

FARMERS' KNOWLEDGE ON ADVERSE EFFECT OF USING AGRO-CHEMICALS

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**FARMERS' KNOWLEDGE ON ADVERSE EFFECT
OF USING AGRO-CHEMICALS**

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Dedicated
To
**MY DEPARTED FATHER
AND
BELOVED MOTHER**

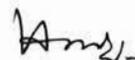
CERTIFICATE

This is to certify that thesis entitled "**FARMERS' KNOWLEDGE ON ADVERSE EFFECT OF USING AGRO-CHEMICALS**" 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 *bona fide* research work carried out by Mr. **Md. Saidul Islam** Roll and Registration No. 19740 under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

Dated: 31.12.05.

Place: Dhaka, Bangladesh



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THESIS ABSTRACT

The purposes of this study were to identify the farmers' knowledge on adverse effect of using agro-chemicals and to determine their selected characteristics, namely age, education, family size, farm size, annual income, organizational participation, cosmopolitaness, extension contact, innovativeness and attitude towards use of agro-chemicals. The study also explored the relationships between farmers' selected characteristics with their knowledge on adverse effect of using agro-chemicals for crop production. The study was conducted in *Kolerkandi*, *Shekerdari*, *Jagannathpur* and *Mirkamari* villages of Solimpur Union of Ishwardi Upazila under Pabna district. Data were collected from a sample of randomly selected 100 farmers out of a total population of 550. The data were collected through personal interview by using an interview schedule during the period from 20 August to 21 September 2005. Appropriate scales were developed in order to measure the variables. Pearson's Product Moment Correlation Co-efficient (r) were computed to examine the relationship between the concerned variables.

Findings revealed that three-fourth (75 percent) of the respondents had medium level of knowledge on adverse effect of using agro-chemicals as compared to 14 percent low and 11 percent high knowledge. Correlation analysis indicated that six characteristics of farmers namely education, farm size, annual income, cosmopolitaness, extension contact and innovativeness had significant positive relationships with their knowledge on adverse effect of using agro-chemicals. On the other hand, age and attitude towards use of agro-chemicals had significant negative relationship. Family size and organizational participation of the respondents had no relationship with their knowledge on adverse effect of using agro-chemicals.

ABBREVIATIONS AND ACRONYMS

BARC	=	Bangladesh Agricultural Research Council
BBS	=	Bangladesh Bureau of Statistics
BRI	=	Bangladesh Rice Research Institute
BS	=	Block Supervisor
DAE	=	Department of Agricultural Extension
FAO	=	Food and Agricultural Organization
FFS	=	Farmers Field School
GO	=	Government Organization
HEIA	=	High External Input based Agriculture
IFAD	=	International Fund for Agriculture Development
NEMAP	=	National Environment Management Action Plan
NGO	=	Non Government Organization

CHAPTER 1

INTRODUCTION

1.1 Background

Nature was balanced and mostly uninterrupted by the primitive men before the dawn of civilization. However, to meet the demands for food, shelter and fuel, the early man had to manipulate nature. With the passage of time more pressure was generated to exploit the resources of nature to satisfy ever-increasing requirements of human beings. Even then the environment of the earth was not changed remarkably due to very few human population and primitive technology. But with the advent of technology and the growing population, human started to manipulate all the available resources on earth without caring much about the laws of nature. For achieving rapid progress, forests were destructed; urban areas were expanded; industries were erected; channels, lakes and rivers were polluted with hazardous industrial wastes and agro-chemicals. All these activities done by man have led to a widespread denudation of land causing almost unrecoverable damage to environment. On the other hand, extensive alteration of natural landscape has taken place through agriculture, dams, embankments, polders, canals, roads, highways, railways, etc. which also created several environmental and ecological problems. As a result the civilized men have been surrounded by environmental crisis. The alarming symptoms of this crisis have appeared as specific problems, namely, depletion of resources, changes in regional and global climates, reduction of bio-diversity, reduction of agricultural productivity, increase in number of insect-pests and diseases, soil pollution, air pollution, water pollution, soil erosion, deforestation, etc. Drought, flood and other natural calamities were occurring more frequently.

Nonetheless agriculture itself is a major cause of environmental degradation in agro-based countries. For example, in Bangladesh, to bring success in green revolution during 1960s and subsequently to meet up emerging food demand for its vast population, package technologies were used to increase rice production. Encouraging use of agro-chemicals that is fertilizers and pesticides by the farmers. This has greatly increased the use of agro-chemicals in the last two decades. Due to lack of proper knowledge, consciousness and perception on harmful Effects of using agro-chemicals on environment, the farmers often used agro-chemicals indiscriminately, which ultimately caused pollution of soil, water and air, reduction of crop production in the subsequent years, deterioration of the productivity of soil, destruction of certain species of birds and wild animals, increase of insect-pests and diseases, reduction of fish species, enhanced human and animal health hazards, etc.

Non- and excessive use of different fertilizers contributes nitrate leaching, eutrophication, cadmium uptake by crops, as well as green house gas emissions. Environmental pollution caused by fertilizer may be broadly separated into two aspects namely i) pollution associated with fertilizer use in crop production and, ii) Pollution associated with fertilizer production in the factories (Bumb and Baanante, 1996). Usually, the pollution associated with fertilizer use in crop production due to nitrate leaching and eutrophication falls in the category of non-point pollution. In this pollution, the pollution is separated from the polluted objects. On the other hand, most of the pollution problems associated with fertilizer production generally takes place at the point of production. They include emission of fluorine, nitrous oxide and sulphur dioxide; disposal of phosphogypsum; and waste water discharged from the fertilizer factories, During crop production when nitrogen supply exceeds nitrogen uptake by crops excessive rainfall or irrigation occurs to saturate the soil, nitrates leaching takes place. High

concentration of these uncrates in drinking water arid considered harmful to human health. Eutrophication takes place when $P_2 O_5$ and N fertilizers are carried away by water run off and soil erosion to canals, lakes, ponds, rivers, and other water bodies. Consequently, excessive growth's of algae takes place that ultimately results in oxygen depletion and fish mortality. Due to the use of $P_2 O_5$ fertilizers in crop production cadmium pollution in the soil also takes place. Cadmium hazardous to human health when taken in large quantities with food. Moreover, oxides of nitrogen evolved from nitrogenous fertilizers mainly in paddy field and CO_2 evolved from fertilizer factories pollute environment. Hence, fertilizer use and production facilities have the potential to increase concentrations of greenhouse gases such as carbon dioxide, nitrous oxide and methane in the atmosphere which ultimately causes the rising of temperature and global warming.

There is a widespread presumption that chemical pesticides are harmful to human health and environment (Backman, 1997). Though the use of pesticides have reduced crop losses due to pest infestation, its use has often lead to increase and unnecessary pest outbreaks and increased crop losses due to unintentional destruction of natural enemies of the pests and the emergence of both pest-resistance and secondary pests, consequently, the use and abuse of pesticide cause destruction of the ecological balance between pests and their predators. Pesticides used in crop field persist in the soil and water table, and sometimes break down to even more toxic components that ultimately contaminate crops and water system. Pesticides applied in crop filed being washed out to streams, canals, lakes, ponds, rivers and bays causing fishery losses. Besides pesticides kill aquatic insects and small invertebrates that are food for fish.

Most of the pesticides, contain toxic compounds and their impact on health can occur through inhaling, ingesting, contact while spraying pesticides, or eating

crops, vegetables and fruits with pesticide residues, some highly toxic pesticides can cause cancer, birth defects, male sterility, genetic mutations, and behavioral changes. Pesticides 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. Air driven pesticides can disperse far in the atmosphere and can result in concentration of pesticide residues in mothers' breast milk. Concentration of persistent organo-chlorine compounds like DDT in the fat of mothers' milk can create health problems for future generations. It is apparent; therefore, that non- use of pesticides is also the cause of death of birds, mammals and other wild life. Fish production in the rice field areas in South-East Asia is falling drastically due to the use of highly toxic pesticide on the high-yielding rice varieties (Yudelman, *et al.* 1998).

In Bangladesh, use of agro-chemicals has been increased considerably in recent years due to expansion of irrigation facilities and rapid increase of continuous rice cropping area. Most of these irrigated uplands somehow are linked up with nearer ponds, canals, rivers and marshy lands. Pesticides naturally disseminated directly from the point of application to the flowing stream of water especially during rainy season of through the irrigation water and ultimately contaminate air, plants, animals, soil and aquatic environment.

1.1.2 Status of Crop Production in Bangladesh

Bangladesh is traditionally and predominantly an agro-based country having about 140 million people with 1,47,570 square kilometers of land area. The importance of agriculture is indicated by the fact that accounts for about 30% of GDP at current prices. It is even more evident due to relative size of economically active labour force employed in agriculture comprising about 60% of the total.

Bangladesh agriculture accounts for about 32% of export earnings. The crop sector alone accounts for 73% share of agricultural output followed by fisheries (9.9%), livestock (9.6%) and forestry (7.4%) (Karim, 1999).

Rice, wheat, jute, sugarcane, tea, tobacco, oilseeds, pulses and potatoes are the major crops growing in Bangladesh. Additionally various kinds of vegetables and spices are produced throughout the year. Banana, pineapple, mangoes, jackfruits, coconuts are also abundantly grown in Bangladesh.

Rice production is vital to the Bangladesh economy. Rice contributes about 50% of the agricultural value added and 60-70% of the total agricultural labour force is employed in rice production, processing, marketing and distribution. About 75% to the total cropped area and 83% of the total irrigated area are presently used for rice cultivation. Rice is also the major food item in Bangladesh accounting for an estimated 75% of the people's average caloric intake and 66% of protein intake (Dey *et al.*, 1996).

1.1.3 Status of Agro-chemicals Use in Bangladesh

Chemical fertilizer as an important agro-chemical in Bangladesh was first introduced with limited use in early sixties. Its consumption has increased progressively over the last three decades. Total consumption of fertilizers increased around four folds from 0.87 million tons in 1980-81 to 3.04 million tons in 1996-97 with a growth rate of 8.36% per annum. In South Asian region, the fertilizer use became more than doubled from an average of about 35kg of plant nutrient per hectare in 1980-81 to about 80kg/ha in 1994-95. Increase of fertilizer use in terms of plant nutrients during this period was comparatively larger in Bangladesh (from 45.5kg/ha to 108.1kg/ha), Pakistan from 53.2kg/ha to 102.3 kg/ha, and India from 32.9 kg/ha to 79.7 kg/ha (Roy *et al.*, 1998).

At present about 2.2 million tons of chemical fertilizers are being annually used in Bangladesh. However, most of the arable soils are highly depleted due to continuous crop removals, uninterrupted monoculture of rice and excessive soil mining. Compared to other Asian countries, fertilizer use in relation to cropped area in Bangladesh is still inadequate. But nutrient use is not at all balanced. For HYV rice, 75% of the applied fertilizers is nitrogen, 12% phosphate and only 6% potash, as against the recommended ratio of 100:60:60.

Annual growth in the use for all fertilizer nutrients was 4.63% over the period from 1989-90 to 1996-97 against 8.28% achieved in the eighties. Use of fertilizer-nitrogen grew at 6.75% annually between 1989-90 to 1996-97 compared to 8.99% annual growth between 1980-81 to 1988-89. On the other hand, consumption of phosphate (P_2O_5) indicated a negative growth of 9.6% annually between 1989-90 to 1996-97 against a significant 5.9% positive growth recorded annually between 1980-81 and 1988-89. This might be due to rapid decline in use of TSP as a source of phosphorus fertilizer since 1993-94. Accordingly the use of potash (K_2O) grew at 5.54% during 1989-90 to 1996-97 against 8.96% during 1980-81 to 1988-89.

In Bangladesh, due to intensification of agricultural production, the total fertilizer sale by product during the last two decades has increased rapidly. The total fertilizers sales by product during 1980-81 to 1997-98 in Bangladesh which clearly indicates the dramatic increase of the fertilizer consumption in Bangladesh. According to Black (1999) in the year 1997-98, nitrogenous (N) fertilizer sales by nutrient was 864, 714 metric tons which was 74.62 percent of the total fertilizer sales by nutrient in that year. In the same year amount of phosphatic (P_2O_5) and potassic (K_2O) fertilizers sale by nutrient were 107,540 and 116, 098 metric tons which were 9.28 percent and 10.02 percent respectively of the total fertilizers sales by nutrient. But amount of sulphur (S) and zinc (Zn) fertilizers sales by nutrient was 6.06 percent and 0.02 percent of the total fertilizer sales in that year.

