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An Appraisal of Knowledge of Pesticide Management Among Grains Traders in Major Commercial Markets in Ilorin Metropolis, Kwara State, Nigeria

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ABSTRACT
Pesticides provide protection to grains against destructive pests but its residues or metabolites has been linked to various health challenges. Its lipophilic nature and consumption of food with residue results into the accumulation of the residues beyond the level the body can handle which leads to gradual deterioration of health and eventual emergence of disease state. The aim of this study is to assess the knowledge of pesticide management by grains traders as well as the perception of the traders on pesticide usage in the study area. 120 Questionnaires were distributed to volunteered traders from three (3) major markets in Ilorin Kwara State with Mandate Market as reference category. All the questionnaires were recovered (100%) and Statistical analysis was performed using Multinomial Logistics and Latent Class Analysis. From the result obtained through the statistical analysis , Oja Oba recorded a p-value of 0.03 while Ipata market has a p-value of 0.009 being less than that of the reference category (Mandate) at $\alpha = 0.05$ which indicated majority of grain traders at Major Market in Ilorin have knowledge of pest management. Majority of the respondents were also found to be persistence in their perception on pesticide usage.
Keywords: grains, knowledge, analysis, management

INTRODUCTION

The world population is projected to be 8.5 billion people by 2030 with an annual growth rate of 1.2% of world population (Godfray et. al, 2010, Carvalho, 2006) and increasing food demand to feed the growing population has intensified the use of pesticides to meet this increasing food demand (Clark & Tilman, 2017; Crist et. al, 2017).

The United Nations (UN) has estimated that 95% of this increase in world population will occur in the developing countries and regions such as sub-Sahara Africa (UN, 2001, UN, 2005) hence there is need to step-up food production through increase in agricultural productivity to ensure food security.

Nigeria food regime is based essentially on two foods: grains, which provide 46% of calories and 52% of protein consumed, and root crops/tubers, which provide 20% of calories and 8% of proteins consumed. Grains which consist of Cereals and legumes generally constitute the most vital diet component for the majority of people in the world (Duranti, 2006, Rajashekar et. al, 2016) by providing the calories and protein consumed majorly by poor people.

Nigeria alone account for about 50% (Blien et. al, 2008) of the grain crops produced in West Africa. The country has remained the largest producer of cowpeas with about 3million tons growth in 2008 (which is 8% of regional production)

The challenges of food security in sub-Saharan Africa largely can only be subdue with improvement on food production through the use of sustainable agricultural practices and the reduction of post-harvest losses caused by pests and diseases (Adedire, 2001). However various methods adopted in reducing this post-harvest loss has largely affected the food quality and environment by being largely compromised and adversely affected.

The consumption of food grains that have been laced with pesticides by vendors to preserve their shelf life and protect them from destruction by pests put potential consumers at risk of various forms of ailment. Pesticide Action Network (PAN) show that approximately three million people are poisoned annually while the World Health Organization (WHO, 2005) estimated that 200,000 persons die annually as a result of food poisoning out of which 20,000 deaths have been linked to pesticides exposure through food consumed. The largest number of these deaths occurs in developing countries (Gwary et al, 2012).

There have been several cases compromise in food quality which has led to fatality in Nigeria. Shaibu (2008) reported that two children died and 112 people were hospitalized after eating a meal prepared from cowpea treated with pesticide in Cross Rivers State. Also, in 2010, it was reported that twenty (20) fast food outlets were closed in Nigeria because of fatalities traced to pesticide residue in their products (Chikwe, 2010). In November, 2018, four members of a family in Ilorin, kwara state capital died after eating a meal of 'amala' a local delicacy prepared from yam. These incidents were investigated and several laboratory analyses conducted by the National Agency for Food and Administrative Control (NAFDAC) concluded that the deaths were caused by the consumption of poisoned beans which contained high levels of pesticides residue (Zhao, 2017).

Pesticides are important management tool in agricultural enterprise; they increase yields and protection against insects at post-harvest storage and it has continued to be vital to increase in agricultural productivity through extension of produce storage life span (Olabode et al., 2011). Most pesticides are poisonous to target and non-target organisms, this calls for caution and effective regulation in their usage. Pesticides application increases agriculture productivity, crops yield, crop protection, improve food affordability and increased farmers' income (Antonini and Argilés-Bosch, 2017). However, due to uncontrolled pesticides application and abuse, pesticide residues in the environmental media (including food products food) is now a leading cause of chemical adverse human health effects (Udeigwe et al., 2015). Food substances such as cereals, vegetables, fruits and honey and their finished products have been reported to contain pesticide residue due to poor agricultural, processing or storage practices (Heard et al., 2017; Rivera-Becerril et al., 2017).

