African Journal of Social and Behavioural Sciences (AJSBS)
Volume 14, Number 2 (2024) ISSN: 2141-209X

ASSESSMENT OF SAFE UTILIZATION OF HERBICIDES AWARENESS AMONG CROP FARMERS IN OWERRI WEST, NIGERIA

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ABSTRACT: The study examined the safe utilization of herbicides among crop farmers in Owerri-West Local Government Area of Imo State, their level of awareness on the dangers of herbicide misuse and compliance with safety measures in the use of herbicides. Data were collected with a structured questionnaire administered to eighty crops farmers The data collected were analysed using descriptive statistical techniques. The Likert scale was used in analysing the level of awareness while chi-square was employed for the research hypothesis. The findings of the study showed that farmers have a high level of awareness in the use herbicides by crop farmers in the study area. The study also revealed that the most perceived problems in the use of herbicides by crop farmers in the study area are inadequate equipment (x= 3.19) and skill (x= 2.84) respectively and spraying of herbicides to unintended plants (x= 2.55), while the level of precautionary measure on eating, drinking and talking while spraying is high (x = 3.21). The research hypothesis showed no significant relationship between farmers' level of awareness and the safe utilization of herbicides in the study area. Generally, herbicide application among crop farmers in the study area is not safe for health and the environment, hence the study recommends among others, the training and retraining of farmers on the safe utilization of herbicides in crop production so as to inculcate the necessary skills in the use of herbicides by the government using agricultural extension workers and also with the collaboration of the chemical companies and non-governmental organizations and farmers' association where available.

Keywords: Assessment, Herbicide Awareness, Crop Farmers, Safe Utilization, Nigeria

INTRODUCTION

The advancement in science and technology has brought some innovations in the way man carries out his activities in different sectors of his various endeavours. One of such innovations is the use of chemicals to control weeds in crop farms with the aim of reducing human labour and increasing crop production. Although herbicides can lead to increased food production, there is every need to utilize them properly in order not to do more harm than good to man and his environment (Hussaini & Lado, 2015). Farmers' knowledge concerning safe handling techniques of herbicides is very essential. Unfortunately, crop production in developing nations is one of the sectors in which the technology of herbicides is utilised without the required knowledge of its impacts.

The use of herbicides in Nigeria was introduced through the agricultural reforms of 1970s,

While the subsequent establishment of the River Basin Development Authority (RBDA) and Agricultural Development Projects (ADPs) strengthened the process. Alade and Ubeku (2018), argued that the use of herbicides, especially non-selective ones by farmers in Nigeria is gaining acceptability and is on the increase. The current situation concerning herbicide utilization in Nigeria can be said to be unsatisfactory because farmers do not adhere to safety measures when using herbicides (Kolo, 2014). Therefore, efforts need to be made to create awareness of the risks involved in the improper use of herbicides. Most farmers in developing countries lack registration systems and proper information concerning the hazardous properties of imported products or restrictions on their uses. Farmers' knowledge regarding safety application techniques, timing and dosage of herbicide use is often inadequate. According to Olowogbon et al, (2013), lack of safety precautions causes contamination and poisoning in the field. They went further to state that the common risks associated with human beings include: acute toxicity, chronic toxicity, carcinogenicity, teratogenicity and biological concentration. The misuse and abuse of these chemical farm inputs are rampant in Nigeria due to inadequate education on the guidelines and control on the safe use and disposal of used herbicide containers, including limited awareness about the toxicity of the chemicals. In recent times, the use of herbicide has become one of the means of controlling weeds by some farmers in the Owerri West as opposed to manual weeding which was the only means of controlling weeds before now in the area. Obidike (2011) pointed out that the least expensive input for improving rural agricultural development is adequate access to knowledge and farm inputs. It is on this light that the need to study the level of safe utilization of herbicides among farmers in the study area becomes imperative.

Statement of the Research Problem

Over the years, farmers in Owerri-West used the traditional method of manual weeding to suppress weeds in their crop farms. The method appears not to be effective, demanding human labour and a longer time to eradicate weeds. In order to do away with the difficulties associated with manual weeding, some farmers in the area have resorted to the use of chemicals (herbicides) in weed elimination from farms. Innovations in science and technology have made the use of chemicals in pest and weed control in the farms possible thereby leading to an increase in crop yield. Iyagba (2013) stated that farmers in Nigeria do not observe the safety precautions in the use of these herbicides which may result to adverse consequences in life of humans and the environment. Also, some researchers have observed over the years that farmers are faced with problems of poor handling techniques and random utilization of herbicides (Ogundu, 2016; Hussaini & Lado, 2015; Gushit et al, 2013). Hence, it is important to assess the level of safe utilization of herbicides among crop farmers in Owerri-West Local Government Area.