Pesticides as agro-chemicals were introduced in Bangladesh in 1957 and were distributed by the Government to the farmers free of cost up to 1973. Because of their quick and visible effect, and no cost, the use of pesticides soon became very popular among the farmers of Bangladesh for crop protection. In 1974, the subsidy was reduced to 50 percent and in 1979, which was completely withdrawn. Although the use of pesticides declined early years of subsidy withdrawal, their use is on the rise again reaching over 11 thousand metric tons in 1996. At present 84 pesticides with 242 trade names have been registered in Bangladesh. The types of pesticides being used in Bangladesh are insecticides, fungicide, herbicide and rodenticide. In Bangladesh insect infestation is more serious in agricultural crops than the attack of diseases. In 1995, the amount of insecticides used was 8416.16 metric tons which is 91.27% of total pesticides used in that year. The amount of fungicide used in the same year was 587.96 metric tons, which is about 6.38% of total pesticide use. On the other hand in that year use of herbicides and rodenticides were 1.52% and 0.83% respectively of the total pesticide use.

Of the used pesticides in Bangladesh, 90% was applied for rice pest control throughout the country, the rate being approximately 0.085 kg ai/ha in (Karim, 1994). However, the current use of pesticide in the country is much lower than in many other countries. It is 0.03 kg/ha compared with 0.3 kg/ha in India, 0.4 kg/ha in Sri Lanka and 0.8 kg/ha in Indonesia. In developed rice growing countries like China, Korea, and Malaysia pesticide use is well over 1 kg/ha. (Karim, 1999). Despite low use of pesticide, its use in Bangladesh is alarming due to a number of pesticides, which are banned in other countries for environmental, and health reasons are still in use in the country.

1.2 Statement of the Problem

Agriculture and the environment have always been closely inter-linked. We depend upon the environment, on the resources of land, water, sunlight and .

biological organisms for agricultural production. The environment provides opportunities for agriculture but it is also a source of constraints and problems (Conway, 1990). The environment of the world is slowly degrading due to industrial and agricultural emissions and the people are much anxious about the degradation as this may cause serious damage to lives on the earth (Sattar, 1983). Today is an established fact that agriculture not industry is a major polluter of environment on a local, regional and global basis (Conway and Pretty, 1991).

The primary function of knowledge is to make sense of the information taken in the process of sensation. The study of knowledge is, therefore, expected to reveal how the farmers interpret the adverse effects of using agro-chemicals on crop production with regard to environmental pollution. Therefore, it is quite logical to assume that knowledge of the farmers on the adverse effect of using agro-chemicals might have relationship with their various social, cultural and psychological factors. It is, therefore, necessary and of course, logical to undertake a research on this aspect.

In view of the above reasons and facts, the present study is an attempt to find answers to the following questions:

1. What are the farmers' selected characteristics?
2. What is the level of farmers' knowledge on adverse effect of using agro-chemicals?
3. Are there any relationships between the selected characteristics of the farmers with their knowledge on adverse effect of using agro-chemicals?

1.3 Justification of the Study

Many studies have so far been conducted on knowledge of various aspects of agriculture. But only a little research has been reported in home and abroad to determine the farmers' knowledge on the adverse effect of using agro-chemicals. However, it is very much important to ascertain farmers' knowledge on the adverse effect of using agro-chemicals. More than 70% people of Bangladesh live in rural areas and their main livelihood is agriculture. In recent years it is no denying the fact that in agriculture sector and in rural areas agro-chemicals are the main polluter of environment. The National Environment Management Action Plan (NEMAP) of Bangladesh Government has also identified that increased use of agro-chemicals has contributed to the pollution of potential surface and ground water (GOB, 1995). But due to lack of farmers' knowledge on adverse effect of using agro-chemicals, they unconsciously use agro-chemicals indiscriminately for various purposes. The main cause of their unconsciousness on environmental issues may be due to lack of literacy and lack of their proper motivation, mass media exposure and training on environmental issues.

In order to achieve this target it is essential to undertake a massive training and motivational programmes for the farmers. However before designing training of motivational programme it is necessary to take clear-cut idea about the present status of farmers' knowledge on adverse effect of using agro-chemicals. On the above circumstances the researcher has undertaken the present study entitled "Farmers' knowledge on adverse effect of using agro-chemicals".

1.4 Objectives of the Study

In view of the problem stated above the following objectives were put forward for giving proper direction to the study:

1. To describe the selected characteristics of the farmers. The selected characters were: i) Age, ii) Education, iii) Family size, iv) Farm size, v) Annual income, vi) Organizational participation, vii) Cosmopolitaness, viii) Extension contact, ix) Innovativeness, and x) Attitude towards use of agro-chemicals
2. To determine farmers' knowledge on adverse effect of using agro-chemicals
3. To explore the relationships between the selected characteristics of the farmers' with their knowledge on adverse effect of using agro-chemicals

1.5 Scopes and Limitations

The study was undertaken with a view to have farmers' understanding of the adverse effect of using agro-chemicals with regard to crop production. In order to conduct the research in a meaningful and manageable way, it became necessary to impose some limitations in certain aspects of the study. Considering the time, money, labour and other necessary resources available to the researcher, the following limitations have been observed throughout the study:

1. The study was confined to only four villages namely Kolerkandi, Shekerdari, Jagannathpur and Mirkamari villages under Ishwardi Upazila of Pabna district.
2. There were many farmers in the study area, but only the farmers who were involved in crop cultivation were considered for this study.
3. Characteristics of the farmers were many and varied but only ten characteristics were selected for investigation in this study.

5. Population for the present study was kept confined within only the heads of farm families in the study area, because they were the decision makers in their respective families in respect of knowledge on adverse effect of using agro-chemicals.
6. Finally, for collection of information, the researcher had to depend on the data furnished by the respondents during their interview with the researcher. As none of the farmers kept records of their farming activities, they furnished information to the different questions by recall.
7. The present study highlights a new dimension of research in the field of agricultural extension in Bangladesh and so the researcher could not provide sufficient evidence in equipping his study report with relevant literature reviews.

1.6 Assumptions

Following assumptions (Goode, 1945) were in the mind of the researcher during conducting the study:

1. The respondents included in the sample were capable of furnishing proper responses to the questions included in the interview schedule.
2. Views and opinions furnished by the respondents were the representative views and opinions of the study area.
3. The responses furnished by the respondents were reliable.
4. The researcher himself as the interviewer was able to collect the responses of the farmers with adequate precision.
5. The researcher who acted as an interviewer was well aware of the social and cultural environment of the study area. Hence, the data collected by the researcher were free from bias and the respondents furnished their opinions without hesitations.

1.7 Definition of Terms

Certain terms used throughout the study are defined and interpreted below for clarity of understanding.

Age

Age of a respondent refers to the period from his birth to the time of interviewing.

Education

Empirically it refers to the number of years spent by the respondent in receiving formal education.

Family size

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

Annual Income

Annual income of a respondent refers to the total amount of money (Taka) earned by him and other members of his family from various agricultural (crops, livestock, vegetables, fruits and timbers, fish, and other) and non-agricultural (service, business, other) sources in a year for maintaining his family.

Farm Size

Farm size of a respondent refers to the area of farmland employable for raising crops and animal grazing. It includes the land holdings which the farmer has got ownership upon and have the prospect of engaging in farming as and when he wishes.

Cosmopolitaness

It is defined as the orientation of an individual external to his own social system. Empirically it referred to the number of times a person pays visits to places other than his own locality.

Organizational Participation

Organizational participation of an individual refers to his association and participation in various organizations within a specified period of time with a view to serve the society voluntarily toward development.

Extension Contact

Extension contact refers to the extent to which a respondent is exposed to the various channels of communication through which messages are exchanged.

Attitude

Attitude is the mental predisposition of an individual to act in a particular way. In other words, it refers to one's favourable or unfavourable feelings, beliefs, and actions towards an object and concept.

Knowledge

Literally knowledge means knowing or what one knows about a subject, fact, person etc. knowledge, however, refers to the amount of facts or information about an idea, object or person which a person knows. Regarding technological aspect knowledge occurs when an individual is exposed to a technology's existence and gains some understanding of how it functions (Rogers, 1983).

Agro-chemicals

It refers to the chemicals like chemical fertilizers and chemical pesticides of different kinds, which are frequently used for agricultural crop production and protection respectively.

CHAPTER 2

REVIEW OF LITERATURE

Little research has so far been conducted in this field in Bangladesh. However, available literature was extensively reviewed by the researcher to search out related works in Bangladesh as well as in other countries. But only a few studies exploring the relationships of the characteristics of individuals with their knowledge came to the notice of the researcher. However, in course of review of literature in home and abroad, the researcher observed that a number of studies have been conducted to explore the relationships of the characteristics of individuals with their awareness on environmental pollution caused by using agro-chemicals and their attitude towards use of agro-chemicals. It is expected that farmers who have favourable knowledge on adverse effect of using agro-chemicals on crop production might have positive relationships with awareness on environmental; such considerations indicate that studies dealing with the relationship of the farmers' characteristics with awareness on environmental pollution caused by agro-chemicals, reviews of the literature related to the major study are presented. It may be relevant here to mention that a good number of research activities concerning farmers' knowledge on adverse effect of using agro-chemicals. However, this chapter comprises three sections in the following manner: i) in the first section the concept of the adverse effect of using agro-chemicals by the farmers; ii) in the second section findings in connection with the relationships between independent variables with dependent variable and iii) in the last section a conceptual framework of the study has been formulated to conduct the present study in the right direction.

2.1. Concept of the Adverse Effect of Using Agro-chemicals

A concise review of literature on adverse Effect of using agro-chemicals like fertilizers and pesticides on environmental pollution and environmental degradation has been presented below.

The predominance of cultivation has resulted in an over emphasis on the use of nitrogen, where fertilizers are used, at the expense of other nutrients. Even when other nutrients are added they are usually limited to phosphorus (P) and potassium (K). As a consequence, Bangladesh soils are hungry, sick and almost lifeless; they are in urgent need of organic matter to put life into them and of the right kinds of chemical fertilizer (Islam, 1983). However, in a study on fertilizer trial, about 60-70 percent were reported to have been unutilized and the plants utilized only 30-40% of the applied fertilizers. Consequently these fertilizers were converted into other forms and cause serious environmental pollution (Anon., 1996). Gani (1997) opined that the use of chemical fertilizers are being increased in Bangladesh. The chemical fertilizers are essential inputs for high yielding variety of crops. But many farmers do not know what type of fertilizer should be applied to what kind of soil. Urea is easily dissolves into water. Soil cannot absorb more than 40% of the urea used in the land. The excesses urea gets fixed with water and runs into the rivers, lakes, etc. The nitrogen in this area increases the number of aquatic plants into water. As a result the water gets contaminated and the fish and other aquatic creatures get contaminated from that poison. The nature around us gradually becomes polluted as a result of using chemical fertilizers. Reazuddin (1994) Further reported that the residual fertilizers in the soil are carried by surface run-off from the land and discharged in the surface water. The excess nitrogen and phosphorus in water bodies disrupt the aquatic food chain; deteriorates water quality and affect aquatic life.

Karim *et al.* (1994) reported that all fertilizers contain some hazardous substances. Nitrogenous fertilizers supply nitrate. It is essential to life, but becomes hazardous if applied in the wrong place at the wrong time. Gani (1997) also stated that the indiscriminate use of chemical fertilizers not only brings bad result to our agriculture but also damages the natural property of the soil. The soils become unfertile and unproductive. Reazuddin (1994) Further reported that residual fertilizer in soil also infiltrated into the soil with applied irrigation water or rain water and percolate through a long way to join the ground water and leach ate from fertilized land is the major sources of nitrate pollution of ground and surface water.

