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Farmer's perception and safety adopted during pesticide application in vegetable fields: A Case study at Jessore district, Bangladesh

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ABSTRACT

With the modernization of agriculture, the role of insecticides has become intensely important and the farmers are mainly exposed to the health risk due to lack of maintaining the proper safety procedure during the pesticide application. The study aims at investigating the present pesticide application practices, farmers' knowledge and attitude toward pesticide application, identifying the problems regarding pesticide application and proposals for modification. To achieve these objectives a questionnaire survey was conducted in Abdulpur, Jessore and the data were analyzed in IBM SPSS (Statistical Package Software Spreadsheet). Pesticide use in the study area appears to be influenced by the local pesticide sellers and it is found that majority (96%) of the farmers are well aware of the harmful effect of pesticides but contrary to expectations, these do not significantly change their practices or attitude towards safe pesticide use. The survey also revealed that beneficial insects, birds and other animals may have been affected in the study area since the majority (74%) of the interviewees applied the pesticide at low pest densities. Farmers in this study generally demonstrated a poor knowledge of pesticide handling. An important finding of this study is that there are low levels of adoption of protective behaviors to reduce occupational exposure during pesticide application. To improve the situation comprehensive pesticide training program is needed and to reduce farmers' heavy reliance on pesticides in pest control, IPM (Integrated pest management) strategies should be implemented.

Key Words: *Pesticide application, Farmers' Perception, Safety Procedure, Environmental Protection*

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I. Introduction

Vegetables are very important group of crops and they constitute a major part of the diet contributing nutrients and vitamins. But most of vegetables those are grown in Bangladesh are attacked by insect due to modernization of agriculture which provide favorable climate of insects. Pests, including insects, mites, pathogens (disease causing organisms), weeds, nematodes, rodents and others significantly contribute to high farm production costs and reduce quality and yields (Henneberry *et al.*, 1991). The use of insecticides, however, carries several dangers. Non-optimal and non-judicious use of insecticides may result in serious problems related to crop production and certain externalities like pollution and health hazards. Pesticide poisoning is a major global health problem, and it is more prevalent in countries like Bangladesh. The harmful effects on human beings in the form of acute and chronic toxicity exposed to insecticides are well established. The incidence of pesticides poisoning is increasing, and it is estimated that about 5 million people die every year as a result of intentional, accidental and occupational exposure worldwide (Singh and Gupta, 2009). Both overuse and misuse of insecticides may lead to the loss of effectiveness of insecticides due to the development of resistance (Forrester, 1990) and could cause human health hazards through residue (Paul, 2003) on food and environmental pollution (Maclntyre *et al.*, 1989). On the other hand, inappropriate selection and improper spray scheduling of insecticide may failure in controlling insects (Phillips *et al.*, 1990). Vegetables were often grown close to the household, thus creating the potential for exposure of women and children. Vegetable plots were also often located next to waterways or ponds to facilitate irrigation, thus creating the potential for contamination. Finally, vegetables tend to be sprayed heavily up to the time of harvest, and then shipped directly to market with no waiting period; moreover, many are consumed whole. These create a very significant potential for pesticide residues causing negative health effects on consumers (Dasgupta *et al.*, 2006). Pesticides cause acute and chronic human health effects, contamination of atmospheric, ground and surface water (Howard *et al.*, 1991; Mullen, 1995; Matthews, 2006).

In Bangladesh many government and non-government organization are working in the field of agriculture. Several works have done on pesticide use impact on environment during vegetable production. Few farmers took protective measures: only 6% covered their faces to protect against inhalation, and 74% reported taking no safety measures at all. Accordingly, about half of vegetable farmers experienced sickness related to pesticide application, including vomiting, respiratory problems and skin or eye complaints. (Dasgupta *et al.*, 2005) Farmers were not ignorant of the dangers, however fully 75% knew that insecticides were harmful to themselves and others. This indicates that farmers use insecticides despite negative effects because the economic returns from vegetable cultivation are essential for their livelihoods, and they have no other options to protect their crop. The objective of this study was to identify farmers perception on pesticide application in vegetables fields at Abdulpur, Jessore as well as problems of pesticide application and proposal for modification.

II. Materials and Methods

Study Area

The study was conducted Abdulpur villages (Figure 01) belongs to Jessore Sadar Upazila. It has area of 435.41 sq km, located in between 23°04' and 23°20' north latitudes and in between 89°06' and 84°06' east longitudes. Main source of income is agriculture 35.09%, non-agricultural labourer 4.73%, industry 2.14%, commerce 21.17%, transport and communication 6.23%, service 17.31%, construction 2.57%, religious service 0.16%, rent and remittance 0.84% and others 9.76%. Landowner 49.68% and landless 50.32%, where agricultural landowner in urban 36.14% and in rural 55.91%. Main crops in this region are Paddy, potato, wheat, cotton, mustard, sugarcane, vegetables (Banglapedia, 2015).

Sampling Procedure

The farmers' pesticide use profiles were specified in terms of what practices are enacted, how much pesticides are applied, how farmers select, store, mix and spray pesticides and how they dispose of empty containers. Subsequently, the farmers' lifestyle which has an individual aspect because each person has not only his own unique ideas, beliefs, competences and identity, but also a collective aspect because social practices are always shared resulting in a common storyline. In order to

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generate sufficient information of the knowledge, attitude and practices regarding pesticide among farmers in Abdulpur, Jessore the technique of stratified random sampling was used to obtain cross-sectional data for this study.

A questionnaire is prepared for the survey. The sample size of the survey was determined by using Solvin's formula. The initial sample size is determined using the following formula:

$$n_o = \frac{Z^2pq}{e^2}$$

P = Degree of variability = 0.50 (assumed maximum variability)
And, let Degree of Variability is maximum that is 50%.
P = 0.5
As, q = 1 - P
So, q = 0.5
We will use 93 % confidence level. Z=1.75
e = Desired level of precision or sampling error = 8 % = 0.08

The sample size therefore, $n_o = \frac{(1.75)^2(.5)(.5)}{(0.080)^2}$ = 119.62= 120 nos

Considering maximum degree of variability and a confidence level of 92%, the sample size is 120 no. The farmers were selected randomly. As a result, a total of 120 farmers were selected randomly.

