

Full Length Research Paper

Utilization pattern and risk assessment of herbicides usage by farmers, marketers and agricultural extension workers (AEWs) in Plateau State, Nigeria

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This research involved carrying out a field survey using a semi structured questionnaire which assessed the practice and risk involved in the usage of herbicides by farmers, marketers and agricultural extension workers using field surveys for two seasons starting in June 2010. The parameters of interest in the survey are: assessments of the level of understanding of these groups of people on the toxicity of the herbicides, precautions taken and basic health symptoms experienced during or after handling the herbicides. The survey was done using the local languages to ensure that all target groups understand and make realistic contributions. The outcome of the survey indicates that 5 herbicides which include: atrazine, paraquat, glyphosate, 2,4-D-Amine and Pendimethalin, are the most frequently used within the study area. Lack of awareness of the risk involved on exposure to these chemicals substances exposed a good percentage of the users to the chemicals, either when spraying or packaging the products; this informs why the low percentages (15%) of understanding of the basic precautions needed to handle the herbicides was observed among peasant farmers. The data collected were described using descriptive statistics. From the field survey, it was evident that more awareness and training need to be carried out on the usage of herbicides and other pesticides, most especially with the peasant farmers on the basic ethical practice and precautions needed in handling these classes of chemical farm inputs.

Key words: Herbicides, risk assessment, utilization, farmers, marketers, agricultural extension workers (AEWs).

INTRODUCTION

Herbicides account for over 50% of pesticides widely used in most agricultural production to prevent or inhibit the growth of weeds which in turn improve the yield and output of the farm products (Sattin et al., 1995; Zimdahl, 2002). They protect crops from undue competition from weeds and enhance the nutritional quality of foods. Out of

the total quantity of herbicides used, only small amounts generally get to the targeted weed either as pre-emergence or post-emergence, leaving majority of the residues in the environmental sectors (Cserhati, 2004). It is a very important chemical farm input that is gaining wide acceptance by majority of the farming population and relevant stakeholders in the area covered in this study.

The herbicides are widely associated with so many risks that can be hazardous if not properly managed and

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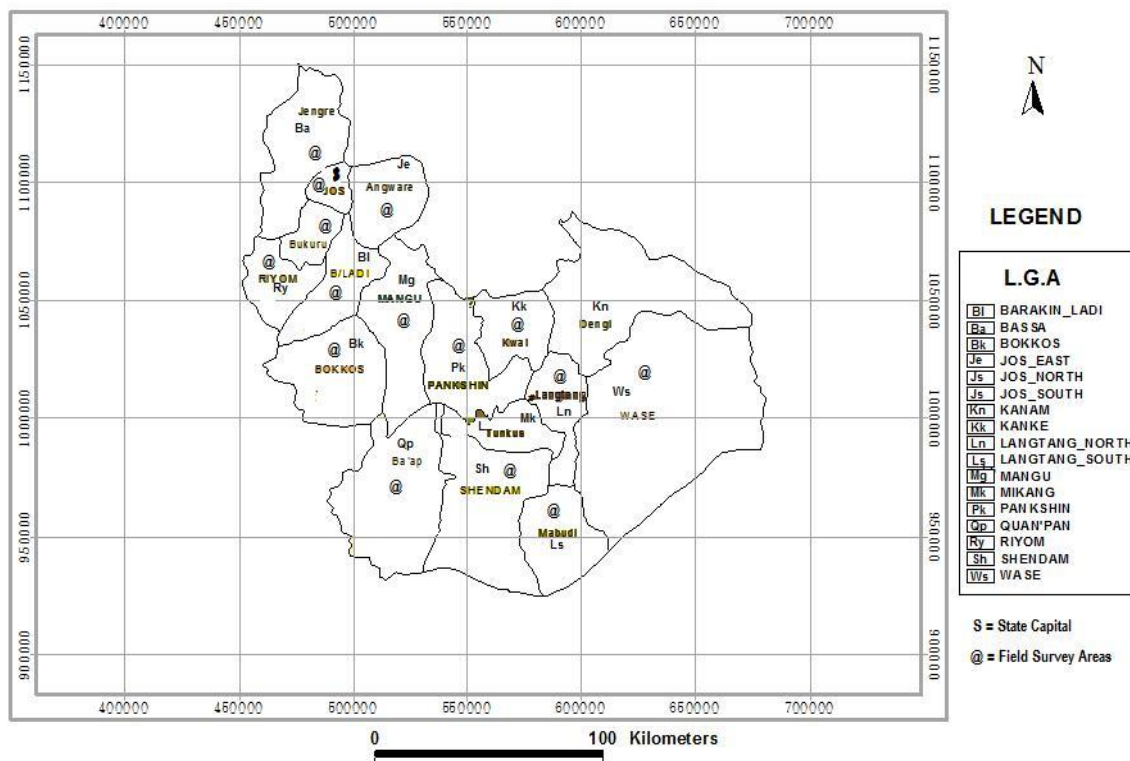