Gani (1997) stated that, farmers use chemical fertilizers for excess nourishment. As a result fertility of the soil decreases and the physical properties and water retention capacity diminishes. Moreover, the soil loses the organic compounds. If the soil lacks in organic compounds the number of microorganisms reduces due to lack of nutrients in the soil. The ecosystem becomes imbalanced. The diseases of crops and plants increase and so the production reduces. Moreover, according to Dhaliwal *et al.* (1996) artificial fertilization in the farmland is essential if man used to remove nutrients in the form of grains, fruits, vegetables and other products from the land. Otherwise, the land will lose its fertility. However, the problems of micro-nutrients have already arisen in the areas where intensive cultivation takes place with the use of artificial fertilizer. Also, the soil sub-system may be disturbed as the micro flora and fauna of the soil are adversely affected by the chemicals. These results in making the soil sick, upsetting the recycling process and deteriorating its fertility.

Massive and non- use of agro-chemicals by the farmers for a long period of time has been damaging our natural resources such as land, fishes, beneficial insets, and soil microbes, etc. Soils of Bangladesh are fertile compared to other countries of the world. However, it has lost its fertility to a great extent due to over use of chemical fertilizers as well as the soil organic matter status which has been reduced to 0.5 percent and acidity of the land has also increased (Anon., 1994). Gani (1997) also reported that chemical fertilizers drive out useful creatures like frogs, earthworms, birds, etc. and onslaughts of pests become imminent and therefore, use of chemical pesticides becomes inevitable to combat these attacks.

According to Dhaliwal *et al.* (1996) the insect pests are controlled with the use of chemicals, which have destructive influence on the useful fauna, and create environmental pollution. Moreover, Islam (1990b) opined that the success of pesticides in controlling pests on a short-term basis cannot be denied, but their long-term efficacy against pests, their overall effects on ecosystems (including human health) and environment are very much doubtful for two major reasons. One is the rapid evolution of new breed of pests, resistant to the pesticides applied, and another is the increasing pesticide hazard. In addition to these according to Swaminathan (1991) indiscriminate use of pesticides, fungicides and herbicides could cause biological imbalance as well as to increase in the incidence of cancer and other diseases through the toxic residues being present in grains of other edible parts of the plants.

Reazuddin (1994) indicated 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 studies have shown that some chlorinated pesticides seriously inhibit nitrification by soil bacteria. If surface run-off 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) reported that use of pesticides kill beneficial creatures and insects and make the land infertile and full of pests. Besides, the indiscriminate use of pesticides create a resistance arising insects and pests which in turn creates an increased threat to the crops. Islam (1990b) 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. Moreover, according to Hussain *et al.* (1996) harmful pesticides are being indiscriminately used in different fields for so called "green revolution" particularly for HYV rice crops. The different destructive pesticides are being include dieldrin, DDT, Nogos, Sumithion, BMC, Diaginone, etc. The direct and indirect residual effect of these pesticides caused environmental degradation in rice ecosystem year after year. Reazuddin (1994) stated that poisonous chemicals used to cotton injuries insects also kill large number of beneficial insects. Insects have their enemies. Large number of small insects of the order Hymenoptera parasitize eggs and larvae of phytophagous insects and control them. Lady bird beetles control many crop pests. Ants are predators of many scale insects and aphid. Spraying of insecticides also kill them. However, according to Islam (1990b), there are circumstantial evidences, which indicate that the use of insecticides has reduced that natural population of fishes, birds, pollinators, arthropod and vertebrate predators and parasites. Thus the use of

insecticides has had an indirect role in polluting the environment by creating ecological imbalance in at least those areas of the country where insecticides are in continuous use.

Gani (1997) stated that pesticides also affect 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 lung failure, anemia, cancer, etc. According to Reazuddin (1994) insecticides sprayed in the field don't always stay there. Rain washes them to small water bodies, canals and rivers. When too much pesticide is used, our fishery resources are heavily affected. We want to control pests in crop, but non-target animals and fishes get affected. Moreover, Bouwman (1990) opined that the improved technologies including fertilizer and pesticides create some problems in the soils and environments.

2.2 Relationships between Selected Characteristics of the Respondents with their Knowledge

2.2.1 Age with Knowledge

Saha (2003), Sana (2003), Sarker (2002), Saha (2001), Rahman (2001), Hossain (2000), Islam (1993), found no relationship between age and knowledge in their studies.

Rayapradhy and Jayaramaiah (1989) worked on Village Extension Officer's (VEOs) knowledge of rice production technology, and found that age of the VEOs showed a negative relationship with the knowledge level of VEOs.

Rahman *et al.* (1988), Chandargi (1980) found a positive significant relationship between age and knowledge in their research.

2.2.2 Education with Knowledge

Saha (2003), Sana (2003), Sarker (2002), Saha (2001), Hossain (2000) found that education of the farmers was positively and significantly related with their knowledge in their research work.

Islam (1993) found that the general education of the BSs had no significant relationship with their knowledge on modern agricultural technologies.

2.2.3 Farm Size with Knowledge

Sana (2003), Hossain (2000) found that farm size of the farmers had no relationship with their knowledge. Sharma and Sanoria (1983) found that no significant differences in knowledge of both the contact and non-contact farmers with their operational holding size.

Sarker (2002), Hossain (2001) found that there was a positive relationship between farm size of the farmers and their knowledge in their research.

2.2.4 Annual Income with Knowledge

Ali (1984) also found that income of the contact and non-contact farmers differed significantly. He also found that income of the contact and non-contact farmers had significant positive contribution to both of their agricultural knowledge and adoption of innovations.

Hossain (2003) found that income of the rural women farmers had negative relationships with their knowledge of modern Boro rice cultivation.

Nurzamman (2000) found that incomes of the rural women farmers had no relationships with their knowledge of the FFS and non-FFS farmers.

2.2.5 Cosmopolitanism with Knowledge

Hossain (2000) found that there was no relationship between cosmopolitanism of the farmers and their knowledge on Bina dhan-6.

Hossain (1999) found a positive significant relationship between cosmopolitanism of the farmers and their knowledge on the use of agro-chemicals.

2.2.6 Organizational Participation with Knowledge

Sana (2003), Sarker (2002) and Saha (2001) in their study reported that there were positively significant relationships with knowledge and organizational participation.

Ali (1984) and Ahmed (1974) also found that organizational participation of contact and non-contact farmers had significant positive contribution to their agricultural knowledge.

Hossain (2000) found no significant relationship between organizational participation of the farmers and their knowledge on Binadhan-6.

Rahman (1995) in his study also found that organizational participation of potato growers had no relationship with their knowledge regarding improve practices of potato cultivation.

2.2.7 Extension Contact with Knowledge

Sana (2003), Sarker (2002) and Rahman (2001) found in their study that media exposure of farmers were highly positive significant relationships with their knowledge. Hossain (2000) and Nandiwal, Pattel and Kalla (1999) also concluded

that media exposure of the farmers had a significant relationship with their knowledge.

2.3 Conceptual Framework

The conceptual framework of Rosenbarg and Hovland (1960) was kept in mind while framing the structural arrangement for the dependent and independent variables. Knowledge on adverse effect of using agro-chemicals of the respondents as dependent variable which is supposed to be influenced and through interacting forces of many characteristics in his/her surroundings. It is impossible to deal with all characteristics in a single study. It was therefore, necessary to limit the characteristics which include age, education, family size, farm size, annual income, organizational participation, cosmopolitaness, extension contact, innovativeness and attitude towards use of agro-chemicals (Fig.1). Based on this discussion and the review of literature the conceptual framework of this study has been formulated as shown in figure 1.

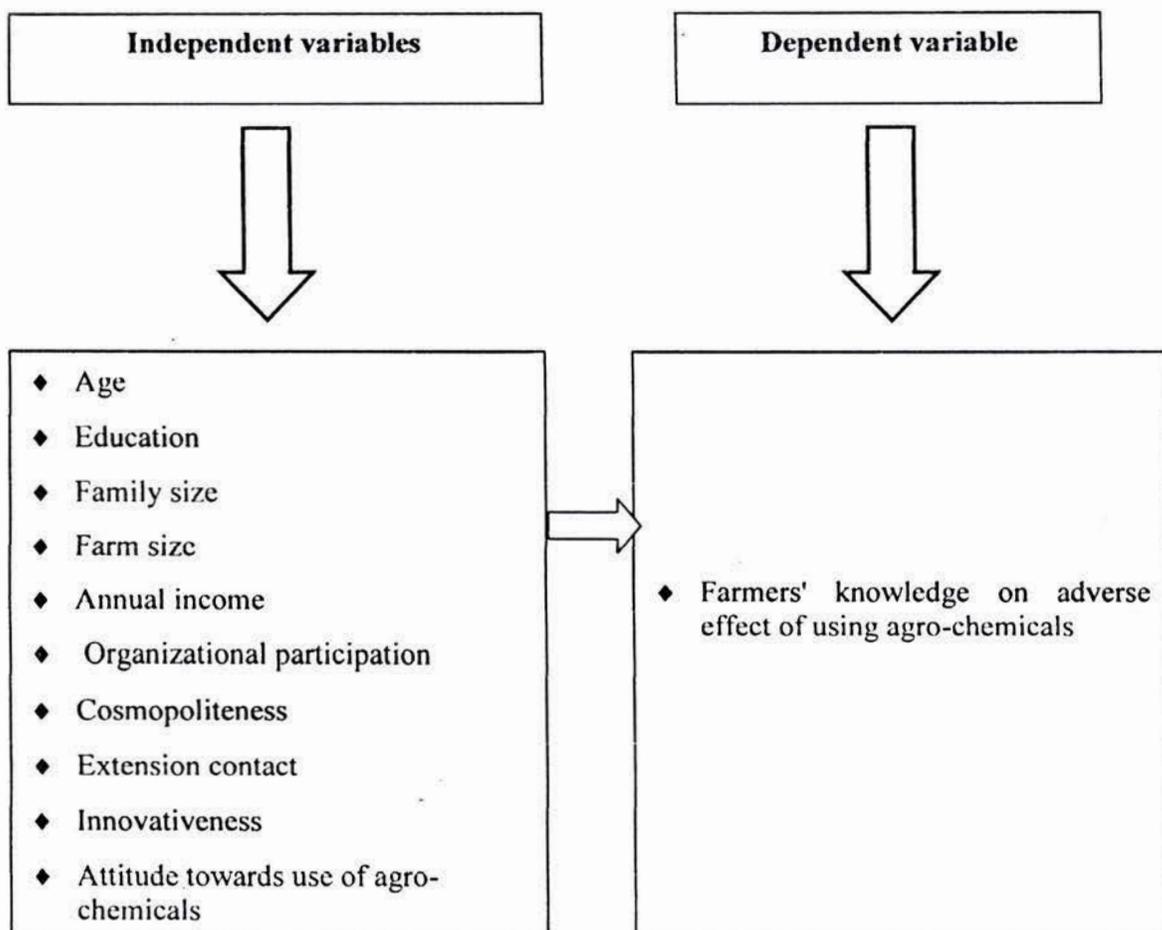


Fig.1 A simple conceptual framework for the study

CHAPTER 3

METHODOLOGY

The methods and procedures followed in conducting this study have been discussed in this chapter. Further, the chapter includes the operational format and comparative reflection of some variables used in the study. Also statistical methods and their use have been mentioned in the later section of this Chapter.

3.1 Locale of the Study

The study was conducted at Solimpur union of Ishwardi upazila under Pabna district. Out of 14 villages of Solimpur union, four villages namely Kolerkandi, Shekerdaire, Joggnathpur and Mirkamari were randomly selected. The selected villages were located on the North-East directions of the Union Parishad office and 8 km away from Upazila head quarters. Selected villages were situated just near the Dasuria-Paksy Highway. The map of Bangladesh showing the study area is presented in Figure 3.1 and Figure 3.2 depicts the particular study area under Ishwardi Upazila.

3.2 Populations and Sample

The 550 families in the selected four villages of Solimpur Union of Ishwardi Upazila were randomly selected for this study. A list of 550 family heads was collected from Upazila Agriculture Office at Ishurdi constituted the population for the study. Out of this population 110 family heads were selected by taking 20% of each village by using Random Numbers' Table (Kerlinger, 1973). Out of that population, 100 were selected for the final sample and 10 were as reserve list. When a person in the original list may not be available, then the farmers from

reserve list were used. The village-wise distributions of the population, sample as well as reserve list are shown in Table 1.

