ADOPTION OF SELECTED ECOLOGICAL AGRICULTURAL PRACTICES BY THE FARMERS

A Dissertation

Submitted to the

Bangladesh Agricultural University, Mymensingh

In partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

By

MD. SEKENDER ALI

Roll No. 02/2003-04
Regn. No. 13237/1984-85

Department of Agricultural Extension Education

Bangladesh Agricultural University, Mymensingh

October 2008

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October 2008

DEDICATED

TO

MY PARENTS

DECLARATION

It is hereby declared that, except otherwise stated, this Dissertation is entirely the own work of the present researcher under the guidance and supervision of the Supervisory Committee and has not been submitted in any form to any other University for any degree.

The Researcher
July 2008

BIOGRAPHICAL SKETCH

The author was born on 01 October 1967 at Village-Mothurapur, Upazilla-Modhukhali, District-Faridpur, Bangladesh. He came from a reputed and enlightened Muslim family. He passed the S. S. C. examination from Kasiani G. C. Pilot High School, Kasiani, Gopalgonj in 1982 and H. S. C. examination from Government Rajendra college, Faridpur in 1984 and obtained first division in both. He obtained B. Sc. Ag. (Hons) degree in 1988 and M. Sc. (Ag. Ext. Ed.) degree in 1989 both from the Bangladesh Agricultural University, Mymensingh, Bangladesh.

He started his service career in 1991 as a Programme Organizer (Ecological Agriculture) of Proshika, a Non-Government Organization of Bangladesh. Then in 1994, he joined as a Member (Agriculture) of Technical Resource Team of Bangladesh Rural Development Board at Dinajpur. In May, 1996 he joined as a Lecturer of the then Hazi Mohammad Danesh Agricultural College, Dinajpur that is now turned as Hazi Mohammad Danesh Science and Technology University, Dinajpur. In December, 1996 he joined as a Lecturer of the then Bangladesh Agricultural Institute, Dhaka that is now established as Sher-e-Bangla Agricultural University, Dhaka. In September 2001, he was promoted as an Assistant Professor of Sher-e-Bangla Agricultural University, Dhaka. In May, 2007 he was further promoted as an Associate Professor of the same University and since then he has been working as an Associate Professor, Department of Agricultural Extension & Information System, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh.

He was awarded scholarship from University Grants Commission of Bangladesh for conducting this Ph.D. Programme. But later he was awarded more advantageous scholarship and research grants with three years deputation from Sher-e-Bangla Agricultural University, Dhaka, while he got himself admitted for conducting this Ph.D. degree in Bangladesh Agricultural University, Mymensingh, Bngladesh.

He is a life member and Joint secretary (2008-09) of Bangladesh Agricultural Extension Society (BAES), Joint Secretary of Agricultural Educators Forum of

Bangladesh, General Member of Krishibid Institution of Bangladesh, Joint Editor of Journal of Agricultural Education and Technology (ISSN 1729-097X) and Treasurer of Sher-e-Bangla Agricultural University Teachers' Association (2007-08). He visited Bidhan Chandra Krishi Viswavidyalaya of West Bengal and Indian Agricultural Research Institute (IARI), New Delhi, India in connection with research and academic mattes for conducting this Ph.D. degree programme.

The author is married to Mrs. Sharifa Yesmin and blessed with two daughters: Tayaba Khanum (Ocean) and Elma Khanum (Elma).

The Researcher

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The Researcher

ABBREVIATIONS AND ACRONYMS

AAEO	Assistant Agriculture Extension Officer
ABI	Average Benefit Index
ADC	Area Development Center
AESA	Agro-Ecosystem Analysis
AEZ	Agro-Ecological Zone
API	Average Problem Index
ASA	Association for Social Advancement
BAU	Bangladesh Agricultural University
BBS	Bangladesh Bureau of Statistics
BCKV	Bidhan Chandra Krishi Viswaviddyalaya
BI	Benefit Index
BRAC	Bangladesh Rural Advancement Committee
BS	Block Supervisor
BSMRAU	Bagabandhu Sheikh Mujibur Rahman Agricultural University
CARE	Cooperative Assistance and Relief Everywhere
CEA	Chinese Ecological Agriculture
CV	Co-efficient of Variation
DAE	Department of Agricultural Extension
EAI	Ecological Agriculture Index
EAP	Ecological Agricultural Practices
FAO	Food and Agriculture Organization
FFS	Farmers Field School
GO	Government Organization
GTI	Graduate Training Institute
HAT	Homestead Agricultural Technologies
HYV	High Yielding Varieties
IAP	Indigenous Agricultural Practices
IARI	Indian Agricultural Research Institute
ICM	Integrated Crop Management
IFOAM	International Federation of Organic Agriculture Movements
IFS	Integrated Farming System
IFT	Indigenous Farming Technology
IHFT	Integrated Homestead Farming Technology
IPM	Integrated Pest Management
IPNS	Integrated Plant Nutrient System

INM	Integrated Nutrient Management
IR-20	International Rice-20
ITK	Indigenous Technical Knowledge
KU	Khulna University
MOA	Mukuchi Okada Association
MP	Muriate of Potash
NGO	Non Government Organization
NM	Nutrient Management
PI	Problem Index
PM	Pest Management
PROSHIKA	Proshikkhan (Training), Shikkha (Education) and Kaj (Work), an NGO
RO	Rank Order
SAU	Sher-e-Bangla Agricultural University
SD	Standard Deviation
TSP	Tripple Super Photphate
UBINIG	Unnayan Bikalper Nitinirdharony Gobeshona
USDA	United States Development Agency
YRHF	Year-round Homestead Fruit
e.g.	exempli gratia (for example)
et. al.	et all (and other people)
etc.	et cetera (and the rest)
i.e.	id est (that is)
viz.	videlicet (namely)