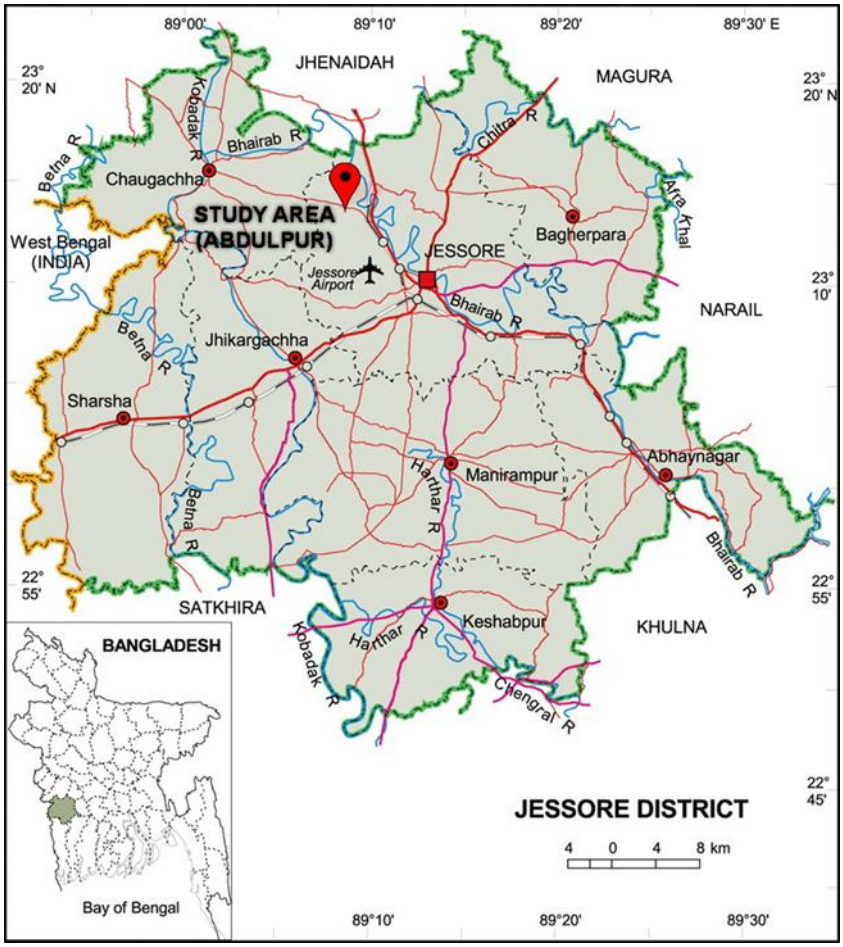

Figure 01. Map of Jessore District Showing Study Area

Collection of Primary Data

Data collection was conducted during the period of February-April 2018. The study utilized primary data collected among smallholder farmers. Diagnostic surveys, formal interviews, and field observations were used to gather information on farmers' knowledge of pesticides and safety practices. Questions were closed-ended questions in a single-choice or multiple-choice format and some questions demanded multiple answers.

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Collection of Secondary Data

Secondary data were collected from different sources. The information on farmer, area and population were collected from the Jessore Statistical Department. Information on various pesticide uses by Abdulpur farmer and picture of pesticide container was collected from pesticide shop near Abdulpur bazar and Churamonkathi bazar. A large amount of published papers, journal and reports were reviewed to understand the knowledge, attitudes and practices of Jessore vegetable farmers in Abdulpur area regarding pesticide use. Farmers' attitude regarding training on safe handling and practices of pesticide was collected from the department of agriculture Extension (DAE), Jessore.

Analysis of the Data

The questionnaire survey was reviewed after the interviews and the answers to each question were coded and entered in SPSS. SPSS is a software package used for logical batched and non-batched statistical analysis. The current versions (2015) are officially named IBM SPSS Statistics. SPSS is a widely used program for statistical analysis in social science.

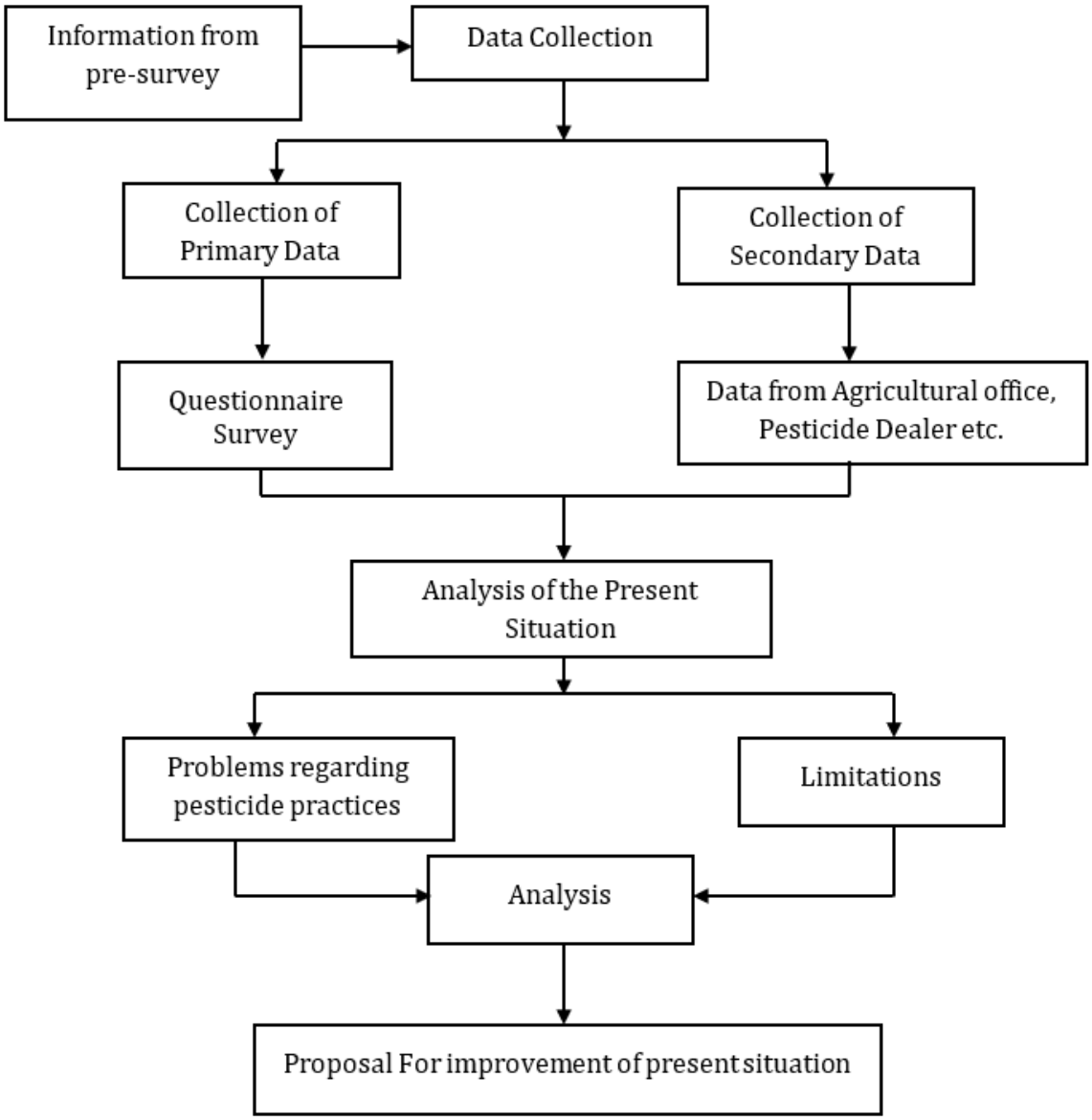

Figure 02. Flow Chart of Methodology

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III. Results and Discussion

Demographic Characteristics and Profile of the Farmer

For this study 120 small-scale farmers were surveyed in the study area. Among them 88.6% were male and 11.4% were female (Figure 03). The farming activities especially those related to pesticide use are performed exclusively by men in Jessore, Abdulpur. The age structure of farmers revealed that 20.83% were less than 30 with average age of 25. 26.67% were in between 30 to 40 with average age of 36. The majority (52.5%) of farmers was above 40 years old with an average age of 45 (Figure 03).