Research Questions

i. Are the farmers aware of herbicides' effects on human health, ecosystem and the environment?
ii. What are the problems of herbicide use by farmers in the study area?
iii. Do the farmers adhere to the precautions and safety measures in the safe utilization of herbicides?

Ho: There is no significant relationship between farmers' level of awareness and safe utilization of herbicides in the study area.

LITERATURE REVIEW

Concept of Safe Utilization of Herbicides

The word herbicide is derived from two Latin words herb, meaning "plant" and caedere meaning "to kill". Herbicide had been defined by EPA (2007) as chemical substances or mixture of substances intended for killing pest plants that may be applied to the target area as spray or by hand using various techniques. It is also defined by Qasem, (2011) as chemicals that negatively affect weeds' normal growth, it quickly act and may be applied to a specific area or where other methods of weeds control are not possible or may be integrated with other weeds control methods. The use of herbicides for weed control and management took root with introduction of chemical called Bordeaux (mixture consisting copper, sulphate, lime and water) in 1896 with developed interest in chemical weed control. Most herbicides are organic chemicals that are primarily made up of carbon (C) and hydrogen (H) atoms. They have played and will continue to play important roles in the field of agricultural production.

In most cases, farmers hardly follow instructions or understand the potential hazards associated with careless handling of these herbicides. Gushit et al, (2013) observed that misuse and abuse of herbicides are rampant in Nigeria due to inadequate understanding on the guidelines on safe use and disposal of used herbicide containers and limited awareness about the lethal toxicity of the chemicals. Hence, some products of the WHO category 1 are still in use.

Significance of Herbicide in Crop Production

Majority of the crop protection chemicals are herbicides, the objectives of which are to reduce or eliminate an unwanted plant that disturb our desired or valuable crops by either consuming part of the biomass or even causes inconveniences (Mannion, 2011). Herbicides are chemicals toxic to plants which inhibit some vital processes in plants to the extent that the plants die up or can no longer grow (Mcwen et al, 2012). For chemicals that are to be used to control weeds within agricultural crops or planting of other desirable plants, there must be some methods of achieving selective phytotoxicity prepared when no vegetation is wanted in an area. For effective control of weed in an area, rationale use of various herbicides should be encouraged so as to minimize residual accumulation in the soil. The use of herbicides is reported to have reduced the cost of weed control, cost of production and increase the profitability in field/vegetable crop production (Lagoke & Shebayan, 2018).

Lack of correct diagnosis of the weed problem, selection of incorrect herbicide and prevalence of unsuitable weather conditions, improper application techniques are all reason behind failure of herbicide in controlling existing weeds. Proper handling, precautions and some considerations in herbicides application in the field are factors that need to be considered as they contribute in the success of chemical weed control. Diagnosis of the weed species found in the field is the first step towards any successful weed control program (Qasem, 2011). Application of herbicides is related to the form of the herbicides formulation and the equipment to apply the herbicide. According to Qasem (2011), herbicide formulations are many including water-soluble liquids (require wetting agents), water soluble powders (need stirring or agitation in preparation), water emulsion (require some agitation and held together by an emulsifier), wettable powder (need continuous agitation and most used in soil), water

dispersed liquids, water dispersed granules, granules (need water to leach them down in to the soil) and pellets (usually used in spot treatments). However, the most used formulations are aqueous and granules and are all applied by either sprayers or spreaders. Qasem (2011) further stated that, the main and serious problem with herbicide application or uses is the people applying these chemicals. Wrong application commonly resulted from failure in sprayer calibration. Sprayer calibration aims at uniform herbicide spray distribution and coverage of treated surface/weeds that means the receipt of the same amount of spray solution per each unit area of treated surface. Sprayer calibration is the first step to be carried out before herbicide application. While Badowski et al, (2008) cited in (Qasem, 2011) suggested that, herbicides application in the field should be carried out since failure of distribution of any herbicide may result in ineffective weed control or crop injures and thus herbicide residue.