Objectives of this study include:

- Assessment of the knowledge of pest management among grain sellers in Ilorin
- Evaluation of the perception of grain sellers in Ilorin metropolis on pesticide usage

Pesticide Residue

Pesticide residue is refers to as pesticides or its metabolic products that may remain in food grains, vegetables and fruits after they are applied to crops. They are deposits of pesticide active ingredient, its metabolites or breakdown products which persist in environmental media after their application (Dasika et. al., 2012). The toxicological effect of Pesticide residues has continued to be a concern to consumers due its non-differentiation of non-target pests (Keikotlhaile and Spanoghe, 2011). Varieties of daily human and animal consumed food products ranging from grains, tubers, fruits as well as vegetables are found to have pesticide residues in different concentration depending on the nature of food material (Chourasiya et. al, 2015).

Grains are considered to be good for consumption not only if they are free from foreign materials, smell, unusual colour, mycotoxins and contaminations with live pests, but also when the pesticide residue limit is within the maximum residue limits (MRLs) (European Union, directive 2002), and FAO/WHO (2013). Deterioration of grains and other food products through pest and insect infestation leads to economic loss

of the product due to poor quality and reduction in quantity. Pesticides are used for protection of grains before and after harvesting against pests for protection of grains from damage. Pesticides found their ways into grains and their products as a result of continuous usage from cultivation to storage (Vela et al., 2007). Grains are treated with degradable pesticides, including organophosphates, carbamate, synthetic pyrethroids and insect growth regulators, both in storages and prior to shipment in order to prevent insect infestation (Collins, 2006). Many of these chemical residues, especially derivatives of chlorinated pesticides, exhibit bioaccumulation which could build up to harmful levels in organism body as well as in the environment (Sachs, 2010). Persistent chemicals can be magnified through the food chain and have been detected in products ranging from grains, meat, poultry, and fish, to vegetable oils, nuts, and various other food products. Nigeria recorded an astronomical demand for pesticide shortly after her independence, this drastically increase the various risks associated with the pesticides due to the rate of usage. Banjo et al. (2010) corroborated Ogunjimi and Farinde (2012) position and posited that the growth of synthetic pesticides usage took a foot hold in the1940s with the discovery and introduction of DDT, BHC, Adrin, Chlorodane, and Parathion.

Study Area

Ilorin is located in North Central of Nigeria, the most populous town and capital of Kwara State. It is located on latitudes 08^0 32^1 N and 04^0 35^1N East. It has a forest area of about 1000km^2 situated in the transaction zone between the forest woodland of the South and Savanna of the North in South Western of Nigeria

