

ASSESSMENT OF THE PESTICIDES USAGE IN SELECTED LOCAL GOVERNMENT AREAS IN OYO STATE, NIGERIA

Background: Importance of agriculture cannot be over emphasized globally. It is fundamental to live hood and Oyo State happens to be one of the major agricultural producing States in Nigeria with some processing companies. The use of pesticide poses serious threats to farmers, consumers and the environment. Controlling pest by using pesticides has created health issues for the farmers mainly due to improper handling of the toxic chemicals as well as the non-use of personal protective clothing. The indiscriminate disposal of pesticide containers also has serious environmental implications. Apart from the hazards of pesticide use on farmers and the environment, consumers also face huge health risk by consuming food crops with high pesticide residues. Furthermore, government needs to invest in research of pesticides toxicity in order to come out with a sustainable pest control strategy that is effective, thus organic pesticides should be effectively looked into. Proper training of farmers is also required for any alternative pest control strategy to succeed because farmers will only adopt if they are convinced that it would work.

Objective: To evaluate the pesticides usage, farmers' knowledge, compliance and the risk of exposure of farmers to pesticides during its application through questionnaires in Oyo State, Nigeria.

Materials and Method: One hundred farmers were selected randomly from Local Government Areas (LGAs) in Oyo State and structured questionnaires were used for data collection.

Results: Almost all the respondents (94%) in the surveyed areas sprayed their crops with pesticides to control pests and diseases. The remaining 6% farmers use physical method (hand weeding), their decision could be based on the small size of their farms. It was revealed from the result that most of the farmers (94%) had at least 2 acres of land for farming and farming happens to be their major occupation, which is their source of livelihood. Chemical pesticides were sprayed in combination (31 % farmers), and the efficacy of one may mask the inefficacy of others in the mixture. Most farmers (88%) focus on planting during the rainy season because of availability of water. This research also showed that 68% do not read nor follow the label instructions on the pesticides containers. Farmers (14%) used complete protective kits during spraying. This unprotected spraying practice presents a great potential for exposure of farmers to chemicals from both skin contact and inhalation. Also, 54% talks when spraying, making them prone to inhalation and accidental ingestion of these toxic chemicals. The commonest way of disposing of pesticides containers is burying (63%) but this might not be the best means of dispose because most of the containers are plastic; they are not easily bio-degradable. Some of the farmers (11%) throw them on the field. A 24% farmers use the empty containers for domestic purposes, which is a great health concern to look into. Most of the crops that are often planted in these five LGAs belong to the "dirty dozen list".

Conclusion and Recommendation: There is therefore a need for carefully conducted scientific studies to assess the degree of environmental contamination due to pesticides.

INTRODUCTION

The use of chemicals in modern agriculture has significantly increased productivity. But it has also significantly increased the concentration of pesticides in food and in our environment, with associated negative effects on human and animal health. Annually there are dozens of million cases of pesticide poisonings worldwide (Richter, 2002). Moreover, it is now better understood that pesticides have significant chronic health effects, including cancer, neurological effects, diabetes, respiratory diseases, fetal diseases, and genetic disorders. These health effects are different depending on the degree and the type of exposure. There are also effects on consumers through pesticide residues in food (Bassil *et al.*, 2007).

Humans and animals are occasionally and unintentionally exposed to lethal and sub-lethal doses of pesticides (Martin *et al.*, 2003). They can be directly exposed to pesticides by inhalation, ingestion, contact with skin and eyes. Apart from the direct exposure, indirect exposure occurs in animals by consuming food that contains high residues of pesticides (Clydet *et al.*, 2012). Chemical herbicides are persistent and mobile thus can re-enter the land through precipitation and leaching, thus forming residues in crop (EPA, 2002).

