FARMERS' AWARENESS CONCERNING HARMFUL EFFECT OF INSECTICIDES ON ENVIRONMENT

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CERTIFICATE

This is to certify that the thesis entitled **"Farmers' Awareness Concerning Harmful Effect of Insecticides on Environment"** submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **Master of Science in Agricultural Extension and Information System**, embodies the result of a piece of bonafide research work carried out by **Md. Abdullah-Al-Mamun**, Registration No. **09-03476** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that any help or source of information, received during the course of this investigation has been duly acknowledged.

Dated:
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DEDICATED TO

MY

BELOVED PARENTS

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ACRONYMS AND ABBREVIATIONS

BBS	Bangladesh Bureau of Statistics
BRRI	Bangladesh Rice Research Institute
DAE	Department of Agriculture
DDT	Dichlorodiphenyltrichloroethane
et al.	All others
etc.	et cetera, and the other
FFS	Farmers Field School
GDP	Gross domestic Product
HYV	High yielding variety
IPM	Integrated Pest Management
SPSS	Statistical Package for Social Science
UNEP	United Nations Environment Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific

ABSTRACT

The main purpose of this research was to assess farmers' awareness concerning harmful effect of insecticides on environment. Besides, attempt was made to explore the contribution of the selected characteristics of the farmers on their awareness concerning harmful effect of insecticides on environment. The study was conducted at Damurhuda upazila under Chuadanga district. Data were collected by interviewing 119 randomly selected farmers of three villages of Damurhuda union. The majority (47.90%) of the farmers had low awareness concerning harmful effect of insecticides on environment, while 40.34 percent and 11.76 percent of them had medium and high awareness respectively. Step-wise multiple regressions method was administered and 10 independent variables namely: age, education, family size, farm size, annual income, farming experience, agricultural knowledge, extension contact, training on pest management and knowledge on IPM were fitted together in step-wise multiple regression analysis. Stepwise multiple regression exposed that knowledge on IPM, education, age and training on pest management had significant contribution to their awareness concerning harmful effect of insecticides on environment. These four variables combinedly explained 67 percent of the total variation on awareness concerning harmful effect of insecticides on environment, where knowledge on IPM of the respondent had highest (57.3%) contribution to awareness concerning harmful effect of insecticides on environment followed by level of education (6.7%).

CHAPTER 1

INTRODUCTION

1.1 General Background

Agriculture has experienced a tremendous and significant development since Bangladesh came into being. Agriculture is the most important sectors of the Bangladesh economy. Approximately 84 percent of the people are directly or indirectly dependent on agriculture for the major source of their livelihoods (Hoque, 2001). Now Agriculture accounts for 15.96% of its gross domestic product (GDP) in 2015, and absorbs 45.1% of the country's labor force (BBS, 2015). Sustained government investment in irrigation facilities, rural infrastructure, agricultural research, and extension services has helped Bangladeshi farmers achieve dramatic increases in agricultural production. The process of agricultural production is, however, underpinned by the increasing use of agrochemicals and multiple cropping. Agricultural production has improved dramatically in the last two decades due to the advancement of modern technologies.

The environment is of global concern and is a very important issue for discussion for the developed as well as developing countries. It is defined as the whole physical and biological systems in which man and other organisms live. According to the American Heritage Science Dictionary "environment denotes all of the biotic and abiotic factors that act on an organism population, or ecological community and influence its survival and development. Biotic factors include the organisms themselves, their food and their interactions. Abiotic factors include such items as sunlight, soil, air humidity, salt, water and climate". It is important

that the environment is always changing. Climate change has become a growing concern across the globe, a major threat to wreak on world ecosystems and humankind. The global environment is changing rapidly due to loss of ozone layer, desertification, water pollution, deforestation, air pollution and other hazards.

Agriculture and environment are closely interlinked. Agricultural production system depends on the environment for utilization of land, water, sunlight and biological organisms. To feed the large number of world‘s population, the need to boost agricultural production serves as a powerful driving force to promote the intensive use of land, high yielding varieties (HYVs), agro-chemicals and irrigation which has impacted disastrously on the wider environment (e.g. non-target species, landscapes and communities), agro-ecosystems and human health (Maredia and Pingali, 2001; UNEP, 2002; lbitayo, 2006; Mancini, 2006; Devine and Furlong, 2007). More notably, farmers in developing nations have been using many toxic, non-patented and persistent pesticides irrationally to check crop damages from pests, which are proved to be environmentally unsound and ultimately undermine the World’s food insecurity (Ecobichon, 2001; UNESCAP, 2002).

Insecticide use in crop production has been suspected of being a major contribution to environmental pollution. There are widespread and growing concerns of pesticide overuse, relating to a number of dimensions such as contamination of ground water, surface water, soils and food, and the consequent impacts on wildlife and human health (McLaughlin and Mineau, 1996). Farmers often spray hazardous insecticides like organophosphates and organochlorine up to five to six times in one cropping season while only two applications may be sufficient.

According to a study released by Bangladesh Rice Research Institute (BRRI) 2012, the use of toxic pesticides by Bangladeshi farmers increased by 328 percent during the past 10 years, posing a serious health hazards on human health due to its long term residual effect. The survey, studying the use of toxic pesticides in farmland during 1997 to 2008, showed that in 1997 the use of pesticides in Bangladesh was more than 8,000 tons; it doubled to 16,000 tons in 2000; in 2005-06, it increased to nearly 20,000 tons and in 2008 it rose up to 48,690 tons.

Most devastating ecological imbalance is caused due to indiscriminate use of insecticides. Insecticides affect fishes, living in the river tank, pond etc. It is proven that dangerous insecticides are present at an unacceptable level in the fishes of the Bay of Bengal which is too much harmful for human health. There are many other negative consequences of using pesticides such as aquatic lives are being reduced in numbers at alarming rate. On the other hand use of improper doses of insecticides makes the insect pest resistant requiring further stronger doses of chemicals. The use and abuse of insecticides has disturbed the ecological balance between pests and their predators. Pest control becomes a social need in countries where the food supply is short and there is an urgent necessity to increase rice production. Insecticide choice in the developing world is often older, broad-spectrum compounds belonging to the organophosphate and carbamate classes chemical families noted for their acute toxicity.

In this situation, it is very important to study the awareness level of the people on the use of insecticides and their impact on the humans and the environment. There is a literate deficit on the issues caused by the insecticides, their impact on farmers' health and environment; and their relationship with farmers' awareness level.

1.2 Statement of the problem

The rapid increase in the use of insecticides in agriculture in recent years has lead to concern about its environmental effects. Most of the insecticides contain toxic compounds and their impact on health during inhaling, ingesting, contact while spraying insecticides, or eating vegetables and fruits with insecticide residues. Some highly toxic insecticides cause cancer, birth and fests, male sterility, genetic mutations, and behavioral changes. Insecticides also affect human health by causing allergies or breathing trouble or by affecting the liver, kidneys and nervous system if proper protection measures are not taken. Non judicious use of insecticides damage natural resources like land, fishes, beneficial insects, soil, microbes etc. Most of the farmers of Bangladesh are not capable of taking decisions on pest management and insecticide application. Often they apply insecticides when there is no real need or they use wrong chemicals at wrong doses, methods and times. As a result they kill the beneficial organisms easily and create pest resistance causing the greater problems and crop losses.

Considering the above facts, department of agricultural extension (DAE) and different NGOs have been initiated extension programs project and activities for creating awareness of the farmers about harmful effect of insecticides on environment. But there is hardly any systematic study to find out how much awareness concerning harmful effect of insecticides on environment have been created among the farmers. That is why, the researcher took the present study to search answer to the following research questions:

- What are the characteristics of the farmers that related to their awareness concerning harmful effect of insecticides on environment?
- What is the level of farmers' awareness concerning harmful effects of insecticides on environment?
- What are the contributions of the selected characteristics of the farmers to their awareness concerning harmful effects of insecticides on environment?

1.3 Specific Objectives

The following specific objectives were formulated to give proper direction to the study:

1. To determine and describe some selected characteristics of the farmers. The selected characteristics were:
    a. Age
    b. Education
    c. Family size
    d. Farm size
    e. Family annual income
    f. Farming experience
    g. Agricultural knowledge
    h. Extension contact
    i. Training on pest management
    j. Knowledge on IPM;
2. To determine and describe the farmers' awareness concerning harmful effects of insecticides on environment; and
3. To explore the contribution of the selected characteristics of the farmers to their awareness concerning harmful effects of insecticides on environment

1.4 Justification of the Study

Bangladesh is an agro-based country. Most of the people live in the villages and they are directly or indirectly involved in agriculture. The trend of agricultural pesticide consumption, mainly insecticides and fungicides, has been increased gradually. Farmers are highly dependent on insecticide application to protect their crops, without considering its detrimental effects on environment. Use of broad spectrum insecticides has posed serious risk to the environment, leading to diminishing bio-diversity, hampering the growth of aquatic habitats, disrupting natural pest control, reducing earthworms, causing toxicity in soil, developing resistance among target pests and creating potential hazards to human health. The depletion of resources and deterioration of living conditions simultaneously weaken the production efficiency of farmers and eventually lead them to vulnerability. However, several steps have been undertaken to raise farmers' awareness on environmental issues.