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ABSTRACT

The main purpose of the study was to determine the adoption of selected ecological agricultural practices by the farmers and the factors influencing the adoption. Proshika-selected ecological farmers of six selected upazilas of four districts of Dhaka division constituted the population of the study. A total of 144 farmers were finally selected which constituted the sample of the study by using random numbers. Data were collected from the farmers during February to August, 2006 by using a pre-tested interview schedule. Two case studies were conducted on a successful ecological farmer of Proshika and another successful ICM farmer of DAE to compare the two types of farmers with reference to purposes, methods and outcomes. Twenty five selected characteristics of the farmers were considered as the independent variables. Adoption of selected ecological agricultural practices by the farmers was the dependent variable. Overwhelming majority (86 percent) of the farmers had very low to low composite adoption of selected ecological agricultural practices, ecological nutrient management practices (84 percent) and ecological pest management practices (79 percent), while none had high adoption of composite ecological agricultural practices, ecological nutrient management practices and ecological pest management practices. Among ecological nutrient management practices, adoption of cowdung ranked first followed by crop residues/weed fertilizers, compost, poultry excreta, farmyard manure and others. Among ecological pest management practices, adoption of proper weeding and eradication of insect/disease attacked plants/plant parts ranked first followed by use of quality seed, crop rotation, pest control by ash, pest control by hand/hand net and others. On the basis of Average Standardized Benefit Index (ASBI) among the types of benefits obtained from ecological agriculture, social benefits ranked first followed by technical & economical benefit, environmental benefit and psychological benefit. On the basis of Average Standardized Problem Index (ASPI) among the types of problems faced by the farmers in using ecological agricultural practices, social problem ranked first followed by economical problem, psychological problem, technical and marketing problem. The correlation co-efficient was initially computed to determine the relationships among the variables. Step-wise multiple regression and path analyses were used to explore the contribution and effect of the selected characteristics of the respondent farmers to/on their adoption of selected ecological agricultural practices. Regression analysis indicated that among other variables ecological agricultural knowledge of the farmers was the most crucial characteristics which strongly and positively influenced their adoption of selected ecological agricultural practices. Benefit obtained from ecological agriculture and attitude towards ecological agriculture also had remarkable positive influence upon adoption of selected ecological agricultural practices by the farmers. Training exposure, NGO contact, animal-poultry excreta availability, commercialization and risk orientation had somewhat positive influence on the adoption of ecological agricultural practices. Individual local contact and annual family income had somewhat negative influence on the adoption of ecological agricultural practices. The standardized partial 'b' co-efficients of the above 10 independent variables formed the equation contributing to 83.5 percent of the total variation in adoption. Results of path analysis revealed that attitude towards ecological agriculture had the highest (0.595) total indirect effects followed by risk orientation, benefit obtained from ecological agriculture, animal-poultry excreta availability, ecological agricultural knowledge and training exposure in the positive direction. Individual local contact and annual family income had appreciable negative total indirect effect while commercialization had appreciable positive total indirect effect. The variable NGO contact had the lowest (0.078) positive total indirect effect on adoption of ecological agricultural practices.

CHAPTER 1

INTRODUCTION

1.1 General Background

Ecological agriculture is multi-layered, multi-structured, multi-functional and intensively managed comprehensive agricultural production system that is established by deriving nourishment from past successes in various agricultural practices (Zhengfang, 1995). The human society has experienced by following the principles of ecology and by applying modern scientific and technical approaches at a time when the modern conventional agriculture is confronted with vital challenges. Ecological agriculture is just a comprehensive agricultural production system intensively engaged in accordance with the principles of ecology. The practices that are used in ecological agriculture are known as ecological agricultural practices. Ecological agriculture is the combination of agricultural practices without using any agro-chemicals (fertilizers and pesticides). Mainly organic, mechanical, physical and cultural practices of agriculture are used in ecological agriculture. Ecological agriculture is one of the important areas in which some NGOs like PROSHIKA, Winrock International, World Vision, CARE Bangladesh etc. and some private extension providers like UBINIG, and Paribesh Andolon are working in Bangladesh.

The crop land of Bangladesh has been losing its fertility by using anti-natural practices like use of chemical fertilizers and chemical pesticides. Murakami (1991) stated that the anti-natural agricultural practices degrade the soil and ecological balance in many ways resulting poor output. The anti-natural practices increase the cost of production in one hand and decrease the microbial activities in the soil, on the other, which creates new hazardous situation in the entire crop production system including health hazards. Chemical fertilizers and chemical pesticides not only contaminate surface water, they also affect fish population and human health as well.

Though ecological agriculture has various types of benefits, it has some limitations also. Proportion of plant nutrient contents is poor in organic fertilizers. Farmers can supply plant nutrient easily by using chemical fertilizers. On the other hand, it is very difficult to control pest without chemical pesticides at the time of severe attack. For these reasons, farmers use chemical fertilizers and chemical pesticides for crop production. But, in chemical agriculture, it is necessary to increase the doses of chemical fertilizers and chemical pesticides year after year for the same amount of production. It can be understood from the statistics of uses of agro-chemicals in Bangladesh. From the statistics, it can be observed that though the cultivated land of Bangladesh is not increasing, but the use of chemical fertilizers and chemical pesticides is steadily increasing (Table 1.1). As a result the ecological status of Bangladesh is being deteriorated. But this can not be allowed to continue, if one wishes to make environmental balance.

Table 1.1 Chemical fertilizers and chemical pesticides sales in Bangladesh

Year	Chemical Fertilizers Sales ('000' Metric tons)	Chemical Pesticides Sales ('000' Metric tons)
1989-90	2043	4.809
1990-91	2108	7.182
1991-92	2287	7.183
1992-93	2316	7.442
1993-94	2217	7.700
1994-95	2640	7.859
1995-96	3023	9.573
1996-97	3037	11.225
1997-98	2732	11.367
1998-99	2824	11.611
1999-00	3213	14.340
2000-01	2991	15.632
2001-02	3285	15.945
2002-03	3339	17.832
2003-04	3364	20.841
2004-05	3755	23.369

Source: BBS, 2004

To regain the lost ecological status, it is high time to start the ecological agriculture without further delay. Some NGOs became very much concerned about the

devastating effect of imbalanced use of chemical fertilizers and pesticides and earnestly felt the need for developing an alternative agricultural strategy that is sustainable, productive and environment-friendly. Since 1976, Proshika has been working towards development of this alternative strategy and termed it as “Ecological Agriculture” (Proshika, 2002). UBINIG, a private extension providing organization acts as an NGO. It is also practicing a special method of ecological agriculture and termed as “Nayakrishi Andolon (New Agricultural Movement)”. The methods of ecological agriculture based on modern ecological science combined with time-tested indigenous knowledge, giving emphasis on a mode of cultivation that takes into account the whole ecology of which human being is a part.