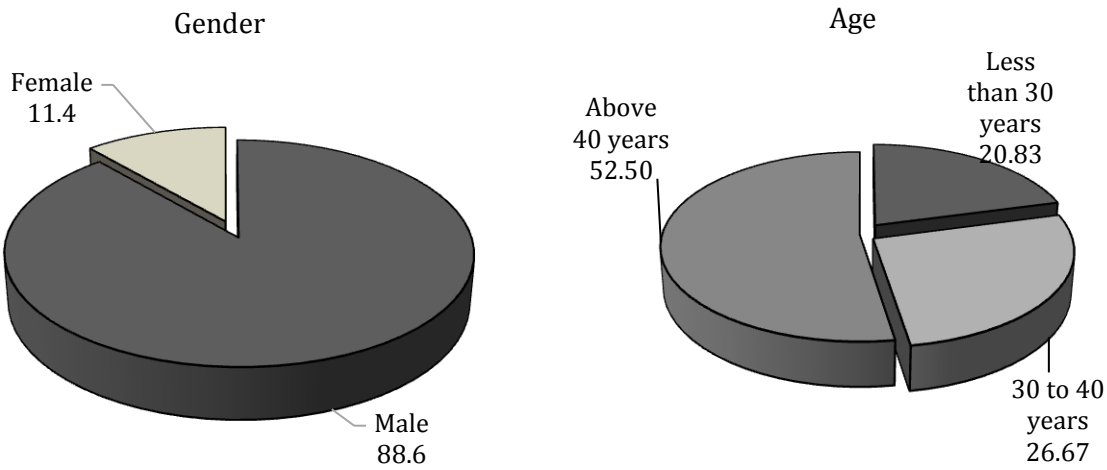

Figure 03. Categories of Surveyed farmers by age and gender

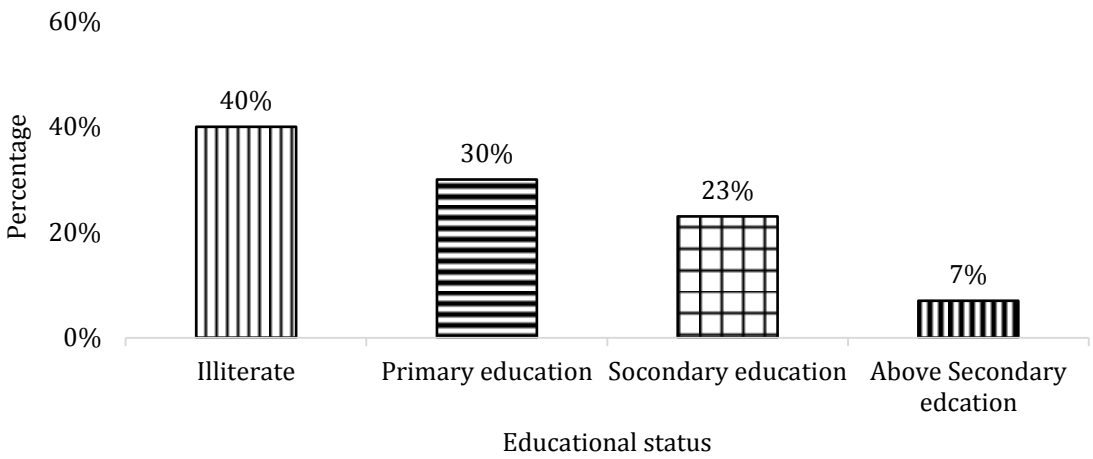

Figure 04. Categories of Surveyed farmers by literacy rate

Literacy rate of farmers depicts that 40% were illiterate, 30% had received primary education, secondary 23%, and 7% were received higher secondary education (Figure 04). Kabir and Rainis (2012) reported that in case of the educational level, the mean year of schooling was 5 which are below secondary education.

Figure 05 that shows most of the respondents (40%) had above 15 years of farming experience, 27% having 11-15 years of farming experience, 15% between 1-5 years of farming experience, 18% having 6-10 years of farming experience. As Abdulpur in Jessore is an agricultural village and most of the people's occupation is farming and most of them are working from their father's period. Tekwa *et al.* (2014) found that Farming experience categories differed between age boundaries of 1-10 years and 41-50 years. Concentration of farmers was relatively higher in the categories of between 11-20 years and 21-30 years of farming experience. Few farmers had farming experiences of as high as between 41-50 years, especially in Gella and Lokuwa, which tied at 11% each, with even nil in Digil and shuware.

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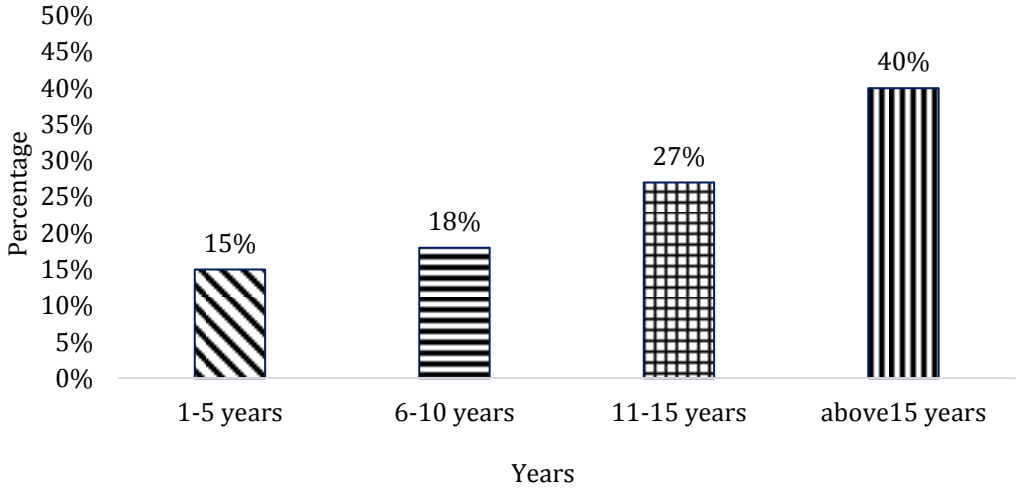

Figure 05. Categories of Surveyed farmers by Farming experience

Pesticide acquisition and storage

From figure 06, even though majority of the respondents (44%) appear to store pesticides at store room of their house after procurement, (14%) don't store pesticide as they use them direct after buying from shop, (9%) of them store pesticide in field, (7%) of them store pesticide in separate and safe place outside from home, A worrying (3%) of the farmers reported storing pesticides in an animal house, (2%) in toilet and (1%) of them store pesticide in kitchen and few number of them (20%) store pesticide in their bedrooms, thereby exposing them to toxicity through direct inhalation of the pesticides.

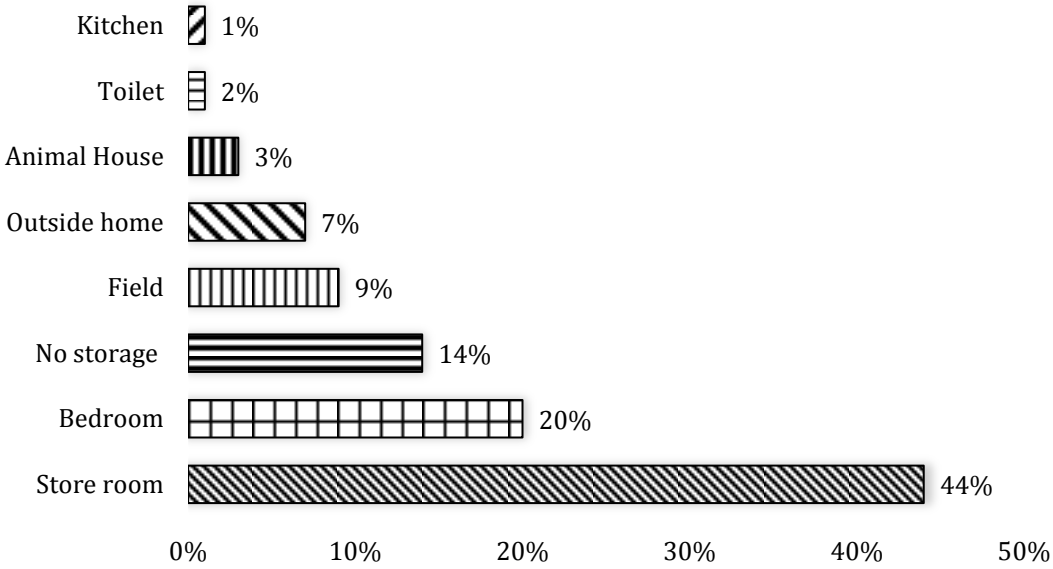

Figure 06. Categories of pesticide storing place by surveyed farmers

Farmers' knowledge, attitude, practices and understanding about Pesticides

The farmers (77%) had not received training on safe handling and application of pesticides, while 23% had received training and among them young and educated farmers are trained. Other who weren't trained they think that they not net any training as they had many years of experience and advice from their elders. They reported that sometimes agricultural extension worker visit them and get various important information, according to them which are similar to training for them. The relatively large cohort of respondents with no technical knowledge in pesticide use can be a major source of worry. The absence of farmers training can further increase the heightened danger of pesticide misuse and abuse in vegetable production. The misuse of pesticide by the farmers can also endanger their health and that of consumers as well as the environment. It appears that even those who claim to have received some form of official training seemed to be still misusing and abusing pesticides in their vegetable fields. For instance, results from (Figure 07) indicate that most farmers apply the pesticide

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either at the sight of insects and/or disease (34%) or noticing crop damage (9%) and large number (57%) of the responded farmers apply pesticides according to calendar spray schedule. Most of the respondent farmers 74% spray in their field at low pest density. When they were asked why they spray at low pest density, 70% replied for reducing pest density in the next crops, 26% replied they spray at low pest density for higher effective prevention and 4% replied for killing pests egg (Figure 08).

