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Assessment of the Risks and Health Hazard Involved in the Use of Agrochemical among Vegetable Farmers in Jama'are River Basin of Jama'are Local Government Area of Bauchi State

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Abstract
The objective of this research is to access the risks and health hazards associated with the use of agrochemicals in the cultivation of vegetables by farmers in the Jama'are River Basin in Jama'are Local Government Area of Bauchi State, Nigeria. The survey inferential design research design was adopted for the study. Purposive sampling technique was employed for the selection of the study villages, while simple random sampling technique was used in selecting thirty households. The study household inclusion criteria were farming, use of agrochemicals and willingness to participate in the study. A total of 30 households from the selected villages were sampled for the study. The number of selected households varied between villages because of differences in populations and number of people involved in vegetative farming activities. Data for the study were collected through the use of structured interview schedule. The information collected included respondent's socio-demographic variables, uses of agrochemicals, sources of information on the use of agrochemicals, their perception and effects of agrochemicals on human health. Data collected for the study were arranged, coded and analyzed through the use of descriptive and inferential statistical tools such as frequency counts, percentages, mean and standard deviation. Findings indicated that poor educational background could partly contribute to the major health effects recorded in the area since 26.7% of the farmers were primary school leavers and up to 40% of them had no formal education who might not be able to read or understand agrochemicals labeling and instructions on use since are written in English..The study also revealed poor awareness (77 %) regarding the harmful effects of agrochemicals among the farmers. The practice of mixing agrochemicals with bare hand (73.3%), throwing away of containers (63.3%), using containers for household purposes (56.7%) and the assumption that agrochemicals won't do anything (50%) appears to be widely prevalent in the study villages. The implication is that there will be serious side effects of agrochemicals in the area since they have direct contact with the chemicals. Despite adequate awareness of safe agrochemicals management by agrochemicals vendor and extension agents, most of the spray-workers were observed to be reluctant to put this knowledge into practice. Only spraying chemicals which should not be directed towards the direction of air (M = 4.07) and bath immediately after spraying of chemicals (M = 4.00) were considered as important precautionary measures against the use agrochemicals. Most of the farmers experienced loss of appetite (90%), dizziness (70%), body itching (66.7%), headache (56.7%) and difficulty in breathing (53.3%) more often following the use of agrochemicals on their farms. Improvement on educating farmers on the use of agrochemicals in appropriate, less risk-related methods, side effects associated with the use of agrochemicals, dangerous habits associated with health risks and the importance of protective measures of agrochemicals especially personal protection equipment and strict laws on the purchase and use of agrochemicals in farming communities should be put in place so as to reduce exposure of farmers and passive individuals to agrochemicals.
Key words: Agrochemicals, Jama'are, vegetables, health effects, environmental effects.

Introduction

Heavy use of toxic pesticides in agriculture worldwide has raised serious concerns about health issues. The World Health Organization (WHO) estimates that acute pesticide poisoning (APP) affects three (3) million people and accounts for 20,000 unintentional deaths per year, with 90 percent of these fatalities believed to be in developing countries (Kesner and Pierre, 2015). Similarly, many of

the chemical pesticides can have harmful effects on human beings either as acute or chronic toxicity. Acute exposure to pesticides can lead to death or serious illness. Rakesh, et. al. (2013) reported that 355,000 people die globally each year due to unintentional acute poisonings. Two-thirds of these deaths occur in developing countries where such poisoning are associated with excessive exposure and or inappropriate use of toxic chemicals and pesticides present in occupational and domestic environments. The cumulative health impacts of human exposures to various agrochemicals can be a factor in a range of chronic health conditions and diseases like cancer, reproductive, endocrine, immunological, congenital and developmental disorders. Ogunjimi and Farinde (2012) in their findings reported that in Edo State, health related problems associated with the use of agrochemicals include tearing and redness of eye, body itching, lack of muscle coordination, yellowing of skin, cough and difficulty in breathing.