Figure 1. Map of Plateau State showing the places covered in the survey.

handled. The common risk associated with human beings includes: acute toxicity, chronic toxicity, carcinogenicity, tetragenicity and biological concentration. It is certain that human exposure to herbicides and other pesticides is an important health and social issue as it usually results in serious health challenges such as a respiratory disorder, strokes, epilepsy, cancer, leukemia, brain and liver tumours, convulsions, etc. Molecules of herbicides are more or less toxic, in that they represent not only an environmental risk but also a health risk (Manahan, 2000). There are reported cases of death as a result of exposure to herbicides and pesticides in other places (Pitmental et al., 1980).

Okopido (2002) observed that misuse and abuse of this class of chemical farm inputs are likely to be rampant in Nigeria due to inadequate education on the guidelines and control on safe use and disposal of used pesticides' containers and limited awareness about the lethal toxicity of the chemicals. Tijani (2006) also confirmed the fact that widespread but poorly regulated and unsafe use of pesticides in developing countries like Nigeria coupled with the absence of adequate workers education and effective regulatory measures has led to concern about the impacts of these chemical farm inputs on public

health and particularly the exposure and poisoning of farmers and farm workers.

This work is aimed at investigating the pattern of the usage and the risk associated with the utilization of herbicides by farmers, chemical marketers and agricultural extension workers in Plateau State of Nigeria.

METHODOLOGY

Field survey

A semi structured questionnaire was designed and provided to elicit the required information in analysable form. The administration and retrieval of the questionnaire were done in line with the methods adopted by the Raw Materials Research and Development Council (RMRDC) Multidisciplinary Task Force (MTF) survey (2007).

The State was divided into three zones covering the 17 Local Government Areas (LGAs) to ensure effective coverage of the state (Figure 1). The zones are:

Zone I: Northern (Bassa, Jos East, Jos South, Jos North, Riyom and Barkin Ladi);

Zone II: Central (Bokkos, Mangu, Pankshin, Kanke and Kanam);

Zone III: South (Langtang North, Langtang South, Mikang, Shendam Quanpan and Wase).

The survey started in June 2010 focusing on three categories of stakeholders who have direct involvement with herbicides. These include: farmers, chemical marketers and agricultural extension workers (AEWs).

Mindful of the dynamics of the culture and tradition of the various ethnic groups in the state, the commonly used languages spoken by the people which include: Angas, Mwaghavul, Mushere, Ron, Ankwai, Pan, Berom and Hausa Languages were used as a medium of communication, except for the AEWs in which English language was widely used as the medium of communication.

The difficulty of speaking other languages was overcome by hiring interpreters who were guided on what the study aims to achieve to mediate and translate the questionnaires to respondents before taking note of their responses.

The farmers were located at their farmlands while marketers were contacted in their chemical stores or business areas. The AEWs were contacted in their offices which is scattered in zones and area offices within the state.