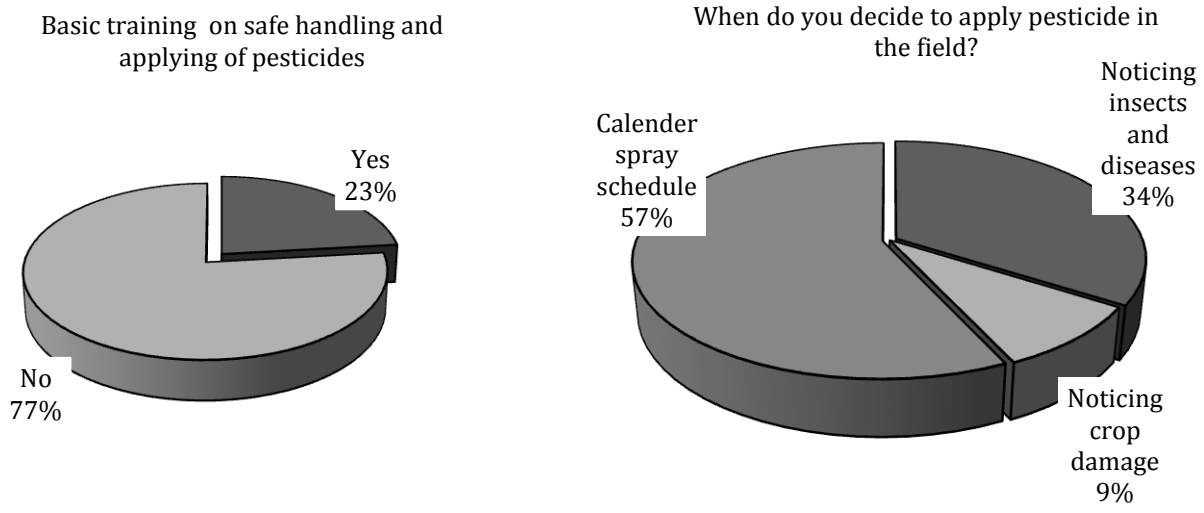

Figure 07. Categories of responded farmer's knowledge on pesticide (Training and Spraying decision)

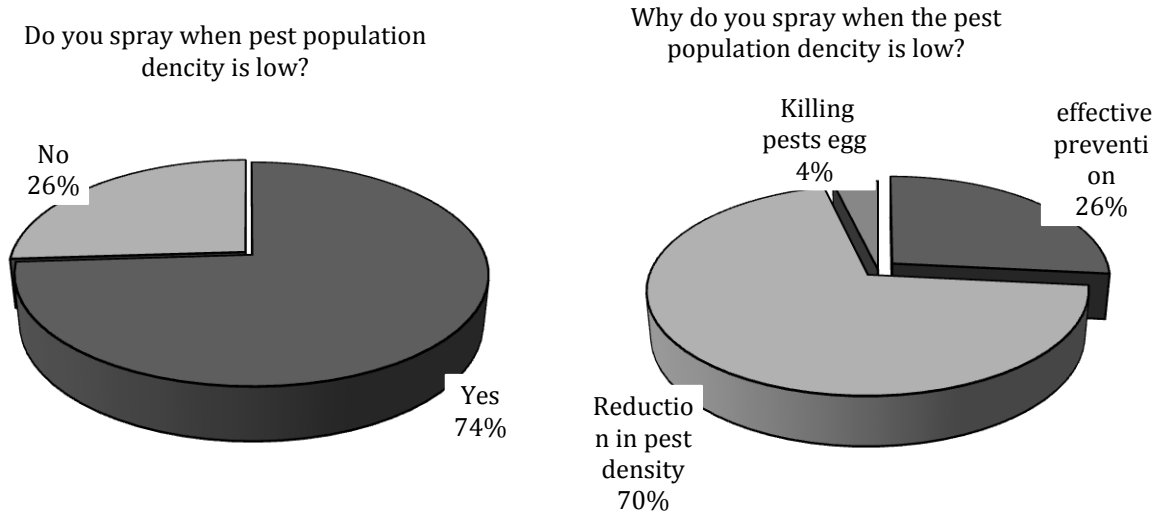

Figure 08. Categories of responded farmer's knowledge on pesticide (Spray in low pest density)

For this practices of the farmers beneficial insects, birds and other animals can be affected. Thus this behavior of the farmers is also a threat for the bio-diversity of that area. Most of the respondent farmers use mixing pesticides without considering their compatibility or active ingredients. 47% of them use more than three pesticides together, 43% use three pesticides together, 9% use two pesticides together and only 1% use only one pesticide at a time (Figure 09). They usually mix pesticide by shaking the sprayer, or using stick. Some of them however confirmed that they mix pesticides with their bare hands. Due to lack of training nearly one-half of the farmers believe that all insects are harmful to crops. About 90% of farmers opined that there is positive relationship between pesticides use and crop production. That means they believe that production will be higher if they use more pesticides and vice versa (Sabur and Molla, 2001).

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Among these farmers 45% said they use mixing pesticide to eliminate different kinds of pests at a time. About 39% said they use mixing pesticide for higher effectiveness and 16% of them said that only one pesticide is not effective that's why they use mixing pesticides. This idea of farmers however, questionable at least as practiced because the combinations used could be indiscriminate and incompatible resulting in ineffectiveness of the pesticides to manage the pests and diseases. Farmers usually prefer to apply pesticide in their crops early in the morning (57%). Some of them (28%) spray at afternoon. 14% among them said that they sometimes spray at afternoon sometimes in morning. About 1% of farmers are observed to apply pesticide in the noon during field survey (Figure 10).