Ecological agricultural farming is steadily gaining popularity throughout the world and there are strong organic movements elsewhere in Europe and North America. Gradually, governments are recognizing that ecological agriculture could make a major positive contribution to the problems created by modern conventional farming (McRobie, 1990). Now-a-days government extension provider of Bangladesh like Department of Agricultural Extension (DAE) is providing Integrated Farming System (IFS) which includes Integrated Plant Nutrient System (IPNS) or Integrated Nutrient Management (INM) and Integrated Pest Management (IPM) in the agricultural farms of the general farmers of Bangladesh. Recently, this IFS is termed as 'Integrated Crop Management (ICM)'.

Some NGOs and private extension providers provide various types of training courses on ecological agriculture for their group members to increase their ecological agricultural knowledge and to form a favourable attitude towards ecological agriculture. Some times they provide credit facility to their group members for practicing ecological agriculture and help them for marketing their ecologically produced organic products. But very little or limited research work has so far been done to determine the extent of adoption of ecological agricultural practices by the target farmers of those NGOs and extension providers.

1.2 Statement of the Problem

Adoption of ecological agricultural practices by the farmers was supposed to be influenced through interacting forces of many factors in their surroundings. Though there were some benefits in using ecological agriculture, there might be some problems in it. If farmers could minimize the problems of ecological agriculture and understand its benefits, they could be able to adopt ecological agriculture. Extension Providers including GOs and NGOs could help to minimize the problems of ecological agriculture and they could organize motivational extension programme among the farmers to show the benefit of ecological agriculture. As a result the farmers could rapidly adopt ecological agricultural practices.

Some farmers respond to an innovation quickly while others delay or sometimes do not adopt at all. The success of any technology depends on its dissemination among the potential users and the success ultimately is measured by the level of adoption of the technology. It is assumed that notable improvements can take place in Bangladesh agriculture, if the ecological agricultural practices are accepted and adopted by the farmers. However, very little is known about the adoption of ecological agricultural practices by the farmers in Bangladesh. Generalization from the studies conducted in abroad regarding the adoption of ecological agricultural practices may not be applicable due to considerable variation in socio-economic and cultural conditions.

It is necessary to have a clear understanding of the present position in respect of adoption of ecological agricultural practices by the farmers in order to prepare programmes and courses of action for wider adoption of ecological agricultural practices. It is also necessary to have an understanding of the factors related to adoption of ecological agricultural practices. An understanding of the relationship of farmers' adoption behaviour with their characteristics will be helpful to the planners and extension workers for promoting better action among the farmers who are concerned with the technology.

For having an understanding on the farmers' adoption of ecological agricultural practices and related matters, the researcher has undertaken this piece of research entitled "Adoption of Selected Ecological Agricultural Practices by the Farmers".

In view of the above considerations, the present study would attempt to find out the answers to the following research questions:

1. To what extent the farmers adopted selected ecological agricultural practices?
2. What were the factors of the farmers involved in adopting ecological agricultural practices?
3. What were the contributions of the selected factors of the farmers to their extent of adoption of ecological agricultural practices?
4. What were the perceptions of the farmers on the benefits derived from ecological agricultural practices?
5. What were the constraints faced by the farmers in adopting ecological agricultural practices?
6. What were the types of crop grown and size of area covered under ecological agricultural practices by the farmers?
7. What were the differences between the Integrated Crop Management (ICM) of DAE and Ecological Agriculture of PROSHIKA in respect of purpose, method and outcome?

1.3 Objectives of the Study

In order to shape the research in a manageable and meaningful way, the following specific objectives were formulated:

1. To determine and describe the extent of adoption of selected ecological agricultural practices by the farmers. The selected ecological agricultural practices included:
    a. Ecological nutrient management (nutrient management without chemical fertilizers), and
    b. Ecological pest management (pest management without chemical pesticides);
2. To determine and describe the characteristics profile of the farmers;
3. To explore the contributions of the selected factors of the farmers to their extent of adoption of selected ecological agricultural practices;
4. To determine the perception of the farmers on the extent of benefits obtained from ecological agricultural practices;

5. To determine and describe the problems faced by the farmers in using ecological agricultural practices;
6. To make a comparison between Integrated Crop Management (ICM) of DAE and Ecological Agriculture of PROSHIKA with reference to purpose, method and outcome

1.4 Justification of the Study

Some scientists thought that ecological agriculture was the best alternative for sustainable agriculture but some were against the use of ecological agricultural practices. There were arguments in favour of both the aspects. Food and Agriculture Organization (FAO) of the United Nations recognized ecological agriculture as a suitable option for sustainable agriculture (IFOAM, 1996). Many authors raised strong arguments for introduction of ecological agriculture. But, some opponents termed ecological agriculture against the process of scientific development (Pretty, 1995).

According to Rahman (2001), a widespread introduction of ecological agriculture in Bangladesh could be justified through the following arguments:

- Ecological farming offers the possibility of long term sustainability;
- Ecological agriculture is affordable for resource poor farmers;
- Problem of rural unemployment could be mininimized through ecological farming; and
- Bangladesh has a long heritage of farming with traditional wisdom, which acts as bases for ecological knowledge.

There were so many arguments in favour of a widespread introduction of ecological agriculture. Whatever might be the result of on-going debate on introduction of ecological agriculture in a country like Bangladesh, this approach of farming should get an opportunity to prove its feasibility (Islam, 2002). Some private extension providers like UBINIG took an initiative to promote “Nayakrishi Andolon” as ecological agriculture with using only manures as fertilizers and without using any kind of organic and biological pesticides. Government organization like Department of Agricultural Extension (DAE) is trying to introduce Integrated Crop Management (ICM) including Integrated Nutrient Management (INM) and Integrated Pest management (IPM) among

the farmers for environment friendly agriculture. In INM, recommended doses of chemical and organic fertilizers are used for nutrient management and in IPM, there is a chance of using recommended doses of chemical pesticides at last phase of pest control. But some NGOs of Bangladesh like PROSHIKA stands in the middle position. They thought that there is no compromise with chemicals like chemical fertilizers or chemical pesticides, but organic manures and biological pesticides may be used in agricultural field. They took the initiative for popularization of ecological agriculture among the farmers. In many parts of the world this practice is already in use. As a new farming technology in Bangladesh, it is necessary to examine its different aspects. Considering these facts the researcher became interested to conduct the present study on adoption of selected ecological agricultural practices by the farmers.