Out of 300 questionnaires designed and administered comprising 170, 70 and 60 numbers targeted for farmers, marketers and AEWs respectively, the total numbers of questionnaires retrieved were 240 which comprise 158 farmers, 52 marketers and 40 AEWs. This maximal retrieval was possible because the exercise was structured to be by on-the-spot administration and retrieval which further allowed room for wide interaction with the target groups on other issues even beyond the scope of the survey.

Three different questionnaires were designed to address the specific operations of each of the potential group of respondents which include:

Farmers

Survey of the usage and knowledge of toxicity of herbicides among farmers in Plateau State: The information solicited for in their questionnaires are information on their age, literacy level, years of exposure to herbicides, knowledge of the use of herbicides and their toxicity, precautions, and symptoms experienced as a result of using the herbicides. The respondents here include farmers that use herbicides either directly or indirectly through the commercial herbicides sprayers and the sprayers.

Marketers

Survey of the usage and knowledge of toxicity of herbicides among agro chemical marketers in Plateau State: The information solicited for include: age, sex, profession, literature, toxicity knowledge and understanding of precaution tips. The respondents include proprietors and staff that supply the herbicides, work in the warehouse, stores and other field market outlets.

AEWs

Survey of the understanding of the knowledge of toxicity of herbicides among AEWs in Plateau State:

The information solicited for here are the age, experience, challenges encountered in relating to farmers about the herbicides, knowledge of use and precautions of the herbicides' handling. The respondents here include the technical staff comprising Agronomists and Extension staff who are widely believed to influence farmers and their farming practice within the area covered by this study. The data collected were described using descriptive statistics as listed in study's Tables.

RESULTS AND DISCUSSION

The demographic characteristics of the farmers, marketers and agricultural extension workers (AEWs) in the study area are shown in Table 1. These are characteristics that are widely believed to influence the effective utilization of the herbicides by these groups who are in regular contacts with the herbicides, most especially during the farming seasons. From the table, out of the total number of farmers interviewed who handled the herbicides, 100% of the farmers (158) were male and none was a female. Out of the 100%, 70% are young men within the age of 15-39 years who are found to be the ones to be involved in either actively spraying the herbicides in farms or marketing the products within the study area. More unschooled (illiterate) peasant farmers with a statistic of about 56% are more involved in the herbicides' utilization. Similarly, most of those reported to be handling the herbicides started doing that in less than 5 years from when this research was conducted. More farmers and marketers believe the herbicides are only slightly toxic while 100% of the AEWs are of the opinion that the herbicides are highly toxic.

Table 3 provides the list of symptoms experienced on exposure to herbicides in which 70 (25.90%) of farmers encounter respiratory related symptoms which include one or combination of more than one of the following: irritation, coughing, choking and tight chest. This is similar to what is experienced by marketers numbering

Table 1. Demographic characteristics of the users of herbicides (farmers, marketers and AEWs) in Plateau State.

Characteristics	Farmers (n=158)	Marketers (n=52)	*AEWs (n=40)
Gender			
Male	158 (100%)	39 (75%)	23 (70 %)
Female	0 (0%)	13 (25%)	12 (30%)
Age			
<15 yrs	12 (7.56%)	05 (9.60%)	0(0%)
15-23 yrs	50 (31.50%)	20 (38.40%)	0(0%)
24-39 yrs	70 (56.70%)	18 (34.56%)	12(30%)
> 40 yrs	26 (16.38%)	09 (17.44%)	28(70%)
Education			
Literate	68 (42.84%)	49 (94.08%)	40 (100%)
Illiterate	90 (56.70%)	03 (5.92%)	0(0%)
Exposure			
Direct	128 (80.64%)	45 (86.40%)	18(45%)
Indirect	30 (19.36%)	07 (13.60%)	22(55%)
Duration of herbicide use			
≤5 yrs	133 (83.79%)	43 (82.56%)	0(0%)
≥ 6yrs	25 (16.21%)	09 (17.44%)	40 (100%)
Farm location			
Fadama	30 (18.90%)	-	0(0%)
Upland	70 (44.10%)	-	0(0%)
Both	58 (32.00%)	-	40 (100%)
Comment on herbicides toxicity			
No effect	30 (18.90%)	04 (7.68%)	0(0%)
Slightly toxic	80 (50.40%)	28 (53.76%)	0(0%)
Highly toxic	48 (30.70%)	20 (38.56%)	40 (100%)