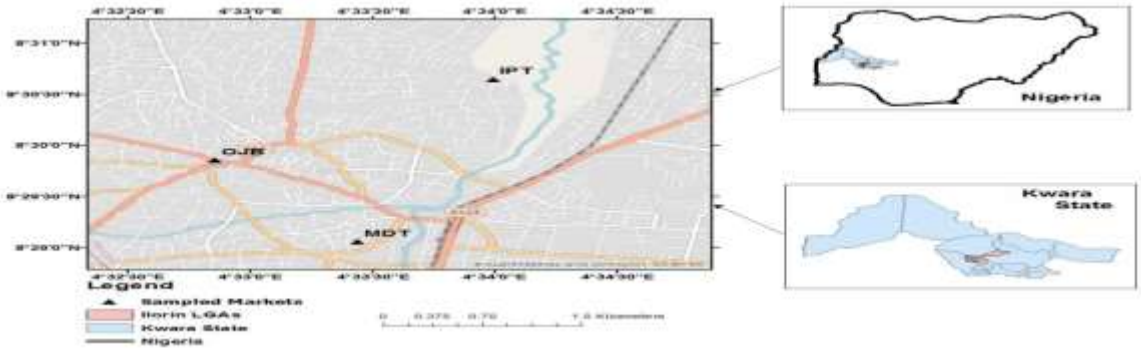

Figure 1: Map of Ilorin West and Ilorin East Showing the three market locations

Procedure

The target population of this study consists of grain traders in Ilorin metropolis and our major interest is on major market that is well known to be selling grains. We adopted purposive sampling technique to select three main markets namely: Ipata, Oja-Oba and Mandate. The three markets were stratified using stratification technique on 120 respondents. The 120 respondents were obtained based on the sample size calculation formula as recommended by Charan et al., (2013). In each of these markets, we randomly sampled different respondents with regards to their availability and willingness to partake in the study. With Ipata market only 43 respondents were captured, 45 respondents showed interest in Mandate while 32 respondents from Oja-oba participated in the study respectively. The three main markets belong to two Local Governments of Ilorin West and East, according to geographical location. The location of these markets are fully highlighted in Kwara State Map above

RESULT AND DISCUSSION

Sample size determination

Sample determination was done using the formula below as exemplified by Charan et al., 2013

$$Sample\ size\ (n) = \frac{Z_{1-\alpha/2}P(1-P)}{d^2}.$$

Where $Z_{1-\alpha/2}$ is the standard normal variate at 5% type I error which is 1.96, P is the expected proportion in the population based on the previous survey $(p = 0.1877)$ and d=precision 0.05.

$$Sample\ size\ (n) = \frac{19.6 \times 0.1877 \times 0.8123}{0.05^2} = 119$$

Statistical methods

In order to assess, identify and compare the relationship between the respondent knowledge, perception, general awareness of the pesticide usage and storage across the three selected market some relevant statistical tools were employed virtually and computationally. This study adopted the use of Multinomial logistics regression. Multinomial logistics regression analysis which is a technique used to predict a nominal dependent variable given one or more independent variables. It is sometimes considered an extension of binomial logistic regression that allow for a dependent variable with more than two categories (Patefield, 1981) and which will be used to analyse people opinion on some items. The Chi-Square test is used for categorical analyses (Agresti, 2007). This study briefly discussed the chi-square analysis for full understanding description please see Agresti., 2007 and Lawal 2017.

Respondent Demographic Variables Results

The results from figure 2 (D) revealed that only 55 male respondents participated in this study, which suggested that male participants are lower than the female (65). With figure 2 (C), the number of married participants were much more than the single and widow respondents. Consequently, we also observed in figure 2 (B) that the participants within age group 26-35 are the most respondents that are interested in our study than any other age groups. With figure 2 (A), most of the participants are from Mandate market (45) followed by Ipata with 43 respondents and only 32 respondents we observed from Oja-oba.