In Bangladesh many government and non-government organizations are working in the fields of agriculture and sustainable rural development. Proper agricultural growth and protection of environment are the issues of high priority nowadays. The findings of this research will be useful to those who are concerned with planning, implementation and evaluation of agricultural, rural development and environmental protection issues. The knowledge and skills gained by the researcher in conducting this research will help to conduct similar other studies in the future. Besides, different insecticides companies and farms can also make use of the findings of this research in determining policies and practices for the marketing of their products.

1.5 Assumptions of the Study

An assumption is the supposition that an apparent fact or principle is true in the light of available evidence (Goode and Hatt, 1952). The researcher had following assumptions while undertaking this study:

I. The respondents selected for the study were able to furnish proper responses to the questions included in the interview schedule.

II. The data collected by the researcher from the respondents were considered reliable and dependable.

III. Information provided by the farmers was the representative of the whole population of the study area.

IV. The researcher who acted as interviewer was adjusted to social and environmental condition of the study area. Hence the data collected by him and the respondent were free from bias.

V. The findings of the study will have applications to the other parts of the country with similar, socio-economic and cultural conditions.

1.6 Scope of the study

The present study was designed to have an understanding the farmers' awareness concerning harmful effects of insecticides on environment and to explore its relationship with their selected characteristics. Particularly, the finding of the study will be pertinent to Damurhuda Union, Damurhuda Upazilla under Chuadanga district. However, the findings may also be applicable to other areas of the country where socio-cultural, economical and the psychological condition do not differ much than those of the study area. The findings of the study will be helpful to the extension workers and planners for preparation of programmers in creating famers concerning harmful effect of insecticides on environment. By the

help of the findings of the research, the concern authority can expect to select appropriate strategies for establishing judicious use of insecticides.

1.7 Limitations of the study

Considering time, money and other necessary resources available to the researcher and to make the study manageable and meaningful it became necessary to impose certain limitations. The limitations were as follows:

1. The study was confined to three villages namely Damurhuda , Keshbpur and Purapara of Damurhuda upazila under Chuadanga district.
2. Among many characteristics only eleven characteristics were selected for investigation of the study.
3. The study was restricted within the farmers who had at least some cultivable land under own cultivation.
4. For data collection about the study, the researcher dependent on the data furnished by the selected respondents during interview with them.
5. In many situations, the researcher had to face unexpected interference from the over interested side talkers of the non target respondents.

1.8 Definition of Terms

For clarity of understanding certain terms frequently used throughout the study are defined and interpreted as follows:

Age: Age of a farmer has been defined as the period of time in years from his birth to the time of interview.

Education: Education referred to the ability of the respondents to read and write or having formal education received up to a certain level from educational institute at the time of interview. Education was measured on the basis of completed years of schooling.

Family size: Family size referred to the total number of members including the respondent himself, his wife, children and other permanent dependents, who eat and lived together in a family unit.

Farm size: It referred to the total area of land on which a farmer's family carried on farming operations, the area being estimated in terms of full benefit to the farmers' family.

Annual income: The term annual income referred to the total amount of money earned by the respondent himself and his family members from agriculture, livestock, fisheries and other accessible sources (business, service, daily labour etc.) during the previous year. It was expressed in thousand taka.

Farming experience: Farming experience referred to the experience which one gains from farming activities directly. Farming experience of the farmers was measured in years which he gained from involvement in farming activities.

Agriculture knowledge: It was the extent of basic understanding of the farmers in different aspects of agricultural subject matters i.e. crops livestock, fisheries, agro-forestry, soil, seed, fertilizer, insects and diseases of crops etc. it was measured by the score.

Extension contact: Extension contact referred to an individual exposure to or contact with different information sources and personalities involved for dissemination of new technologies among the farmers.

Training on pest management: Training on pest management of a respondent was referred by the number of days a respondent trained on pest management.

Attitude: Attitude defined of as a person's perspective toward a specific target and predisposition to act, perceive, think and feel in relation to something. It is learned and formed from the environment and social system.

IPM: Integrated pest management (IPM) is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, use of resistant varieties etc.

Awareness: Awareness is the ability to perceive, to feel, or to be conscious of events, objects, thoughts, emotions, or sensory patterns. It is knowledge that something exists, or understanding of a situation or subject at the present time based on information or experience.

Environment: The sum total of all surroundings of a living organism, including natural forces and other living things, which provide conditions for development and growth as well as of danger and damage. It is the physical and biological factors along with their chemical interactions that affect an organism or a group of organisms.

Insecticide: An insecticide is a substance used to kill insects. They include ovicides and larvicides used against insect eggs and larvae, respectively. Insecticides are claimed to be a major factor behind the increase of agricultural productivity in 20^{th} century. Nearly all insecticides have the potential to significantly alter ecosystems; many are toxic to humans; some concentrate along the food chain.

CHAPTER 2

REVIEW OF LITERATURE

Reviews of the literatures relevant with the objectives of this study are presented in this Chapter. This study was mainly concerned with farmers' awareness on the harmful effects of insecticides on environment. The purpose of this Chapter is to review previous studies, opinions and observations of experts having relevance to this research study. A comprehensive and systematic review of previous research works provide a strong base for carrying out any scientific research. The purpose of this study was to have an understanding of the farmer's awareness concerning harmful effects of insecticides on environmental pollution. Available literature was extensively reviewed by the researcher to search out related works in Bangladesh as well as other countries. But only a few studies related to the present study were found. This Chapter has been presented in four sections as follows:

Section 1: Harmful Effect of Pesticides on Environment

Section 2: Farmers Awareness Concerning Harmful Effects of Insecticides on Environment

Section 3: Selected Characteristics of the Farmers' and Their Awareness Concerning Harmful effect of insecticides on environment

Section 4: The Conceptual Framework of the Study

2.1 Harmful Effects of Pesticides on Environment

A concise review of literature on harmful effect of insecticides on environmental pollution has been presented below.

According to Dhaliwal *et al.* (1996), the insect pests are controlled with the use of chemicals which have harmful influence on the useful fauna and create environmental pollution. Moreover, Islam (1990) stated that the use of pesticides in controlling pests on a short term basis cannot be most harmful, but their long term efficacy against pests, their overall effects on ecosystems and environment are very much doubtful for two major reasons. One is the rapid evolution of new breed of pests, resistant to the insecticides applied, and another is the increasing pesticide hazards.

According to Swaminathan (1991), imbalance use of insecticides, fungicides and herbicides could cause biological imbalance as well as to increase in the incidence of cancer and different diseases through the toxic residues being present in grains or other edible parts of the plants.

Reazuddin (1994) reported that the danger of high concentrations of pesticides in soil arises from the fact that fertile soils contain much living matter. One pound of rich farm soil contains up to 1 trillion bacteria, 200 million fungi, 25 million algae and 15 million protozoa as well as worms, insects and mites. They fix atmospheric nitrogen for continued fertility of the soil, make minerals available to the plants, retain moisture, aerate soil and bring about the essential process of decay. That some chlorinated pesticides seriously inhibit nitrification by soil bacteria. If surface runoff takes place after heavy application it may increase the concentration of pesticides in the river, lake or other water bodies to a level lethal to all the fish species.

Gani (1997) stated that use of insecticides kill beneficial creatures and insects and make the land infertile and full of pests. Besides, the imbalance use of pesticides creates a resistance against insects and pests which in turn creates an increased threat to the crops. Islam (1990) further stated that use of different types of pesticides has been contributing to the evolution of "Super pests" that are immune to the chemicals. Resistance to pesticides has also been developed in a certain species of fungi as well as in weeds.

Islam (1990) reported that pesticides kill non-targeted organisms including parasites and predators of pests that were innocuous to the application of pesticides, resulting in outbreaks of those pests. Insect pollinators, birds, fish and other animals have been killed by pesticides. Repeated application of insecticides over a long period to protect vast areas of rice fields have been reported to have serious adverse effect on the microbial population, which are essentially needed for maintaining soil health.

Pesticide use in crop production has been suspected of being a major contribution to environmental pollution. There are widespread and growing concerns of pesticide overuse, relating to a number of dimensions such as contamination of ground water, surface water, soils and food, and the consequent impacts on wildlife and human health (McLaughlin and Mineau, 1996).

From an environmental perspective, chemically-polluted runoff from fields has contaminated surface and ground waters, damaged fisheries, destroyed freshwater ecosystems and created growing "dead zones" in ocean areas proximate to the mouths of rivers that drain agricultural regions (Pimental and Lehman, 1993; Tardiff, 1992).

Gani (1997) stated that pesticides also affect the human beings seriously sometimes directly and sometimes indirectly. According to specialists, the pesticides may cause heart disease, neurosis, various kinds of skin diseases kidney and lungs failure, cancer, etc.

2.2 Farmers' Awareness Concerning Harmful Effects of Insecticides on Environment

Hanif (2000) in his study reported that among the Farmer Field School (FFS) farmers, 100% had high awareness on environmental pollution due to use of pesticides. In case of non FFS farmers, 66.67% had poor awareness, while 30% had medium and 3.33% had high awareness on environmental pollution due to use of pesticides.

Hossain (1999) indicated that the majority of the farmers (63%) had moderately favourable perception of the adverse effects of' agro- chemical on environment while 22 and 15 percent of them had slightly favourable and favourable perception respectively.

Sarkar (1999) reported that only 6 percent of the farmers‘ had medium perception as compared to 77 percent high perception and 17 percent very high perception regarding environmental degradation due to use of agro-chemicals.