Table 1. Distribution of Population and Sample of Farmers in the Study Area

Name of village	Total no. of population	Sample drawn	Reserve list
Kolerkandi	85	17	1
Shekerdari	141	28	2
Jagannathpur	153	31	3
Mirkamari	171	34	4
Total	550	100	10

3.3 Research Instrument

An interview schedule was used as the research instrument in order to collect relevant information from the respondents. The interview schedule was prepared considering the objectives of the study in mind. The questions and statements contained in the schedule were simple, direct and easily understandable by the farmers without giving rise to doubt and misunderstanding in their minds. The schedule contained both opened and closed form of questions adopting the technique for measuring selected characteristics (age, education, family size, farm size, annual income, organizational participation, cosmopolitaness, extension contact, Innovativeness and attitude towards use of agro-chemicals) of the farmers and their knowledge on adverse effect of using agrochemicals. Questions were set in accordance with the question setting criteria suggested by Kerlinger (1973). Before finalization the interview schedule a pre-test was run in the study area in actual field situations. Pre-test was administered to 20 farmers of the selected area

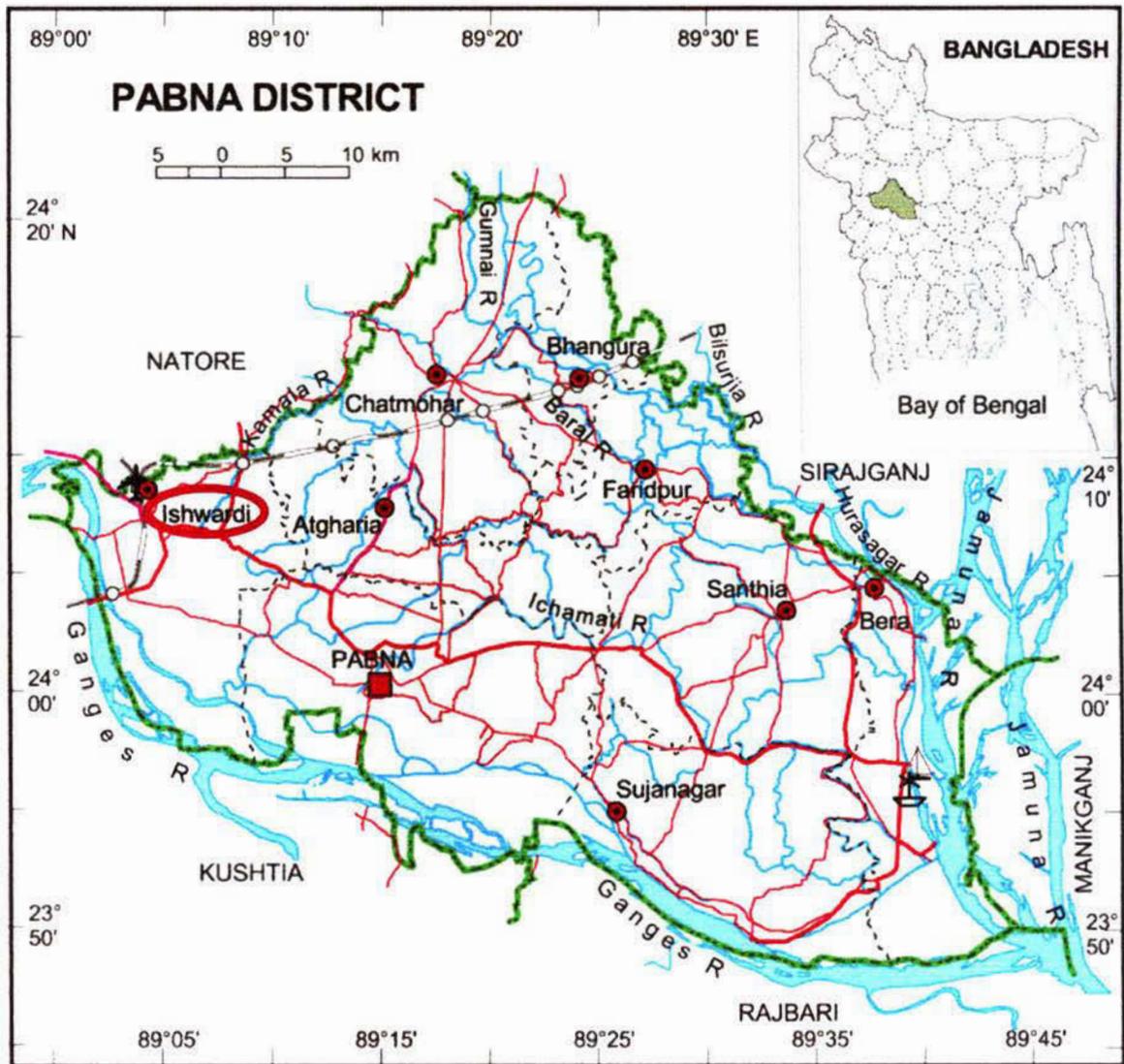


Figure 2. A Map of the Pabna District Showing the Locale of the Study Area

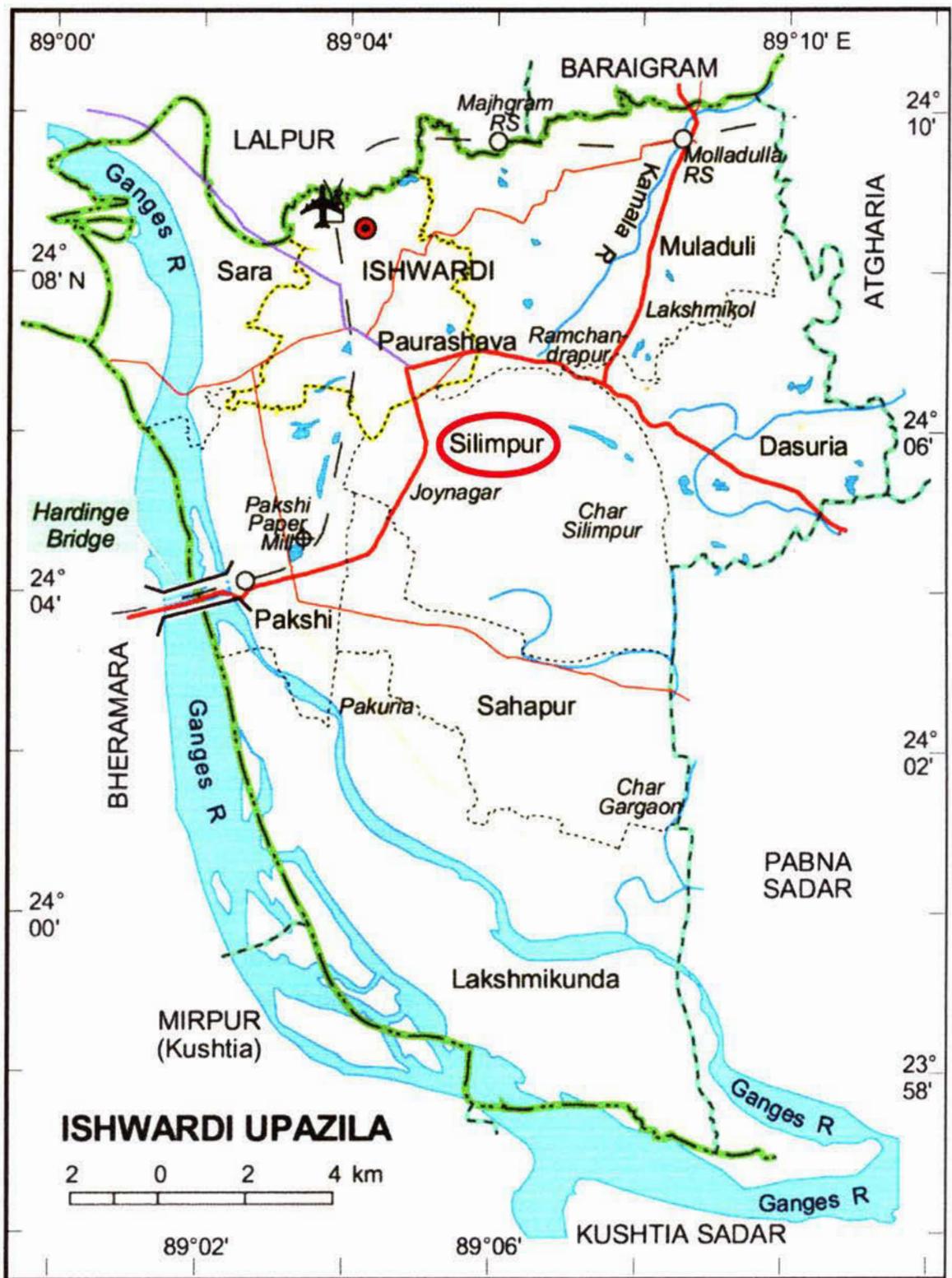


Figure 3. A Map of the Ishwardi Upazila Showing of the Study Area

out of sample list. Alterations and adjustment were made for the final interview schedule on the basis of experience of the pre-test. During modification of the schedule the researcher incorporated valuable suggestions from his research supervisor and research co-supervisor. Finally, the interview schedule was replicated to 100 keeping in view the total number of the respondent

3.4 Operationalization of Variables

3.4.1 Variable Selection

Before the onset of the study the researcher visited the study area several times and talked to the crop-growing farmers intimately. Moreover, by staying in the study area for sometime, the researcher was able to observe the personal, socio-economic, socio-cultural and psychological factors of the farming community, which the researcher assumed, might have influenced on the behavior pattern of the farmers. Based on this practical knowledge, side by side an extensive literature review and discussions with relevant experts and academicians, the researcher selected ten independent variables and one dependent variable for this study.

3.4.2 Measurement of Variables

3.4.2.1 Independent Variables

The independent variables of the study were the attributes or characteristics of the respondents. To keep the research manageable, ten independent variables were selected. The way of measurement of the selected variables were discussed below:

Age

The age of the respondents was measured in terms of actual years from his birth to the time of interview on the basis of his statement. A score of one (1) was assigned for each years of his age. It appears in item no. 1 in the interview schedule.

Education

Education of a respondent was measured in terms of years of schooling completed by him. For example if a respondent can sign his name or went to school for 1 year and passes class one his education score was given 1 (one). Thus 2 was given for two years of schooling and so on. A respondent who did not go to school and did not know reading and writing was given 0 (zero). This variable is placed in item no. 2 in the interview schedule.

Family Size

Family size was measured by computing the number of members in a family. A family normally consists of head of household, wife, unmarried sons and daughters, married sons, who are dependent and other dependent relatives, servants, boarders and loggers.

Farm Size

The farm size of the respondents was computed in hectares using the following formula:

$$FS = A_1 + A_2 + A_3 + \frac{1}{2} (A_4 + A_5)$$

where,

FS = Farm size

A_1 = Homestead

A_2 = Own land under own cultivation

A_3 = Land taken from others on lease

A_4 = Land taken from others on barga

A_5 = Land given to others on barga

Farm size is shown in item no. 4 in the interview schedule.

Annual Income

Annual income of a respondent was measured by the total yearly earning of an individual in Taka. A score of 1 (one) was given for every one thousand Taka. The total income was measured by adding all the income from various sources such as crop cultivation, cattle rearing, poultry rearing, fisheries, service, business etc.

Organizational Participation

Organizational participation score of a respondent was computed on the basis of his/her participation in eight different organizations. Scores were assigned for participation of a respondent in an organization as the following manners.

Nature of participation	Scores assigned
No participation	0
Participation as ordinary member for 1 year	1
Participation as executive committee member for 1 year	2
Participation as executive officer for 1 year (President, Secretary etc.)	3

The organizational participation of a respondent in a particular organization was measured by the following formula:

$$OP = P_{om} \times y + P_{em} \times 2y + P_{eo} \times 3y$$

where,

OP = Organizational participation score

P_{om} = Participation as ordinary committee member

P_{em} = Participation as executive committee member

P_{eo} = Participation as executive committee officers (President, Secretary and Treasurer)

y = Number of year, the respondents involved in a particular organization.