1.5 Scope of the Study

In this study extent of adoption of ecological agricultural practices were determined. This would also enable to identify the factors which affect the adoption of ecological agricultural practices. This important aspect would ultimately help the extension providers in formulating appropriate technologies of ecological agriculture and that would be helpful to develop sustainability in agriculture.

NGOs and private extension providers are working for development programmes. Some of them are working for sustainable development of agriculture by environment friendly ecological agriculture. With the help of the findings of the research, the concerned authority could expect to select appropriate strategies for establishing ecological agricultural programme in Bangladesh.

The study had also found out the benefits of ecological agriculture and constraints faced by the farmers in adopting ecological agricultural practices. The study had made a comparison between ecological agriculture of PROSHIKA and Integrated Crop Management (ICM) of DAE. The development agencies and extension providers

would utilize this key information for adopting ecological agricultural practices properly.

However, the overall findings of the study would enable the planners, policy makers and the extension providers to formulate extension policy and appropriate strategy to reach the specific target groups. The findings of the study were expected to be helpful to the academicians and researchers. The findings might be supplementing other empirical evidences to different aspects of ecological agricultural practice in order to build an adequate conceptualization of ecological agriculture.

1.6 Assumptions

The researcher had the following assumptions in mind while undertaking this study.

1. The respondents selected for the study were competent enough to answer the queries made by the researcher.
2. The respondents included in the sample were capable of furnishing proper responses to the questions included in the interview schedule.
3. The views and opinions provided by the farmers included in the sample were the representative views and opinions of all farmers of the study area.
4. The data collected by the researcher from the respondents were free from biases.
5. The items, questions and scales used for measuring the variables were reasonably adequate to reflect the respondents' real views and opinions.
6. The data for the study were valid and reliable.
7. The findings of the study were expected to be useful for planning and implementation of various extension programmes for improving ecological and sustainable agriculture of the country.

1.7 Limitations

The study had the following limitations:

1. Since the findings were based on the ability of the respondents to recall and on the verbal opinions expressed by them, the objectivity of the study was confined to their ability to recall, and also their sincerity and honesty in providing the needed information.

2. This study was conducted in selected areas of Bangladesh, not the whole country.
3. Factors of the farmers were many and varied, but in the present study only 25 factors on personal, economical, social and psychological aspects were taken into consideration.
4. There were many and vast areas of ecological agriculture like, crops, livestock, fisheries, etc. But for this study, information related to selected aspects of ecological agriculture like nutrient management without chemical fertilizers and pest management for crop production without chemical pesticides were considered.
5. The focus of the study was made mostly on the extent of adoption of ecological agricultural practices, its benefits and constraints faced by the farmers in adopting ecological agricultural practices, but it was not possible to investigate other issues of the problem in depth.
6. Many of the factors of farmers and situations were excluded from the investigation due to the limitations of time, money and other resources.

1.8 Definition of Terms

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

Ecological agricultural practices

Ecological agricultural practices referred to the agricultural practices without using any chemical fertilizers and chemical pesticides.

Ecological nutrient management

Ecological nutrient management referred to the plant nutrient management without using any chemical fertilizers.

Ecological pest management

Ecological pest management referred to the pest management for crop production without using any chemical pesticides.

Integrated crop management (ICM)

Integrated crop management referred to the judicious integrated use of chemical and non-chemical inputs in crop production. It has two broad dimensions: Integrated Nutrient Management (INM) and Integrated Pest Management (IPM)

Integrated nutrient management (INM)

Integrated nutrient management referred to the judicious integrated use of chemical and non-chemical fertilizers for plant nutrient management. Sometimes, it is termed as integrated plant nutrient system (IPNS).

Integrated pest management (IPM)

Integrated pest management referred to the judicious integrated use of chemical and non-chemical pesticides to pest control for successful crop production.

Adoption

Adoption is a decision to use an innovation by an individual and continue to use the innovation (Rogers, 1995). In the present study, adoption of selected ecological agricultural practices by the farmers was taken into consideration.

Age

Age referred to the period of time of a respondent from his birth to the time of interview.

Education

Education of an individual was defined as the extent of formal education received by him from the educational institute or adult learning center.

Family size

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

Working family size

Working family size of a respondent referred to the total number of adult members and others on the basis of partial or full working ability with the age-level of more than six years.

Effective land possession

Effective land possession of a respondent referred to his total area of land in terms of ownership and benefit obtained from the land.

Cropping intensity

Cropping intensity of a respondent referred to the ratio of total cropped area and net cropped area expressed in percentage.

Animal-poultry excreta availability

Domestic animals like cattle, buffalo, sheep, goat, poultry, etc. offer great scope for organic farming, when their dung/excreta and urine can be collected and usefully converted into manure (Joshi and Prabhakarasetty, 2005). In this study, animal-poultry excreta availability of a respondent referred to the availability of crop nutrients obtained from dung/excreta and urine of those domestic animals under his possession.

Annual family income

Annual family income referred to the total earnings of a respondent and the members of his family from agricultural and non-agricultural sources (business, services, daily labour etc.) during the previous year.

Commercialization

Commercialization of an individual referred to the ratio of value of crops sold and total value of crops raised. It was expressed in percentage.

Credit need

Credit need of a respondent referred to the percentage of difference between total requirement of credit and amount of credit received with total requirement of credit.

Marketing opportunity

Marketing opportunity of a respondent referred to the opportunities available in respect of transport, buying price of agricultural inputs, selling price of agricultural produces and storage facilities.

Benefit obtained from ecological agriculture

Benefits obtained from ecological agriculture by a respondent referred to the extent of benefit obtained from using ecological agricultural practices as perceived by him in terms of social, environmental, technical and economical, and psychological aspects.

Cosmopoliteness

Cosmopoliteness referred to the degree to which an individual was oriented external to his own social system.

Individual local contact

Individual local contact of a respondent referred to the extent of contact with 3 different types of local individuals viz. neighbour farmers/friends/relatives, group leaders and seed dealers.

NGO contact

NGO (Non-Government Organization) contact of a respondent referred to the extent of contact with 3 different NGO officials, viz. unit level NGO workers, Area Development Center (ADC) level NGO workers and central NGO personnel. In this study, Proshika has been used as the NGO.