Gundhi and Patel (1997) studies on farmers' awareness of the environmental impact of pesticide use. Survey data were collected from a sample of 216 fanners of three districts India, namely Guntur district (Andhra Pradesh), Ferozepur (Punjab) and Ahmedabad (Gujarat). The results revealed that farmers' awareness about the effects of pesticides was limited to the immediate surroundings (impact on human and animal health) and did not extend much to the effects on water, air

and crop residues. Awareness about when and how to use pesticides was very limited. Pesticides use levels were found to be determined significantly by the extent of irrigation, and intensity of use was higher on small farmers.

Parveen (1995) reported that 65% of farm women had poor awareness, while 29% had medium and 6% had high awareness on environmental degradation due to use of modern agricultural technologies.

2.3 Selected Characteristics of the Farmers' and Their Awareness Concerning Harmful Effect of Insecticides on Environment

2.3.1 Age and farmers' awareness

Sutradhar (2002) found in his study that there was positive insignificant relationship between age and their awareness on the environmental degradation caused by the use of modern agricultural technologies.

Kashem (2001) found in his study that age of the farmers had no relationship with their awareness on the environmental pollution.

Hanif (2000) found that age of the farmers had positive relationship with the environmental awareness in his study.

Sarkar (1999) found that age of the farmers had significant negative relationship with their awareness on environmental degradation caused by the use of insecticides.

Islam et al. (1998) conducted a survey to determine the awareness of the farmers on environmental pollution and found a negative relationship between age and their awareness on environmental pollution.

Hamid (1995) found in his study that age of the farmers had significant negative relationship with their awareness on environmental pollutions.

2.3.2 Education and farmers' awareness

Adhikary (2012) observed in his study that there was positive significant relationship between education and their awareness on the environmental pollution caused by the use of pesticides.

Sutradhar (2002) found in his study that there was positive significant relationship between education of the respondents and their awareness on the environmental pollution caused by the use of pesticides.

Kashem (2001) found in his study that education of the farmers had a significant positive relationship with the environmental awareness on the environmental pollutions.

Hanif (2000) found in his study that there was a positive significant relationship between education of the respondents and their awareness on environmental pollution.

Sarkar (1999) reported that the level of education of the farmer had significant positive relationship with their perception on environmental degradation.

Hossain (1999) found that education of the farmer had significant positive relationship with the awareness on environmental degradation.

Islam et al. (1998) stated that education of the farmer had significant positive relationship with their perception on environmental degradation.

2.3.3 Family size and farmers' awareness

Sutradhar (2002) observed in his study that there was positive significant relationship between family size of the respondents and their awareness on the environmental pollution caused by the use of modern agricultural technologies.

Kashem (2001) found in his study that family size of the farmers had no relationship with the environmental awareness on the environmental pollutions.

Hanif (2000) found in his study that there was a positive insignificant relationship between family size of the respondents and their awareness on environmental pollution.

Sarkar (1999) observed that there was no relationship between family size of the farmers and their perception on environmental degradation.

Hossain (1999) observed that there was no relationship between family size of the farmers and their perception on the effect of agro- chemicals on environment.

2.2.4 Farm size and farmers' awareness

Sutradhar (2002) observed in his study that there was positive significant relationship between farm size of the respondents and their awareness on the environmental degradation caused by the use of pesticides.

Kashem (2001) found in his study that farm size of the farmers had no relationship with the awareness on the environmental pollutions.

Hanif (2000) in his study found there was a negative insignificant relationship between farm size of the respondents and their awareness on environmental pollution.

Hamid (1997) observed that area under cultivation of the farmers had insignificant relationship with the awareness on environmental pollution.

2.3.5 Annual income and farmers' awareness

Adhikary (2012) observed in his study that there was insignificant relationship between annual income and their awareness on the environmental pollution caused by the use of pesticides.

Sutradhar (2002) found in his study that there was positive significant relationship between annual income of the respondents and their awareness on the environmental degradation caused by the use of pesticides.

Kashem (2001) found in his study that annual income of the farmers had positive significant relationship with the awareness on the environmental pollutions.

Hanif (2000) obtained in his study that there was a negative insignificant relationship between annual income of the respondents and their awareness on environmental pollution.

Hamid (1997) observed that the annual income of the farmer had significant positive relationship with the awareness on environmental pollution.

2.3.6. Farming experience and farmers' awareness

Kashem (2001) found in his study that farming experience of the farmers had no relationship with the awareness on the environmental pollutions.

2.3.7 Agricultural knowledge and farmers' awareness

Hoque (2001) observed in his study that there was significant relationship between agricultural knowledge and their awareness on the environmental pollution caused by the use of pesticides.

Hanif (2000) found that there was a significant positive relationship between agricultural knowledge and environmental awareness.

Islam *et al*. (1998) obtained that agricultural knowledge had a significant relationship with awareness on the environmental pollutions.

2.3.8 Extension contact and farmers awareness

Adhikary (2012) observed in his study that there was insignificant relationship between extension contact and their awareness on the environmental pollution caused by the use of pesticides.

Sutradhar (2002) observed in his study that there was positive significant relationship between extension contact of the respondents and their awareness on the environmental degradation caused by the use of pesticides.

Kashem (2001) found in his study that extension contact of the farmers had positive significant relationship with the awareness on the environmental pollutions.

Hanif (2000) obtained in his study that there was a positive significant relationship between extension contact of the respondents and their awareness on environmental pollution.

2.3.9 Training on pest management and farmers' awareness

Adhikary (2012) observed in his study that there was positive significant relationship between training on pest management and their awareness on the environmental pollution caused by the use pesticides.

Parveen (2010) observed in his study that there was positive significant relationship between training on pest management and their awareness on the environmental pollution caused by the use of pesticides.

Rahman (2003) observed in his study that there was positive significant relationship between training on pest management and their awareness on the environmental pollution caused by the use of pesticides.

Hossain *et al.* (2000) observed in his study that there was positive significant relationship between training on pest management and their awareness on the environmental pollution caused by the use of pesticides.

2.3.10 Knowledge on IPM and farmers' awareness

Parveen (2010) obtained in his study that there was positive significant relationship between Knowledge on IPM and their awareness on the environmental pollution caused by the use of pesticides.

Rahman (2003) observed in his study that there was positive significant relationship between Knowledge on IPM and their awareness on the environmental pollution caused by the use of pesticides.

Hoque (2001) found in his study that there was positive significant relationship between knowledge on IPM and their awareness on the environmental pollution caused by the use of pesticides.

Hossain *et al.* (2000) observed in his study that there was positive significant relationship between knowledge on IPM and their awareness on the environmental pollution caused by the use of pesticides.

2.4 The Conceptual Framework of the Study

According to Rogers and Havens (1960) the conceptual framework is kept in mind while framing the structural arrangement for the dependent and independent variables. This study was concerned with farmers' awareness concerning harmful effect of insecticides as dependent variable and selected characteristics of the farmers as independent variables. Based on these above discussion and the review of literature, it was observed that all of the earlier studies were to explore relationship between farmers' awareness towards harmful effect of insecticides on environment. But the present study was mainly targeted to explore contribution of the selected characteristics of the farmers to their awareness concerning harmful

effect of insecticides on environment. Considering the above mentioned discussion a conceptual framework has been developed for this study, which is diagrammatically presented in the following figure 2.1