Finally organizational participation of a respondent was measured by adding all the score of all the organizations.

Cosmopolitaness

Cosmopolitaness of a respondent was measured in terms of his nature of visits to the eight different places external to his own social system. A five-point rating scale served this purpose. The way of this variable was measured is presented below:

Place of visit	Nature of visit	Weightage
1 Friend or relative or other known person's house located outside of his own village but within own union.	Not even once a month	0
	1-2 times a month	1
	3-4 times a month	2
	5-6 times a month	3
	>6 times a month	4
2. Visit to market place	Not even once a month	0
	1-2 times a month	1
	3-4 times a month	2
	5-6 times a month	3
	>6 times a month	4
3. Visit to own upazila head quarter	Not even once a month	0
	1-2 times a month	1
	3-4 times a month	2
	5-6 times a month	3
	>6 times a month	
4. Visit to other upazila sadar	Not even once a year	0
	1-2 time once a year	1
	3-4 times once a year	2
	5-6 times once a year	3
	>6 times once a year	4
5. Visit to own district sadar	Not even once a year	0
	1-2 time a year	1
	3-4 times a year	2
	5-6 times a year	3
	>6 times a year	4

6. Visit to other district town	Not even once a year	0
	1 times a year	1
	2-3 times a year	2
	4-5 times a year	3
	>5 times a year	4
7. Visit to capital/divisional city	Not even once a year	0
	1 time a year	1
	2 times a year	2
	3 times a year	3
	>3 times a year	4
8. Visit to abroad	Not even in life	0
	1 time in whole life	1
	2 times in life	2
	3 times in life	3
	>3 times in life	4

The criteria indicating the nature of visit were adjusted on the basis of pretest experience. Thus, the cosmopolitanism score of a respondent was calculated by adding together the scores obtained for his visits to all the eight types of places as shown in item no. 7 in the interview schedule. The cosmopolitanism score of an individual could range from 0 to 32 where 0 indicated no cosmopolitanism and 32 indicated cosmopolitanism of highest level.

Extension Contact

In this study, the extension contact score was computed for each respondent on the basis of the extent of his contact with 20 selected media as ascertained from his responses to item no. 8 in the interview schedule.

A six-point rating scale ranging from "no contact" to weekly contact" was developed for this purpose. The scoring technique used for computing the extension contact score of respondent is given below:

Nature of contact	Score assigned
Not at all	0
Yearly	1
Half yearly	2
Quarterly	3
Monthly	4
Weekly	5

Extension contact score was determined by summing the scores of all the 20 extension media included in item no. 8 in the interview schedule. Extension contact score could range form 0 to 100, where zero (0) indicated no extension contact and 100 indicated highest level of extension contact.

Innovativeness

The term innovativeness refers to the degree to which an individual is relatively earlier in adopting new ideas than the other members of his social system (Rogers, 1983). Innovativeness of a respondent was measured on the basis of adoption of 11 selected improved technologies by the respondents. Score was assigned on the basis of two dimensions a) how many technologies were applied and b) how many years have taken to apply these selected technologies after being informed for the first time. Following formula was used for computing the innovativeness score of a respondent.

$$\text{Innovativeness (I)} = T_n \times Y_0 + T_n \times Y_1 + T_n \times Y_2 + T_n \times Y_3 + T_n \times Y_4 + T_n \times Y_5$$

Where,

I = Innovativeness

T_n = Number of technologies

Y₀ = No application of technology = 0 score

Y₁ = Application after 4 years = 1 score

Y₂ = Application within > 3 to 4 years = 2 score

Y₃ = Application within > 2 to 3 years = 3 score

Y₄ = Application within > 1 to 2 years = 4 score

Y₅ = Application within one or less than one year = 5 score

However, the innovativeness score of a respondent for a particular innovation could range from 0 to 5. Data obtained in response to item No. 9 of the interview schedule were used to determine the innovativeness score of the respondents. Thus, the possible score of innovativeness of the respondents could range from 0 to 55, while 0 indicating no innovativeness and 55 indicating high innovativeness.

Attitude towards Use of Agro-chemicals

Attitude of a respondent towards use of agro-chemicals for crop production was measured by developing an attitude scale with the help of Likert method of summated ratings (Likert, 1967).

Twenty statements expressing positive and negative feelings towards use of agro-chemicals for crop production were constructed. A statement was considered positive if it indicated a favourable attitude towards use of agro-chemicals for crop production. If the case was reverse, it was considered as a negative statement. Out of these 20 statements 10 were positive and 10 were negative. Scoring was done

by assigning 4, 3, 2, 1 and 0 scores to the five alternative responses as: "strongly agree", "agree", "undecided", "disagree", and "strongly disagree", respectively in case of a positive statement. Reverses were assigned for a negative statement. However, attitude towards use of agro-chemicals score for a respondent was obtained by summing up his scores for all the 20 statements in item no. 10 in the interview schedule. Attitude score thus obtained for a respondent could range from 0 to 80, where 0 (zero) indicated very unfavorable attitude and 80 indicated highest level of favourable attitude towards use of agro-chemicals for crop production.

3.4.2.2 Dependent Variable

Knowledge on Adverse Effect of Using Agro-chemicals

The knowledge of a farmer on various aspects of adverse effect of using agro-chemicals for crop production was measured by using a test, which is shown in item no.11 of the interview schedule. A total of 25 questions were inserted in the knowledge test. A respondent could get a score of one (1) against each item for correct response and zero (0) for wrong response. There were options for giving partial score for partial correct answer. The summation of obtained scores against 25 questions of the respondent was the score of knowledge on adverse effect of using agro-chemicals for crop production of that respondent.

Knowledge score of a respondent could range from Zero (0) to 25 where zero (0) indicating low knowledge and 25 indicating very high knowledge on adverse effect of using agro-chemicals.

3.5 Procedure of Data Collection

The researcher himself collected data during the period from 20th August to 21st September 2005. The task was accomplished through a door-to-door visit to the selected respondents using the structured interview schedule.

The researcher could realize it very well that the collected data would be of no value if they were not valid. It also acted in the mind of the researcher that people, particularly in a traditional society, might view an outsider with suspicious. This might have unfavourable effect in obtaining valid and pertinent information from the respondents. Having comprehended all these, the researcher had purposively chosen his own birthplace to overcome the difficulties. This made the researcher come closer to the respondents easily as he was not regarded as an outsider in almost all cases. In the case where the respondent was found an unknown individual, the researcher made all possible efforts to establish proper rapport with him. That was not a difficult task for the researcher since he was well conversant in the local language. Moreover, as an extra care, the researcher kept two well-known youths of the area with him who assisted him in establishing proper rapport with the respondents. All possible efforts were made by the researcher to explain the purpose of the study to the respondents and their answers were carefully recorded. Whenever any respondent faced difficulty in understanding a question, care was taken to explain the same adequately. Moreover, at the time of data collection, the researcher was also careful about side talking and tried to avoid that problem tactfully.

3.6 Data Processing

3.6.1 Editing

The collected raw data were examined thoroughly to detect errors and omissions. As a matter of fact the researcher made a careful scrutiny of the completed

interview schedules to make sure that they were entered as complete as possible and well arranged to facilitate coding and tabulation. Very minor mistakes were detected by doing this, which were corrected promptly.

3.6.2 Coding and Tabulation

Having consulted with his research supervisor and co-supervisor the investigator prepared a detailed coding plan. In case of qualitative data, suitable scoring technique was followed by putting proper weightage against each of the traits to transform the data into quantitative forms. These were then tabulated in accordance with the objectives of the study.

3.7 Statement of the Hypothesis

As defined by Goode and Hatt (1952) the following null hypothesis was formulated for this study: "There is no relationship between the selected characteristics of the farmers and their knowledge on adverse effect of using agro-chemicals".

3.8 Categorization of Data

Following coding operation, the collected raw data as well as the respondents were classified into various categories to facilitate the description of the independent and dependent variables. These categories were developed for each of the variables by considering the nature of distribution of the data and extensive literature review. The procedures for categorization have been discussed while describing the variables under consideration in chapter 4.

3.9 Analysis of Data

Statistical measures such as number, frequency, percentage, range, mean, standard deviation, and co-efficient of variance were used in describing the selected dependent and independent variables. In order to test the formulated hypothesis of the study, Pearson's product-moment correlation co-efficient (r) was used. Through this statistical treatment, nature of relationship between the independent with dependent variables was determined.

CHAPTER 4

RESULTS AND DISCUSSION

In this Chapter findings of the study and their logical interpretations have been presented according to the objectives of the study. Results have been discussed in relation to other similar studies wherever these were applied. The chapter has been divided into three sections. The first section deals with selected characteristics of farmers. The second section deals with the dependent variable (knowledge on adverse effect of using agro-chemicals) and the third section deals with the relationships between the selected characteristics of the farmers' with their knowledge on adverse effect of using agro-chemicals.

4.1 Selected Characteristics of the Farmers

The ten selected characteristics of farmers included their age, education, family size, farm size, annual income, organizational participation, cosmopolitenss, extension contact, innovativeness and attitude towards use of agro-chemicals. The salient features of these characteristics are shown in table 2.

Table 2. Distribution of the Farmers According to their Characteristics

Variables	Measuring unit	Range		Categories	Number and percent (N=100)	Mean	SD
		Possible	Observed				
Age	Years	.	22-65	Young (up to 32)	22	42.97	11.37
				Middle-aged (33-54)	52		
				Old (>54)	26		
Education	Year of schooling	.	00-14	Illiterate (0)	15	6.26	4.08
				Primary (1-5)	22		
				Secondary (6-10)	48		
				Above secondary (>10)	15		
Family size	Number	.	03-11	Small size (up to 4)	27	5.64	1.79
				Medium size (5-8)	48		
				Large size (>8)	25		
Farm size	Hectare	.	0.02-3.15	Small (0.2-1.00)	57	1.14	0.88
				Medium (>1.00-1.80)	22		
				Large (>1.80)	21		
Annual income	Rated score	.	40-240	Low (upto 60)	15	113.16	50.61
				Medium (>60 - 80)	40		
				High (>80 - 100)	21		
				Very high (>100)	24		
Cosmopolitaness	Scale score	00-32	06-16	Low (up to 7)	19	9.49	2.13
				Medium (8-12)	73		
				High (>12)	08		
Organizational participation	Scale score	.	06-35	Low participation (up to 14)	27	20.78	7.45
				Medium participation (15 - 28)	60		
				High participation (>28)	13		
Extension contact	Scale score	00-100	22-46	Low (up to 27)	27	34.12	7.28
				Medium (28 - 41)	52		
				High (above 41)	21		
Innovativeness	Scale score	00- 55	20 - 49	Low (up to 34)	10	40.21	4.70
				Moderate (35 - 45)	81		
				High (> 45)	09		
Attitude towards use of agro-chemicals	Scale score	00- 80	26- 77	Unfavourable (<35)	09	53.65	7.45
				Neutral (35- 50)	21		
				Moderately favourable (51- 65)	51		
				Highly favourable (>65)	19		

Age

The age of the respondents ranged from 22-65 years, the average being 42.97 years with a standard deviation of 11.37. Based on their observed distribution of age, the respondents were classified into three categories as it appears in table 2. The highest proportion (52 percent) of the respondents belonged to middle-aged category as compared to 22 percent of them being young and 26 percent old. This leads to the understanding that the phenomena with regard to the knowledge on adverse effect of using agro-chemicals and other related factors would be related more by the middle aged group.

Education

Education scores of the respondents ranged from 0 to 14, the average being 6.26 with a standard deviation of 4.08. The respondents were placed under four categories according to their level of education as shown in table 2. More than four-fifth (85 percent) of the total population had education of different levels. Only 15 percent of them had no education. This truly picturizes the gradual increase in the country's literacy rate since independence. However, the literacy rate of the respondents is higher than that of the national average of 52.8 percent (BBS, 2001). This is, perhaps, because of the inclusion of only male farmers in the present study. If the women had been considered together with the men, the literacy rate might have been similar with the national average. Because the literacy rate of women is much lower than that of men in Bangladesh. The findings of the study keep consistency with the studies of Huque (1990), Majydyan (1996) and many others who also observed higher literacy rate among the farmers than the national average.