The environmental impact of pesticide use can be huge. Feeding birds and other wildlife are susceptible to negative effects of grains coated with mercury. Several species including fishes and other aquatic creatures have experienced reduction in procreation and increased mortality. The adverse effects of pesticide use has therefore led to wildlife distress, disruption with reproduction, birth defects as well as depressed immunity which negatively affect wildlife numbers and the ecosystem as a whole (Fianko *et al.*, 2011). The exposure of experimental animals or humans to some industrial chemicals including heavy metals has been shown to generate (Nordberg and Arnér 2001; Abdollahi *et al.*, 2004). The application of pesticides in fields and for sanitary reasons is an essential evil.

Pesticides are any substance or mixture of substances intended for preventing, destroying, or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals, causing harm during or otherwise interfering with the production, processing, storage, transport, or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances that may be administered to animals for the control of insects, arachnids, or other pests in or on their bodies. The term includes substances intended for use as a plant growth regulator, defoliant, desiccant, or agent for thinning fruit or preventing the premature fall of fruit. Also used as substances applied to

crops either before or after harvest to protect the commodity from deterioration during storage and transport (FAO, 2002).

Pesticides can be classified by target organism (e.g., herbicides, insecticides, fungicides, rodenticides, and pediculicides (Gilden et al., 2010), chemical structure (e.g., organic, inorganic, synthetic, or biological (biopesticide), (CSAAMA, 1997), although the distinction can sometimes blur), and physical state (e.g. gaseous (fumigant)) (C.S.A.A.M.A, 1997). Biopesticides include microbial pesticides and biochemical pesticides (EPA, 2009).

Pesticides can save farmers' money by preventing crop losses to insects and other pests; in the U.S., farmers get an estimated fourfold return on money they spend on pesticides (Kellogg *et al.*, 2000). One study found that not using pesticides reduced crop yields by about 10% (Kuniuki, 2001). Another study, conducted in 1999, found that a ban on pesticides in the United States may result in a rise of food prices, loss of jobs, and an increase in world hunger (Knutson, 1999).

Pesticides may cause acute and delayed health effects in people who are exposed (USEPA, 2007). Pesticide exposure can cause a variety of adverse health effects, ranging from simple irritation of the skin and eyes to more severe effects such as affecting the nervous system, mimicking hormones causing reproductive problems, and also causing cancer. A 2007 systematic review found that "most studies on non-Hodgkin lymphoma and leukemia showed positive associations with pesticide exposure" and thus concluded that cosmetic use of pesticides should be decreased (Bassil *et al.*, 2007). There is substantial evidence of associations between organophosphate insecticide exposures and neurobehavioral alterations (Weselak *et al.*, 2007; Jurewicz and Hanke, 2008; Wigle *et al.*, 2008; Mink *et al.*, 2011). Limited evidence also exists for other negative outcomes from pesticide exposure including neurological, birth defects, and fetal death (Sanborn *et al.*, 2007).

The World Health Organization and the UN Environment Programme estimate that each year, 3 million workers in agriculture in the developing world experience severe poisoning from pesticides, about 18,000 of whom die (Miller, 2004). Owing to inadequate regulation and safety precautions, 99% of pesticide related deaths occur in developing countries that account for only 25% of pesticide usage. According to one study, as many as 25 million workers in developing countries may suffer mild pesticide poisoning yearly (Jeyaratan, 1990). There are several careers aside from agriculture that may also put individuals at risk of

health effects from pesticide exposure including pet groomers, groundskeepers, and fumigators (CDC, 2016). Gunnell et al (2007) stated that pesticide self-poisoning is a method of choice in one third of suicides worldwide, and hence recommended, among other things, more restrictions on the types of pesticides that are most harmful to humans.

Pesticide use raises a number of environmental concerns. Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, including non-target species, air, water and soil (Miller, 2004). Pesticide drift occurs when pesticides suspended in the air as particles are carried by wind to other areas, potentially contaminating them. Pesticides are one of the causes of water pollution, and some pesticides are persistent organic pollutants and contribute to soil contamination.