Basic Principles and Methods of Herbicides Application

Herbicides are chemicals negatively affect weeds' normal growth, they quickly act and may be applied to specific areas where other methods of weed control are not possible. The use of herbicides for weed control creates public concern and receives much criticism nowadays due to a lack of technical extension and experience in herbicide application. In addition, lack of correct diagnosis of the weed problem, selection of incorrect herbicides and prevalence of unsuitable weather conditions, improper application techniques are all reasons behind the failure of herbicides in controlling existing weeds. Proper handling, precautions and some considerations in herbicide application in the field are factors that need to be considered as they contribute to the success of chemical weed control. Diagnosis of the weed species found in the field is the first step towards any successful weed control program (Qasem, 2011). The application of herbicides is related to the form of the herbicide's formulation and the equipment to apply the herbicide. According to Foy and Pritchard (1996) cited in (Qasem, 2011), herbicide formulations are many and may include water-soluble liquids (require wetting agents), water-soluble powders (need stirring or agitation in preparation), water emulsion (require some agitation and held together by an emulsifier), wettable powder (need continuous agitation and most used in soil), water dispersed liquids, water dispersed granules, granules (need water to leach them down into the soil) and pellets (usually used in spot treatments. However, the most used formulations are aqueous and granules and are all applied by either sprayers or spreaders. Qasem (2011), further stated that the main problem associated with herbicide application or use is the people using these chemicals. The wrong application commonly results from a failure in sprayer calibration. Sprayer calibration aims at uniform herbicide spray distribution and coverage of the treated surface, which means the receipt of the same amount of spray solution per unit area of the treated surface. Sprayer calibration is the first step to be carried out before herbicide application.

According to Ogbuji (2014) cited in (Lado, et al, 2015), herbicides are applied in various ways to plants or soils and the most common methods include broadcasting, band treatment and injection. The choice of method for herbicide application is influenced by herbicide formulation, the target to be treated and the type of weed problem to be solved. Rao (2016), stated that herbicide application is determined by time, weed species, time of germination of weed and plants growth stage. Most herbicides are water-based spray, using ground equipment that varies in design according to the area to be sprayed. Tu et al (2014), suggested that, herbicides can be applied in variety of ways and stated that the most appropriate is determined by the weed being treated, the herbicide being applied, the skills

of the applicator and the application site. The various ways according to Tu et al (2014) include:

Foliar Application: This is method where by herbicides are applied through the leaves and stems of a plant.

Basal Bark Application: This method applies a 6-12inch band of herbicide around the circumference of the trunk of the target plant, approximately one foot above ground.

Frill Method: This method can also be called "hack and squirt" In this method, the plant is cut using a sharp object. Herbicide is then immediately applied to the cut with a syringe or similar equipment.

Injection Method: According to Hawver et al, (2000), cited in (Tu et al, 2014), herbicide can be injected into the trunk of a tree using a specialized tool such as a metal tube that has teeth on one end that grip the trunk of the tree. A sharp push on the other end of the tube sends a brass capsule of herbicide into the tree trunk. It is a convenient way of applying herbicide and requires minimal preparation or cleanup. It is also an easy and safe way to apply herbicide with minimal exposure.

Cut-Stump: This method of herbicide application is often used on woody species that normally re-grow after being cut. The herbicide is applied to the entire exposed cambium of the stump within minutes after the trunk is cut using sprayer or point brushes. The outer bark needs to be sprayed.

Classifications of Herbicides

Classification of herbicides cannot be absolutely rigid as some herbicides may fall into more than one group. Kasasian (2011), came up with a classification on the basis of time of application, type of weed to be controlled and whether the effect is primarily through the shoot or root while Ferell et al (2017), stated that herbicides can be classified in several ways depending on where or how they are applied and their actions in or on the plant.