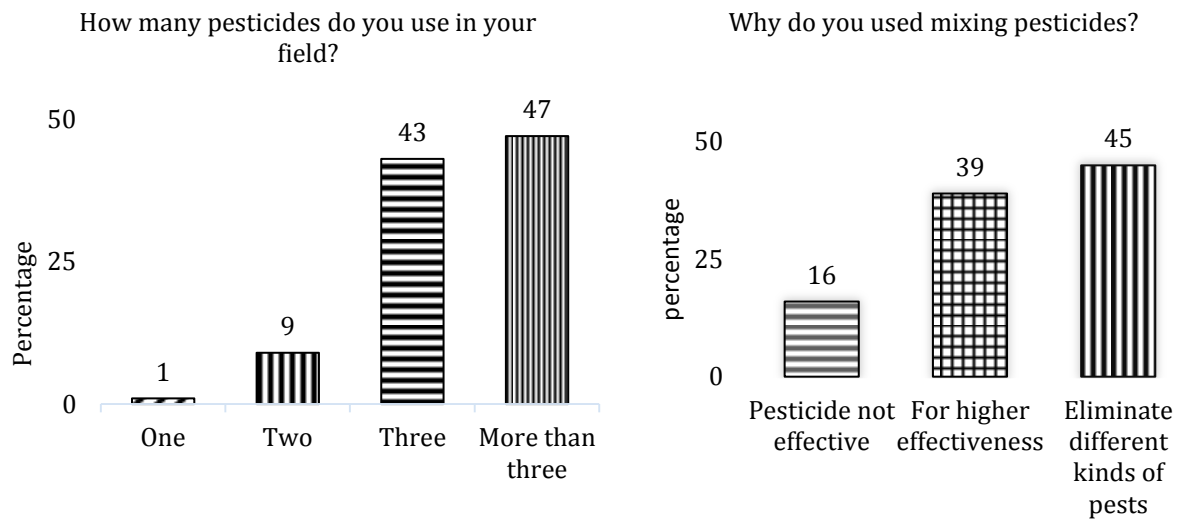

Figure 09. Categories of farmers' pesticide practices

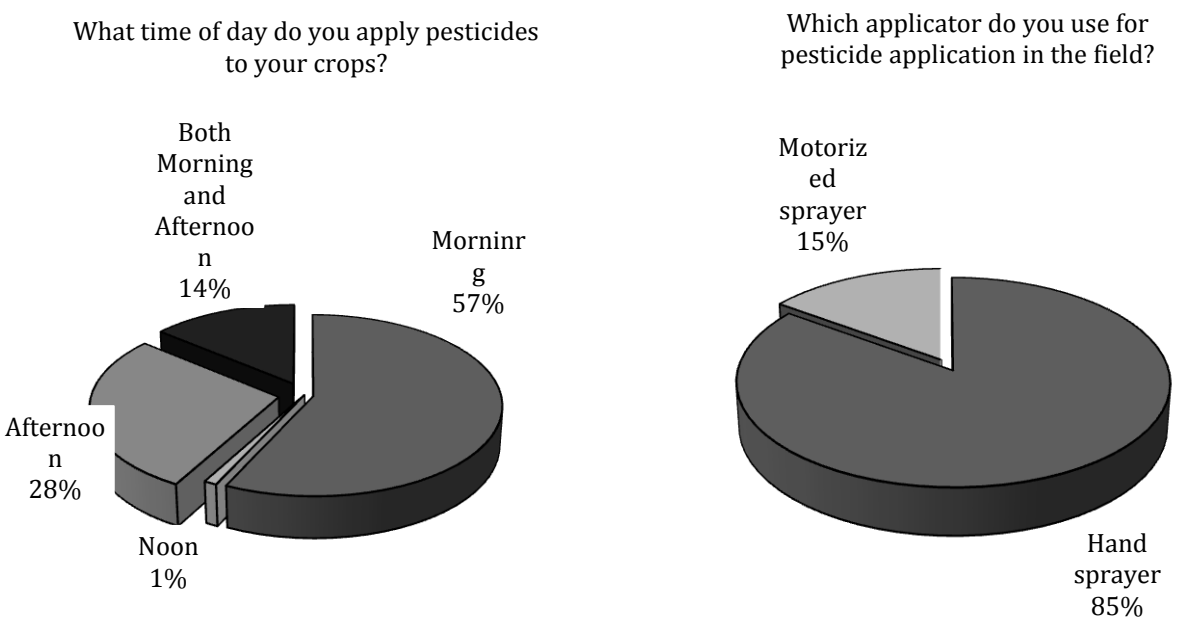

Figure 10. Categories of farmers' pesticide practices

With respect to pesticide application procedures, hand sprayer was the most popular spraying equipment used (85%), though a few farmers did use motorized sprayers (15%). They thought hand sprayer is easy to use and carry. They also mentioned that it is cheaper than motorized sprayer. While survey farmers were asked what they do when pesticide not effective, 34% reported switching to another pesticide which had a higher toxicity if the previous one was ineffective, 55% of farmers combined and used the same pesticide with another pesticide, and 11% applied higher doses to

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achieve greater effectiveness (Figure 12). Some of the responded farmers (78%) said that they increased the dosage of pesticides of land compared to the dosage they used for the same land 5 years ago. This is because continuous use of the same pesticide against a particular pest can lead to the development of resistance by the pest against the pesticide, thereby rendering the pesticide ineffective. Unfortunately, this is the currently being practiced by most of the vegetable farmers in the surveyed communities. They were asked about the reason of increasing dosage, 89.7% said they increased dosage because insects did not die anymore at low dosage, 8.9% said they increased dosage because suppliers said so and 1.4% said that they increased dosage as other farmers also did that (Figure 13). According to Sabur and Molla (2001) farmers use higher amounts of pesticides than recommended doses because of ignorance, lack of training, experience, awareness etc. Farmers believe that production will be more if they apply more of pesticides. For that reason, they use excess pesticides. For selling more pesticides the traders advise farmers to use more pesticides. Sometimes pesticides are applied according to the advice of neighboring farmers who do not know the proper doses. Generally, the traders sell pesticides on credit, which results in using more amounts of pesticides.

Figure 11. Farmers using hand sprayer for pesticide application in the field.

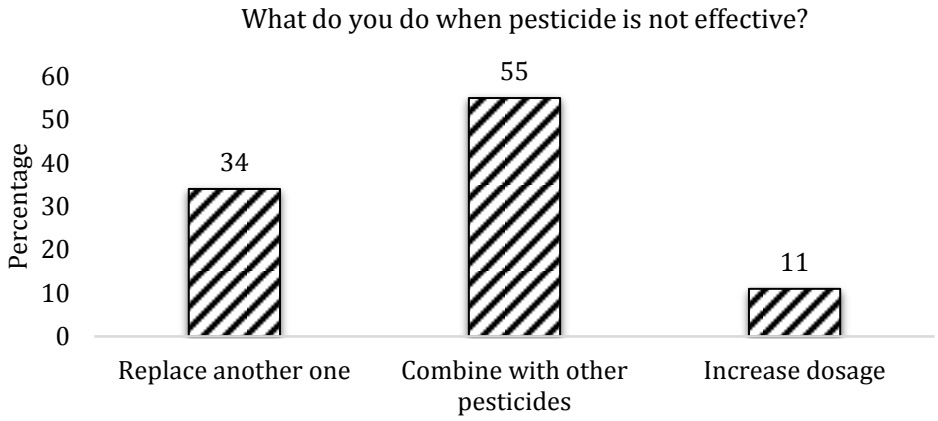

Figure 12. Categories of responded farmer's pesticide practices

Twenty one percentage of surveyed farmers reported that they spray pesticides 20 cm above the plant tops, as they follow the instruction of agricultural extension worker. 28% of them sprayed directly on targeted insects and disease damage sites, 17% of them sprayed at plant tops, and most of them (34%) sprayed randomly (Figure 14). Most farmers such as 55% are adopting safer pesticide application practices such as spraying considering the wind direction to minimize inhaling pesticides and skin contact. Among them 26% spray randomly without considering wind direction or any technique, and 19% of them walk forward to spray pesticide in the field, such practices expose them to the harmful effect of pesticide. However, majority of the respondents do not display warning signs after spraying so as to prevent public or any member of the household from entering a sprayed field. This is not

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surprising because majority of the farmers even re-enter a sprayed field within 24 hours. Mohiuddin *et al.* (2009) Most of the farmers relied only on insecticide for control of insect pests and maximum of them (80%) used it from the initial attack and thereafter on a routine basis. Only 16% of the farmers of both Hathazari and Satkania and 4% farmers of Patiya sprayed insecticides in their fields without observing the attack of insect pests. The proportion of farmers spraying insecticides after detection of insect pest in their crops was 28% in Satkania, 24% in Hathazari and 16% in Patiya.