GO contact

GO (Government Organization) contact of a respondent referred to the extent of contact with 3 different GO officials, viz. Sub Assistant Agriculture Officers, Upazilla level Agriculture Officers and District or above level Agriculture Officers. In this study, Department of Agricultural Extension (DAE) has been used as the GO.

Group contact

Group contact of a respondent referred to the extent of contact with 4 selected group communication media, viz. group meeting, farmers' field day, method demonstration meeting and result demonstration meeting.

Mass contact

Mass contact of a respondent referred to the extent of contact with 7 selected mass communication media, viz. radio, television, daily newspapers, leaflet/folder, booklets/agricultural magazines, film show and agricultural fair.

Training exposure

Training exposure of a respondent referred to the total number of days that the respondent had undertaken different types of training in his entire life from different organizations.

Decision making ability

Decision making ability of a respondent referred to the extent of ability to make decision with 3 different aspects, viz. decision making by alone', 'decision making with family members', and 'decision making with others outside the family' involving six selected items of decisions.

Ecological agricultural knowledge

Knowledge is those behaviour and test situations which emphasized the remembering either by recognition or recall of idea, material or phenomenon (Bloom *et al*., 1956). In this study ecological agricultural knowledge indicated the extent of ecological agricultural knowledge of a respondent at the time of interview as evident from his responses to a set of questions related to ecological agriculture logically scientifically prepared for this purpose.

Problems faced in ecological agriculture

It referred to the extent of problems faced by a respondent in using ecological agriculture in terms of social, technical, economical, marketing and psychological problems.

Attitude towards ecological agriculture

Thurstone (1946) defined attitude as 'the degree of positive and negative affect associated with psychological object like symbol, phrase, slogan, person, institution,

or ideas towards which people can differ in varying degrees'. In the present study, attitude towards ecological agriculture referred to the extent of knowledge, feeling, belief and action tendency towards ecological agriculture.

Aspiration

According to Haller (1968), an aspiration usually refers to a person's or a group of persons' orientation towards a goal. In the present study aspiration of an individual has been defined as the standards set by himself regarding the level he wanted to achieve with future performance.

Risk orientation

Supe ((1969) defined risk orientation as the degree to which a farmer is oriented towards risk and uncertainty and has the courage to face the problems in farming. In the present study, risk orientation has been defined as the degree to which a farmer was oriented towards encountering risk and uncertainty in adoption of new ideas related to farm affairs.

CHAPTER 3

METHODOLOGY

3.1 Study Area

The study was conducted in six Area Development Centers (ADCs) of Proshika in six upazillas under four districts. Location of these six ADCs included Ghatail and Madhupur upazillas under Tangail district, Muktagacha upazilla under Mymensingh district, Pakundia upazilla under Kishoreganj district, and Belabo and Raipura upazilla under Narsingdi district.

3.1.1 Basic facts about the study area

Some basic facts about the study area like agro-ecological zone, area, total cultivable land, number of household, population, literacy rate, main occupation, important NGOs, main crops, extinct and nearly extinct crops, and main fruits are presented in Table 3.1 and Table 3.2 as stated in BBS (2004) and Anonymous (2000).

Table 3.1 Agro-ecological zone, area, total cultivable land, number of household, population and literacy rate of the study area

ADC (Upazilla)	Agro-ecological Zone (AEZ)	Area (Sq. Km)	Total cultivable land ('000' hectare)	Household ('000')	Population ('000')	Literacy rate
Ghatail	All 6 upazillas falls under AEZ - 28 (Modhupur Tract)	451	33.3	85	372	27.4%
Madhupur		501	32.9	99	417	25.3%
Muktagacha		315	24.42	81	366	22.90%
Pakundia		181	13.04	50	236	29.3%
Belabo		118	11.77	33	165	25.9%
Raipura		313	24.39	87	455	22.5%

Table 3.2 Main occupation, important NGOs, main crops, extinct and nearly extinct crops, and main fruits of the study area

ADC	Main occupations	Important NGOs	Main crops	Extinct and nearly extinct crops	Main fruits
Ghatail	Agriculture- 59.46%, agricultural laborer- 16.7%, wage labourer- 1.47%, commerce- 7.78%, transport- 1.54%, service- 5.23%, others 7.82%	BRAC, PROSHIKA, ASA, SVS, Palli Unnayan Sangstha and Jibika	Paddy, jute, mustard seed and potato, pineapple, ginger, turmeric and banana	Sesame, linseed, wheat, garlic	Mango, jackfruit, banana, papaya, berry, watermelon and pineapple
Madhupur	Agriculture-52.29%, Agricultural labourer-22.8%, wage labourer- 2.82%, commerce- 8.42%, transport- 2.11%, service- 2.79%, others- 8.77%	BRAC, ASA, PROSHIKA CARITAS, World Tourist Mission, Family and Child Welfare Centre	Paddy, jute, wheat, cotton, potato, patal, ginger, betel leaf, *kasava* and vegetables	Varieties of pulses and aman paddy	Mango, jackfruit, litchi, papaya, pineapple and olive

Muktagacha	Agriculture- 47.71%, agricultural labourer- 22.76%, wage labourer- 2.82%, commerce- 8.3%, service- 3.59%, others- 14.82%	BRAC, GRAMEEN BANK, PROSHIKA, CARITAS, ASA, SDP, Atta Karma Juba Unnayan, Pratasha and SDS	Paddy, jute, wheat, betel leaf, sugarcane and mustard seed	Local variety of banana and pulses	Jackfruit, mango, banana, watermelon, *jam*, coconut
Pakundia	Agriculture- 61.51%, agricultural labourer- 16.42%, wage labourer- 2.05%, commerce- 7.10%, service- 4.7%, others- 8.22%	BRAC, PROSHIKA, ASA, CARITAS	Paddy, wheat, potato, onion and vegetables	Sugarcane, mustard seed, jute and sweet potato	Pineapple, mango, jackfruit, banana, papaya, litchi and black berry
Belabo	Agriculture- 61.49%, agricultural labourer- 12.61%, wage labourer- 2.21%, industry- 1.1% commerce- 9.73%, transport- 1.26%, service- 3.17%, others- 8.43%	ASA, PROSHIKA, Shapla Nir, Deshseba and Papri	Paddy, jute, ginger, turmeric, chilly and vegetables	Linseed, sesame, *kaun*, china, peanut, sugarcane, indigo and *arahar*	Jackfruit, papaya, *latkol*, guava, *deaua*, *dephal*, *karamcha*, *jambura* and *kamranga*