In addition, pesticide use reduces biodiversity, contributes to pollinator decline (Wells, 2007), destroys habitat (especially for birds) (Palmer *et al.*, 2007), and threatens endangered species (Miller, 2004). Pests can develop a resistance to the pesticide (pesticide resistance), necessitating a new pesticide. Alternatively a greater dose of the pesticide can be used to counteract the resistance, although this will cause a worsening of the ambient pollution problem.

Since chlorinated hydrocarbon pesticides dissolve in fats and are not excreted, organisms tend to retain them almost indefinitely. Biological magnification is the process whereby these chlorinated hydrocarbons (pesticides) are more concentrated at each level of the food chain. Among marine animals, pesticide concentrations are higher in carnivorous fishes, and even more so in the fish-eating birds and mammals at the top of the ecological pyramid (Castro and Michael, 2010). Global distillation is the process whereby pesticides are transported from warmer to colder regions of the Earth, in particular the Poles and mountain tops. Pesticides that evaporate into the atmosphere at relatively high temperature can be carried considerable distances (thousands of kilometers) by the wind to an area of lower temperature, where they condense and are carried back to the ground in rain or snow (Amie, 2012).

 The aims of this study is to evaluate farmers' knowledge and compliance as regarded to pesticides usage in five selected local government areas of Oyo state, Nigeria.

MATERIALS AND METHODS

Study Area

The study was conducted in two zones (Oke-Ogun and Ibadan), which covers Iseyin, Saki West, Atibo, Ido and Akinyele Local Government Areas (LGAs) of Oyo State. The choice of these areas was on the basis that they are the prominent food crops producing areas in Oyo State.  Ze, Yam, Cucumber, watermelon, tomatoes, cassava etc. Latitudes and longitudes of Iseyin ($7^{\circ}58'35.37\text{N}$ and $3^{\circ}35'29.02\text{E}$), Ido ($7^{\circ}30'37.74\text{N}$ and $3^{\circ}43'9.82\text{E}$). These areas lie between longitudes $8^{\circ}00'\text{N}$ and latitudes $4^{\circ}00'\text{E}$. Oyo State is bordered in the North by Kwara State, East by Osun State, South by Ogun State, West partly by Ogun State and partly by the Republic of Benin as shown in Figure 1.

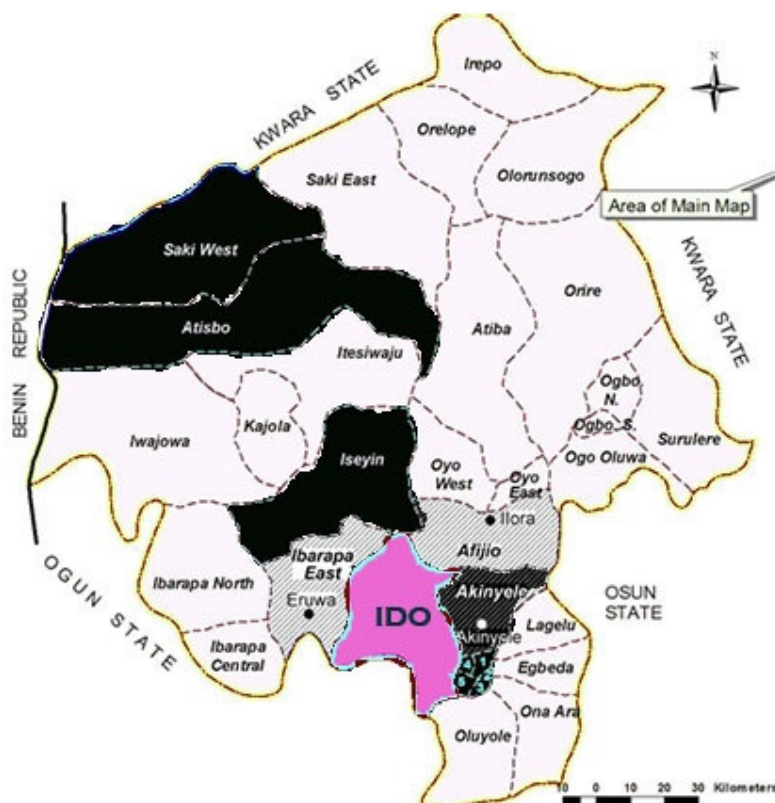


Figure 1: Map showing various local government areas in Oyo State and the study areas being shaded.