The classification system was developed with the idea that if the site of action of herbicide was easily and readily available, recommendations for herbicide resistance management would be easier. Generally, herbicide is said to be contact when it destroys only the plant tissue in contact with a chemical and it is called systematic herbicide when its activity starts from foliar down to the roots or from soil up to the leaves. Selectivity of herbicides is its ability to kill target plant species in a mixed plant population without affecting the other plants in the mix. According to Rao (2016), herbicides can be classified based on the method of application, chemical affinity, structural similarity and mode of action. While Qasem, (2011) based his classification on different factors which are; selectivity (killing or inhibiting weeds and not harming crop plants beyond the point of economic recovery), action (killing plant parts that come in contact with) and method of application. Hence, herbicides are grouped into three main types based on the mechanism of action, which is related to the effects of the chemical on the growth and development of weeds. The basic classes include:

Pre-Planting Herbicides: These herbicides are applied on the soil surface before the crop is planted, in most cases at present time these herbicides are incorporated in to the soil as pre- plant treatment. The great advantage of these incorporated treatment is that the herbicides is placed in the zone where weed seeds germinated and is not dependent on rainfall to move the herbicides into this zone. Herbicides which have greater toxicity on the emerging crop seedlings are applied before the crop is planted.

Pre-Emergence: These herbicides are applied to soil surface when the seeds are planted prior to the emergence of both weeds and the plant (Lado et al, 2014). It prevents the germination or early growth of weeds by inhibiting key enzymes. This pre-emergence application is usually applied to soil surface and requires rainfall or irrigation to move the herbicides into the soil, if the herbicide is not moved into the soil where the weed is located it will not be effective and if left on the soil surface these herbicides are often lost due to photodecomposition and vaporization. In some areas of the world, pre-emergence herbicides are used to prevent crab grass (annual grass) from appearing in summer lawns (Robert, 2010).

Post-Emergence Herbicides: These herbicides are applied after crop weeds have

emerged. It is applied to weed foliage within two weeks after crops have emerged. They can be selective or non-selective. Selective herbicides are designed to act on only one type of weed and are much more useful when the focus may be on controlling a particular weed species (EPA, 2007).