Raipura	Agriculture- 40.54%, fishing- 2.06%, agricultural labourer- 12.76%, wage labourer- 2.52%, service- 5.09%, industry- 1.96%, commerce- 13.69%, weaving- 12.43% and others- 8.95%	BRAC, ASA, PROSHIKA, Mauchak, GRAMEEN BANK and Palli Sahayata Karmasuchi	Paddy, wheat, potato, mustard seed, ground nut, brinjal and vegetables	Linseed, *kaun*, *aus* and *aman* paddy, jute and *arahar*	Jackfruit, mango, black berry, papaya, guava, banana, *boroi* and watermelon

3.1.2 Selection of the study area

Since independence of Bangladesh a large number of NGOs have been working for social and economic development in general and poverty alleviation in particular. As claimed by the organization, Proshika, an important NGO worked for an alternative agricultural method, known as ecological agriculture, which was sustainable and productive, conducive to bio-diversity, and was absolutely against the use of chemical fertilizers and pesticides. Proshika (2002) reported that from 1978 it began spreading ecological agricultural practices among its group members by growing varieties of seasonal vegetables and multipurpose trees in their homestead areas. Gradually the practice was extended to two other inter-related areas: crop production and seed production. This environment-friendly ecological agricultural method was in practice in various places of Bangladesh to produce crop, vegetables and seeds. Since the introduction of ecological agriculture as an alternative to chemical intensive agriculture, 761,845 farmers were successfully practising ecological agriculture and brought 227,286 acres i.e. 93,533 hectares of land under this programme in 196 Area Development Centers (ADCs) of Bangladesh (Proshika, 2006).

An ADC usually covered one or two Upazilla(s) of Bangladesh. In 2001 Proshika introduced a sister programme of ecological agriculture entitled “Organic Vegetable Production and Marketing” to promote the consumption of organic vegetables in 10

ADCs out of 196. But Proshika personnel reported that emphasis had been laid on marketing of organic products to six ADCs out of these 10 ADCs. Organic vegetables produced by the group members (beneficiaries) of these six ADCs of Proshika were available in it's sale center 'Trinamul' in Dhaka city. Besides this, vegetables were supplied to different apartment complexes, mega shops and departmental stores in different locations of Dhaka city. Mobile vans were also used to sell vegetables in some accessible areas and departmental stores. These six ADCs namely Ghatail and Madhupur under Tangail district, Muktagacha under Mymensingh district, Pakundia under Kishoreganj district, and Belabo and Raipura under Narsingdi district were purposively selected as the study area. For better understanding, a map of Bangladesh showing Tangail, Mymensingh, Kishoreganj and Narsingdi districts is presented in Figure 3.1. Again a map of Tangail, Mymensingh, Kishoreganj and Narsingdi districts showing the study area has been presented in Figure 3.2.

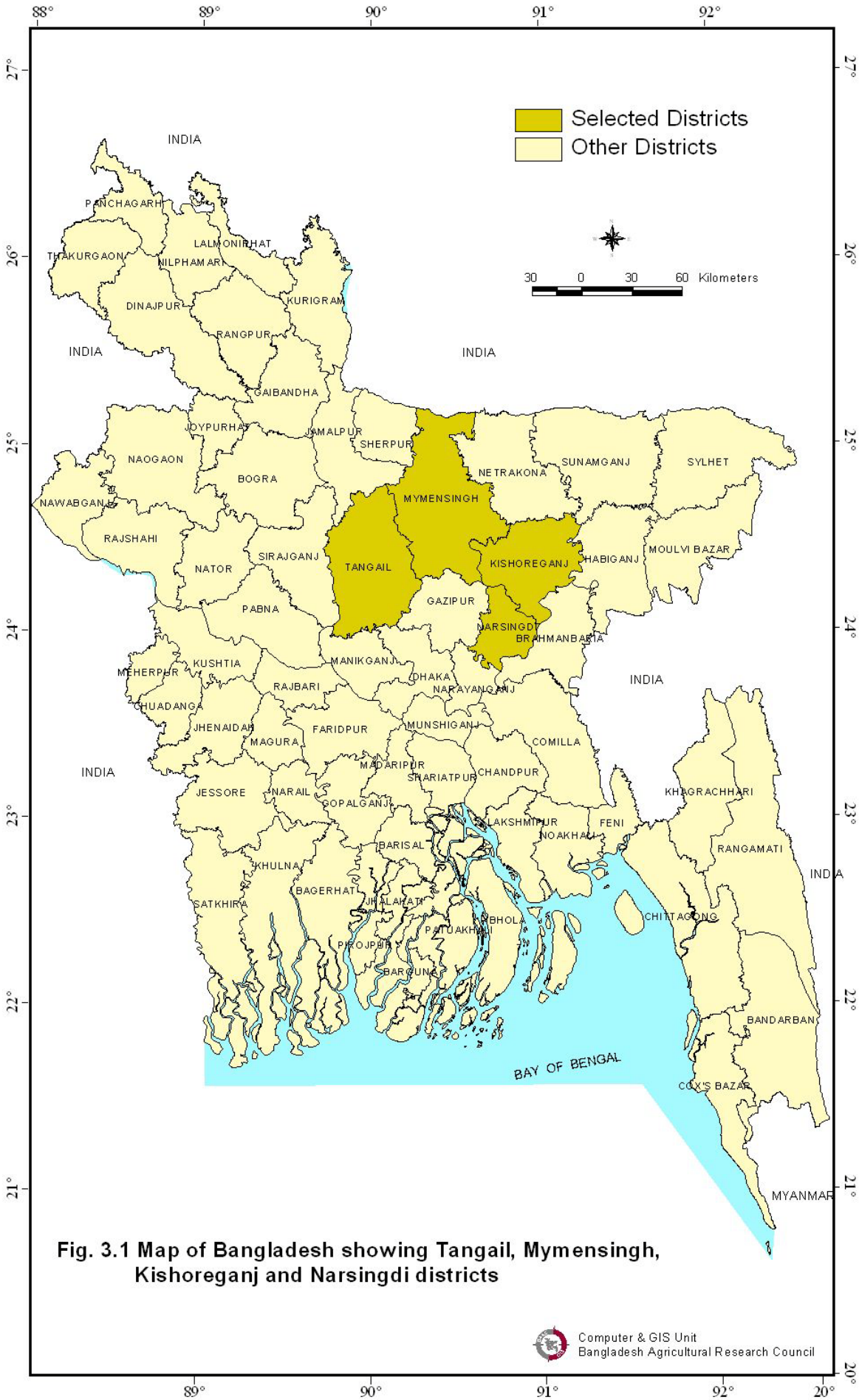


Fig. 3.1 Map of Bangladesh showing Tangail, Mymensingh, Kishoreganj and Narsingdi districts