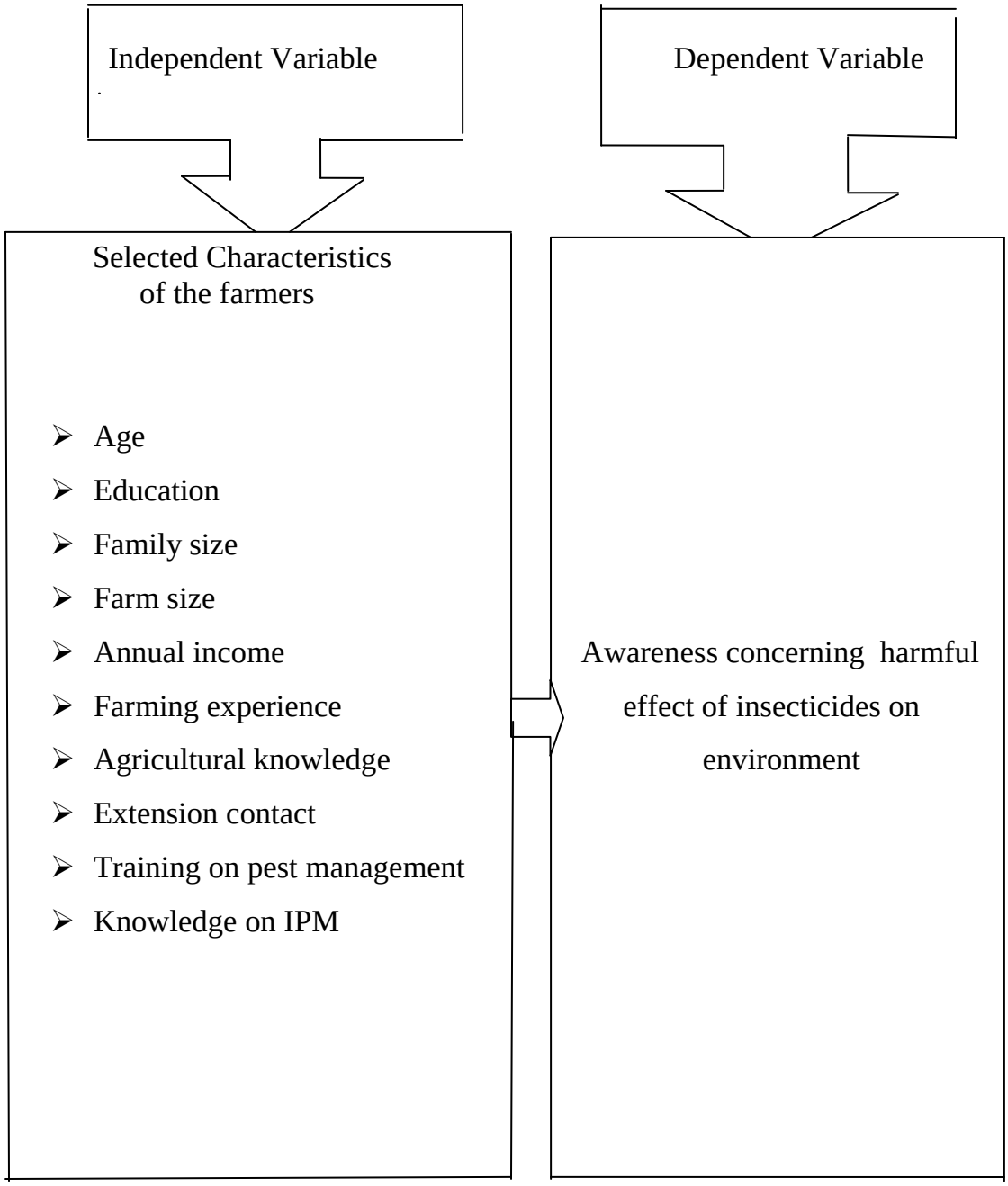

Figure 2.1.The conceptual framework of the study

CHAPTER 3

METHODOLOGY

Methods and procedures are very important in any scientific research. To develop in conducting research need very careful consideration. Methodology enables the researcher to collect valid information and to analyze them properly to arrive at correct decisions. Keeping in this point of view, the researcher had taken intensive care for using proper methods in all aspects of the investigation. Methods and procedures followed in this study have been described in this Chapter.

3.1 Locale of the study

The study on farmers' awareness concerning harmful effect of insecticides on environment requires the selection of such sites where objectives of the study can be fulfilled. The study was conducted at Damurhuda union of Damurhuda upazila under Chuadanga district.

Out of 12 villages of Damurhuda union, three villages namely Damurhuda, Keshabpur, and Purapara were randomly selected. There were two important reasons for selecting this area. Firstly, limitations of time and resources and secondly, well communication facilities prompted the researcher to carry out the research in this area. A map of Chuadanga district showing Damurhuda upazila and another one showing the study area (Damurhuda union) within the upazila are presented in the figure 3.1 and 3.2 respectively.

Figure 3.1 A map of Chuadanga district showing Damurhuda upazila

Figure 3.2 A map of Damurhuda upazila showing the study area (Damurhuda Union)

3.2 Population and Sample of the Study

An updated list of the farmers was prepared with the help of Sub assistant Agricultural Officer (SAAO). A total number of farm families in three villages was 572 which constituted the population of the study. According to Yaman's (1967) formula, sample size was determined as 119. In calculating sample size from the following formula, 8% precision level, 50% degree of variability and value of Z = 1.96 at 95% confidence level were chosen. Then 119 farmers were selected from the population following proportionate random sampling technique. The formula is shown below –

$$n = \frac{Z^2 P(1-P)N}{Z^2 P(1-P) + Ne^2}$$

Where, n = sample size

N = population size

e = the level of precision

z = the value of the standard normal variable given the chosen confidence level

p = the proportion or degree of variability

Besides, a reserve list of 17 farmers was prepared which was approximately 15 percent of the sample size. Farmers in the reserve list were used only when a respondent in the original list was not available. The distribution of the population, sample and reserve list given in table 3.1.

Table 3.1 Distribution of the population, sample and reserve list for the Study

Villages	Population	Sample size	Reserve list
Damurhuda	286	60	9
Keshabpur	176	36	5
Purapara	110	23	3
Total	572	119	17

3.3 Instrument for Collection of Data

An interview schedule was prepared for collection of data from the respondents keeping the objectives of the study in mind. Both open and closed forms questions were included in the interview schedule. The simple questions were included in the schedule to collect data on the selected dependent and independent variables. Different scales were developed to measure the selected variables of the respondents. Questions were asked systematically and explanations were made whenever it is necessary. The respondents were interviewed at their leisure time so that they can give accurate information in a cool mind.

3.4 Data Collection

Data for this study were collected by the researcher himself. To build rapport and motivation in the interview situations, the researcher endeavored to provide conditions that maximized trust, maintained each respondent's interest and minimized status differences. However, it was not possible to collect data from all the sample farmers in those villages due to their non-availability in the time of interview despite several attempts to contact them. Therefore, the researcher had

to collect data from 119 farmers. The data collection took near about 30 days from 23 February to 22 March 2016.

3.5 Selection of Variables

The success of a research depends of appropriate selection of variables. Improper and inconsistent selection of variables may lead error in result. The researcher took adequate care in selection of the variables for the study considering personal, psychological, social and economical factors of the rural people

3.6 Measurement of Variables

Ten individual characteristics of the farmers were considered as independent variables and farmers' awareness concerning harmful effect insecticides on environment was considered as dependent variable of the study. The procedures followed in measuring different variables have been discussed below:

3.6.1 Measurement of independent variables

The selected characteristics of the respondent farmers constituted the independent variables of the study. To keep the research within the manageable sphere, 10 independent variables were selected for the study. The procedures of measurement of the selected variables were as follows:

3.6.1.1 Age

The age of a farmer is defined as the number of years from his birth to the time of interview and was rounded to the nearest whole number. It was measured in terms of actual years on the basis of his response to item No.1 of the interview schedule.

3.6.1.2 Education level

The education is defined as the years of schooling, a farmer had completed in educational institutions which was determined by his response to item No. 2 of the interview schedule. It was expressed in scores. A score of one (1) was given for each year of schooling completed. For example if a respondent passed class V or equivalent, his education score was given as 5, if he passed the final examination of class X, his score was 10. If a respondent did not know how to read and write, his education score was zero. A score of 0.5 was given to that respondent who could sign his name only.

3.6.1.3 Family size

The family size was measured by the total number of members in the family of a respondent. The family members included the respondent himself, his wife, sons and daughter and other dependents. The information was obtained by respondents response to item No. 3 of the interview schedule. The total number of family members was considered as the family size score of a respondent.

3.6.1.4 Farm size

Farm land is the most important capital of a farmer and the farm size has influence on many personal characteristics of a farmer. Farm size of the farmer was measured by the land area possessed by him. Data obtained in response to questions under item No. 4 of the interview schedule formed the basis for determining the farm size of the respondent. Here, farm size was computed by using the following formula:

Farm size = $A_1 + A_2 + 1/2(A_3 + A_4) + A_5$

A_1 = Homestead Area (A_1)

A_2 = Own land under own cultivation (A_2)

A_3 = Land taken from others on borga system(A_3)

A_4 = Land given to others on borga system (A_4)

A_5 = Land taken from others on lease (A_5)

The unit of measurement was hectares.

3.6.1.5 Annual income

Annual income indicates total earning of a farmer and the members of his family both from agriculture and other socially acceptable regular means such as business, service etc. during a year. The value of all the agricultural products encompassing crops, livestock, fisheries, fruits, vegetables etc. were taken into consideration. For calculation, a score of one (1) was assigned for each one thousand taka of income in the item No. 5 in the interview schedule.

3.6.1.6 Farming experience

For measuring farming experience, a score of one (1) was assigned for each year of working experience of a respondent either in his own farm or his parents farm. Farming experience is shown in the item No. 6 in the interview schedule.

3.6.1.7 Agricultural Knowledge

Agricultural knowledge of a respondent was measured by making correct answers of 20 different kinds of question in open form as shown in the item No. 7 of the interview schedule. Two score was assigned for each of the questions. The total

assigned score of all the questions was 40. If a respondent was able to provide a correct answer to a question, he could receive full score (2) for that particular question. Respondent could receive zero for wrong answer and half or partial score was given for partial correct answer of a question. The total score obtained by a respondent was considered as the agricultural knowledge of the respondent. Agricultural knowledge score of a respondent score could range from 0 to 40, while 0 indicating very low knowledge and 40 indicating very high agricultural knowledge.

3.6.1.8 Extension contact

In this research, extension contact score of a respondent was calculate on the basis of the extent of his contact with 12 selected media as ascertained from his or her responses to the question as shown in the item No . 8 of the interview schedule. The extension contact was determined against (4) four point scales as not at all, rarely, occasionally and regularly. The score was assigned to represent the same as 0, 1, 2, and 3 respectively.

Extent of contact	Scores assigned
Not at all	0
Rarely	1
Occasionally	2
Regularly	3

The extension contact of a respondent was determined by adding the total responses against 12 selected extension media. The extension contact score of a respondent could range from 0 to 36, 0 indicating no contact and 36 indicating very high contact.

3.6.1.9 Training on pest management

It was determined by the total number of days a respondent received training in his/her entire life on pest management from different organizations as shown in the item No. 9. For measuring score of 1 was assigned for each days of training.