Environmental Impacts of Herbicide Use

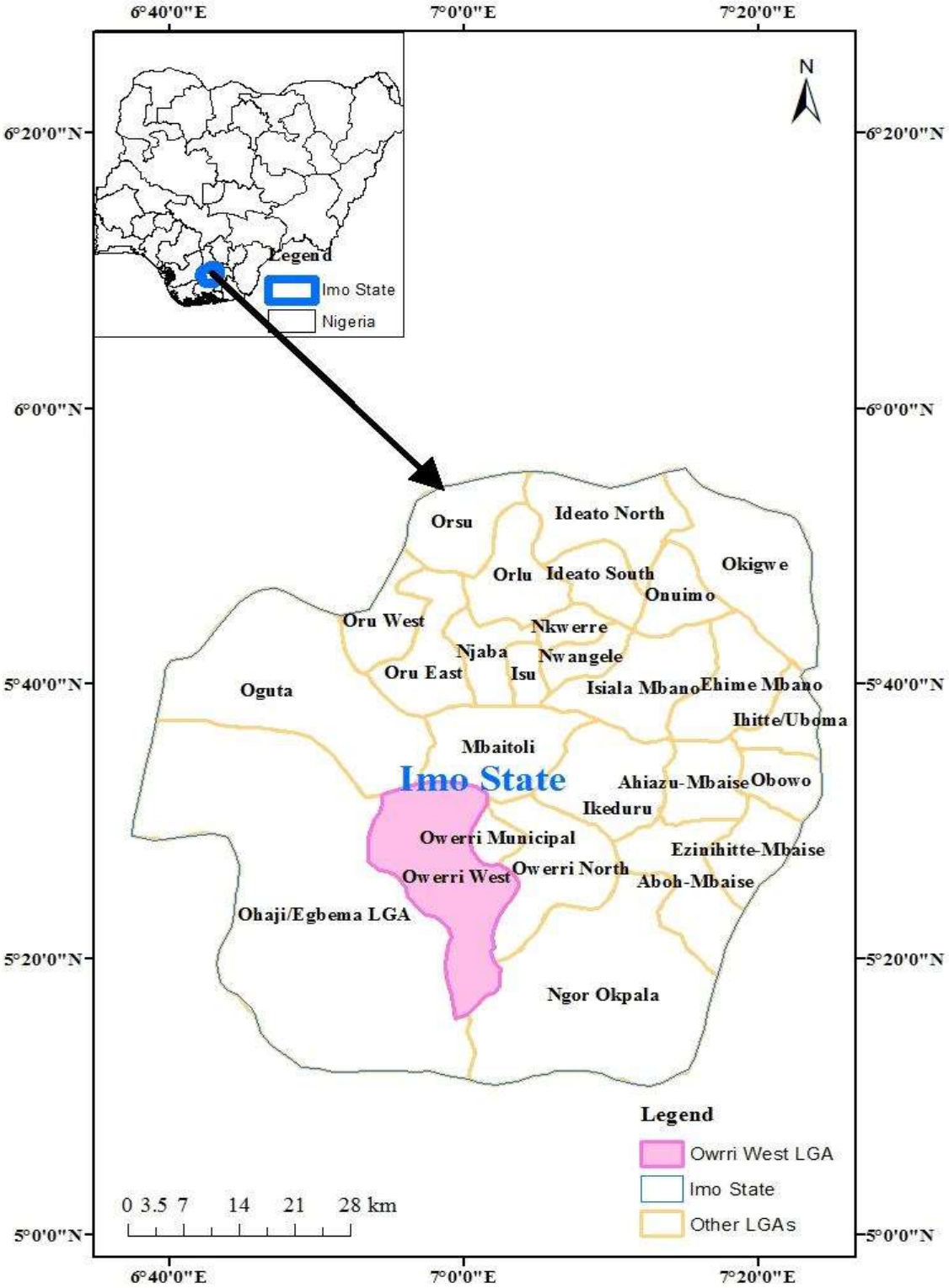
The environmental fate of herbicides is a matter of recent concern as small portion of the herbicide reaches the target organisms. While herbicides are very important to agriculture, under certain circumstances they may act as pollutants that can deteriorate soils, ground and surface water, while most herbicides are not intentionally applied on soil, they can enter the soil from direct interception of spray, runoff of herbicides, from vegetation and leaching and from dead materials. Herbicides in soil causes toxicity to soil micro-organisms which may alter community structure including potential increase in plant or animal pathogens. Herbicides may also cause changes in microbial community function and concomitant impacts on soil health and ecosystem processes (Zabaloy et al, 2011). Ananata (2016), stated that herbicide plays an important role in the disturbance of soil ecosystem where soil micro flora and fauna work in the breaking down of organic matter; incorporating it into the soil and releasing nutrients for plant growth. The herbicides can have a direct effect upon decomposing micro-organisms, root pathogens and disease antagonists such as parasites and predators as well as organisms pathogenic to invertebrates. As herbicides are designed specifically to minimize plant diversity by controlling weeds thus promoting monoculture, so, they can also indirectly decrease populations and diversity of related soil organisms and lessen the natural input of organic matter into the soil as well as have direct effect on soil organisms. According to Miller (2016), over 95% of the sprayed herbicides reach destinations other than the initial target species including air, water, bottom sediments and food. When herbicide is sprayed, it unintentionally gets diffused and suspended in the air as particles are carried by wind and many be blown into nearby areas potentially posing threats to human and wild lives. Havens et al, (1995), stated that in some conditions, herbicides can be transported through leaching or surface runoff that leads to ground water or distant water

sources contamination which are all intensified by persistence degradation and high-water solubility. The number of herbicides that migrate from the intended application area is influenced by the particular chemical's properties such as its tendency for binding the soil, its vapour pressure, its solubility and resistance to being broken down. Factors in soil such as its texture, its ability to retain water and, its organic matter content also affect the amount of herbicide that will leave the area (Kellog et al, 2000). The benefits of grass cover or weeds such as reduction of runoff and erosion, maintenance of fertility in the soil etc. must be weighed against the demerits of using herbicides. Herbicides can contaminate unintended land and water when they are sprayed aerially or allowed to fields, or when they escape from production sites and storage tanks or are inappropriately discarded. Miller (2016) asserted that some herbicides contribute to global warming and the depletion of the ozone layer. The use of herbicides is replacing other practices of land use management which are rather complex because weeds exist in a wide variety of environments and this must be considered when alternative management strategies are proposed. Herbicides residues in the soil can be directly toxic to soil micro-organisms or can exert sub-stable effects by influencing their activities, behaviour, reproduction and metabolism. Soil organisms such as earth movers suffer strong toxic reactions due to the use of herbicides (Tudun-Wada, 2004). Herbicides used against the control of grasses can kill beneficial insects like ladybugs and aphids, among others. When the beneficial insects are gone, there is no natural control over the pest, so their populations can increase much more quickly after the initial application, requiring further application of pesticides to control the original pest. Herbicides can kill butterflies, moths, spiders and bees which play other roles in the environment such as pollinating plants.