Computer & GIS Unit
Bangladesh Agricultural Research Council

Fig. 3.2 Map of Tangail, Mymensingh, Kishoreganj and Narsingdi districts showing the study upazilas

3.2 Population

All the farmers of six ADCs producing organic vegetables was the population for this study. As per Proshika report (2002) a total of 569 farmers from ten Area Development Centers (ADCs) were involved in producing organic vegetables covering 485 acres (nearly 200 hectares) of land. But the total number of farmers producing organic vegetables in the aforesaid six ADCs was 478. Thus, these 478 farmers of the six ADCs constituted the population of the present study.

3.3 Sample and Sampling Procedure

Considering the time, financial resources and other constraints, data were collected from a sample rather than the entire population. Thirty percent of the population of farmers was randomly selected from each of the ADCs by following the stratified random sampling method considering the upazillas as the strata. A total of 144 farmers so selected constituted the sample for the present study. A reserve list of 14 farmers was prepared in addition to the preparation of the sample list taking 3 percent of the farmers randomly from the population of each ADC. The reserve list was used in case of any absence of farmers included in the original sample list. Distribution of the farmers included in the population, sample and farmers included in the reserve list has been shown in Table 3.3.

Table 3.3 Distribution of the population and sample of farmers and those included in the reserve list

Sl. No.	ADC (Upazilla)	District	No. of farmers included in the population	No. of farmers included in the sample	No. of farmers included in the reserve list
1.	Ghatail	Tangail	101	30	3
2.	Madhupur		85	26	3
3.	Muktagacha	Mymensingh	60	18	2
4.	Pakundia	Kishoreganj	148	44	4
5.	Belabo	Narsingdi	45	14	1
6.	Raipura		39	12	1
Total			478	144	14

3.4 Methods/Instruments for Data Collection

An interview schedule (in Bengali language) containing direct questions and some scales were used for data collection from the selected respondents. English version of the interview schedule has been shown in Appendix-I of this thesis. The interview schedule was prepared in line with the measurement procedures for different variables. The researcher intensively searched literatures, internet and consulted with the relevant experts of Bangladesh and India. Appendix-II shows the letter from the Thesis Supervisor of the researcher to the Head, Division of Agricultural extension, Indian Agricultural Research Institute (IARI), New Delhi and Head, Department of Agricultural Extension, Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India and others seeking necessary co-operation for developing the interview schedule. Several meetings of the supervisory committee of the concerned researcher were arranged to draft the pre-test schedule. The draft schedule was pre-tested among 24 farmers to test its suitability. Necessary corrections, additions and adjustments were made on the

basis of pre-test experience. A meeting of supervisory committee of the concerned researcher was arranged to finalize the data collecting instruments before going for final data collection. Validity and reliability of ecological agricultural knowledge and some scales of psychological variables were properly determined.

Respondents of this study were practising ecological agriculture by following the suggestions of Proshika. On the other hand, extension providers of the Government of Bangladesh like DAE was promoting environment friendly Integrated Crop Management (ICM) including Integrated Nutrient Management (INM) for judicious integrated use of chemical and non-chemical fertilizers and Integrated Pest Management (IPM) for controlling pest for successful crop production to the general farmers of Bangladesh. There might be some basic differences between the activities of these two organizations. To make a comparison between ecological agriculture of PROSHIKA and ICM of DAE, two case studies were conducted by taking one successful farmer from each organization with reference to purpose, method and outcome. Interview guide (appearing in Appendix-III) and video cassette player were used for conducting the case studies. One register book was kept to each of the selected two farmers for a period of six months from July to December, 2006 to keep records about the practices used by them for plant nutrient and pest management. Format of the register book is shown in Appendix-IV.

3.5 Variables of the Study

The variables of the study had been selected after a thorough searching of literatures and discussions with the supervisory committee members, and relevant experts of both home and abroad. There are two types of variables in any relationship study, viz. independent variable and dependent variable. An independent variable is the presumed cause of the dependent variable, the presumed effect (Kerlinger, 1973). The 25 selected characteristics of the farmers were considered as independent variables of the study and these were age, education, family size, working family size, effective land possession, cropping intensity, animal-poultry excreta availability, annual family income, commercialization, credit need, marketing opportunity, benefit obtained from

ecological agriculture, cosmopoliteness, individual local contact, NGO contact, GO contact, group contact, mass contact, training exposure, decision making ability, ecological agricultural knowledge, problem faced in ecological agriculture, attitude towards ecological agriculture, aspiration, and risk orientation. Adoption of selected ecological agricultural practices by the farmers constituted the dependent variable of the study. The variables of the study were operationalized through direct questions, developing relevant scales by the researcher and adopting scales developed by others as shown in Table 3.4.