Source: <https://www.researchgate.net>.

Sampling Procedure

A survey was conducted at the five selected Local Government Areas (LGAs) through Mr. Dare Ayoola (a contact person link with the farmers) and questionnaires were validated by Dr K.A. Thomas, Department of Agricultural Extension and Rural Social development, Faculty of Agriculture, University of Ibadan. Randomly sampling technique was used to administer the questionnaires.

Sample Size

Twenty farmers from each selected LGA making the total sample size of 100.

Sampling Procedure

Data collection tools

A purposive and structured questionnaire was developed by referring different to literatures and modifying according to the objectives of this study. The questionnaire had seven parts which enabled to collect information on demographic information, herbicides, fertilizer application, Insecticides, diseases, storage and general knowledge on pesticides.

Method of Delivery

The Questionnaire is a four pages containing questions based on demographic information, herbicides, insecticides, fertilizers application, diseases and storage. And it takes 10 minutes to complete. Some of the farmers filled theirs unassisted while some were assisted. English and Yoruba (Native Language) were means of communication.

Statistical analysis

Data collected in this study were analyzed using SPSS software version 21(year). Descriptive statistics distribution and percentages were used to describe the findings according to each specific objective.

RESULT

Socio-Demographic Characteristics

All the 100 (100%) of the farmers administered questionnaires to participated in the survey. The farmers 74 (74%) were male, 26 (26%) were female and 93 (93%) of the studies farmers were married. The details of the questionnaires included age, religion and education background as presented in Table 1.

Table 1. Socio-demographic characteristics of farmers

No.	Variables	Frequency	Percentage (%)
1.	Sex		
	Male	74	74
	Female	26	26
2.	Age		
	18-25	2	2
	26-35	20	20
	36-45	58	58
	46-above	20	20
3.	Marital status		
	Single	3	3
	Married	93	93
	Widow/widower	4	4
4.	Religion		
	Christian	46	46
	Islamic	45	45
	Traditional	9	9
5.	Education background		
	No formal education	20	20
	Primary education	31	31
	Secondary education	25	25
	Tertiary education	14	14
	Adult education	2	2
	Quaranic education	8	8

Table 2: How long have you been into farmin 

Years	Frequency	Percent	Valid Percent	Cumulative Percent
1-5yr	15	15.0	15.0	15.0
6-10yrs	23	23.0	23.0	38.0
11-15yrs	22	22.0	22.0	60.0
16&above	40	40.0	40.0	100.0
Total	100	100.0	100.0	

Table 2 showed that majority of the farmers have been farming for the past 6 years.

Table 3: Size of farm

Size	Frequency	Percent	Valid Percent	Cumulative Percent
<2_acres	6	6.0	6.0	6.0
2-4acres	53	53.0	53.0	59.0
5-7acres	8	8.0	8.0	67.0
8&above	33	33.0	33.0	100.0
Total	100	100.0	100.0	

Table 3 showed that  90% of the farmers in this study have land greater than 2 acres

Table 4: Season of planting

Season	Frequency	Percent	Valid Percent	Cumulative Percent
Rainy	88	88.0	88.0	88.0
Dry&	12	12.0	12.0	100.0
Rain				
Total	100	100.0	100.0	

Table 4 shown most farmers prefer to plant in the rainy season.