Education imparts changes in human behaviour through the acquisition and assimilation of information. An educated individual is likely to be more receptive

to the modern facts and ideas. Educated individuals get mental strength in deciding on a matter related to problem solving in their every day life. Thus the farming community of the study area may well be considered as a suitable ground for the introduction and execution of change programmes whatever needed.

Family Size

The family size of the farmers ranged from 2 to 11 with an average of 5.64 and standard deviation was 1.79. On the basis of their family size, the farmers were classified into three categories as shown in table 2. The highest proportion (48 percent) of farmers fell under the medium category compared to 25 percent large family and the remaining 27 percent with small family. Data indicate that the average family size (5.64) of the respondents in the study area was about equal to the national average of 5.6 (Bangladesh Bureau of Statistics-BBS, 1998).

Farm Size

The total farm size of the respondents varied from 0.02 to 3.15 hectares with an average of 1.14 ha, standard deviation of 0.88. Depending on the farm size, the respondents were classified into three categories as shown in table 2. The highest proportion (57 percent) of the respondents had small farm size, while 22 percent was medium farm and 21 percent large farm. More than half of (57 percent) the respondents had fallen under small category. The percentage distributions of national average are 70.34 percent for small farm, 24.72 percent for medium and 4.94 percent for large farm (BBS. 1994). In the study area large farm categories are more than the national statistics. Land is one of the important factors of production (land, labour, capital, organization) having important roles in many innovation-decision issues including the question of compatibility of a particular innovation. However, it seems that the client system stands on a favourable

situations on this variable regarding the introduction of low-cost, small-scale technologies well suited to the farm size of the small and medium farmers.

Annual Income

Annual income scores of the farmers ranged from 40 to 240 with the mean, standard deviation of 113.16, 50.61 respectively. The distribution of the farmers in different categories on the basis of their annual income has been shown in table 2. The highest proportion (40 percent) of the respondents belonged to medium income group. The percentages of farmers in the low, high and very high categories were 15, 21 and 24 respectively. The national average per capita income of the country is 14,961 Taka (BBS, 2001) according to the current exchange rate. Since the greater proportion (55 percent) of the farmers was in low and medium income groups. It is logical to assume that they had limited access to modern high-cost technologies. This is so because income is obviously associated with the purchasing power of an individual. The findings, thus, provide a rational ground for the dissemination of low-cost technologies alternative to the green-revolution ones in the study area.

Cosmopolitaness

The computed cosmopolitaness scores of the respondents ranged from 06 to 16 against the possible range of 00 to 32. The average score was 9.49 with standard deviation 2.13. Based on the calculated scores, the respondents were categorized into three groups as shown in table 2. The information presented in the above table 2 show that about three-fourth (73 percent) of the respondents maintained medium cosmopolitaness with various sources outside their own local system and 19 percent respondents had low cosmopolitaness. Only 08 percent of the respondents maintained high cosmopolitaness.

Organizational Participation

Organizational participation score of the respondents ranged from 06 to 35 with an average of 20.78, and standard deviation of 7.45. According to the participation scores, the respondents were classified into three categories such as "Low participation", "Medium participation" and "High participation". Analysis of data presented in table 2 reveals that 87 percent of the respondents had low to medium organizational participation. Only 13 percent respondents had high participation. The participation tendency seems to be satisfactory in the study area.

Extension Contact

The scores of extension contact of the respondents ranged from 22 to 46 against a possible range of 00 to 100 with an average 34.12, and standard deviation of 7.28. Based on the observed individual scores, the respondents were classified into three categories i.e. low, medium and high shown in table 2. More than half (52 percent) of the respondents had medium extension contact while only 21 percent of them had high contact. Besides that 27 percent of the population belongs to low media contact. So, it could be concluded that about three-fourth (73 percent) the respondents of the study area have sufficient information about the adverse effect of using agro-chemicals.

Innovativeness

The procedure followed in computing innovation proneness of the respondent farmers has been described in Chapter 3. The computed innovativeness scores of the respondent farmers ranged from 20 to 49 with mean and standard deviation of 40.21 and 4.70 respectively where possible score were 00 to 55. On the basis of the innovativeness scores, the farmers were classified into three categories as shown in table 2.

Data presented in table 2 indicate that 90 percent of the respondents had moderate (81 percent) to high (9 percent) innovativeness. This result might help the extension planner to make some good planning for future extension programme for transfer of technologies to the potential farmers.

Attitude towards Use of Agro-chemicals

The procedure followed in computing the respondent farmers' attitude towards use of agro-chemicals has been described in Chapter 3. The computed attitude scores of the respondent farmer ranged from 26 to 77 against possible scores of zero (0) to 80. The mean and standard deviation were 53.65 and 7.45 respectively. On the basis of the computed attitude scores, the farmers were classified into four categories as shown in Table 2. Data entered in the table 2 indicated that the more than half proportion (51 per cent) of the respondent farmer had moderately favourable attitude towards use of agro-chemicals as compared to 21 per cent neutral and 19 per cent highly favourable attitude towards use of agro-chemicals while only 9 percent fell into unfavourable attitude categories. The data also revealed that the high majority (70 per cent) of the respondent farmers had moderate to high level of favourable attitude towards use of agro-chemicals.

4.2 Knowledge on Adverse Effect of Using Agro-chemicals

Knowledge on adverse effect of using agro-chemicals for crop production has been described below:

The procedure followed in computing knowledge on adverse effect of agro-chemicals of the farmers has been described in Chapter 3. The scores of the farmers of the study area ranged from 14 to 25 against the possible score of zero (0) to 25. The mean and standard deviation were 18.84 and 1.62 respectively. According to the knowledge of the farmers, they were classified into three categories as shown in table 3.

Table 3. Distributions of the Farmers According to their Knowledge on Adverse Effect of Using Agro-chemicals

Categories (Scores)	Farmers Number and Percent (n = 100)	Mean	SD
Low knowledge (<17)	14	18.84	1.62
Medium knowledge (17-21)	75		
High knowledge (>21)	11		

Table 3 shows the distribution of the farmers according to their knowledge on the adverse effect of using agro-chemicals. Analysis of the data contained in Table 3 indicated that the three-fourth (75 percent) of the respondent had medium level of knowledge on adverse effect of using agro-chemicals as compared to 14 percent low and 11 percent high knowledge on adverse effect of using agro-chemicals. The majority (89 percent) had either low or medium knowledge on adverse effect of using agro-chemicals.

4.3 Relationship between Selected Characteristics of the Farmers with their Knowledge on Adverse Effect of Using Agro-chemicals

To explore the relationships between the selected characteristics of farmers' knowledge on adverse effect of using Agro-chemicals, Pearson's Product-Moment

Correlation Co-efficient, 'r' has been used. Table 4 is placed below with direction and interpretation of the meaning of 'r' (Cohen and Hilliday, 1982).

Table 4. Correlation Coefficient between Independent and Dependent Variables

Characteristics of the farmers	Correlation of co-efficient (r) with knowledge	Tabulated value significant at	
		0.05 level	0.01 level
Age	-0.417**	0.195	0.254
Education	0.497**		
Family size	.0189		
Farm size	0.273**		
Annual income	0.223*		
Organizational participation	0.071		
Cosmopoliteness	0.210*		
Extension contact	0.409**		
Innovativeness	0.355**		
Attitude towards use of agro-chemicals	-0.500**		

** Significant at $P < 0.01$; * Significant at $P < 0.05$

A hypothesis was rejected when the observed 'r' value was greater than the tabulated value of 'r' at 0.05 level of probability. As mentioned earlier, the ten selected characteristics of the farmers were the independent variables of the study. The variables were age, education, family size, farm size, annual income, organizational participation, cosmopoliteness, extension contact, innovativeness and attitude towards use of agro-chemicals. The dependent variable was farmers' knowledge on the adverse effect of agro-chemicals. The results of the correlation analysis between the independent and dependent variables are shown in table 5. In

a bid to achieve the said inter-correlations the correlation coefficients among the variables were arranged in matrix from which in Appendix-B.

Table 5. Meaning of Correlation Co-efficient

'r' value	Meaning
$\pm 0.00 - 0.19$	Very low correlation
$\pm 0.20 - 0.39$	Low correlation
$\pm 0.40 - 0.69$	Medium correlation
$\pm 0.70 - 0.89$	High correlation
$\pm 0.90 - 1.00$	Very high correlation

Source: Cohen and Holliday, 1982: 93

4.3.1 Relationship between Age with Knowledge on Adverse Effect of Using Agro-chemicals

Computed value of co-efficient of correlation between age of the respondents and their knowledge on adverse effect of using agro-chemicals was found to be -0.417 as shown in Table 4. The following observations were recorded regarding the relationship between these two variables on the basis of co-efficient of correlation.

Firstly, relationship showed a tendency in the negative direction. Secondly, relationship between the concerned two variables was medium. Thirdly, the computed value of 'r' (-0.417) was higher than tabulated value 'r' (0.196) with 98 degrees of freedom at 0.05 level of probability. Hence, the relationship was negatively significant.

The above observations, therefore, led to rejection of the concerned null hypothesis. That is, it may be concluded that the age of the respondents was significant with their knowledge on adverse effect of using agro-chemicals. Age of

the farmers was an important factor in knowledge gain. Hence, diffusion of the technology in the community is likely to occur irrespective of farmers' age.

4.3.2 Education with Knowledge on Adverse Effect of Using Agro-chemicals

The co-efficient of correlation between the concerned variables was found to be 0.497 as shown in table 4. This led to the following observations regarding the relationship between concerned variables.

Firstly, the relationship showed a positive trend. Secondly, the degree of relationship was medium. Thirdly, the computed value of 'r' (0.497) was found to be greater than the tabulated value 'r' (0.254) with 98 degrees of freedom even at 0.01 level of probability. Hence, the relationship was highly significant.

From the above observations, the formulated null hypothesis was rejected which implied that the educations of the respondents were related to their knowledge on adverse effect of using agro-chemicals. The positive trend indicated that the knowledge on adverse effect of using agro-chemicals increased with the increase of education of the farmers.

Education helps individuals gain knowledge and skill in different cognitive contents and develop positive attitudes. The education levels of farmers ultimately increase their power of observation and decision-making. Also educated farmers are more likely to come in contact with mass media, especially printing materials. Thus they gain knowledge and develop favourable attitude.

4.3.3 Family Size with Knowledge on Adverse Effect of Using Agro-chemicals

The co-efficient of correlation between the concerned variables was found to be 0.189 as shown in table 4. This led to the following observations.

Firstly, the relationship showed a positive trend. Secondly, the degree of relationship was very low. Thirdly, the computed value of 'r' (0.189) was found to be smaller than the tabulated value 'r' (0.195) with 98 degrees of freedom at 0.05 level of probability. Hence, the relationship was not significant.

On the basis of above findings, the null hypothesis could not be rejected and hence it can be concluded that family size had no significant relationship with their knowledge on adverse effect of using agro-chemicals.

4.3.4 Farm Size with Knowledge on Adverse Effect of Using Agro-chemicals

Computed value of "r" between the concerned variables was found to be 0.273 as shown in table 4. The following observations were recorded on the basis of "r" value.

Firstly, the relationship showed a positive trend. Secondly, the relationship between the concerned variables was low. Thirdly, the computed value of "r" (0.273) was found to be larger than the tabular value ($r = 0.254$) with 98 degrees of freedom at 0.01 level of probability. Hence, the relationship was statistically significant.

On the basis of the above findings, the null hypothesis was, therefore, rejected. Thus, it may be concluded that farm size of the farmers had a positive significant relationship with their knowledge on adverse effect of

using agro-chemicals. This implies that the farmers with large farm size were more likely to gain knowledge because of more option of technology used in the cultivation.

4.3.5 Annual Income with Knowledge on Adverse Effect of Using

Agro-chemicals

Computed value of co-efficient of correlation between the concerned variables was found to be 0.223 as shown in table 4. The following observations are recorded regarding the relationship between the two variables on the basis of co-efficient of correlation.