3.6.1.10 Knowledge on IPM

Knowledge on IPM of a respondent was measured by making correct answers of 25 different kinds of question in open form as shown in the item No.10 of the interview schedule. Two score was assigned for each of the questions. The total assigned score of all the questions was 50. If a respondent was able to provide a correct answer to a question, he could receive full score (2) for that particular question. Respondent could receive zero for wrong answer and half or partial score was given for partial correct answer of a question. The total score obtained by a respondent was considered as the knowledge on IPM of the respondent. Knowledge on IPM score of a respondent could range from 0 to 50, while 0 indicating very low knowledge and 48 indicating very high knowledge on IPM.

3.6.2 Measurement of dependent variable

Farmers awareness concerning harmful effect of insecticides on environment was consider as the dependent variable in the study. It was measured by asking of different questions related to insecticides and its effects on environment. There were 21 multiple questions asked to the respondents. The questions encompassed different aspect of insecticides and its impacts on various environmental. A respondent could get score of one against each question for correct answer and zero for wrong answer. The summation of obtained scores against 21 questions by

the respondent was the score of awareness concerning harmful effect of insecticides on environment. Awareness concerning harmful effect of insecticides on environment score of a respondent could range from 0 to 21, where 0 indicating no awareness and 21 indicating very high awareness concerning harmful effect of insecticides on environment.

3.7 Statement of the Hypotheses

Hypothesis may be divided into two categories such as research hypothesis and null hypothesis.

3.7.1 Research hypotheses

The following research hypothesis was put forward to test contribution of the selected characteristics of the farmers to their awareness concerning harmful effect of insecticides on environment. The research hypothesis was "Ten selected characteristics of the farmers have significant contribution to their awareness concerning harmful effect of insecticides on environment".

3.7.2 Null hypotheses

In order to conduct statistical tests, the research hypotheses were converted to null form. Hence, the null hypotheses were as follows:

"Each of the selected characteristics of the farmers had no significiant contribution to their awareness concerning harmful effects of insecticides on environment."

3.8 Data Processing and Analysis

3.8.1 Compilation of data

After completion of field survey, data from all the interview schedules were coded, compiled, tabulated and analyzed in accordance with the objectives of the study. In this process, all responses in the interview schedule were given numerical coded values. Local units were converted into standard units and qualitative data were converted into quantitative data by assigning suitable scores whenever necessary. The responses of the questions in the interview schedule were transferred to a master sheet to facilitate tabulation.

3.8.2 Categorization of data

For describing the different characteristics and their awareness concerning harmful effect of insecticides on environment, the respondents were classified into several categories. These categories were developed by considering the nature of distribution of data, general understanding prevailing in the social system and possible observed scoring system. The procedure for categorization of data in respect of different variable is elaborately being discussed.

3.9 Statistical Technique

The analysis was performed using SPSS (Statistical Package for Social Sciences) computer package. Descriptive analyses such as range, number, percentage, mean, standard deviation were used whenever possible. Initially, Pearson's Product Moment Coefficient of Correlation (r) test was done to find relationship. To find out the contribution of identified characteristics of the farmers to their awareness concerning harmful effect of insecticides on environment, stepwise multiple

regression was used. Throughout the study, at least five percent (0.05) level of probability was used as basis of rejecting a null hypothesis.

CHAPTER 4
RESULTS AND DISCUSSSION

In this Chapter, the findings of the study and interpretation of the results have been presented according to the objectives of the study. This chapter has been divided into three sections in accordance with the objectives of the study. The first section deals with the selected characteristics of the respondents. The second section deals with farmers' awareness concerning harmful effect of insecticides on environment. Third and final section discusses the contribution of the selected characteristics of the farmers to their awareness concerning harmful effect of insecticides on environment.

4.1 Selected Characteristics of the Farmers

The ten selected characteristics of the farmers were age, education, family size, farm size, annual income, farming experience, agricultural knowledge, extension contact, training on pest management, and knowledge on IPM. The salient features of these characteristics are shown in table 4.1

Table 4.1 Salient features of the respondents selected characteristics

Sl. No.	Characteristics	Measuring unit	Range		Mean	Standard deviation
			Possible	Observed		
01	Age	Actual Years	Unknown	25 - 69	44.33	10.3
02	Education	Year of Schooling	Unknown	00 - 16	5.57	3.34
03	Family size	Number	Unknown	3-10	5.54	1.57
04	Farm size	Hectare	Unknown	.40-3.20	1.22	0.58
05	Annual income	Thousand Taka	Unknown	60-350	153.41	70.86
06	Farming experience	Years	Unknown	5-42	20.64	9.03
07	Agricultural Knowledge	Score	0-40	5-38	19.75	7.39
08	Extension Contact	Score	0-30	4-23	12.00	4.33
09	Training on pest management	No. of days	Unknown	0-8	4.23	4.00
10	Knowledge on IPM	score	0-50	8-38	19.54	7.51

4.1.1 Age

Age of the respondents varied from 25 to 69 years, with an average of 44.33 and standard deviation of 10.30. According to their age, the respondents were classified into three categories as "young aged" (≤ 35 years), "middle aged" (36-50 years) and "old aged" (>50 years). The distribution of the farmers according to their age is shown in Table 4.2.

Table 4.2 Distribution of the farmers according to their age

Categories	Respondents		Mean	SD
	Numbers	Percent		
Young aged (≤ 35 year)	29	24.37	44.33	10.30
Middle aged (36-50 year)	52	43.70		
Old (> 50 year)	38	31.93		
Total	119	100		

Data represented in Table 4.2 indicate that the highest proportion (43.70 %) of the respondents belonged to middle aged category, while 31.93 percent belonged to old aged category and only 24.37 percent were young aged category. So, it is indicated that majority (68.07 %) of the respondents were young to middle aged in the study area. Therefore, it is expected that the young and middle aged group are very much aware about harmful effect of insecticides on environment. The extension providers can target those people in designing their extension programs.

4.1.2 Education

Education score of the respondents ranged from 0 to16 in accordance with year of schooling. The average education score of the respondents was 5.57 with a standard deviation of 3.34. On the basis of their education, the farmers were classified into five categories as shown in Table 4.3.

Table 4.3 Distribution of the farmers according to their education

Categories	Respondents		Mean	SD
	Number	Percent		
Illiterate	13	10.92	5.57	3.34
Can sign only	8	6.72		
Primary level education	57	47.90		
Secondary level	33	27.73		
Above Secondary	8	6.72		
Total	119	100		

Data shown in the Table 4.3 indicate that 47.90 percent of the respondents had primary education compared to 10.92 percent illiterate, 6.72 percent could sign their name only, 27.73 percent had secondary level education and only 6.72 percent had above secondary education.

Education develops mental and psychological ability of a person to understand, decide and adopt new ideas and practices. It also helps farmers to increase their power of observation and decision-making ability. Hence, it is expected that with the increase of education farmers consciousness on the harmful effects of using insecticides on environmental pollution is also increased.

4.1.3 Family size

The family size of the farmers ranged from 3 to 10 members with an average of 5.54 and standard deviation of 1.57. On the basis of the family size scores, the respondents were classified into three categories as small, medium and large family as shown in Table 4.4.

Table 4.4 Distribution of the farmers according to their family size

Categories	Respondents		Mean	SD
	Number	Percent		
Small (≤ 4)	37	31.09	5.54	1.57
Medium (5-7)	67	56.30		
Large (> 7)	15	12.61		
Total	119	100		

Analysis of data in Table 4.4 shows that 56.30 percent of the respondents had medium family size compared to 31.09 percent of them had small family size and only 12.61 percent had large family size.

4.1.4 Farm Size

The farm size scores of the farmers ranged from 0.40 to 3.20 ha with an average of 1.22 and standard deviation of 0.58. Based on farm size scores the respondent were classified into three categories namely, small farm (0.20-<1.0 ha), medium farm (1.0-3.0 ha) and large farm (> 3.0 ha) which are presented in Table 4.5.

Table 4.5 Distribution of the farmers according to their farm size

Categories	Respondents		Mean	SD
	Number	Percent		
Small farm (0.20-<1.0 ha)	47	39.50	1.22	0.58
Medium farm (1.0-3.0 ha)	71	59.66		
Large farm (> 3.0 ha)	1	0.84		
Total	119	100		

Table 4.5 shows that 59.66 percent of the farmer had medium farm size which was followed by small farm size (39.50%) and large farm size (0.84%) respectively. The findings indicated that overwhelming majority (59.66%) of the farmers had small farm size. Larger farm size is the indication of higher economic status. The farmers with large farms come in direct contact with different information sources like extension agents, input dealers, local experienced farmers, personnel of different nation building organizations, mass media, etc. in course of doing diverse agricultural operations. Therefore, it can be expected that the higher is the farm size possessed by the farmers, the higher will be their perception concerning harmful effects of using insecticides on environmental pollution.

4.1.5 Annual income

Annual income was measured by thousands taka. The family income scores of the respondents ranged from 60 to 350 thousand taka with an average of 153.41 and standard deviation 70.86. The distribution of the farmers in different categories on the basis of their family income has been shown in table 4.6.

