	15.8	21	30.4	70	26.1
	5-8	42	49.4	86	75.4	41	59.4	169	63.1
	Above 8	12	14.1	10	08.8	07	10.1	29	10.8
	$\bar{X}$	5		6		5		5	
Income (monthly, ₦)	800-5000	-	-	21	18.4	15	21.7	81	30.2
	5001-15000	22	25.9	89	78.1	20	28.9	131	48.9
	15000-150000	63	74.1	04	3.5	16	23.2	83	31.0
	$\bar{X}$	27,152.00		9,268.00		9,742.00		15,062.00	
Farmingexperience	1-10	42	49.4	30	26.4	40	58.0	112	41.8
	11-20	29	34.1	64	56.1	22	31.8	115	42.9
	Above 20	14	16.5	20	17.5	07	10.1	41	15.3
	$\bar{X}$	18.5		16.4		12.4		16.0	
Working status	Full time	47	55.3	103	90.4	40	58.0	190	70.9
	Par time	38	44.7	11	9.6	29	42.0	78	29.1

Source: Author's calculation from field survey data, 2016

Table 2: Mixers and sprayers' pesticides use pattern and experience

Variables		Edo State		Delta State		Ondo State		Grand	
		Freq	%	Freq	%	Freq	%	Freq	%
Pesticide use pattern	Mixed and spray	71	83.5	111	97.4	51	73.9	233	86.9
	Mix only	04	04.7	-	-	08	11.6	12	04.5
	Apply only	10	11.8	03	02.6	10	14.5	23	08.6
Pesticide use experience	1-5	51	60.0	27	23.7	26	37.7	104	38.8
	6-10	20	23.5	49	43.0	31	44.9	100	37.3
	11-15	12	14.1	30	26.3	07	10.1	49	18.3
	16-20	01	01.2	08	07.0	04	05.8	13	04.9
	$\bar{X}$ (years)	6		7		8		6	

Source: Author's calculation from field survey data, 2016

Table 4.6 Respondents' adopted pesticide safety measures

Pesticides Safety Measures	Edo Freq	%	Delta Freq	%	Ondo Freq	%	Grand Freq	%
Pre spraying:								
Never keep pesticides with food/feeds	84	98.8	114	100.0	69	100	267	99.6
Keep pesticides away from children/livestock	84	98.8	114	100	69	100	267	99.6
Don't transfer pesticides to other containers	83	97.6	114	100	60	87.0	257	95.9
Never carry/transport pesticides along with food resources	82	96.5	113	99.1	68	98.6	263	98.1
Avoid storage of pesticides in the house	80	94.1	114	100	62	89.9	256	95.5
Avoid carrying pesticides on head, shoulders or the back	80	94.1	113	99.1	59	85.5	252	94.0
Buy only required quantity 100, 250, or 1000 g/ml for single application	83	97.6	105	92.1	56	81.2	244	91.0
Spraying précautions:								
Don't use leaky, defective equipment	83	97.6	113	99.1	66	95.7	262	97.8
Apply only at recommended dose and dilution	82	96.5	114	100	69	100	265	98.9
Don't eat, drink, smoke or chew while preparing solution	84	98.8	112	98.2	69	100	265	98.9
Don't blow/clean clogged nozzle with mouth	85	100	112	98.2	69	100	266	99.3
Don't smell the sprayer tank	84	98.8	112	98.2	64	92.8	260	97.0
Avoid spilling of pesticide solution while filling the sprayer tank	84	98.8	112	98.2	64	92.8	260	97.0
Always protect your nose, eyes, mouth, ears, hands and other parts of your body	83	97.6	112	98.2	66	97.1	261	99.6
Use hand gloves, face mask and head cover	84	98.8	110	96.5	69	100	263	98.1
Don't apply against the wind direction	83	97.6	113	99.1	66	97.1	262	97.8
Prepare spray solution as per requirement	85	100	107	93.9	64	92.8	256	95.5
Concentrated pesticides must not fall on any pack on your body	84	98.8	112	98.2	64	92.8	260	97.0
Don't apply on hot sunny day or strong windy condition	81	95.3	113	99.1	68	98.6	262	97.8
Don't apply just before the rain and after	82	96.5	113	99.1	67	97.1	262	97.8
Read the label on the container before preparing spraying solution	81	95.3	107	93.9	69	100	257	95.9
Don't mix granules with water	84	98.8	108	94.7	63	91.3	255	95.1
Post spraying:								
Left over chemicals should not be emptied into water bodies	83	97.6	112	98.2	65	94.2	260	97.0
Wash the sprayer and bucket with soap and water	85	100	113	99.1	69	100	267	99.6
Containers use for mixing pesticides should not be used for domestic purpose	84	98.8	112	98.2	66	95.7	262	97.8
Avoid entry of humans and animals from entering sprayed field	80	94.1	98	85.9	65	94.2	243	90.7
Used/empty containers should be crushed and buried from water sources	80	95.3	101	88.6	62	89.9	243	90.7
Don't re-use empty pesticide containers for any purpose	80	94.1	107	93.9	67	97.1	254	94.8