Research Methodology

Study Area

The study was conducted in Owerri-West Local Government Area of Imo State. It is located on latitudes $5^0\ 16^1\ 30^{11}$ north and $5^0\ 31^1\ 30^{11}$ and longitudes $6^0\ 51^1\ 00^{11}$ and $7^0\ 5^1\ 00^{11}$. The area shares a boundary with Owerri Municipal, Ngor-Okpala and Mbaitoli Local Government Areas. It is located in the southeastern part of the state. Crop farming is the primary activity and means of livelihood in the area. Different varieties of crops are produced in the area which include cassava, yam, cocoa yam, maize and melon. All the farmers in the study area are the target population.



Map of Imo State Showing the Study Area

RESEARCH DESIGN

The study adopted the descriptive survey research design. This research design was chosen because of the flexibility in survey research method which permits the use of a variety of

procedures and instruments in data collection and analysis. Again, the research design is capable of using inferential statistics which enables appropriate information to be deduced from primary data collected through field observation and questionnaire.

Sampling Method and Sampling Size

The sampling method adopted in this work is the purposive sampling technique. This is because only farmers who are conversant with the use of herbicides in the study area were selected since a large number still use the traditional method. About 70% of the population of Owerri-West Local Government Area are smallholder farmers (NPC, 2006). However, because of the types of information required from a single herbicide user, a total of eighty (80) farmers were selected as sample size. Therefore, eighty questionnaires were administered to the farmers based on their awareness of herbicide usage.

Data Collection Tools

The data were collected using structured questionnaires which were interpreted to the respondents. The snowballing method was employed as a basis for the selection of respondents, where enumerators were recruited to assist researchers to identify the potential respondents (herbicide users). Another tool for data collection in this work was a field survey which involved visiting the farmers in their farms to observe how they handled and used the chemicals on their farms.

Method of Data Analysis

Data from the questionnaire were analysed using descriptive statistics which describes and summarizes the basic features of a dataset and aids researchers to gain a better understanding of their data, Chi-square was employed in identifying the relationship between farmers' level of awareness and safe utilization of herbicides in crop production. This helps researchers make informed decisions about the population being studied. A four-point Likert scale with options; strongly agree (4), agree (3), disagree (2), and strongly disagree (1) with 2.5 cut-offs were equally applied to ascertain the level of awareness of crop farmers on the dangers of unsafe herbicide use

RESULTS AND DISCUSSION

Table 1 shows that there is a high level of awareness (x=3.33) of the health hazard of herbicide misuse while awareness of the effect on the quality of water, air and soil is low (2.19). Also, awareness of the effect of misuse of herbicides on crop yield is equally high (x=2.53). On the other hand, there is low awareness of the effect of herbicides on the ecosystem. This implies that the respondents acknowledged that improper utilization of herbicides can be detrimental to human health. This corroborated the findings of Eno (2018) which opined that herbicides are potential health and environmental hazard. Similarly, farmers who mistakenly applied herbicides directly to their crops experienced death of the crops hence, poor yield. Also due to level of illiteracy among the farmers, most of them are not aware of the impact of herbicides on ecosystem generally. Miller (2016), stated that any misuse of herbicide can degenerate to health and environmental hazard.

Table 1: Level of awareness on the effect of Misuse of Herbicides on the Environmental, Ecological and Health.

Variables	SA	A	D	SD	Means	Remarks
Herbicides can constitute health hazard	52(6.5)	11(13.9)	6(7.6)	10(12.7)	3.33	High
Do you agree that misuse of herbicides can affect soil, water and air quality?	6(7.6)	32(65.8)	12(15.2)	29(36.7)	2.19	Low
Herbicide misuse can cause poor yield	9(11.4)	41(51.9)	16(20.3)	13(16.5)	2.53	High
Herbicides can negatively affect the entire ecosystem generally	4(5.1)	41(51.9)	15(19.0)	19(24.1)	2.38	Low

Source: Field Survey, 2023

Data in Table 2 shows that the most perceived problem in the use of herbicides by crop farmers in the study area is Inadequate equipment (x= 3.19). This is followed by inadequate skill (x= 2.84) and spraying of herbicides to unintended plants (x= 2.55). The above problems can have adverse impact on the use of herbicides which may negatively affect human health and the environment. The farmers did not perceive odour and moisture from herbicides as a problem This finding was corroborated by Gushit and Adamu (2013), whose study identified inadequate skill, and personal protective equipment as major problems of herbicide misuse.