Table 4.6 Distribution of the farmers according to their annual income

Categories	Respondents		Mean	SD
	Number	Percent		
Low income (< 120)	45	37.81	153.41	70.86
Medium income(120-220)	52	43.70		
High income (> 220)	22	18.49		
Total	119	100		

Data were presented in Table 4.6 indicate that 37.81 percent of the respondents felt into low income group, 43.70 percent felt into medium income group and only 18.49 percent felt into high income group. Therefore, it can be concluded that the more the annual income possessed by the farmers, the higher will be their perception concerning harmful effect of using insecticides on environmental pollution. People with low income are comparatively using less insecticide.

4.1.6 Farming experience

The farming experience score of the farmers varied from 5 to 42 years with an average of 20.46 and standard deviation of 9.03. The respondents were categorized into three groups based on their farming experience scores, which are shown in table 4.7.

Table 4.7 Distribution of the farmers according to their farm experience

Categories	Respondents		Mean	SD
	Number	Percent		
Low experience (<12)	26	21.85	20.46	9.03
Medium experience (12-22)	37	31.09		
High experience (> 22)	56	47.06		
Total	119	100		

Table 4.7 reveals that 47.06 percent of the respondents had high farm experience, 31.09 percent respondents had medium farm experience and 21.85 percent of the respondents had low farm experience.

4.1.7 Agricultural knowledge

Agricultural knowledge score of the respondents ranged from 8 to 38. The average and standard deviation were 19.75 and 7.39 respectively. Based on these scores, the respondents were categorized into three groups as shown in table 4.8.

Table 4.8 Distribution of the farmers according to their agricultural Knowledge

Categories	Respondents		Mean	SD
	Number	Percent		
Low (<13)	26	21.85	19.75	7.39
Medium (13-26)	66	55.46		
High (> 26)	27	22.69		
Total	119	100		

Data presented in Table 4.8 indicate that 21.85 percent of the respondents felt into low agriculture knowledge group, 55.46 percent felt into medium agriculture knowledge group and 22.69 percent felt into high agriculture knowledge group. A better agriculture knowledge enables individual to understand interaction between use of insecticides and its effect on environment which ultimately aware them to protect environment through using IPM practices.

4.1.8 Extension contact

The extension contact scores of the respondents ranged from 4 to 23 against the possible range from 0 to 30. The mean was 12.00 and standard deviation was 4.33. The respondents were classified into three categories which are shown in Table 4.9.

Table 4.9 Distribution of the farmers according to their extension contact

Categories	Respondents		Mean	SD
	Number	Percent		
Low contact (<10)	27	22.69	12.00	4.33
Medium contact (10-14)	68	57.14		
High contact (> 14)	24	20.17		
Total	119	100		

Data furnished in Table 4.9 indicate that the largest proportion (57.14%) of the farmers fell in the medium extension contact category, while 22.69 percent of them were in the low extension contact category and about 20.17 percent constituted the high extension contact category. Extension contact is important for

gathering information from many sources. High extension contact is essential for creating awareness about new idea, practice and issues among the individuals.

4.1.9 Training on pest management

The training on pest management scores of the respondents ranged from 0 to 8 with a mean of 4.23 and standard deviation of 4.00. On the basis of their training experience scores, the respondents were classified into two categories as shown in table 4.10.

Table 4.10 Distribution of the farmers according to their training on pest management

Categories	Respondents		Mean	SD
	Number	percent		
No training (0 days)	56	47.06	4.23	4.00
Short training (1-8 days)	63	52.94		
Total	119	100		

Data presented in Table 4.10 indicate that 47.06 percent of the respondents had no training on pest management and 52.94 percent of the respondents had short training on pest management. Training on pest management create awareness among the farmers about judicious use of pest management practices as well as harmful effect of insecticides on environment.

4.1.10 knowledge on IPM

Knowledge on IPM score of the respondents ranged from 8 to 38. The average and standard deviation were 19.54 and 7.51 respectively. Based on these scores, the respondents were categorized into three groups as shown in table 4.12.

Table 4.11 Distribution of the farmers according to their knowledge on IPM

Categories	Respondents		Mean	SD
	Number	Percent		
Low (<13)	33	27.73	19.54	7.51
Medium (13-26)	60	50.42		
High (> 26)	26	21.85		
Total	119	100		

Data presented in Table 4.11 indicate that 27.73 percent of the respondents had low knowledge on IPM, 50.42 percent had medium knowledge on IPM and 21.85 percent had high knowledge on IPM. Better knowledge on IPM practices is helpful to make the individual aware of their environment.

4.2 Awareness Concerning Harmful Effect of Insecticides on Environment

Farmers' awareness concerning harmful effects of insecticides on environment was the main focus of the study. Awareness of the respondents ranged from 4 to 19 against the possible range from 0 to 21. The mean value was 9.15 and standard deviation was 3.88. The respondents were classified into three categories, which are shown in table 4.13.

Table 4.12 Distribution of the farmers according to their awareness concerning harmful effect of insecticides on environment

Categories	Respondents		Mean	SD
	Number	Percent		
Low (<8)	57	47.90	9.15	3.88
Medium (8-14)	48	40.34		
High (> 14)	14	11.76		
Total	119	100		

Data presented in Table 4.12 indicate that majority (47.90 %)of the respondents had low awareness compared to 40.34 percent had medium awareness and 11.76 percent had high awareness concerning harmful effect of insecticides on environment. Farmers who are highly aware of environmental pollution caused by different factors are likely to take necessary steps to minimize those hazards by using environmental friendly technologies for achieving sustainable agricultural development.

4.3 Contribution of the Selected Characteristics of the Respondents to Their Awareness Concerning Harmful Effect of Insecticides on Environment

For this study ten characteristics of the respondent were selected and each of the characteristics was treated as independent variables. The selected characteristics were age (x_1), education (x_2), family size (x_3), farm size (x_4), annual income (x_5), farming experience (x_6), agricultural knowledge (x_7), extension contact (x_8), training on pest management (x_9), knowledge on IPM (x_{10}). Awareness concerning harmful effects of insecticides on environment (Y) was the only dependent variable of this study.

Pearson product moment correlation was initially done to find out the relationship between each of the selected characteristics of the farmers and their awareness concerning harmful effects of insecticides on environment. It was found that education, farm size, annual income, extension contact, agricultural knowledge, training on pest management and knowledge on IPM had positive significant and age had negative significant relationship with their awareness concerning harmful effects of insecticides on environment. Beside these two characteristics of the farmers (family size, farm experience) had no significant relationship with their awareness concerning harmful effect of insecticides on environment. The result has been shown in appendix B.

Full model regression analysis was initially run with the 10 independent variables. But it was observed that the full model regression results were misleading due to the existence of interrelationships among the independent variables. So that, in order to avoid the misleading results and to determine the best explanatory variables, the method of step-wise multiple regressions was administered and 10 independent variables were fitted together in step-wise multiple regression analysis. Table 4.13 shows the summarized results of step-wise multiple regression analysis. It was observed that out of 10 variables only 4 independent variables namely age (x_1), education (x_2), training on pest management (x_9) and knowledge on IPM (x_{10}) were entered into the regression equation. Other 6 variables were not entered into regression equation. The regression equation so obtained is presented below:

$$Y= 4.026 + 0.267X_{10} + 0.313X_2 - 0.057X_1 + 0.161X_9$$

Table 4.13 Summary of stepwise multiple regression analysis showing the contribution of selected characteristics of the farmers to their awareness concerning harmful effect of insecticides on environment

Variables entered	Standardized Partial 'b' Coefficients	Value of 't' (with probability level)	Adjusted R^2	Increased in R^2	Variation explained in percent
Knowledge on IPM (x_{10})	0.267	6.22(0.000)	0.573	0.573	57.3
Education (x_2)	0.313	4.13(0.000)	0.640	0.067	6.7
Age (x_1)	-0.057	-2.68(.008)	0.658	0.018	1.8
Training on pest management (x_9)	0.161	2.25(.026)	0.670	0.012	1.2
Total				0.670	67

Multiple R = 0.825
R-square = 0.681
Adjusted R-square = 0.670
F-ratio = 60.88
Standard error of estimate = 2.23
Constant = 4.026

The multiple R and R^2 values were found 0.825 and 0.681 respectively and the corresponding F-ratio was 60.88 which were significant at 0.000 levels. For determining unique contribution of each of the four variables the increase in R^2 value was determined on farmers' awareness concerning harmful effect of insecticides on environment. These four variables combined explained 67 percent of the total variation on farmers' awareness concerning harmful effect of insecticides on environment. Knowledge on IPM alone contributed 57.3 percent of

the variation followed by education 6.7 percent, age 1.8 percent and training on pest management 1.2 percent variation on farmers' awareness concerning harmful effect of insecticides on environment.

Table 4.13 showed that knowledge on IPM, education, age and training on pest management had significant contribution to farmers' awareness concerning harmful effect of insecticides on environment i.e the farmers who had more knowledge on IPM, education, training on pest management and young age were found to have more awareness concerning harmful effect of insecticides on environment.

Knowledge on IPM

From stepwise multiple regressions, it was found that knowledge on IPM of the respondent had the highest contribution on farmers' awareness concerning harmful effect of insecticides on environment. Correlation matrix also showed that knowledge on IPM of the respondents had significant positive relationship with their awareness concerning harmful effect of insecticides on environment (Appendix-B).

The findings indicate that the farmers having more knowledge on IPM had more environmental awareness, in fact, the farmers were supposed to get enough information regarding the negative impact of pesticides used in their crop field. Knowledge on IPM helps the farmers to grow crops by using environment friendly cultivation practices.