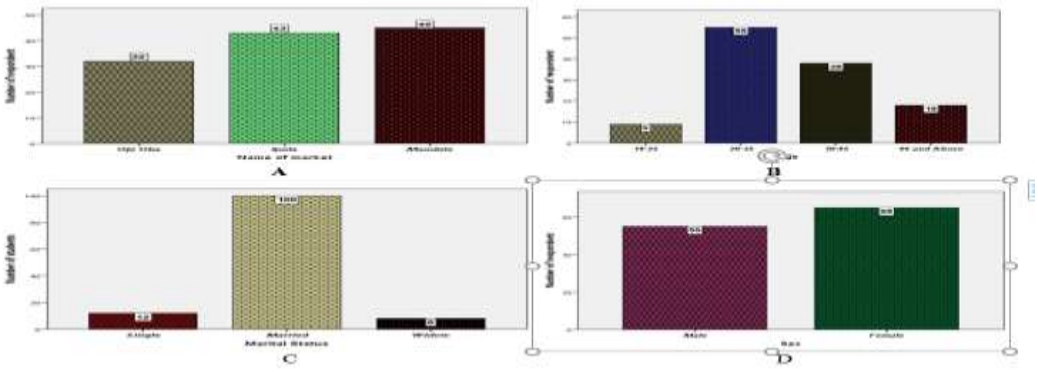

Figure 2: Virtual display of the respondent demographic variables

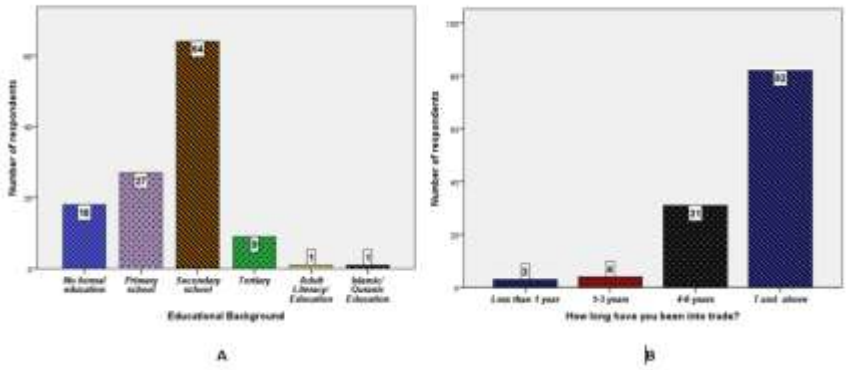

Figure 3: Virtual display of the education level and period of been in the traders

Assessment of the pest management among the grain traders

The thematic assessment of the pest management among grain traders was evaluated using the prominent statistical tool called multinomial logistic regression. For the purpose of full assessment, we selected among three markets, the market with higher response, which is Mandate Market, was used as reference categorical, while other markets serve as comparative categories. The corresponding results were presented in table 1 and the full explanation and meaning of items named A1 to A7 can be depicted from table 2.

Consequently, grain traders in Ipata have the knowledge of application of pesticide in pest management since the p-value of A4 (0.001) is less than $\alpha = 0.05$ with regards to reference category Mandate.

Moreover, the results in table 2 showcase that the proportion of grain traders that is aware and have the knowledge of managing grains in respect to A1 is 77.5% against unaware grain trader with 22.5%, while with item A6 75.8% grain seller use pesticide and other chemical as a means of managing grain across the three selected markets. Similarly, other items can be interpreted in the same manner

Table 1: Multinomial logistic results of assessing pest management among grain sellers in Ilorin metropolis

Name of market[a]		Estimate	Std. Error	P-value
Oja-Oba	Intercept	2.833	3.375	.401
	A1	-.686	.395	.082
	A2	.956	.718	.183
	A3	-.183	.371	.622
	A4	1.710	.786	.030
	A5	-1.028	1.203	.392
	A6	-1.984	.764	.009
	A7	-1.141	1.315	.386
Ipata	Intercept	1.111	2.947	.706
	A1	-.475	.341	.163
	A2	.731	.671	.276
	A3	-.005	.324	.989
	A4	2.167	.677	.001
	A5	-.021	.788	.979
	A6	-1.048	.582	.072
	A7	-1.585	1.179	.179

a. The reference category is: Mandate.

Perception of the grain traders on pesticide usage

Table 2: Case Processing Summary

		N	Marginal Percentage
Name of market	Oja Oba	32	26.7%
	Ipata	43	35.8%
	Mandate	45	37.5%
Type of grains sold(A1)	Beans	64	53.3%
	Corn	36	30.0%
	Millet	20	16.7%
of these insect pests on grain? (A2)	Chew the grains	7	5.8%
	Grain perforation	103	85.8%
	Grain spot	10	8.3%
Major effect on grain (A3)	Pest	64	53.3%
	Heat	39	32.5%
	Moisture	17	14.2%
Pesticide application on grains? (A4)	Yes	93	77.5%
	No	27	22.5%
Do Season affect grains? (A5)	Yes	108	90.0%
	No	12	10.0%
Using other methods of pest management? (A6)	Yes	91	75.8%
	No	29	24.2%
Knowledge of pesticide constituents? (A7)	Yes	7	5.8%
	No	113	94.2%

To obtain the perception of grain sellers in major commercial markets in Ilorin metropolis, using Latent Class Analysis described in the article Nylund et al., 2007. In using LCA models, two-class model was tested and then explored models with more classes. Table 3 shows the fit information (i.e. entropy) for the LCA models with two through five classes. The entropy is the measure of indices to identify class equality.

Table 3: Fit Indices for LCA Models with 2–5 Classes on grain sellers' perception

No. of classes	**Entropy**
2	0.935
3	0.929
4	0.921
5	0.920

The results in Table 3 show that the entropy became smaller as the number of classes increased from 2 to 5 indicating that the model fits lesser and lesser and the best class in class 2. The item probabilities indicate the probability that a member of a given class would endorse the specific perception. Figure 4

presents the profile plots with the six perception items along the x-axis and the probability of endorsing the items along the y-axis.