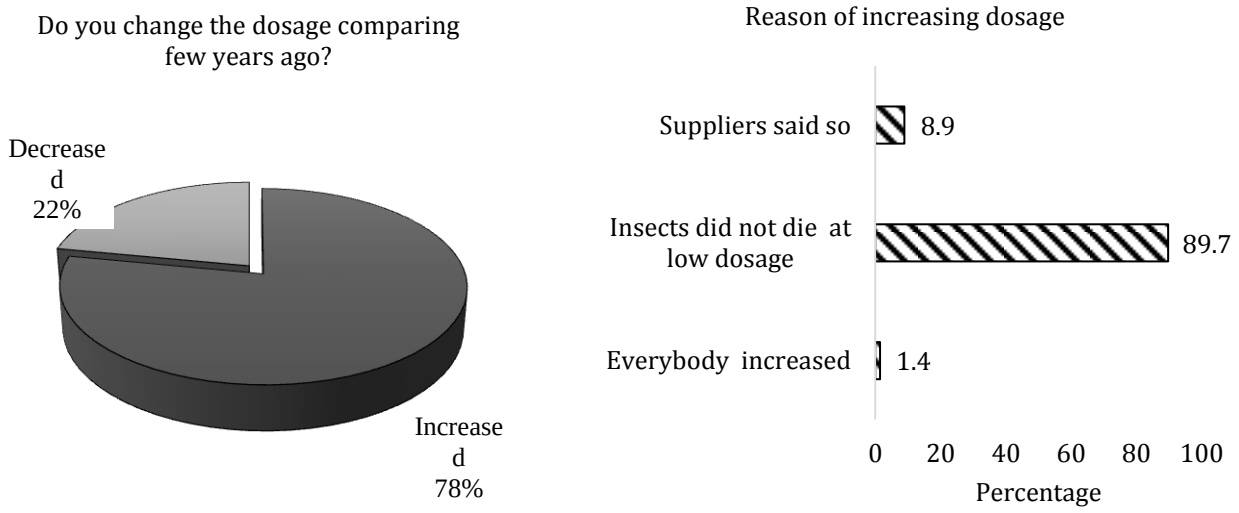

Figure 13. Information about pesticide dosages

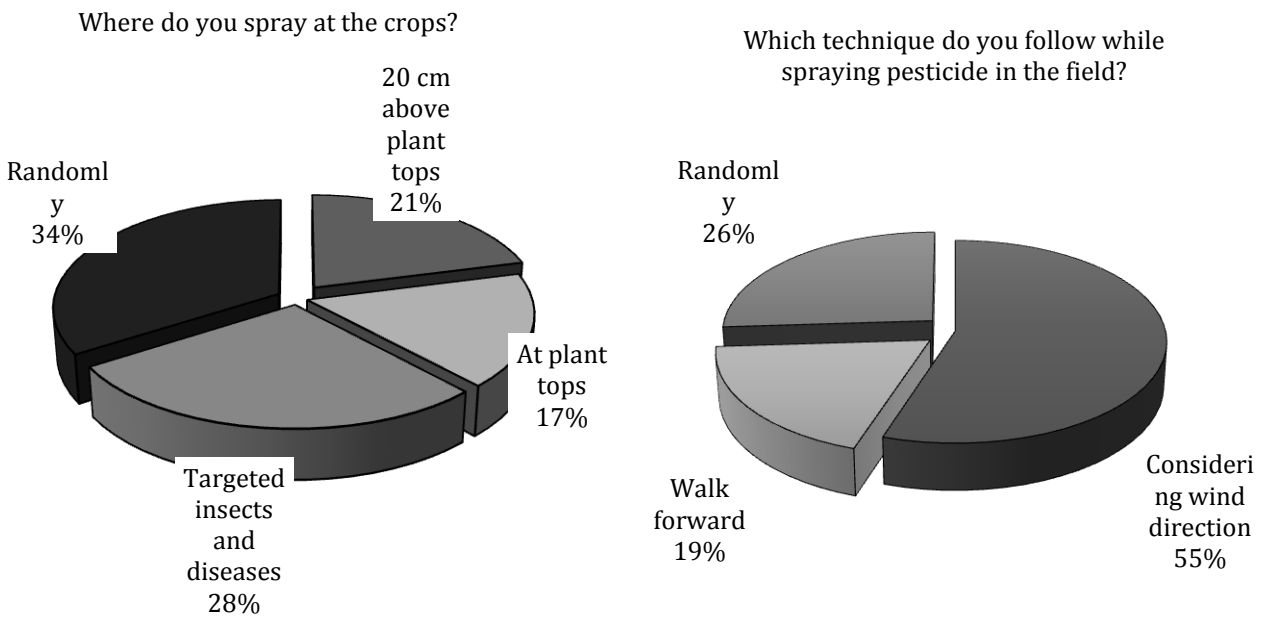

Figure 14. Present pesticide spraying practice

Farmers' Safety Practices on Pesticide Application

The farmers' level of knowledge of pesticides, including effects on the environment and human health, and their awareness of pesticide laws and regulations was analyzed. Farmers were asked if they supplied with information on the pesticide while purchasing pesticides, such as pamphlets or instructions, describing safety issues or problem 85% said yes, 9% said no and 6% said that they sometimes get the information. Farmers' usually get this information from pesticide dealer and agricultural extension worker. The reason not getting the information was as they don't buy the pesticides from any dealer or shop. They were also asked if they read or heard from anyone and

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understand the instructions in the pamphlets, 65% said yes, 4% no and 31% said that they sometimes read or heard and understand the safety instruction. Another question asked to the surveyed works was about following the instruction and safety alert, 12% said that they follow the instruction, 58% said sometimes and 30% said no (Figure 15). Many farmers did not read or follow instructions on pesticide labels, because they were unable to read and understand the meaning of the labels, the labels were written in English (a foreign language to them), and the instructions were too long and complicated. Many of the farmers indicated that font sizes on the labels were too small to easily read.

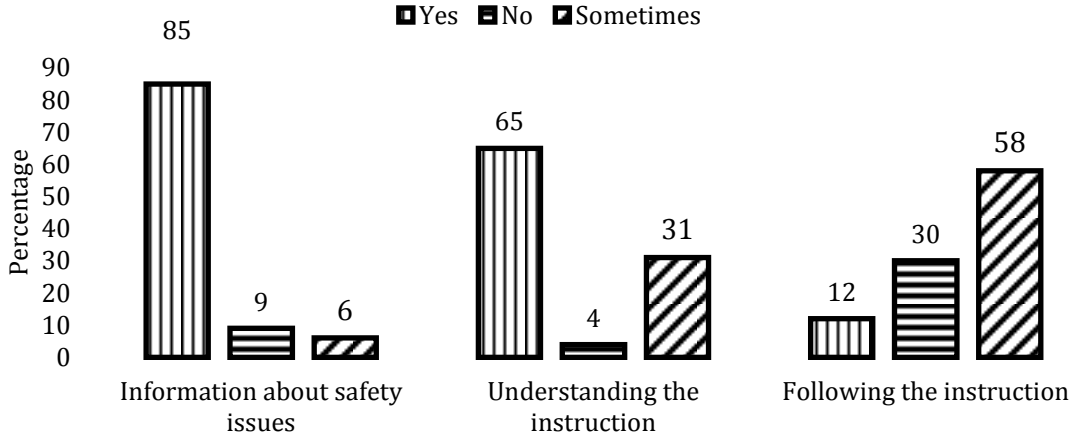

Figure 15. Safety Concern and Practice of farmers

96% of farmers were concerned about the impact of pesticide poisoning to user and the environment. 72.7% reported receiving their knowledge about pesticide toxicity from agricultural extension worker, 20.6% from own experience, 3.2% from others such as by reading books, agricultural training, 2.3% from dealers and 1.2% from pesticide label (Figure 16).

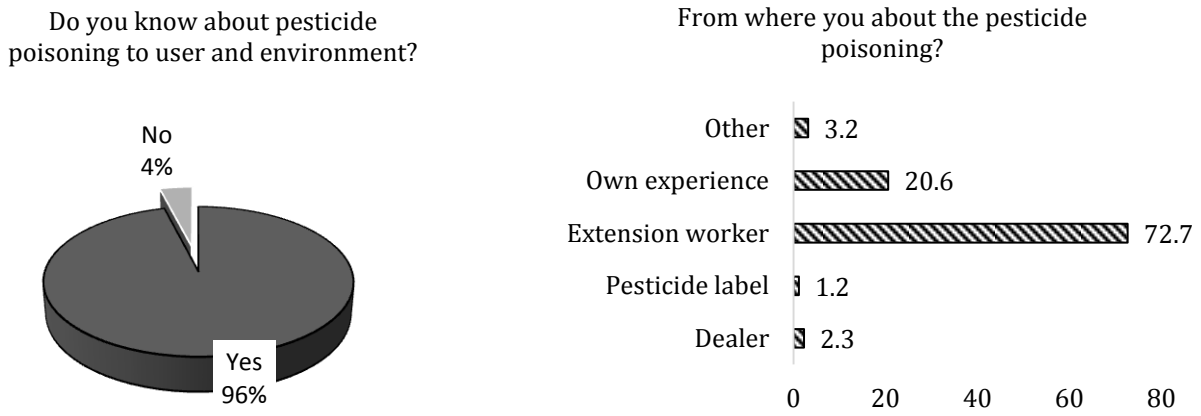

Figure 16. Farmers knowledge about pesticide poisoning

Surveyed farmers were asked if they ever heard of any pesticide related accidents below their local area, 79 % reported about water contamination such as changing the color, odor of the water. 14 % reported about air contamination, according to their thought and experience while spraying that spreads all around through wind and sometimes it caused health effect to other people near the field. 72% said pesticide application caused death of fish, frog, snake, rat, and squirrel Various time (Figure 17). Sixty one percent of them believed that insecticide application was harmful to the health of farm labours. Over 34% of the farmers felt that insecticide application polluted the air. A proportion of 38% of the farmers reported that insecticides caused harm to natural enemies of insects (Mohiuddin *et al.*, 2009).