Table 5: Types of Crops Planted

Crops	Frequency	Percent	Cumulative percent
Corn	68	26	26
Cassava	57	21	47
Water melon	38	14	61
Cucumber	32	12	73
Tomatoes	26	10	83
Rice	10	4	87
Pepper	17	6	93
Yam	11	4	97
Vegetable	9	3	100

Table 5 showed that corn is the frequent crop, followed by cassava.

Table 6: Types of Weed control

Weed Control Methods	Frequency	Percent	Valid Percent	Cumulative Percent
Physical method (Handweeding)	6	6.0	6.0	6.0
Chemical method	94	94.0	94.0	100.0
Total	100	100.0	100.0	

Table 6 showed that focus for weed management is chemical control.

Table 7: Types of herbicides

Herbicides	Frequency	Percent	Valid Percent	Cumulative Percent
Diuron	4	4.0	4.0	4.0
2,4,Dmine	7	7.0	7.0	11.0
Paraquat	60	60.0	60.0	71.0
Glyphosate	12	12.0	12.0	83.0
Atrazine	11	11.0	11.0	94.0

Metalachlor	1	1.0	1.0	95.0
Pendimethalin	5	5.0	5.0	100.0
Total	100	100.0	100.0	

Table 7 showed that Paraquat is the most used herbicide.

Table 8: Combined herbicides

Combined Herbicides	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	31	31.0	31.0	31.0
No	69	69.0	69.0	100.0
Total	100	100.0	100.0	

Table 8 showed that 69% of the farmers do not combine herbicides.

Table 9: Specific Insecticide Used

	Frequency	Percent	Valid Percent	Cumulative Percent
Cypermethrin & lambda-cyhalothrin	24	24.0	24.0	24.0
Cypermethrin- dimethate	1	1.0	1.0	25.0
Lambda-cyhalothrin &Dimethriate	48	48.0	48.0	73.0
Imiforce &Armyforce	3	3.0	3.0	76.0
Any	24	24.0	24.0	100.0
Total	100	100.0	100.0	

Table 9 showed that the frequent used insecticides are lambda-cyhalothrin and Dimethriate.

**Table10: Compliance to recommended herbicides` doses
usage**

Recommended Doses	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	22	22.0	22.0	32.0
No	78	78.0	78.0	100.0
Total	100	100.0	100.0	

Table 10 showed that only 22 of the farmers followed recommended dosades of the pesticides.

Table 11: Compliance to pesticides label instructions

Compliance (Read & Follow)	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	22	22.0	22.0	22.0
No	78	78.0	78.0	100.0
Total	100	100.0	100.0	

Table 11 showed that only 22 of the farmers' compliance to pesticides label instruction.

Table 12: Compliance of using Protective kits during Herbicides Application

Compliance	Frequency	Percent	Valid Percent	Cumulative Percent
Protective kits	14	14.0	14.0	14.0
Safety y boots	15	15.0	15.0	19.0
Nose mask	1	1.0	1.0	20.0
None	80	80.0	80.0	100.0
Total	100	100.0	100.0	

Table 12 showed that over 80% of the farmers are exposed to occupational hazard because of lack of complete protective lit on.

Table 13: Spraying activities

Activities	Frequency	Percent	Valid Percent	Cumulative Percent
Eat	1	1.0	1.0	1.0
Talk	54	54.0	54.0	55.0
None	45	45.0	45.0	100.0
Total	100	100.0	100.0	

Table 13 showed that a good number of the farmers talk while spraying in addition to their uncovered mouth while spraying.

Table 14: Spraying Equipment

Equipment	Frequency	Percent	Valid Percent	Cumulative Percent
Muzzle sprayer	1	1.0	1.0	1.0
Knapsack sprayer	90	90.0	90.0	91.0
Others	9	9.0	9.0	100.0
Total	100	100.0	100.0	

Table 14 showed most farmers used Knapsack sprayer for spraying of pesticides.