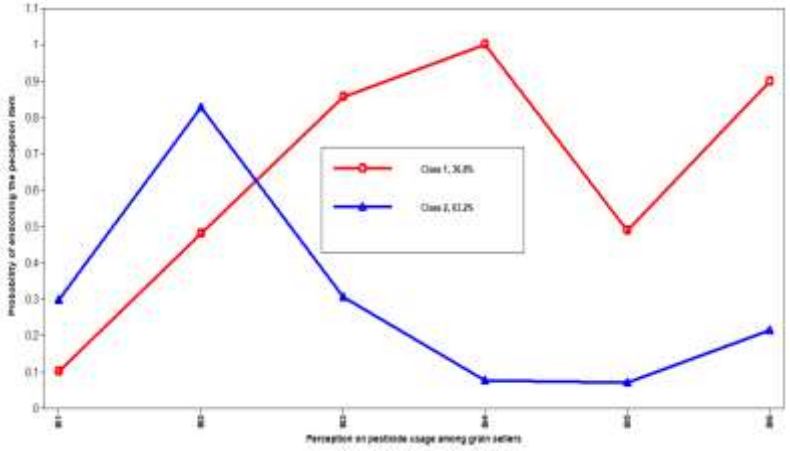

Figure 4: Profile plots for the two-class model

Examining the LCA analysis results from figure 4, it revealed that Class 1 includes 36.8% of the grain traders. This class has a high response probability on items B3, B4, B5 and B6 (see table 4), moderate at item B2 and lower or even zero reaction probability on item B1, and this as the perception can be described as ‘‘Persistent perception or highly persistent perception”. Class 2 includes 63.2% of the whole grain traders across the three market and had a lower response probability on perception items B1, B3, B4, B5 and B6, and high response probability on item B2, this type was named as the ‘‘in-persistent perception or lower persistent perception”. The full meaning of items B1 to B6 can be found in Table 4

Table 4: Case Processing Summary

		N	Marginal Percentage
Name of market	Oja Oba	32	26.7%
	Ipata	43	35.8%
	Mandate	45	37.5%
What type of control measure do you use to protect your stocks? (B1)	Physical control	16	13.3%
	Biological control	10	8.3%
	Chemical control	93	77.5%
	Others	1	0.8%
Do you use more than one chemical? (B2)	Yes	49	40.8%
	No	71	59.2%
Do you read the follow label instruction on pesticide(B3)	Yes	15	12.5%
	No	105	87.5%
Do you use recommended dose specified on the label? (B4)	Yes	9	7.5%
	No	111	92.5%
What are the reasons for chosen a particular pesticide? (B5)	Custom	40	33.3%
	Availability	54	45.0%
	Ease of application	26	21.7%
Have you attended any training on pesticide use? (B6)	Yes	14	11.7%
	No	106	88.3%
Valid		120	100.0%
Missing		0	
Total		120	

CONCLUSON AND RECOMMENDATION

From the result, this study has revealed that traders in the markets surveyed have fair knowledge of pesticide Management with p-value of 0.09 despite using pesticide with p-value of 0.03 and 0.001 at Oja Oba and Ipata Markets respectively against 0.05 p-value of the reference category affirm.

Among the traders interviewed 63.2% of them have in-persistent perception or lower persistent perception on pesticide usage with just 9 respondents (7.5%) having higher education which affirm. This is in agreement with Mustapha et al., 2017 who reported that those that have tertiary education have good knowledge of pesticide practice. Majority (66.7%) of the grains sellers embraced the use of a chemical method of pest management due to availability and ease of application which is in-line with the argument of Adegbola et al. (2011) that preference for method applied is based on perceived effectiveness, lower costs, and non-persuasion about associated adverse effects and trust overtime, that is the product is "time-tested". Also, with about 75 respondents have being to secondary school and expected to read and write but this did not influence the result is an indication that knowledge does not translate to good pesticide application practice. The following recommendations will go a long way in assisting policy and law enforcement agency of governments in ensuring sale of safe and wholesome grains in our markets:

- There should be proper monitoring of pesticides application and promotion of good pesticides application practice.
- Only approved pesticide should be on sale for use
- There should be continuous advocacy on the danger of using unapproved pesticide
- Policy makers should intensify effort to step up their effort through creation of awareness and adequate supervision to ensure food security

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