Source: Author's calculation from field survey data, 2016

Table 3: Difference in respondents' adoption of pesticide safety measures by state

Total observation	Test statistic (H)	Degree of freedom	Sig.	Critical H (2-sided test)
268	50.789	2	.000	5.99

Source: Author's calculation from field survey data, 2016;*Significant at the 5% level)*

Table 4: Pairwise comparison of States

Sample1– Sample 2	Test statistic	Standard error	Student test statistics	Sign.
Ondo-Edo States	55.940	9.163	6.105	0.000*
Ondo-Delta States	56.568	8.625	6.558	0.000*
Edo-Delta States	-0.628	8.104	-0.077	0.938

Source: Author's calculation from field survey data, 2016; **Significant at the 5% level)*

Respondents' pesticide adopted safety measure

With regards to adoption of pre spraying, spraying and post safety precautions, respondents adopted 5 of 7 pre safety measures (71.4%), all the 15 identified spray safety measures (100%) and 3 of 6 post-spraying (50%) as showed in Table 3. These results suggest that respondents adopted all the spraying precautions, most of the pre-spraying and few of the post-spraying. This implies that respondents may have had more constraints in adopting post-spraying safety measures when compared with spray and pre-safety measures. This finding suggests that adoption of pesticide safety measures varied among the three States.

Respondents' extent of adoption of pesticides safety measures

Adoption percentage scores for each of the 28 pesticide safety measures identified (Table 3) were dichotomized into low (90.7 - 95.0%) and high (95.1 - 99.6%) adoption categories. The results at the aggregate level show that respondents had high level of adoption rate (95.1 - 99.6%) in 23 out of the 28 safety measures identified, representing (82.1%). States wise, Edo State respondents scored over 95.1% in 24 (85.7%), Delta State 23 (82.1%) and Ondo State 16 (57.1%). This implies that adoption of pesticide safety measures is highest in Edo State based on the findings than the other two states.

Differences in adoption of pesticide safety measures in surveyed States

The H estimate (50.789) is higher than critical H-value (5.99) (Table 3). So there is significant difference between the surveyed states in terms of adoption of pesticide safety measures at 5%. There is difference between the states in terms of adoption of pesticide safety measures. The existing differences among the three states in terms of adoption may be attributable to the differences that were observed in age, educational background, farming experience, pesticide mixing and spraying and working status of the respondents.

The test statistic results (Table 4) showed that there were significant differences in terms adoption between Ondo and Edo States (test statistics = 55.940) and Ondo and Delta (test statistic = 56.568), but there was non-significant difference between Edo and Delta (test statistic = -0.628) State. The high adoption of pesticide adoption in Ondo State may have resulted from the high educational experience and pesticide use experience of Ondo State respondents, vis-à-vis other respondents from the other two States.

Conclusion

Most mixers and sprayers of pesticides in oil palm farms/plantations in Edo, Delta and Ondo States mixed the pesticide they sprayed unlike others who don't mix but only spray after other people have mixed the chemical. Their experiences in pesticide use ranged from a year to fifteen years. And there is a statistical significant difference in the adoption of pesticide safety measures between the three States and adoption of pesticide safety measures was found to be higher in Ondo State than the other two. It is recommended that the services of agricultural extension agents and extension specialist should be used to educate the mixers and sprayers of pesticides on the importance of pesticide safety measures in the wellbeing of farmers, farm workers, environment, and on general national food security.

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