Table 2: Perceived Problems of Farmers in the Utilization of Herbicides in the Study Area

Variables	Mean	Remark
Inadequate skill	2.84	High
Inadequate equipment (PPE, Sprayer)	3.19	High
Spraying of herbicide to unintended plants	2.55	High
Odour from herbicide mixture	1.44	Low
Moisture from herbicide mixture	1.24	Low

Source: Field Survey, 2023 Mean (x) =2.5

Table 3 shows that in some cases, the level of adherence to precautionary measures in the study area is high, like on eating, drinking and talking while spraying (x = 3.21), disposal of used containers and unused mixture (x = 2.84), knowledge of operation of equipment and the calibration (x = 3.19) and observation of safe storage and transportation of herbicides (x = 2.55). In other cases, the level of adherence is low such as knowledge of the application techniques, timing and dosage (1.33), and use of recommended PPE (1.47). Others include no emergency plan and lack of understanding of instructions on the container labels. This implies that human health and the environment could be affected in the area as most of the precautionary measures are not carried out to the letter. This agrees with the findings of Hilmer (2017), who opined that most rural farmers do not adhere to precautionary measures in the use of herbicides.

Tab 3: Distribution of Respondents on Adherence to Precautionary Measures in the Utilization of Herbicides

Variables	Mean	Remark
Knowledge in the application techniques, timing and dosage	1.33	Low
Use of recommended PPE (goggle, hand gloves, boot etc)	1.47	Low
Proper disposal of used container and unused mixture	2.84	High
Knowledge of proper operation of equipment and the calibrations	3.19	High
Understanding instructions on container label	1.24	Low
I have emergency plans (spill containment, clean up equipment etc)	1.24	Low
Observation of safe storage and transportation of herbicides	2.55	High
I don't eat, drink, talk during mixture and application of herbicides	3.21	High
Direction of the wind is observed during application	1.94	Low

Source: Field Survey, 2023 Mean (x) = 2.5

Relationship between Awareness and Compliance to Safe Utilization of Herbicides by Crop Farmers

Ho: There is no significant relationship between farmers' level of awareness and safe utilization of herbicides in the study area. The analysis between the awareness and safe utilization of herbicides as represented by Table 4 shows that there is a positive and non-significant relationship ($r = 0.72$; $p>0.05$) between awareness and safe utilization of herbicides by crop farmers, since p-value is above the significant level of This infers that the level of awareness by crop farmers on the dangers of unsafe utilization of herbicides is not proportionate with their level of compliance to safe utilization of the herbicides in the area.

Table 4: Chi-Square Analysis of the Relationship Between Awareness and Compliance to Safe Utilization of Herbicides by Crop Farmers.

	Value	df	Asymp.sig (2
Pearson chi square	0.358	0.0 5	0.715

Source: Field Survey, 2023

Conclusion

Although majority of crop farmers in Owerri-west Local Government Area apply the traditional method of weed control, it is evident that use of herbicides among the few crop farmers is not safe to the lives of the farmers and the environment. This is as a result inadequate skills and personal protective equipment, inability to understand instructions on the container labels among others by the farmers. Most of the precautionary measures in the use of herbicides are not usually adhered to by the farmers despite their high level of awareness on the problems of unsafe utilization of herbicides in the study area. Herbicide use is effective in weed control than the traditional method and ensues higher yields, but the

attitude of crop farmers in handling the herbicides is not safe for human health and the environment.

To ensure effective use of herbicides in the area, the following recommendations were made;

1. Opportunities should be provided for training and retraining of farmers in the safe use of herbicides in crop production, especially in inculcating the necessary skills, the need for personal protective equipment by the farmers etc. This should not be done only by the government but also by the chemical companies and non-governmental organizations in the study area.
2. There is a need for enhanced collaboration among suppliers' manufacturers, and users of herbicides to promote the safe and effective utilization of herbicides through the use of languages that can be easily be understood by farmers on the container labels
3. Sensitization on the proper disposal of used containers, unused mixtures and safe storage of herbicides is very imperative, this can be achieved through agricultural h extension services.
4. There is equally, the need to introduce locally Integrated Weed Management (IWM) practices due to low-level technology among the farmers

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