Problem of pests and diseases in the study area have resulted in poor or low crop yield which have made the farmers to engage in the use of pesticide and other agrochemicals. The problem is serious in areas where irrigated farming is practiced because of multiple cropping and their susceptibility to insect pests (Nonga, et. al. 2011). Vegetable farming is highly practiced in the Jama'are river basin who frequently use agrochemical without knowing their risks on human health and the environment. Because of its soil fertility, shallow water level and arable irrigatable land, the Jama'are river basin has recently attracted many immigrants from all parts of the northern Nigeria especially neighboring states such as Jigawa, Plateau, Yobe, Kano and Kaduna States. Irrigation and grazing along the flood plains (Fadama lands) occur throughout the dry season Abdullahi, et al. (2014). While increased agriculture and agrochemical uses are generally considered a panacea for farmers' to increased production, farming practices, use of the agrochemicals and possible environmental pollution and health hazard from vegetable farming in the basin has not been investigated.

The current study was conducted to assess the risk of agrochemicals utilization among vegetable farmers and their possible pollutions to the environment and human health. It is envisaged that information presented in this study will contribute to our understanding of agricultural situation in the river basin and the possible types of agrochemical pollutions released to the environment and the risk involved in their usage to human health. This may be useful as baseline information for sustainable agriculture, identify specific constraints and opportunities for appropriate and sustainable agriculture in the basin aimed at increased production and safeguard the public health and conservation of the basin. The broad objective of the study is to assess the risks and health hazard of agrochemical among vegetable farmers in Jama'are river basin of Jama'are Local Government Area (LGA). Specifically, the study will seek to:

i. identify the common practices regarding the use of agrochemical in agriculture,

ii. ascertain the common sources of information on the effects of agrochemical on human health,

iii. assess the perception of farmers on the precautionary measures regarding the use of agrochemical and,

iv. identify the major health effects involved in the use of agrochemical

Methodology

Study area

The study was carried out in Jama'are LGA of Bauchi State, Nigeria. Its headquarters are in the town of Jama'are. It has an area of 493 km² and a population of 117,883 at the 2006 census and 2947.075 by 2017 at population growth rate of 2.5%. Its geographical coordinates are 11^0 40' 0" North, 9^0 55' 53" East longitude. It is populated by a Fulani tribe that migrated from Dulare in the Lake Chad basin in the Republic of Chad. The town is situated along the Jama'are River, which is a tributary of the Katagum, and at the intersection of roads leading from Wudil, Azare, and Faggo. Most of the inhabitants of the emirate are members of the Fulani, Shirawa, Kanuri, or Hausa peoples. They cultivate peanuts (groundnuts), cotton, sorghum, millet, cowpeas, and vegetables, which they grow on the floodplain; they also keep goats, cattle, sheep, donkeys, and horses. The Hadejia–Jama'are River Basin Development Authority was created in the late 1970s to improve agricultural productivity in the area (https://wikivividly.com/wiki/jama'are).

Purposive sampling technique was used for selection of the study villages because they were within Jama'are basin and accessible. Simple random sampling technique was used for households' selection from where respondents were recruited. Information from village leaders and agricultural extension officers were used to generate a list from which the sampling of households was used. The study household inclusion criteria were farming, use of agrochemicals and willingness to participate in the study. A total of 30 households from the selected villages were involved in the study. The number of selected households varied between villages because of differences in populations and number of people involved in vegetative farming activities. Data for the study were collected through the use of structured interview schedule. The structured interview schedule used covered different topics so that relevant information related to the study objectives was captured and these were translated to Hausa (the local language). The information collected included respondent's socio-demographic variables, uses of agrochemicals, sources of information on the use of agrochemicals, their perception and effects of agrochemicals on human health. Data collected for the study were arranged, coded and analyzed through the use of descriptive and inferential statistical tools such as frequency counts, percentages, mean and standard deviation.

Results and discussion

Sex

Data in Table 1 shows that all the respondents were male (100%). This is based on the belief and culture of the communities that women are considered for domestic and household service only. This implies that vegetable farming in the area is dominated by men who are most likely the bread winners of their homes. Also, in Northern Nigeria farming activities are considered as male occupation. Women are in charge of cooking in the kitchen and to take care of the young ones at home. The finding is in agreement with the findings of Ogunjimi and Farinda (2012) who reported that more men are involved in the use of agrochemical in Osun and Edo States.