Level of education

Stepwise multiple regressions showed that education of the respondents had positive contribution to their awareness concerning harmful effect of insecticides on environment and it was found to be the 2nd highest contributor. Correlation matrix also showed that education of the respondents had significant positive relationship with their awareness concerning harmful effect of insecticides on environment (Appendix-B).

Education plays a key role on the environmental awareness of the farmers. It indicates that education makes an individual wise, broadens one's outlook and extends the horizon of knowledge. The educated persons are supposed to have frequent contact with printed materials and are exposed in various external sources which increase their power of understanding. So, the individual having more education was found to have high environmental awareness.

Age

Stepwise multiple regressions showed that age of the respondents had negative contribution to their awareness concerning harmful effect of insecticides on environment and it was found to be the 3rd highest contributor. Correlation matrix also showed that age of the respondents had significant negative relationship with their awareness concerning harmful effect of insecticides on environment (Appendix-B).

Age play a important role in using insecticides on agricultural cultivation. The findings showed that old aged farmers had low awareness about harmful effects of insecticides on environment. The findings indicate that the young to middle aged

farmers had more environmental awareness. The young to middle aged farmers had more knowledge about use of insecticides in crop field. The young to middle aged persons had frequent contact with printed materials and were exposed in various external sources which increase their power of understanding. So, the young to middle aged had more awareness about harmful effect of insecticides on environment.

Training on pest management

From stepwise multiple regressions, it was found that training on pest management of the respondent had 4^{th} highest contribution to their awareness concerning harmful effect of insecticides on environment. Correlation matrix also showed that training on pest management of the respondents had significant positive relationship with their awareness concerning harmful effect of insecticides on environment (Appendix-B).

Training on pest management plays a key role on the environmental awareness of the farmers. Training received develops the farmers' knowledge, skill, and attitude in positive manner for eco-friendly agricultural cultivation. The farmer who has no training cannot gain enough knowledge, skill and practical experience. Such consideration indicates the need for improving knowledge and skill level of the farmers by supplying enough training for gaining the knowledge on pest management. As a result, awareness on environmental pollution is higher in the trained farmers compared to those who had no training.

CHAPTER 5

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This Chapter presents summary of findings, conclusions and recommendations of the study.

5.1 Summary of findings

The major findings of the study are summarized below:

5.1.1 Selected characteristics of the farmers

Age: The highest proportion (43.70%) of the respondents belonged to middle aged category, while 31.93 percent belonged to old category and only 24.37 percent in the young aged category.

Education: The highest proportions (47.90%) of the farmers had primary education. Secondary, above secondary, can sign only and illiterate level of education found 27.73 percent, 6.72 percent, 6.72 percent and 10.93 percent, respectively.

Family Size: The highest proportion (56.30%) of the farmers had medium family size, while 31.09 percent and 12.61 percent belonged to the small family size and large family size, respectively.

Farm size: The highest proportion (59.66%) of the farmers had medium farm size, while 23.53 percent and 15.97 percent belonged to the small farm size and large farm size, respectively.

Annual income: The highest proportion (43.70%) of the respondents had medium income, while 37.81 percent and18.49 percent had low income and high income.

Farming experience: The highest proportion (47.06%) of the respondents had high farming experience, while 21.85 percent of the respondents had low farming experience and 31.09 percent respondents had medium farming experience.

Agricultural knowledge: The highest proportion (55.46%) of the respondents had medium agricultural knowledge, while 21.85 percent of the respondents had low agricultural knowledge and 22.69 percent had high agricultural knowledge.

Extension contact: The highest proportion (57.14%) of the respondents had medium extension contact, while 22.69 percent of the respondents had low extension contact and 20.17 percent of them had high extension contact.

Training on pest management: Slightly above half (52.94%) of the respondents had short training on pest management and 47.06 percent of the respondents had no training on pest management.

Knowledge on IPM: The highest proportion (50.42%) of the respondents had medium knowledge on IPM, while 27.73 percent of the respondents had low knowledge on IPM and 21.85 percent of them had high knowledge on IPM.

5.1.2 Awareness concerning harmful effect of insecticides on environment: Majority (47.90%) of the respondents had low awareness compared to 40.34 percent had medium awareness and 11.76 percent had high awareness concerning harmful effect of insecticides on environment.

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5.1.3 Contributions of the selected characteristics of the farmers to their awareness harmful effect of insecticides on environment

Out of the ten independent variables, only four variables namely knowledge on IPM, level of education, age and training on pest management had significant contribution to awareness concerning harmful effect of insecticides on environment as indicated by step-wise multiple regression analysis. These four contributory factors combinedly explained 67 percent of the total contribution.

5.2 Conclusions

On the basis of findings of the present study and their logical interpretations relevant the researcher has drawn the following conclusions:

1. The findings of the study revealed that overwhelming majority (88.24%) of the respondents had low to medium awareness concerning the harmful effect of insecticides on environment. Therefore, it may be concluded that there is necessity to increase the awareness level of the respondents about harmful effect of insecticides on environment.

2. The findings indicate that knowledge on IPM of the respondents had great contribution to the awareness concerning harmful effect of insecticides on environment. But more than three fourth (78.15%) of the farmers had low to medium knowledge on IPM. The above facts lead to the conclusion that any arrangement made to increase the knowledge on IPM of the farmers would ultimately increase their awareness concerning harmful effect of insecticides on environment. It may be concluded that the respondents having more knowledge on IPM had more about aware harmful effect environmental issues.

3. The findings indicate that level of education had a significant contribution to the awareness concerning harmful effect of insecticides on environment. It may be concluded that the respondents having more level of education had more environmental awareness.

4. The findings indicate that the age of the respondents had negative contribution to their awareness concerning harmful effect of insecticides on environment. In the view of above facts, it may be concluded that the young to meddle aged farmers had more knowledge about use of insecticides in crop field. The young to meddle aged had more awareness concerning harmful effect of insecticides on environment than the old aged.

5. The findings indicate that training on pest management of the respondent had 4^{th} highest contribution to their awareness concerning harmful effect of insecticides on environment. But slightly above half (52.94%) of the respondent had short training on pest management. The above facts lead to the conclusion that any arrangement made to increase the training on pest management of the farmers would ultimately increase their awareness concerning harmful effect of insecticides on environment. Therefore, it may be

concluded that respondent having more training exposure on pest management had more knowledge on environmental pollution by effect of insecticides.

5.3 Recommendations

5.3.1 Recommendations for policy implications

Recommendations based on the findings and conclusions of the study the following are presented below**:**

1. Application of insecticides creates enormous problems and cause massive disaster to the environment. Application of insecticides to field crop also causes the major disturbances to both aquatic flora and fauna. Organic farming can be the best alternative to save our environment. Most of the developed countries, started practicing organic farming in order to protect environment and human health. Department of Agricultural Extension (DAE) and the concerned authority need to take proper steps to minimize the adverse effect of insecticides on environment. Through creating awareness among the farmers about harmful effect of insecticides on environment.

2. The findings indicate that knowledge on IPM of the respondents had great contribution to the awareness concerning harmful effects of insecticides on environment. Therefore it may be recommended that the specific and relevant information should be provided to farmers to adopt IPM techniques and other cultural practices to minimize the health and environmental risks of using insecticides. The Department of Agricultural

Extension (DAE) should take necessary steps to increase knowledge on IPM of the respondents through various extension programme.

3. The findings indicate that level of education had a significant contribution to the awareness level of the respondents about the harmful effects of insecticides on environment. Most of the respondents in the study area had primary education. To overcome this condition arrangement should be made for providing functional education to the farmers and made them aware of different aspects of environmental issues. Education helps an individual to understand the present and future needs at personal, social and national levels. The farmers should be educated to be perceived the probable impact of their practice towards the health and environment. Therefore, it may be recommended that attempts should be taken to establish adult learning centre to increase educational level as well as environmental awareness on the effects of insecticides.

4. The findings indicate that the age of the respondents had negative contribution to their awareness about harmful effects of insecticides on environment. Young and middle-aged farmers constituted the majority (68.07%) of the farming community. So, young to meddle aged farmers should be encouraged to motivate their older counterparts towards adoption of environmentally safe farming practices. Therefore, it may be recommended that, extension workers should give closer attention to the older farmers so that they become aware about environmental hazards due to indiscriminate use of insecticides.

5. The findings indicate that training on pest management of the respondent had 4^{th} highest contribution to their awareness about harmful effects of insecticides on environment. Therefore it may be recommended that, the

farmers should be provided with proper training and mass media campaign to improve more knowledge on use of insecticides and to increase awareness on the impacts of insecticide on environmental pollution.

5.3.2 Recommendations for further research

1. The study was conducted in Damurhuda upazilla under Chuadanga district. Similar studies should be conducted in other parts of the country to get a clear view of the whole country which will be helpful for effective policy formulation.

2. Contribution of ten characteristics of the farmers with their awareness concerning harmful effect of insecticides on environment was investigated in this study. Further research should be conducted to exploring contribution of other characteristic of the farmers with their awareness about harmful effect of insecticides on environment.

3. In the present study has been carried out at farmer level to determine their awareness concerning harmful effect of insecticides on environment. Similar study could be conducted with the field of extension stuff of DAE as well as other extension agencies.