Table 15: Disposing methods of Pesticides containers

Disposing Methods	Frequency	Percent	Valid Percent	Cumulative Percent
Burning	1	1.0	1.0	1.0
Burying	63	63.0	63.0	64.0
Domestic uses	24	24.0	24.0	88.0
Throw away	11	11.0	11.0	99.0
For Seed storage	1	1.0	1.0	100.0
Total	100	100.0	100.0	

The proportion of farmers using empty pesticides containers for domestic is 24%, Burying is 63% and Throwing away on the field is 11% 

DISCUSSION

Pests pose big problems in crops production. The damage caused by them led to farmers using pesticides. Almost all the farmers (94%) in the present survey studied sprayed their crops with herbicides to control weeds. Only 6% of the farmers used physical method (hand weeding) and their decision could be based on the small size of their farms.

It was discovered that most of the farmers (94%) at least 2 acres of land for farming. Farming happens to be their major occupation, as in questionnaires which are the source of their living food.

From this study, it was realized that Paraquat is the commonest herbicide used, lambda-cyhalothrin and Dimethriate the insecticides commonly used. However, the farmers perceived that herbicides use is able to suppress weeds for a longer time and over a wider

area than manual weeding with hoe and cutlass. These together can reduce weeding time and labour cost (Charles, 2009).

More than one quarter percentages of the farmers were using chemical herbicides in combination believing that the efficacy of one may mask the inefficacy of others in the mixture (Biney, 2001). Mixing of pesticides was encouraged by the farmers' desire to have rapid knockdown of pests and longer time of weed control due to their efficacies. This idea is questionable (Medina, 1987), because the combinations used are indiscriminate. The practice of using indiscriminate combinations of pesticides, particularly of insecticides, may have contributed to the increase in incidences of insect pest infestation of some food crops like tomatoes (Biney, 2001, Raymond, 2010).

For instance, Metcalf (1980), in his recommendation of strategies for pesticide management, stated that the use of mixtures of insecticides must be avoided, since they generally result in the simultaneous development of insect pests' resistance.

Most farmers (88%) focused on planting during the rainy season because of availability of water but pests and disease also proliferate more in this season, and there is high tendency of increased wash-off by rainfall of some of the applied pesticides especially herbicides into the water bodies causing a threat to aquatic organisms (Oguntoyinbo and Akintola, 1983).

High percentage of the farmers does not use recommended doses, what they used was above the recommended doses, which would definitely add cause of toxicity outbreak in the ecosystem community. This might be due to ignorant of not reading the label instructions, this research showed that 68% did not read nor follow the label instructions on the containers; this can also be due to their level of Education, 20% of the farmers do not have any formal education.

Farmers which were very few in number (14%) complied in using complete protective kit during spraying. This unprotected spraying practice presents great potentials for exposure of farmers to hazardous chemicals from both skin contact and inhalation which might lead to respiratory injury toxicity. Also, usually talked when spraying, making them prone to inhalation and accidental ingestion of these toxic chemicals.

With regards to pesticide application procedures, the knapsack equipment is the most popular sprayer used. The use of the knapsack sprayer itself presents some dangers to the user, since it is prone to leakage, especially as the sprayer ages. Matthews *et al.* (2003) have identified causes of leakage from the knapsack sprayers and have emphasized the need to provide better-quality sprayer at an acceptable cost that will be more durable in a hot and humid tropical environment.

The commonest way of disposing pesticides containers is burying as revealed in this study. This might not be the best means of dispose because most of the containers are plastic; toxic fumes might be released into the environment and also they are not easily bio-degraded.

Non-target flora and fauna may concentrate these toxic chemicals in their tissues and pass them along the food chain. The bio accumulation of such pollutants in the food chain may lead to pesticides residues in valuable sea food resources such as fish, crabs, cray fish, oysters etc., which might have health risk problems on the consumers. A population of 24% of the farmers uses the empty containers for domestic purposes, which is a great health concern to look into; this habit from the farmers might be due to ignorant of the adverse effect or poverty level.