Farmers' practices on disposal of empty pesticide containers and left over pesticides

Farmers' attitudes towards disposal of empty pesticide containers and residual pesticide solutions are shown in (Figure 18). The most common methods reported for disposing of leftover pesticides were spraying until the tanks were empty (40%) or emptying containers in the field (22%). Some farmers

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(9%) claimed to prepare an exact pesticide volume for each application and some claimed to store for further use. Farmers' disposal of leftover pesticides differed significantly according to their educational status. From the figure 19 the commonest way of disposing of empty pesticide containers among the respondent farmers (85.3%) was by throwing them on the field. After use, most empty pesticide packages (11%) were gathered and store for sell, while 3.7% were collected and buried. There were significant differences among educated and illiterate regarding the disposal of empty pesticide packages.

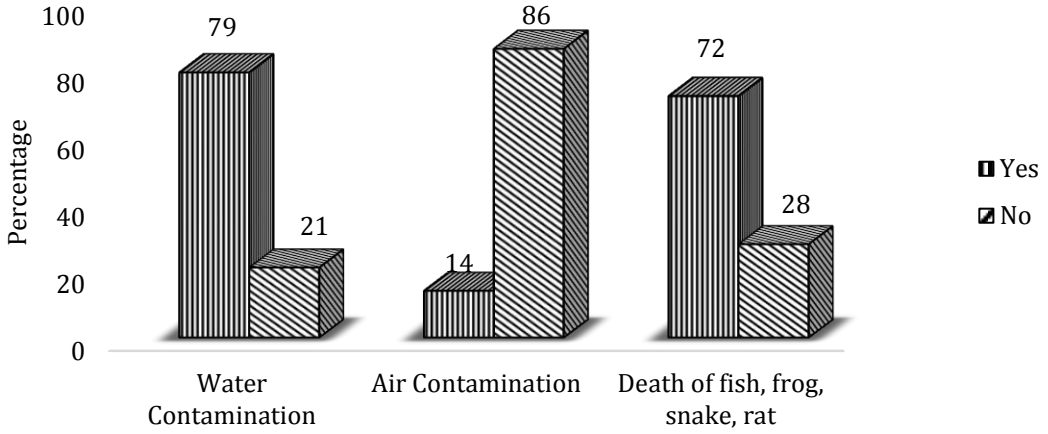

Figure 17. Pesticide related accidents

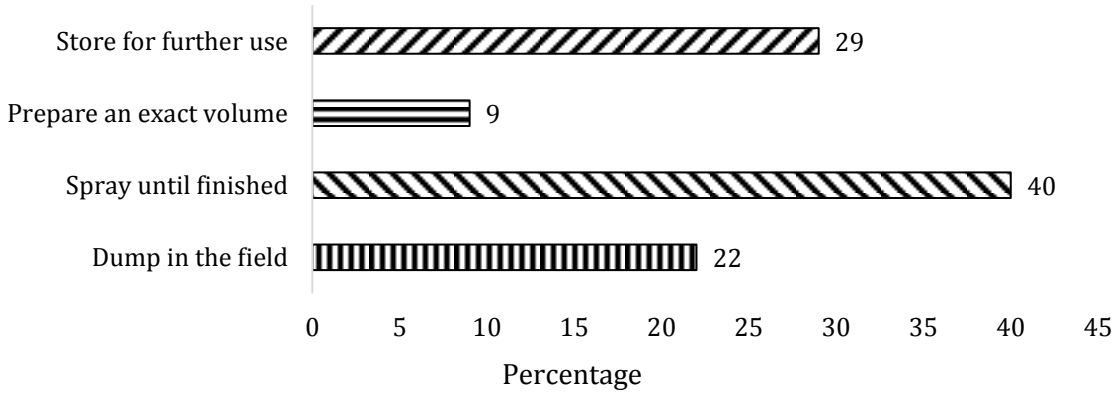

Figure 18. Present Practice of disposal of left over pesticide

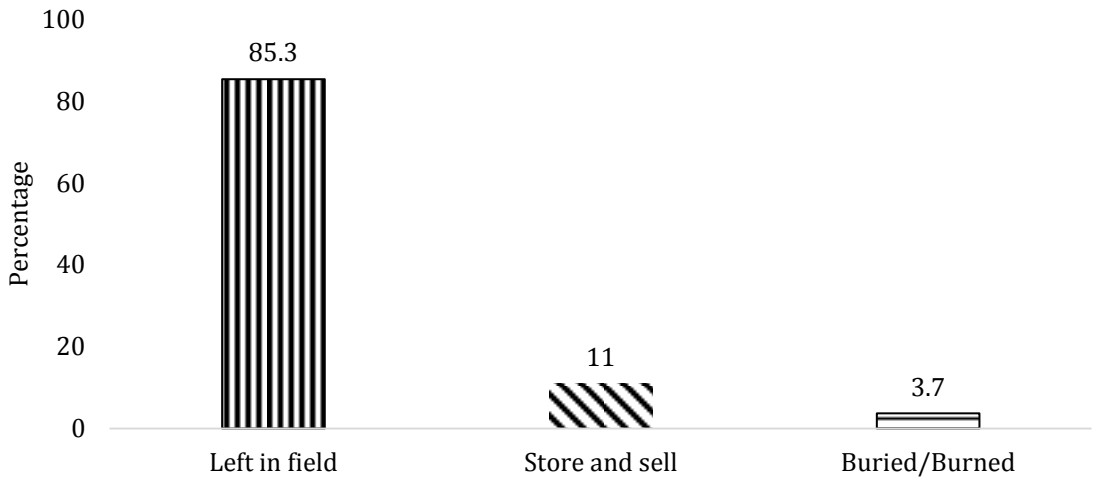

Figure 19. Present Practice of disposal of empty pesticide container

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Self-reported toxicity symptoms related to pesticides

The PPE most often used were body protective 67% and 13% said they sometimes use full coverage personal protective equipment. They usually use lungi, Full sleeves shirt, trouser for protecting their body from pesticide poisoning. 5% said they cover head and 12% said that they sometimes cover head while spraying pesticide in the field. They use hats, caps or towel for protecting their head. There was very few responded found who concern about eye protection only 1% said they sometimes use eye protection such as googles or glasses. A significant number of respondents reported not wearing respirators (92%) only 7% said that they sometimes use mask while spraying pesticide in the field. Beside this many farmers were found smoking and chowing betel-roll while spraying in the field. 47% said that they use sandal while spraying but there was no farmer found who use boots, in fact a large number of farmer spray bare footed in their field for protecting their crops from damaging. Jallow *et al.* (2017) found that the majority (58%) of the farmers did not use any PPE when mixing or spraying pesticides. When respondents were asked to indicate the main reasons for not using PPE, lack of availability when needed (35%), and PPE being uncomfortable in the local hot and humid climate (90%), too expensive (65%), and slowing you down (29%) were the most reasons cited.