Age

Table 1 shows that a greater proportion (30.0%) of the agrochemical users were between 33 to 42 years of age, 23.3% of these farmers were between 43 and 52 years of age The average age of the farmers was 48 years. The average age (48years) of the respondents implies that these farmers were still in their middle age and as such are in their active years. This could offer them the privilege of being able to be effective in various forms of agrochemicals application and other farming activities as a means of livelihood for them and their households. Also, the application of agrochemicals is tedious and requires extra strength to carry the knapsack sprayers.

Educational level

Table 1 reveal that a greater proportion (40.0%) of the respondents had no formal education, 26.7% (8 persons) of them have completed their primary school education and 16.7% (5 persons) of them have Quaranic education. This result reveals that most of these farmers have no formal education that will enable them read and understand hazards involved in the use of agro chemicals.

Farming Experience

Entries in Table 1 reveal that 30.0% of the farmers had 3 - 5 years of farming experience, 23.3% of them had farming experience of between 6 - 9 years while 20.0% of them had between 10 - 15 years of farming experience. The average years of farming experience among these farmers was 33 years. This implies that these respondents have a good number of years of experience which could serve as an advantage for better adoption of new techniques such as the use of fertilizer and other agrochemicals in controlling weeds and insects. This finding agrees with the assertion of Adebayo (2014) that long farming experience could influence farmer's willingness to learn and adopt new techniques.

Experience in agrochemical usage

Entries in Table 1 reveal that greater proportions (46.7%) of the farmers have less than 8 years of experience, 33.3% of them have agrochemical experience of between 8 - 12 years while 13.3% of them have between 18 - 22 years of experience. The average years of work experience among the agrochemical users was 9 years. This implies that the farmers have reasonable number of years in using agrochemicals which is enough for them to know more about the harmful effects of agrochemical. This result confirms the findings of Issa, (2016) that individuals with more experience in using agrochemicals would likely understand the quality, quantity, usage perhaps reflecting their experience.

Table 1: Socio economic characteristics

Variables	**Frequency**	**Percentage**	**Mean (SD)**
Sex			
Male	30	100	
Female	0	0	
Age (years)			
23-32	3	10	48.3 (13.86)
33-42	9	30	
43-52	7	23.3	
53-62	6	20.0	
Above 62	5	16.7	
Educational level			
No formal education	12	40.0	
Primary school	8	26.7	
Secondary school	1	3.3	
Quaranic education	5	16.7	
Adult education	4	13.3	
Farming experience			
0 – 2	3	10.0	33.23 (13.7)
3 – 5	9	30.0	
6 – 9	7	23.3	
10 – 15	6	20.0	
16 – 21	4	13.3	
Above 21	1	3.3	
Experience in agrochemical usage (years)			
3-7	14	46.7	8.90 (5.3)
8-12	10	33.3	
13-17	2	6.7	
18-22	4	13.3	