*AEWs = Agricultural Extension Workers.

55 (35.75%) out of 155 samples. They encounter respiratory related symptoms on exposure to the herbicides while in their business premises. More marketers with a total of 80 (52%) people encounter haematological symptoms which have to do with tiredness and weakness (anaemia). For AEWs, 25 (22.50%) encounter more neurological (headache, dizziness, confusion, depression, comma, convulsions) symptoms on exposure to the herbicides and other pesticides. Table 4 shows the results for the test of the knowledge of precautions and extents of compliances of all the groups to the precautions required to handle the

herbicides. Majority of the farmers, marketers and the AEWs (80, 60 and 30%, respectively) know and comply to a maximum of only 3 precautions, and on a worst scenario quite a number of them do not know about any of the precautions not to talk of complying in handling the herbicides.

The investigation of herbicides use and practice among farmers, marketers and agricultural extension farmers (AEWs) in Plateau State showed that six herbicides are frequently used for the control of weed by farmers within the state. These include: atrazine, 2,4-Dichloro phenoxy acetic acid, paraquat, glyphosate, pendimethalin and

Table 2. Assessment of the awareness of herbicides toxicity among farmers, marketers and AEWs in Plateau State.

Herbicides	Farmers (n=158)		Marketers (n=52)		AEWs (n=40)		OT*
	No. used	Use (%)	No. used	Use (%)	No. used	Use (%)	
Paraquat-I	44	28.16	20	38.42	4	10.00	VIII
Glyphosate-II	35	22.40	15	28.80	13	32.50	I
Atrazine-III	28	17.92	4	7.68	16	40.00	III
Pendimethalin-IV	17	10.88	-	-	-	-	VI
Propanil-V	19	12.16	3	5.76	4	10.00	IV
Butachlor-VI	05	3.20	3	5.76	-	-	II
Oxidiazone-VII	05	3.20	5	9.60	-	-	V
2,4-DAmine-VII	05	3.20	2	3.84	3	7.50	VII

OT* = Order of Toxicity by the World Health Organization (WHO).

propanil. From Table 1, 100% of the 158 farmers interviewed used herbicides out of which about 88.22% of them are young adults within the age limits of 15-39 years. About 56% of the farmers are illiterates who cannot read or write English language, being the language of instructions in which herbicides' labels are written; at best it was observed that only very few of the farmers can read Hausa language with high dependence on the agrochemical suppliers for directive on how to use the herbicides. 83.79% of the farmers started handling and controlling the herbicides weeds in their farms not exceeding five years with very few having a history of long time exposure beyond five years (16.21). Over 50.40% believe that herbicides is not anything to be too cautious about since it is only slightly toxic; this understanding influenced them not to pay much attention to basic precautions required in handling the agrochemicals. Interviews based on the farming practice indicate that 44.10% of the farmers farmed in upland farms which were done only during the rainy season, while a good number of them were involved in farming at both the *fadama* and upland farmlands.