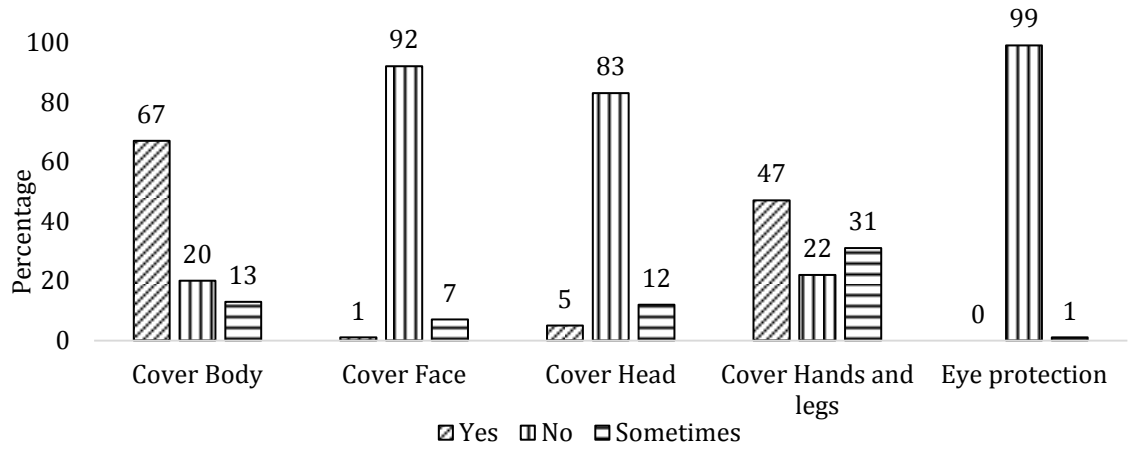

Figure 20. Types of protective measures during pesticide application.

Results from (Figure 21) show that, the most common pesticide poisoning side effects mentioned by the farmers based on multiple responses were skin irritation (88%), headache (69%), eye irritation (87%), vomiting (16%), and diarrhea (13%), shortness of breath (20%) fever (35%), convulsion (11%) and dizziness (20%). Some farmers also mentioned burning sensation, catarrh, stomach pain, unconsciousness and body pains as hazards associated with use of pesticides. Other symptoms reported by respondents were poor vision, excessive sweating. When respondents were asked what action they took following an incident of poisoning, a majority reported taking no action as the incident was minor or required only self-medication. Only a few of respondents reported a serious poisoning incident that required medical attention in a hospital. Jallow *et al.* (2017) found that the most frequently reported symptoms were headaches (82%), nausea (49%), dizziness (41%), fatigue (50%), and coughing (22%). Pesticide users in the study area are often exposed dermally; about 61% reported suffering from skin diseases including irritation and itching. About 63% of total respondents reported having eye problems such as-itching, irritation, pain, cataract, pupil problem and diminished eye sight, either temporarily or permanently (Miah *et al.*, 2014).

Relationships between pesticide's side effects with gender of the farmers

The susceptibility of male and female farmers to the hazards of pesticides differed among the farmers interviewed (Table 01). For common symptoms of pesticide poisoning such as headache, dizziness, vomiting and stomach pains, females were found to be more vulnerable than males. However, male farmers were equally as susceptible as their female counterparts with respect to itching which is the most common symptom reported by both genders (Afari- Sefa *et al.*, 2015).

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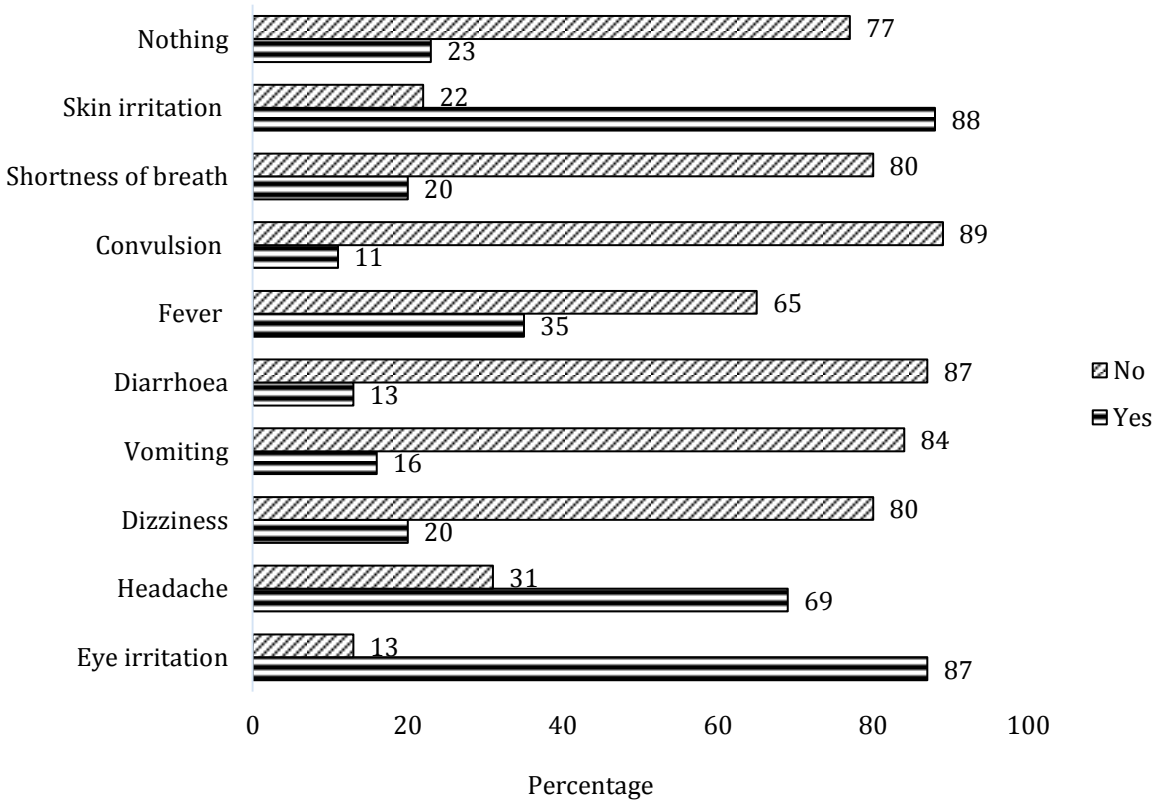

Figure 21. Health problems faced by surveyed farmers after applying pesticides.

Table 01. Relationship between pesticide poisoning and gender

Symptoms of pesticide poisoning	Female (n=14)		Male (n=106)	
	F	%	F	%
Eye Irritation	12	85.7%	91	85.8%
Headache	11	78.6%	72	68%
Dizziness	7	50%	17	16.1%
Vomiting	8	57.1%	11	10.8%
Diarrhoea	3	21.4%	12	11.3%
Fever	4	28.6%	38	35.9%
Convulsion	4	28.6%	9	8.5%
Shortness of Breath	7	50%	17	16.1%
Skin Irritation	13	93%	92	86.8%
Nothing	1	7.2%	27	25.5%

IV. Conclusion

Survey responses indicate the widespread improper use of pesticides including excessive application frequency, inappropriate pesticides mixtures, dangerous leftover pesticide disposal methods, and inadequate pre-harvest intervals that pose hazards to the human health and environment. Although farmers reported that they read pesticide labels, they also report frequently not following label instructions including applying pesticides with insufficient protective clothing and equipment. Many farmers reported receiving professional training about pesticide use but also reported not following instructions in day-to-day activities. The majority of farmers interviewed use pesticides according to their own opinions and experience and ignore potential threats to personal health and environmental contamination. Farmers appear to be unaware or uncaring about the extent of pesticide residue levels on local food products or long-term health effects of pesticide residues on consumers. To improve the situation comprehensive pesticide training program is needed involving close interaction among researchers, extension workers, agribusiness, and farmers to improve farmers' knowledge of the appropriate use, storage, and disposal of agrochemicals and to reduce farmers' heavy reliance on pesticides in pest control IPM strategies should be implemented.

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V. References

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