*Multiple responses

Common practices regarding the use of agrochemical

Table 2 revealed that a greater majority (93.3%) of the respondents mix their agrochemicals on the farm. While 73.3% uses bare hand to mix chemical before spraying their vegetable farm land Disposal of empty agrochemical containers was agreed by 63.3% that they threw away the containers, 56.7% used the containers for household purposes while about 56.7% usually left the containers in the farm without properly disposing them. poor awareness (77 %) regarding the harmful effects of agrochemicals among the farmers. The practice of mixing agrochemicals with bare hand, throwing away of containers, using containers for household purposes and the assumption that agrochemicals won't do anything (50.0%) appears to be widely prevalent in the study villages.Table 2 shows that a large proportion (77.0%) of the farmers acknowledged that they were not aware of agrochemical environmental effect. Also, very few (13.3% and 6.6%) uses protective clothes and gloves respectively. The implication is that there will be serious side effects of agrochemicals in the area since they have direct contact with the chemicals. This is because farmers, who mix, load, and spray agrochemicals can be exposed to these chemicals due to spills and splashes as a result of faulty or missing protective equipment, or even drift. A related study by Bassi, et al (2016) confirm that exposure to the chemicals such as mixing agrochemical with bare hand and using containers for households purposes contributes to the possibility of developing serious side effects such as body itching, headache, vomiting and redness of the eyes. This also confirms the findings of Christos et al (2016) that pesticides can enter the human body by three common ways: through the skin (contact), the mouth (ingestion), and the lungs (inhalation). The state of the chemical, *i.e.*, solid, liquid, or gas, affects the chances of pesticide penetration into the body. Liquid or gas products can get into the body through all three routes of entry, whereas solids tend to have a lower chance of entry through the lungs. However, if solid particles of the pesticide are small enough or if they remain on the skin long enough, penetration into the body can take place in the same ways as those of liquids or gases. The most common pathway for pesticide poisoning among common users is absorption through the skin. Dermal absorption may occur as a result of splashes and spills when handling (mixing, loading or disposing of pesticides. To a minor degree, dermal absorption may occur from exposure to great load of residues. The degree of hazard by dermal absorption depends on the toxicity of the pesticide to the skin, the duration of the exposure, the pesticide formulation, and the body part contaminated Christos et al (2016).

Table 3 shows that 83.3%, 70.0% , 46.7% and 43.3% of the respondents sourced information from agrochemical vendors, fellow farmers, market and extension agents respectively. This agreed with the findings of Nonga, et al (2011) that the knowledge on the type, handling and applications of pesticides to most of the respondents (75%) was obtained from the agrochemical shop owners. The respondents also sourced information from the Non-Governmental Organizations (NGOs) (33.3%) and radio (16.7%).

Table 2: Frequency and percentages of common practices regarding the use of agrochemicals

Method of mixing chemical	Frequency	Percentage
i. Use stick	12	40.0
ii. Use bare hand	22	73.3
iii. Use hand gloves	8	26.7
Place of mixing agrochemicals		
i. At home	2	6.7
ii. In the farm	28	93.3
Disposal of empty sachets/tins		
i. Throw away	19	63.3
ii. Buried	4	13.3
iii. Use for household purposes	17	56.7
iv. Left in the farm	17	56.7
v. Burnt	4	13.3
vi. Give to rag pickers	8	26.7
Cleaning immediately after spraying agrochemicals		
i. Bath or wash with soap and water	19	36.7
ii. Use water only	4	13.3
iii. Won't do anything	11	63.3
Personal protective equipment while applying agrochemicals		
i. Use gloves	02	6.6
ii. Use protective clothes	04	13.3
iii. Cover face with mask	0	0.0
iv. Use boot	03	10.0
v. Use all the above equipments	0	0.0
vi. Won't do anything	15	50.0
Knowledge on agrochemicals environmental effects		
i. Knowledgeable	7	23
ii. Not aware	23	77

*Multiple responses

Sources of information on agrochemicals effects on health

This result confirms the findings of Mokwunye *et al*. (2012) that the source of agrochemicals used by the farmers includes agrochemicals retailers, traders, fellow farmers and Agricultural Development Programmes (ADPs) extension agents who educate the farmers on the needs to use agrochemicals on the farm.

Table 3: Percentage of common sources of information on agrochemical use and effects on health

Source	Frequency	Percentage
Market	14	46.7
Agrochemicals vendor	25	83.3
Hospital and health units	0	0.0
Extension agents	13	43.3
Radio	5	16.7
Fellow farmers	21	70.0
Non-governmental organizations (NGOs)	10	33.3
Religious organizations	0	0.0

*Multiple responses

Farmers' perception of the precautionary measures regarding the use of agrochemicals