Similarly, out of 52 chemical marketers and 40 AEWs respondents interviewed, 75% of the marketers and 70% of the AEWs are males which confirm that more males are likely to be exposed to the herbicides, and this further agrees with a similar work carried out by Udoh and Umoh (2011). In their work, 55.7% of the respondents were males while 44.1% were females which attest to the fact that more men are involved in farming and likely to go out to source for pesticides. The literacy level of the AEWs informed why their understanding of the toxicity agrees with WHO classification charts of most of these herbicides (Tables 2), in which over 80% of the respondents acknowledge that paraquat, glyphosate and atrazine are more toxic among the six most frequently used herbicides within the study area. Both the marketers

and AEWs agree that pendimethalin is not toxic at all as none of these groups indicated that it is toxic. This understanding does not agree with a similar study reported by Koi et al. (2002) which reveal that pendimethalin is persistent and its half life is 98 days at 30°C, often classified and non leaching compound. Toxicological report of pendimethalin shows that pendimethalin causes liver and kidney damages and a number of mutagenic effects (Dimitro et al., 2006). There is a need for awareness to be created on the chemical characteristics behavior of this herbicide which is fast gaining wide acceptance among the users.

The outcome of the assessment of the symptoms experienced on exposure to the herbicides by farmers, marketers and AEWs as shown in Table 3, indicate that majority of farmers encounter respiratory (25.9%), neurological (16.65) and dermatological (25%) related symptoms on exposure to the herbicides, while marketers experience more haematological (52%) and respiratory (35.75%) cases. The AEWs who are more involved with farming/farmers have related symptoms of neurological (22.5%), dermatological (31.5%) and respiratory (13.5%). This agrees with the results of a related work in Bolivia by Jors et al. (2006) in which the most frequent symptoms mentioned by the sprayer of pesticide were headache, dizziness and tiredness. The only difference is in the blurred vision and vomiting experienced on exposure to certain pesticides by the Bolivian farmers while the farmers in Plateau does not experience such symptoms.

The survey of the precaution factors and adherence to it will help in averting the risk of ingesting some of these herbicides shown in Table 4, from which 56.7% of farmers indicated that they blow or suck the nozzles of knapsack sprayer with their mouth when obstructed with particles. Indiscriminate throwing away of empty herbicides containers in the field or water ways is a common practice among farmers within the study area. In

Table 3. Assessment of symptoms experienced on exposure to herbicides by farmers, marketers and AEWs in Plateau State.

S/N	Toxicity category	Common symptoms	Organs affected	Farmers (n=270)	Marketers (n=155)	AEWs (n=90)
1	Respiratory	Irritation, coughing, choking, tight chest	Nose, trachea, lungs	70 (25.90%)	55 (35.75%)	15 (13.50%)
2	Gastrointestinal	Nausea, vomiting, diarrhea	Stomach, intestines	15 (5.55%)	05 (3.35%)	05 (4.5%)
3	Renal	Back pain, irregular urination (more or less)	Kidney	15 (5.55%)	05 (3.35%)	0 (0%)
4	Neurological	Headache, dizziness, confusion, depression, coma, convulsions	Brain, spinal cord	45 (16.65%)	0 (0%)	25 (22.50%)
5	Hematological	Aneamia (tiredness, weakness)	Blood	0 (0%)	80 (52%)	10 (9%)
6	Dermatological	Rashes, itching, redness, swelling	Skin, eyes	70 (25%)	10 (6.7%)	35 (31.5%)
7	Reproductive	Infertility, miscarriage	Ovaries, testes, fetus	0 (0%)	0 (0%)	0 (0%)
8	No Effect	Unknown	Unknown	55 (20.35%)	5 (3.25%)	0 (0%)

*AEW = Agricultural extension workers.

Table 4. Assessment of precaution factors important for intoxication of humans and pollution of the environment when herbicides are handled by farmers, marketers and AEWs in Plateau State.