Firstly, the relationship showed a positive trend. Secondly, the degree of relationship was low. Thirdly, the computed value of 'r' (0.223) was found to be greater than the tabulated value 'r' (0.195) with 98 degrees of freedom even at 0.05 level of probability. Hence, the relationship was significant.

Thus, the null hypothesis was rejected and the researcher concluded that annual income had significant positive relationship with the knowledge on adverse effect of using agro-chemicals. Thus, indicated that high annual income makes strong economic base of family and contributes to the performance of crop production more efficiently which ultimately help in gaining knowledge by the farmers.

4.3.6 Organizational Participation with Knowledge on Adverse Effect of Using Agro-chemicals

The co-efficient of correlation between the concerned variables was found to be 0.071 as shown in table 4. This led to the following observations regarding the relationship under consideration.

Firstly, the relationship showed a positive trend. Secondly, the degree of relationship was very low. Thirdly, the computed value of 'r' (0.071) was found to be smaller than that of tabulated value 'r' (0.195) with 98 degrees of freedom even at 0.05 level of probability. Hence, the relationship was not significant.

Based on the above observations the null hypothesis could not be rejected and hence, the researcher concluded that organizational participation of the respondents had no relationship with their knowledge on adverse effect of using agro-chemicals.

4.3.7 Cosmopolitaness with Knowledge on Adverse Effect of Using Agro-chemicals

The co-efficient of correlation between the concerned variables was found to be 0.210 as shown in table 4. This led to the following findings.

Firstly, the relationship showed a positive trend. Secondly, the degree of relationship was low. Thirdly, the computed value of 'r' (0.210) was found to be greater than the tabulated value 'r' (0.195) with 98 degrees of freedom even at 0.05 level of probability. Hence, the relationship was significant.

Therefore, the null hypothesis was rejected and it was suggested that the respondents' cosmopolitaness had a positive significant relationship with their knowledge on adverse effect of using agro-chemicals.

The interpretation of the present findings is that, a cosmopolite farmer is more mobile. When a farmer goes frequently to places other than his own locality, the possibility are that he comes in contact with more and many progressive farmers and gets opportunity to acquire more knowledge on adverse effect of using agro-chemicals.

4.3.8 Extension Contact with Knowledge on Adverse Effect of Using Agro-chemicals

The co-efficient of correlation between the concerned variables was found to be 0.409 as shown in table 4. This led to the following observations regarding the relationship between under consideration.

Firstly, the relationship showed a positive trend. Secondly, the degree of relationship was high. Thirdly, the computed value of 'r' (0.409) was found to be greater than the table value 'r' (0.254) with 98 degrees of freedom even at 0.01 level of probability. Hence, the relationship was highly significant.

According to observations, the null hypothesis was rejected, which implied that the extension contact of the respondents was related to their knowledge on adverse effect of using agro-chemicals. The positive trend indicated that the knowledge on adverse effect of using agro-chemicals increased with the increase of extension contact of the farmers.

The farmers with higher extension contact had possessed higher knowledge on adverse effect of using agro-chemicals. Extension contact enables individual to come more in contact with different kinds of information of cognitive, affective and psychomotor domains. These stimuli, after being processed by the various senses of the farmers, are quite able to impart knowledge on the various innovations. Thus, it was possible to gain more knowledge with the increase of contact with various media.

4.3.9 Innovativeness with Knowledge on Adverse Effect of Using Agro-chemicals

Computed value of "r" was found to be 0.355 as shown in table 4. The following observations were recorded on the basis of "r" value:

Firstly, the relationship showed a positive trend. Secondly, the relationship between the concerned variable was found low. Thirdly, the computed value of "r" (0.355) was found to be larger than the tabular value ($r = 0.254$) with 98 degrees of freedom at 0.01 level of probability. Hence, the relationship was highly significant.

Based, on the above findings, the null hypothesis was, therefore, rejected. Thus, it may be concluded that innovativeness of the farmers had a positive significant relationship with their knowledge on adverse effect of using agro-chemicals. Innovative farmers are usually willing to take risks and to come toward to use innovation (Rogers, 1995). This study, however, implies that innovativeness of the respondent was important factor for agro-chemical knowledge gain in using modern agricultural technologies.

4.3.10 Attitude towards Use of Agro-chemicals with Knowledge on Adverse Effect of Using Agro-chemicals

The co-efficient of correlation between the concerned variables was found to be 0.500 as shown in table 4. This led to the following observations regarding the relationship between the variables under consideration.

Firstly, the relationship showed a negative trend. Secondly, the degree of relationship was high. Thirdly, the computed value of 'r' (-0.500) was found to be

greater than the tabulated value 'r' (0.254) with 98 degrees of freedom even at 0.01 level of probability. Hence, the relationship was highly negative significant.

According to observations, the null hypothesis was rejected, which implied that the attitude towards use of agro-chemicals was related with their knowledge on adverse effect of using agro-chemicals. The negative trend indicated that the knowledge on adverse effect of using agro-chemicals increased with the decrease of attitude towards use of agro-chemicals and vice-versa.

It means that the farmers with lower attitude towards use of agro-chemicals had possessed higher knowledge on adverse effect of using agro-chemicals. It was quite logical.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This section deals with summary, conclusions and recommendations for further study.

5.1 SUMMARY

5.1.1 INTRODUCTION

In Bangladesh, use of agro-chemicals has been increased considerably in recent years due to expansion of irrigation facilities and rapid increase of continuous rice cropping area. There is a widespread presumption that chemical pesticides are harmful to human health and environment (Backman, 1997). Though the use of pesticides have reduced crop losses due to pest infestation, its use has often lead to increase and unnecessary pest outbreaks and increased crop losses due to unintentional destruction of natural enemies of the pests and the emergence of both pest-resistance and secondary pests, Consequently, the use and abuse of pesticide cause destruction of the ecological balance between pests and their predators. The National Environment Management Action Plan (NEMAP) of Bangladesh Government has also identified that increased use of agro-chemicals has contributed to the pollution of potential surface and ground water (GOB, 1995). But due to lack of farmers' knowledge on adverse effect of using agro-chemicals, they unconsciously use agro-chemicals indiscriminately for various purposes. The main cause of their unconsciousness on environmental issues may be due to lack of literacy and lack of their proper motivation, mass media exposure and training on environmental issues. However, it is necessary to take clear-cut idea about the present status of farmers' knowledge on adverse effect of using

agro-chemicals. On the above circumstances the researcher has undertaken the present study entitled “Farmers’ Knowledge on Adverse Effect of Using Agro-chemicals”.

The objectives of this study were 1) To describe the selected characteristics of the farmers which were i) Age, ii) education, iii) Family size, iv) Farm size, v) Annual income, vi) Organizational participation, vii) Cosmopolitaness, viii) Extension contact, ix) Innovativeness and x) Attitude towards use of agro-chemicals; 2) To determine farmers' knowledge on adverse effect of using agro-chemicals and 3) To explore the relationships of the farmers' selected characteristics with their knowledge on adverse effect of using agro-chemicals.

5.1.2 METHODOLOGY

The study was conducted in *Kolerkandi; Shekerdari, Jagannathpur* and *Mirkamari* villages of Solimpur Union of Ishwardi Upazila under Pabna district. Data were collected from a sample of randomly selected 100 farmers out of a total population of 550. The data were collected through personal interview by using interview schedule during the period from 20 August to 21 September 2005. Appropriate scales were developed in order to measure the variables. Pearson's Product Moment Correlation Co-efficient (r) were computed to examine the relationship between the concerned variables.

5.1.3 RESULTS

The age of the respondents ranged from 22-65 years, the average being 42.97 years with a standard deviation of 11.37. Education scores of the respondents ranged from 0 to 14, the average being 6.26 with a standard deviation of 4.08. The family size of the farmers ranged from 2 to 11 with an average of 5.64 and standard deviation was 1.79. The total farm size of the respondents varied from 0.02 to 3.15 hectares with an average of 1.14 ha, standard deviation of 0.88.

Annual income scores of the farmers ranged from 40 to 240 with the mean and standard deviation of 113.16 and 50.61 respectively. The computed cosmopolitanness scores of the respondents ranged from 06 to 16 against the possible range of 00 to 32. The average score was 9.49, standard deviation was 2.13. Organizational participation score of the respondents ranged from 06 to 35 with an average of 20.78, and standard deviation of 7.45. The scores of extension contact of the respondents ranged from 22 to 46 against a possible range of 00 to 100 with an average 34.12, and standard deviation of 7.28. The computed innovativeness scores of the respondent farmers ranged from 20 to 49 with mean and standard deviation of 40.21 and 4.70 respectively where possible score were 00 to 55. The computed attitude towards use of agro-chemicals scores of the respondent farmer ranged from 26 to 77 against possible scores of zero (0) to 80 and the mean and standard deviation were 53.65 and 7.45 respectively. The adverse effect on knowledge on adverse effect of using agro-chemicals scores of the farmers of the study area ranged from 14 to 25 against the possible score of zero (0) to 25 and the mean and standard deviation were 18.84 and 1.62 respectively.

5.2 CONCLUSIONS

On the basis of above findings, the following conclusions were drawn:

1. Age of the farmers was an important factor in knowledge gain. Hence, diffusion of the technology in the community is likely to occur respective of farmers' age.
2. Education helps individuals to gain knowledge and skill in different cognitive contents and develop positive attitudes. The education levels of farmers ultimately increase their power of observation and decision-making ability. Also educated farmers are more likely to come in contact with mass

- media, especially printing materials. Thus they gain knowledge and develop favourable attitude.
3. Farmers with large farm size were more likely to gain knowledge because of more option of technology used in the cultivation.
 4. High annual income makes strong economic base of family and contributes to the performance of crop production more efficiently which ultimately help in gaining knowledge by the farmers.
 5. A cosmopolite farmer is more mobile. When a farmer goes frequently to places other than his own locality, the possibility are that he comes in contact with more and many progressive farmers and gets opportunity to acquire more knowledge on the adverse effect of agro-chemicals.
 6. The farmers with higher extension contact had possessed higher knowledge on adverse effect of agro-chemicals. Extension contact enables individual to come more in contact with different kinds of information of cognitive, affective and psychomotor domains. These stimuli, after being processed by the various senses of the farmers, are quite able to impart knowledge on the various innovations. Thus, it was possible to gain more knowledge with the increase of contact with various media.
 7. Innovative farmers are usually willing to take risks and to come toward to use innovation. Innovativeness of the respondent was important factor for agro-chemical knowledge gain in using modern agricultural technologies.
 8. This study implies that the farmers with lower attitude towards use of agro-chemicals had possessed higher knowledge on the adverse effect of agro-chemicals and vice versa. It was quite logical.

5.3 RECOMMENDATIONS

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

1. It may be recommended that steps are necessary to provide environment related massive training to farmers giving emphasis on adverse effect of agro-chemicals for achieving sustainable agricultural development. Special extension programme may be taken by the DAE and NGOs for providing effective training to the farmers.
2. Knowledge of the farmers with illiterate and primary level of education was considerable lower than that of the farmers with secondary or above secondary education category. Hence, for creating environmental awareness on adverse effects of using agro-chemicals motivational training should be arranged by GOs (DAE, BRDB, BADC) and NGOs specially for illiterate and primary level educated farmers.
3. Knowledge of the lower educated farmers was considerably lower than that of the medium or highly educated categories. Hence, special attention should be given by the DAE and other NGOs to provide massive environmental training.
4. Knowledge of the farmers on adverse effect of using agro-chemicals with the low or medium information source used category was found considerably lower than that of the high information source used category. Hence, for achieving sustainable agricultural development and creating awareness on environmental pollution caused by non- use of agro-chemicals three things are recommended. Firstly, necessary steps should be taken by DAE and other GOs

and NGOs that most of the farmers may come in frequent contact with different information source. Secondly, the knowledge level of personal locality information source should be encouraged by providing more and more farmers training. Third, farmers from low or medium information source used category should be given frequent motivational training on use of agro-chemicals.