Most of the crops that are often planted in the selected five Local Government Areas belong to the “dirty dozen list” (Fidler, 2016). A lot of public enlightenment awareness of principles on healthy living in which one’s diet has to be 50-70% of fresh fruit and vegetables. It is very important therefore, to intensify researches on pesticides residues in crops that belong to this list. There is also a need for carefully conducted scientific studies to assess the degree of environmental contamination due to pesticides.

CONCLUSION AND RECOMMENDATION

CONCLUSION

This present study showed that, the use of pesticide poses serious threats to farmers, consumers and the environment. Controlling agricultural pests by using pesticides would create health issues for the farmers mainly due to improper handling of the toxic chemicals as well as the non-use of personal protective clothing. The indiscriminate disposal of pesticide containers also has serious environmental implications.

Apart from the hazards of pesticide use on farmers and the environment, consumers also face huge health risk by consuming vegetables with high pesticide residues.

A lot of public enlightenment awareness is of principles on healthy living in which one’s diet has to be 50-70% of fresh fruit and vegetables. In particular, eating fruit and vegetables in their raw state provides increased nutrition and gives antioxidants for protection. Some of these fruits and vegetable belong to the ‘DIRTY DOZEN LIST’ (Crops that contain high pesticides residue in them) (Fidler, 2016). From this study it was discovered that farmers, farmers families and even the consumers are at risk of toxic effect of pesticides residue.

There is therefore a need to evaluate the pesticides residues in these crops, farmers and also public enlightenment on proper pesticides usage and if possible alternative to chemical pesticides; organic pesticides (Marcus and Christine, 1997).

Based on the study findings the following are recommended:

There should be an integrated effort from governmental and non-governmental organizations that focus on the awareness of farmers on proper pesticides management and related issues. Also comprehensive laboratory based studies (residual analysis of blood from rats fed with crops treated with pesticides and farmers using pesticides on their farms, soil, water and crops) from the selected studies areas is recommended so that the extent of pesticide damage on public health and the environment could be confirmed.

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APPENDICES

UNIVERSITY OF IBADAN

FACULTY OF VETERINARY MEDICINE

DEPARTMENT OF PHARMACOLOGY AND TOXICOLOGY

QUESTIONNAIRE

This questionnaire is prepared to determine the nature of herbicides, insecticides and fertilizer usage in crops across Ibadan and Oke-Ogun Region of Oyo State.

Please answer the question with all sincerity as all information will be treated with almost confidence, kindly tick (✓) where necessary and supply adequate information where requires.

Thank you.

SURVEY INFORMATION

Name of farmer:.....

Name of Town/Village:.....

Name of L.G.A:.....

DEMOGRAPHIC INFORMATION

1. Age: 18 – 25 () 26 – 35 () 36 – 45 () and above ()
2. Religion  Christian () Islamic () Traditional Religion () others (Please specify)
3. Sex: Male () Female ()
4. Marital status: Single () Married () widow () widower () Single Parent ()

5. Educational background: No formal education () primary school () secondary school () Tertiary () adult Literacy/Education () Islamic/ Quranic Education () others (please specify).....

6. Occupation: Farming () Trading () Civil servant () other (please specify)

7. What kind of crop(s) do you grow? Cucumber () water melon () corn () tomatoes () others(please specify).....

8. How long have you been into farming? ...

9. What is the size of your farm acreage under cultivation (in acres)? Less than 2 () 2-5 () 5 – 8 () Greater than 8 ()

10.Do you plant the same type of crop year in year out? Yes () No ()

11.Do you plant on the same piece of land year in, year out? Yes () No ()

12.For how long have you been using the piece of land?

13.Do you do shifting cultivation? Yes () No ()

14. What is the type of cropping system? Sole cropping () Intercrop () Mixed cropping ()

15.If intercrops, with what crop(s)? Please list the crop(s)

(I) (II).....

(III)..... (IV).....