S/N	Precaution factor	Positive answers (%)		
		Farmers (n=158)	Marketers (n=52)	AEW (n=40)
1	Using gloves when handling herbicides	05(3.15)	25 (48.00)	30 (75.00)
2	Using boots when handling herbicides	06(5.55)	05 (9.60)	20 (50)
3	Using mask/handkerchief when handling herbicides	15(3.70)	26 (49.92)	32 (80.00)
4	Washing hands after handling herbicides	15(9.45)	41 (78.72)	35 (87.50)
5	Washing the body after handling herbicides	20 (12.60)	41 (78.72)	35 (87.50)
6	Changing clothes after handling herbicides	20 (12.60)	40 (76.80)	38 (95.00)
7	Chewing, smoking or eating when spraying herbicides	25 (15.75)	21 (40.32)	08 (20.00)
8	Entering a field the same day herbicides are sprayed	06(3.78)	-	10 (25.00)
9	Blowing or sucking the nozzle of knapsack sprayer when abstracted	90 (56.70)	-	05 (12.50)
10	Mixing herbicides at the border of a river or a well	17 (10.71)	-	38 (95.00)
11	Washing herbicides containers at the border of a river or a well	120(75.60)	-	38 (95.00)
12	Throwing empty herbicides container in field or water ways	150(94.50)	-	20 (50.00)
13	Spray drift caution effect	121 (76.23)	41 (78.72)	40 (100.00)
14	Using eyes protection glass when spraying	05(3.16)	40 (76.80)	35 (87.50)
15	Drinking of milk before and/or after spraying	158(94.50)	52 (100.00)	40 (100.00)

*AEW = Agricultural extension workers.

some cases, the cans are used by farmers and villagers as drinking water bottle probably after the users believe they must have washed them enough for such uses. Majority of the peasant farmers only rely on what the marketers tell them and occasionally the AEWs give them some basic precaution tips and how to handle the herbicides. When analysing the protective behaviour of the farmers one by one, most of the farmers (80%) and marketers (64%) only adhere to less than 3 precautions when handling herbicides. One of such precaution which is widely practiced by the farmers is drinking of milk after spraying the herbicides. Most of them drink cow milk in the absence of peak milk which is not readily accessible to the farmers.

SUMMARY AND CONCLUSION

The use of herbicides in the study area is gaining wide acceptance as it has helped in increasing food production within the study area. However, it was noted that low level of literacy and lack of technical know-how on the proper usage of the herbicides resulted in indiscriminate use of the herbicides within the study area and if not properly addressed, the used of these chemical farm inputs may in the long run be a threat to public health. The underlisted points were observed during the field survey:

- Some health risk practices such as spraying the herbicides without safety kits like gloves, nose mask, safe boot, etc., are a common practice.
- Many users of the herbicides complain of experiencing haematological, respiratory, neurological and dermatological related symptoms after using the herbicides. Few farmers and the chemical marketers claim that they do not have any side effect.
- Containers of used herbicides were widely used by the users for drinking water and the storage of other consumables drinks.
- Users are not mindful of the likelihood that the residues could spill or sip into their drinking water which is mostly from the ground water source. The common practice is the use of herbicides to kill the grasses within residential houses without minding the water that may be contaminated in the process.
- Herbicides like 2,4-D are used by the farmers to rub the surface of the cuts and blisters believing it heals the wound without minding the toxicity factor.
- There are reported cases of people and animals dying on exposure to herbicides like paraquat and 2,4-D within the study area.
- Men and youths are observed to be at higher risk of exposure because they handle the herbicides most of the time.

- Herbicides solutions splashing on the body of sprayers resulting in surface wounds was widely observed by the farmers.

- Six herbicides were frequently used for control of weed by farmers within the state. These include: atrazine, 2,4-D-Amine, paraquat, glyphosate, pendimethalin and propanil. This information guide in the sampling and chemical analytical determination of the herbicides residues concentrations within the environmental sectors.

It is not arguable in any way that herbicide discovery is a major breakthrough towards enhancing agricultural development. However, for its contributions to be holistic, no effort should be spared towards ensuring that all the stakeholders handling and using it are able to adhere strictly to the precautions expected. Training, awareness creation and pesticides instruction labels to be written in local languages are the major recommendations made in this work.

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