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Appendix-A

Department of Agricultural Extension and Information System
Sher-e-Bangla Agriculrural University, Dhaka-1207
Interview schedule for the research study entitled
"Farmers awareness concerning harmful effect of insecticides on environment"

Name of the respondent:..…… Sl.No……..
Father's Name:……. Date:……
Village: …….. Union:…….
Upazilla.. …….. District……

Please answer the following questions

1. Age

What is your present age?.....Years.

2. Level of Education:

a) Cannot read and write……
b) Can sign only…….
c) I read up to class ……
d) I passed ……class

3. Family size:……Members

4. Farm size:

Please indicate area of your lands according to the following items:

SI. NO.	Use of land	Farm size	
		Local unit	Hectare
1.	Homestead area (A_1)		
2.	Own land under own cultivation (A_2)		
3.	Land taken from others on borga system(A_3)		
4.	Land given to others on borga system (A_4)		
5.	Land taken from others on lease (A_5)		

Total farm size = $A_1 + A_2 + 1/2 (A_3 + A_4) + A_5$

5. Annual income:

Please state the income from different sources during the last one year:

A. Income from agriculture

Sl. No.	**Sources of income**	**Total production Kg/unit**	**Price per kg/unit**	**Total price (Tk)**
1.	Crops • Rice			
	• Maze			
	• Jute			
	• Potato			
	• Oilseed			
2.	Vegetables			
3.	Fruits			
4.	Fisheries			
5.	Livestock			
6.	Nursery			
	Total			

B. Income from other sources

SI NO	Sources of income	Annual income (Tk)
1.	Business	
2.	Services	
3.	Day labour	
4.	Others (if any)	
	Total	

Total income: A + B = ----------Taka

6. Farming experience:

How long you have been involved in farming directly? ----------years

7. Agricultural knowledge:

Please answer the following questions**:**

SI. NO.	Questions	Full marks(2)	Obtained Marks
1.	Name two high yielding varieties of rice.		
2	Mention fertilizer dose of urea in rice cultivation.		
3	Mention the control method of brinjal shoot and fruit borer.		
4	Mention fertilizer dose of maze cultivation.		
5	Name two insecticides available in your local market.		
6	What do you mean by balanced fertilizer?		
7	Mention the compost preparation procedure.		
8	Mention two harmful insects in your area.		
9	Mention two diseases of rice.		
10	Mention two beneficial insects.		
11	Mention the control method of late blight of potato.		
12	Mention the control method of maze cut worm.		
13	Name three high yielding varieties of vegetable.		
14	Mention the control method of rice stem borer.		
15	Mention two varieties of wheat.		
16	State two methods of disease control in rice.		
17.	Mention two seedling disease of rice.		
18.	Mention two varieties of maze.		
19.	What do you mean by green manure?		
20.	What do you mean by intercropping?		

8. Extension media contact:

Please indicate the extent of your contact with the following information sources:

SI. No.	Information source	Extension contact			
		Regularly (3)	Occasionally (2)	Rarely (1)	Not at all (0)
1.	SAAO	>5 times/ Month	3-4 times/ month	1-2 times/ month	
2.	NGO worker	>5 times/ Month	3-4 times/ month	1-2 times/ month	
3.	Upazila level agri-officers	>5 times/ Year	3-4 times/ year	1-2 times/ Year	
4.	Opinion leader/Relatives	>5 times/ Month	3-4 times/ month	1-2 times/ month	
5.	Participation in group Discussion	>5 times/ Year	3-4 times/ year	1-2 times/ Year	
6.	Participation in result demonstration	>5 times/ Year	3-4 times/ year	1-2 times/ Year	
7.	Participation in Field day	>5 times/ Year	3-4 times/ year	1-2 times/ Year	
8.	Newspaper Reading (Agriculture)	>5 times/ Month	3-4 times/ month	1-2 times/ month	
9.	Radio listening (Agricultural program)	>5 times/ month	3-4 times/ month	1-2 times/ month	
10.	Television watching (Agricultural program)	>5 times/ month	3-4 times/ month	1-2 times/ month	

09. Training on pest management:

Did you participate any training on pest management?

Yes …….. No. ……

If yes, mention the following information

SI. NO.	Name of organization	Duration of training (Days)

11. Knowledge on IPM:

Please answer the following questions**:**

SI. NO.	Questions	Full marks(2)	Obtained Marks
1.	What is IPM?		
2.	Mention the method of IPM.		
3.	Mention two bio-pesticides.		
4.	What is trap crop?		
5.	Name two beneficial insects.		
6.	What do you mean by crop rotation?		
7.	Mention the name of two harmful insects.		
8.	What do you mean by herbicide?		
9.	Name two major pest of brinjal.		
10.	What do you bean by crop residues?		
11.	What do you mean by mechanical control?		
12.	Name two major pests of cucurbits.		
13.	What is light trap?		
14.	What is predator and parasites?		
15.	What do you mean by cultural control?		
16.	Name two trap crops.		
17.	What are the qualities of good seeds?		
18.	Name two bio-fertilizer.		
19.	Mention two disadvantage of insecticide.		
20.	What do you mean by balance fertilizer?		
21.	Name two local techniques of aphid control.		
22.	Mention two disadvantage of chemical fertilizers.		
23.	Name two plant extract which are used in pest control.		
24.	What is biological control?		
25.	How to compare chemical pest control with IPM?		

12. Awareness concerning harmful effect of insecticides on environment:

Please mention your opinion on the following statements (put tick marks below)

I. Indiscriminate use of insecticides in crop fields……

a. increase insect-pest resistance
b. decrease insect-pest resistance
c. no increase or decrease insect-pest resistance

II. Insecticides applied in crop fields being washed out of ponds, canals and rivers which……

a. hamper growth and production of fishes
b. improve growth and production of fishes
c. do not affect none of them

III. Application of insecticides cause……

a. beneficial effects on the domestic animals
b. hazardous effects on the domestic animals
c. no effects on the domestic animals

IV. Use of insecticides in crop fields cause……...

a. harmful effects on soil micro organisms
b. beneficial effects on soil micro organisms
c. no effects on soil micro organisms

V. Use of insecticides is ……..

a. toxic for natural environment
b. beneficial for natural environment
c. no toxic or beneficial for natural environment

VI. Application of insecticides in crop fields……

a. break down soil organic substance
b. stable soil organic substance
c. increase soil organic substance

VII. Indiscriminate use of insecticides in crop production is harmful for soil environment which makes the soil…….

a. productive
b. unproductive
c. none of them

VIII. Use of insecticides cause ……. ……..

a. contamination of surface water source
b. decontamination of surface water source
c. none of them

IX. Underground water are contaminated by use of insecticides when it……..

a. removed toxic elements
b. added toxic elements
c. none of them

X. Some insecticides and their residues can exist in human body as a stable compound which causes……

a. harmful effects
b. beneficial effects
c. none of them

XI. Use of insecticides ……

a. reduce beneficial species
b. increase beneficial species
c. does not affect none of them

XII. Air and water bodies can easily …….

a. decontaminated by insecticides
b. contaminated by insecticides
c. none of them

XIII. Application of insecticides……..

a. reduce of biodiversity
b. increase of biodiversity
c. can do none of them

XIV. Use of insecticides causes……...

a. beneficial effects of aquatic lives
b. harmful effects of aquatic lives
c. none of them

XV. Application of insecticides cause……

a. damage on growth and reproduction of earthworm
b. no damage on growth and reproduction of earthworm
c. none of them

XVI. Continuous use of insecticides may cause……..

a. beneficial effects on environment
b. hazardous effects on environment
c. none of them

XVII. Insecticides dumping at canal, river and sea currents may caused……

a. environment pollution
b. no environment pollution
c. none of them

XVIII. Application of insecticides are causes ……..

a. poor root hair development and reduced plant growth
b. rich root hair development and reduced plant growth
c. none of them

XIX. Use of insecticides cause……

a. harmful effects on human health
b. no harmful effects on human health
c. None of them

XX. Use of Insecticides in crop fields ……...

a. reduce soil fertility
b. increase soil fertility
c. do not cause none of them

XXI. Indiscriminate use of insecticides cause …….....

a. break down ecological balance
b. make ecological balance
c. do not affect none of them

Thanks for your co-operation

_____
Signature of the interviewer

Date:…….

Appendix-B

Correlation matrix among the variables of the study (N=119)

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	Y
X_1	-										
X_2	-.303*	-									
X_3	.013	.165	-								
X_4	.217*	-.009	.017	-							
X_5	.124	.021	.005	.629**	-						
X_6	-.030	.124	.413**	.040	.149	-					
X_7	-.014	.472**	.125	.490**	.513**	.177	-				
X_8	-.014	.386**	.125	.593**	.611**	.144	.794**	-			
X_9	.030	.187*	.144	.339**	.370**	.152	.707**	.515**	-		
X_{10}	-.005	.470**	.083	.472**	.503**	.159	.689**	.772**	.683**	-	
Y	-.230*	.590**	.113	.187*	.259*	.144	.751**	.577**	.567**	.759**	-

*Correlation is significant at the 0.05 level

**Correlation is significant at the 0.01 level

X_1 = Age
X_2 = Education
X_3 = Family size
X_4 = Farm size
X_5 = Annual income
X_6 = Farm experience
X_7 = agricultural knowledge
X_8 = extension contact
X_9 = training on pest management
X_{10} = knowledge on IPM
Y = Awareness concerning of the harmful effect of insecticides on environment