5. Steps are necessary by the DAE and other relevant GOs and NGOs to pay more attention to the marginal and small farmers so that they become conscious about environmental pollution caused by indiscriminate use of agro-chemicals.
6. Steps should be taken by the DAE, NGOs and pesticide dealers to provide training to all categories of farmers on Integrated Pest Management (IPM) and Integrated Weed management (IWM) for use of pesticides.
7. Steps should be taken by the DAE and other relevant GO and NGOs to increase organizational participation of the farmers having no or low organizational participation to receive ideas and facts towards sustainable agricultural development.
8. Farmers having unfavourable or neutral attitude towards use of agro-chemicals found to have higher knowledge than farmers with favourable attitude. Hence, it is recommended that the DAE and other GOs and NGOs should take necessary action to motivate farmers having unfavourable attitude towards use of agro-chemicals.

5.4 RECOMMENDATIONS FOR FURTHER STUDY

On the basis of scope and limitations of the present study and observation made by the research work the following recommendations are made for further study:

1. The present study was conducted in only Solimpur union of Ishwardi upazila under Pabna district. Such studies are required to be conducted in other areas of the country.
2. Knowledge of the male farmers has been investigated in this study. In order to formulate policy and planning for effective measures to check environmental pollution for sustainable agricultural development, there is also need for a clear understanding of the knowledge of the adverse effect of using agro-chemicals of female farmers who are engaged in different post harvest activities and play a vital role in decision making with their husbands.
3. Level of pesticide use by the farmers, is likely to have relationship with their knowledge of the adverse effect of using agro-chemicals. But this study does not indicate any relationship of this variable with farmers' knowledge. There is a need for future study to find out the reason.
4. Farmers' knowledge on adverse effect of using agro-chemicals with regard to environmental pollution was investigated only by considering the use of fertilizers and pesticides. But such investigations may also be conducted taking into consideration of other factors of environmental pollution such as irrigation, deforestation etc.
5. Pesticides are occasionally found being used indiscriminately by the farmers. Even banned insecticides are used in the border districts. Hence, it is necessary to undertake a study on the lethal effect of the insecticides in order to protect the environment as well as to achieve sustainable agricultural development.

CHAPTER 6

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APPENDIX A

AN ENGLISH VERSION OF THE INTERVIEW SCHEDULE

Department of Agricultural Extension and Information System
Sher-e-Bangla Agricultural University
Dhaka-1207

**Interview schedule for the research study entitled
"Farmers' Knowledge on Adverse Effect of Using Agro-Chemicals"**

Serial No. :-----

Name of the respondent : -----

Village : -----

Please answer the following questions

1. Age

What is your age? ----- Years.

2. Education

Please mention your educational status from the following:

- a) I cannot read and write.
- b) I can sign only.
- c) I never went to a school but can read and write which equals to
class.
- d) I read up to class/passed.

3. Family Size

Mention the number of male and female members of your family (including yourself)?

a) Male-----

b) Female -----

Total -----

4. Farm Size

Please indicate the area of land under your possession

Sl No.	Types of land use	Land area	
		Local unit	Hectare
1.	Homestead area		
2.	Own land under own cultivation		
3.	Land taken from others on lease		
4.	Land taken from others on barga		
5.	Land given to others on barga		

5. Annual Income

Please mention your annual income of last year in Taka from the following sources.

Sl No.	Source of income	Amount of Taka
1.	Agriculture	
2.	Business	
3.	Services	
4.	Labour	
5.	Others	
Total		

6. Organizational Participation

Please mention the nature and duration of your participation (Past and/or present) with the following organizations.

Sl. No.	Name of organization	No participation	Nature of participation		
			General member	Member of executive committee	Officer of executive committee
1.	NGO Committee				
2.	Cooperative Society Committee				
3.	Madrasha/Mosque/Temple Committee				
4.	Market Committee				
5.	School Committee				
6.	Village defense committee				
7.	Union parishad Committee				
8.	Others				

7. Cosmopolitaness

Please indicate your frequency of communication outside of your locality.

Sl. No.	Place of visit	Type of communication				
		Regularly	Often	Occasionally	Rarely	Not at all
1.	Visit to relatives/friends outside of your own village but within own union	More than 6 times/month	5-6 times per month	3-4 times/month	1-2 times/month	Not even once/month
2.	Visit to Village market	More than 6 times/month	5-6 times per month	3-4 times/month	1-2 times/month	Not even once/month
3.	Visit to own upazila headquarters	More than 6 times/month	5-6 times per month	3-4 times/month	1-2 times/month	Not even once/month
4.	Visit to other upazila headquarter	More than 6 times/year	5-6 times per year	3-4 times/year	1-2 times/year	Not even once/year
5.	Visit to own district town/headquarters	More than 6 times/year	5-6 times per year	3-4 times/year	1-2 times/year	Not even once/year
6.	Visit to other district town/headquarters	More than 3 times/year	3 times per year	2 times/year	Once a year	Not even once/year
7.	Visit to capital/division city	More than 3 times/year	3 times per year	2 times/year	Once a year	Not even once/year
8.	Visit to abroad	More than 3 times in life	3 times in life	2 times in life	Once in life	Not even in life

8. Extension Contact

Please indicate the extent of contact with following extension media in last year

Sl. No.	Name of extension media	Extent of contact					
		Daily	Weekly	Monthly	Quarterly	Yearly	Not at all
1.	Local leader						
2.	Neighbor						
3.	Agricultural input dealer (Seed, Fertilizer, Insecticide dealer etc.)						
4.	Block supervisor (BS)						
5.	Agricultural Extension Officer						
6.	Upazila Agricultural Officer						
7.	Upazila Livestock Officer						
8.	Upazila Fisheries Officer						
9.	Veterinary Surgeon						
10.	Participation in group discussion						
11.	Participation in result demonstration and method demonstration						
12.	Farm and home visit by extension worker						
13.	Listening agricultural program in radio (<i>Sonali fashol, krishi katha, etc.</i>)						
14.	Watching agricultural program in television (<i>Matio-0-Manush</i>)						
15.	Reading agriculture related news on daily newspaper (<i>Krishi Katha</i> of daily <i>Jugantar, Khet Khamar</i> of daily <i>Inquilab, etc.</i>)						
16.	Reading agricultural magazine (<i>Krishi Katha</i>)/ leaflet/book let						
17.	Unit level NGO worker						
18.	Upazila level NGO worker						
19.	Agricultural fair						
20.	Other media						

9. Innovativeness

Please mention the degree of use of the following improved technology.

Sl No.	Name of technologies	Degree of use					Do Not use
		Application within one year	Application within 1-2 years	Application within 2-3 years	Application within 3-4 years	Application after 4 years	
1.	IPM practice						
2.	Use of Organic manure						
3.	Use of green manure						
4.	Use of Bio-fertilizer						
5.	Use of HYV						
6.	STP practice in Sugarcane cultivation						
7.	Crop Diversification Practice						
8.	Crop Rotation						
9.	Sugarcane: <i>Ishardi 16</i>						
10.	Inter Cropping						
11.	Hormone use in vegetable production						

10. Attitude towards Use of Agro-chemicals

Please indicate your opinion on the following statements:

SL No.	Statements	Extent of Opinion				
		Strongly agree	Agree	Undecided	Disagree	Strongly Disagree
+1	I believe that application of chemical fertilizer increase crop production					
-2	I believe that the use of chemical fertilizer in crop production is less profitable in relation to the cost involvement					
+3	I believe that use of chemical fertilizers in crop production is one of the important ways to increase farm income					
-4	I believe that chemical fertilizer is effective only on irrigated crop					
+5	I believe that application of chemical fertilizer gives quick response on crop growth					
-6	I believe that the use of chemical fertilizer requires lot of skilled farmers					
-7	I believe that use chemical fertilizer is not as profitable as it being told					
+8	I trust that application of chemical pesticide in recommended dose is the easiest way to increase crop yield					
-9	Every farmer should refrain from the use of chemical fertilizer because due to its use crop become dependent on fertilizer gradually					
+10	Alternative methods of using chemical fertilizers in the crop field are very time consuming and labourious					

+11	I think that application of chemical fertilizer in crop production is a useful practice					
-12	It is true that the use of chemical fertilizers totally spoils the land					
+13	I believe that instead of totally stopping the use of chemical pesticide it may be used in severe cases only					
-14	I trust that pest infestation of crops can not be solved by using proper pesticide in proper dose in proper time					
+15	I believe that chemical pesticide may be used if pest infestation goes beyond the economic level					
-16	I think that use of chemical pesticides is a luxury, so only big farmers should use chemical pesticides in their farms.					
-17	Farmers should use chemical pesticide before pest infestation as precautionary measure.					
+18	I believe that the use of chemical pesticide in recommended dose is more profitable in crop production in relation to the cost involved					
-19	I believe that use of chemical pesticide is harmful for environment.					
+20	I believe that use of chemical pesticide results in further improvements in farming.					

11. Knowledge on the Adverse Effect of Using Agro-chemicals

Please answer the question that mentioning below:

SL No.	Questions	Full Marks	Obtained Marks
1.	What do you mean by Agro-chemicals?	1	
2.	What do you mean by chemical fertilizer?	1	
3.	What do you mean by chemical pesticide?	1	
4.	Name two chemical fertilizers.	1	
5.	Name two chemical pesticides.	1	
6.	What are the differences between chemical and organic fertilizer?	1	
7.	What are the differences between chemical and organic pesticide?	1	
8.	What are the disadvantages of using chemical fertilizer?	1	
9.	State the harmful effects of indiscriminate use of chemical pesticides.	1	
10.	At what condition you apply agro-chemicals?	1	
11.	What do you mean by chemical pesticide?	1	
12.	How insecticides are causing harm to aquatic lives?	1	
13.	What is the effect of insecticides on human health?	1	
14.	Where do you keep empty containers of insecticides?	1	
15.	What kind of precautionary measure should be taken during application of insecticide?	1	
16.	How is water polluted?	1	
17.	Can any agro-chemical do harm to beneficial insects, birds or animals?	1	
18.	Do you know how soil turns toxic?	1	
19.	Do you have knowledge on the effects of agro-chemicals on soil micro organism?	1	
20.	How agro-chemicals cause air pollution?	1	
21.	Can over dose of agro-chemicals reduce soil fertility?	1	
22.	Do you think use of agro-chemicals increases production cost?	1	
23.	Do you know that agro-chemicals are toxic in nature?	1	
24.	Do you think that dose of agro-chemicals should gradually be increased?	1	
25.	How would you compare chemical pest control with IPM?	1	

Thank you for your co-operation

Signature of the interviewer

Date: -----

APPENDIX - B

Correlation Matrix of the dependent and independent variables (N = 100)

Variable	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁
X ₁	1.000	-	-	-	-	-	-	-	-		
X ₂	-0.579**	1.000	-	-	-	-	-	-	-		
X ₃	0.090	0.185	1.000	-	-	-	-	-	-		
X ₄	0.051	0.137	0.609**	1.000	-	-	-	-	-		
X ₅	0.163	0.088	0.601**	0.832**	1.000	-	-	-	-		
X ₆	0.109	0.177	0.178	0.325**	0.472**	1.000	-	-	-		
X ₇	-0.122	0.189	-0.179	-0.141	-0.017	0.050	1.000	-	-		
X ₈	-0.505**	0.581**	0.100	0.220*	0.015	-0.159	0.121	1.000	-		
X ₉	-0.102	0.346**	0.112	0.193	0.267**	0.339**	0.236*	0.323**	1.000		
X ₁₀	0.417**	-0.694**	-0.64	-0.155	-0.227*	-0.286**	-0.299**	-0.451**	-0.380**	1.00	
X ₁₁	-0.417**	0.497**	0.189	0.273**	0.223*	0.071	0.210*	0.409**	0.355**	-0.500**	1.00

* = Correlation is significant at 0.01 level of probability

** = Correlation is significant at 0.05 level of probability

X₁ = Age
 X₂ = Education
 X₃ = Family size
 X₄ = Farm size
 X₅ = Annual income

X₆ = Organizational participation
 X₇ = Cosmopoliteness
 X₈ = Extension contact
 X₉ = Innovativeness
 X₁₀ = Attitude towards use of agro-chemicals
 X₁₁ = Knowledge on adverse effect of using agro-chemicals