Table 4 shows that, despite adequate awareness of safe agrochemicals management by agrochemicals vendor and extension agents, most of the spray-workers were observed to be reluctant to put this knowledge into practice. Only spraying chemicals should not be directed towards direction of air (M = 4.07) and bath immediately after spraying of chemicals (M = 4.00) were considered as important precautionary measures against the use agrochemicals. Others such as it is not good to harvest immediately after spraying chemical (M = 2.63), burying or burning of empty chemical containers after spraying is necessary (M = 3.10) and wearing of protective clothes during spraying to prevent body exposure to chemicals is good to health (M = 3.43) were not perceived as serious precautionary measures by the spray workers hence will increase their risk to agrochemicals due to their negligence. Furthermore, Table 4 revealed that, a sizable fraction of these workers still had limited knowledge and erroneous risk perceptions in avoiding smoking during spraying chemicals which is injurious to health (M = 3.52), contaminated food during spraying should be buried (M = 3.53), washing of contaminated clothes immediately after spraying is necessary (M = 3.60) and drinking during spraying chemicals should be avoided because it is injurious to health (M = 3.80).

These explain the high occurrence of side effects experienced by these farmers since the duration of exposure to the chemicals contributes to the possibility of developing side effects (Christos, et al, 2016).

Table 4: Perception of farmers on the precautionary measures regarding the use of agrochemicals

Perception	Mean	Std. deviation
Eating during spraying chemical is injurious to health	3.97	1.03
Washing and cleaning spraying equipment is necessary after spraying	3.83	.91
Drinking during spraying chemicals is injurious to health	3.80	1.03
Smoking during spraying chemicals is injurious to health	3.52	.91
Spraying should not be directed towards direction of air	4.07	.82
Wearing of protective clothes during spraying to prevent body exposure to chemicals is good to health	3.43	.89
Washing of contaminated clothes immediately after spraying is necessary	3.60	1.03
Bath immediately after spraying of chemicals is necessary	4.00	.94
Burying or burning of empty chemical containers after spraying is necessary	3.10	.92
Contaminated food during spraying should be buried	3.53	1.13
It is not good to harvest immediately after spraying chemical	2.63	.80

Major health effects associated with the use of agrochemicals

Table 5 shows that most farmers experienced loss of appetite (90%), dizziness (70%), body itching (66.7%), headache (56.7%), tearing and redness of eyes and difficulty in breathing (53.3%) respectively. Other minor health effects include excessive sweating (30%), stomach cramps and fever (23.3%) respectively. This study confirm the findings of Bassi, et al (2016) who stated that most farmers experienced chest pain/tightness, cough, headache, dizziness, reddening of the eyes; sneezing and rheum more often in their study on agrochemical use and associated risk factors in Fadan Daji District of Kaura LGA, Kaduna State, Nigeria.

Table 5: Frequency distribution of major health effects involved in the use of agrochemicals

Symptom	Frequency	Percentage
Body itching	20	66.7
Tearing and redness of eyes	16	53.3
Lack of muscle coordination	3	10.0
Difficulty in breathing	16	53.3
Excessive sweating	9	30.0
Headache	17	56.7
Vomiting	3	10.0
Diarrhea	3	10.0
Stomach cramps	7	23.3
Yellow skin	2	6.7
Fever	7	23.3
Dizziness	21	70.0
Allergy	4	13.3
Dermatitis and conjunctivitis (inflammation of the skin)	0	0.0
Weakness of the sex organ	10	33.3
Loss of appetite	27	90.0

*Multiple responses

Conclusion and Recommendations

Assessment of risks in the use of agrochemiclas among vegetable farmers in Jama'are L.G.A. revealed that majority of the farmers were not educated as such understanding the instructions on the use of agrochemical was a major problem. Limited knowledge of agrochemicals on environmental health and limited extension services were factors for indiscriminate uses of agrochemicals. Improvement on educating farmers on the use of agrochemicals in appropriate, less risk-related methods, side effects associated with the use of agrochemicals, dangerous habits associated with

health risks and the importance of protective measures of agrochemicals especially personal protection equipment and strict laws on the purchase and use of agrochemicals in farming communities should be put in place so as to reduce exposure of farmers and passive individuals to agrochemicals. Increasing farmers' awareness and training aimed at sustainable agriculture, agrochemical uses and proper handling is suggested.

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