16.What season do you plant the crop? Rainy () dry Season()

17.How many acres of land do you cultivate on annually.....

18.How many crop(s) do you plant per acre of land?.....

SECTION B: HERBICIDES

19.How do you control the weed? Cultural method () physical method () chemical method () other

20.If chemical method, what type of herbicides used in control of weed?

(I)(II)..... (III).....

21.Do you use recommended dose has been specified on the label? Yes () No ()

22.Do you read and follow label instruction? Yes () No ()

23.Do you combine herbicides? Yes (), No (). If yes what types of herbicides do you combine? i. ii. iii.

24. Why do you combine such herbicides before use? -----

25.When do you spray herbicide on your farm? ? Before -planting () Immediately after planting () 2 – 4 weeks after planting () () others Specify ()

26.Which herbicide(s) do you use before planting?.....

27. Which herbicide(s) do you use after planting?.....
28. Which herbicide(s) do you use after crop emergence?.....
29. What are the common weeds dominant on your vegetable farm? Grasses ()
broad leaves () the two ()
30. List dominant broad leaves on your farm
(I) (II) (III).....
31. List dominant grasses on your farm
(I) (II)..... (III).....
32. How effective is the herbicide after application on the farm within the first 4 week? Very effective () effective () not effective ()
33. What types of weeds do you notice after chemical application? *Mariscus alternifolius* () *Setaria barbata* () *Phyllanthus amarus* () *Talinum fruitucosum* () others (please specify).....
34. When applying herbicides, what personal protective measure do you use on the farm? Protective jackets () safety boots () nose mask () none ()
35. Do you eat, () smoke () talk () while spraying the herbicide?
36. What do you used for spraying? Muzzle sprayer, Knapsack Sprayer () other

SECTION C: FERTILIZER APPLICATION

37. Do you apply fertilizer to your crops? Yes () No ()
38. If yes, what type of fertilizer? Organic fertilizer () TK5 () Inorganic fertilizer ()
39. Do you practice irrigation technology for your vegetable plantation Yes () No ()
40. What is the source of your water? River () stream () well () dam ()

SECTION D: INSECTICIDES

41. What are the insect pests affecting production in your farm? Wire worms () Beetle () Aphid () Leafhopper () Other
42. What are the effects of these insect pests on your vegetable? Chew the leaves () marks on the crops () wilt on the leaves () root rot () late blight disease () leaf perforation, leaf spot, leaf coloration etc
43. What type of control measure do you use to protect your crops? Physical control, Biological control, others () chemical control ()
44. If you are using more than one chemical at a time what are their names
(I) (II) (III).....

SECTION E: DISEASES

45. What are the diseases affecting your crops on the farm? Fungi () Bacteria () virus () Nematode () Others
46. What are the damages of these diseases on your farm? Necrosis () Rust () chlorosis () root rot () others ()
47. What type of control measure do you use to protect your crops? Biology control () chemical control ()
48. What pesticides are you using for control of diseases on your farm(s)?
.....
49. If you are using more than one chemical at a time what are their names
I. II. III.

SECTION F: STORAGE

50. What type of chemical do you use for the storage of crop after harvesting?.....
51. How long do you keep the crops after applying the chemical before taking it to the market? i. 1 day ii. 1 week iii. 2 weeks iv. 1 month v. others.....
52. What concentrations or doses of chemical do you apply?
53. What time do you usually start chemical application and what time do you usually stop?
54. What type of chemicals do you usually use to prevent the sprouting of crop?
55. How do you dispose the containers of the chemicals after use? Burning (), Burying (), Returning to the company (), Domestic uses ()

SECTION G: GENERAL

56. Where do you source for the chemicals used on your farm? Agrochemical industry () farm cooperatives () local market () agro-dealers, () extension agents ()
57. What is your source of information on how to apply the chemicals?
Local dealer () Agric extension agent () farm cooperatives ()
Manufacturer's instruction () agro- dealers

Thank you!