Table 3.4 Summarized operationalization of the variables of the study with measuring unit

Variables	Measuring unit	Operationalization
Independent Variables		
Personal		
1. Age	Actual years	Direct question
2. Education	Schooling years	Direct question
3. Family size	Number of family members	Direct question
4. Working family size	Scores	Scale developed for this study
Economical		
5. Effective land possession	Hectares	Scale developed for the study with the help of Karim and Mahboob (1974)
6. Cropping intensity	Scores (%)	Scale
7. Animal-poultry excreta availability	Scores	Scale developed for this study with the help of Gaur, *et al.* (1990)
8. Annual family income	'000' taka	Direct question
9. Commercialization	Scores (%)	Scale developed for the study with the help of Karim and Mahboob (1974)
10. Credit need	Scores (%)	Scale developed by Kashem (1986)
11. Marketing opportunity	Scores	Scale developed for this study
12. Benefit obtained from ecological agriculture	Scores	Scale developed for this study
Social		
13. Cosmopoliteness	Scores	Scale developed for this study
14. Individual local contact	Scores	Scale developed for this study
15. NGO contact	Scores	Scale developed for this study

Variables	Measuring unit	Operationalization
16. GO contact	Scores	Scale developed for this study
17. Group contact	Scores	Scale developed for this study
18. Mass contact	Scores	Scale developed for this study
19. Training exposure	Number of days	Direct question
20. Decision making ability	Scores	Scale developed for this study
21. Ecological Agricultural Knowledge	Scores	Scale developed for this study
22. Problem faced in ecological agriculture	Scores	Scale developed for this study
Psychological		
23. Attitude towards ecological agriculture	Scores	Scale developed for this study with the help of Edwards (1957), Likert (1932), Thurston and Chave (1929) and Thurstone (1946)
24. Aspiration	Scores	Slight Modification of the scale developed by Muthaya (1971) and reconstructed by Sagar (1983) and Islam (2000)
25. Risk orientation	Scores	Slight Modification of the scale developed by Supe (1969) and used by Singh (1981), Ray and Bora (1991), Islam (2000) and Haider (2001)
Dependent Variable		
1. Adoption of selected ecological agricultural practices	Scores	Scale developed for this study

3.5.1 Measurement of independent variables

3.5.1.1 Age

The age of a respondent was measured by the length of time from his birth to the time of interview. Age was expressed in terms of complete years.

3.5.1.2 Education

Education of an individual was defined as the extent of formal education received by him from educational institutes or adult learning center. A score of one (1) was assigned for each year of successful schooling from a formal institution. A score of zero (0) was given to a respondent who couldn't read and write and a score of point five (0.5) was given for those who could sign only. A score of one (1) was assigned

for those respondents who learnt only reading and writing on simple basis from the adult learning center.

3.5.1.3 Family size

Family size of a respondent referred to the total number of members of the family including the respondent himself, his wife, children and other dependents who lived, ate and acted together as a family unit. It was measured by the total number of family members of the respondent.

3.5.1.4 Working family size

Working family size of a respondent was measured on the basis of partial or full working ability of the members of his family with the age level of more than six years considering that an individual initially goes to school or possesses the ability to work in the rural areas after six years of age, while he possesses the full working ability usually at the age of above 18 years. Working family size of a respondent was determined by adding up the weights of the family members of that respondent as follows:

Age of family members	Weight
Upto 6 years old	**0.00**
Above 6 years to 12 years	0.33
Above 12 years to 18 years	0.67
Above 18 years	1.00

The weights against the different age levels of his family members were added together to determine working family size of the respondent.

3.5.1.5 Effective land possession

Effective land possession of a respondent referred to his total area of land in terms of ownership and benefit obtained from the land. It was measured in hectares using the following formula as developed by Karim and Mahboob (1974) with some modification:

ELP = a + b + c + d + ½(e + f)

Where,

ELP = Effective land possession (in hectare)

a = Homestead non-agricultural area
b = Homestead agricultural area
c = Own land under own cultivation
d = Land taken from others on lease
e = Land taken from others as half-share basis
f = Land given to others as half-share basis

3.5.1.6 Cropping intensity

Based on net cropped area and total cropped area, cropping intensity of a farmer's land was measured by using the following formula:

$$\text{Cropping Intensity} = \frac{\text{Total Cropped Area}}{\text{Net Cropped Area}} \text{x}100$$

Where,

Net cropped area = Total area of land (in hectares) regardless the number of crops raised in the last year on which the respondent's family carried out farming operation
= Single cropped area + Double cropped area + Triple cropped area

Total cropped area = Total area of land (in hectares) regarding the number of crops raised in the last year on which the respondent's family carried out farming operation
= Single cropped area×1 + Double cropped area×2 + Triple cropped area×3

3.5.l.7 Animal-poultry excreta availability

Domestic animals like cattle, buffalo, sheep, goat, poultry, etc. offer great scope for organic farming, when their dung/excreta and urine can be collected and usefully converted into manure (Joshi and Prabhakarasetty, 2005). Therefore, animal-poultry excreta availability of a respondent was considered as an important variable, which could contribute to the adoption of ecological agricultural practices. Gaur, *et al.* (1990) conducted a research entitled "Livestock and human waste – characteristics and manurial value" and determined the daily average dung/excreta and urine excretion by different domestic animals. Gaur, *et al.* (1990) also determined the munurial values of % N, P_2O_5, and K_2O of those animals' dung/excreta and urine. From the findings of

that research, the annual total nutrient excretion including N, P_2O_5, and K_2O of these animals' dung/excreta and urine was determined (Table 3.5).

Table 3.5 Potential dung/excreta and urine of different farm animals and poultry with their manurial values

Types of Poultry/ Animal	Excretion (kg)				Nutrient content										Annual Total Nutrient (N+ P_2O_5+ K_2O) in Kg
	Daily		Yearly		Dung					Urine					
	Dung	Urine	Dung	Urine	%N	$\%P_2O_5$	$\%K_2O$	Total		%N	$\%P_2O_5$	$\%K_2O$	Total		
								%	Kg				%	Kg	
Poultry	0.025	-	9.125	-	1.0	1.4	0.8	3.2	0.292	-	-	-	-	-	0.292
Sheep	0.3	0.2	109.5	73	0.65	0.5	0.03	1.18	1.292	1.7	0.02	0.25	1.97	1.438	2.730
Goat	0.3	0.2	109.5	73	0.65	0.5	0.03	1.18	1.292	1.7	0.02	0.25	1.97	1.438	2.730
Cattle	5.0	3.3	1825	1205	0.5	0.3	0.9	1.7	31.025	1.2	-	0.75	1.95	23.498	54.523
Buffalo	6.2	3.8	2263	1387	0.7	0.4	0.4	1.5	33.945	1.8	0.3	0.2	2.3	31.901	65.846

Considering the annual total nutrient (N, P_2O_5, and K_2O) from dung and urine excretion of poultry as weightage of one (1) for 0.292 kg, weightage for other farm animals' annual total nutrient (N, P_2O_5, and K_2O) from dung and urine excretion was developed in accordance with the quantity of excretion. Therefore, the weights for annual total nutrient content for each poultry or animal were assigned as follows:

Types of poultry or animal	Annual total nutrient for each poultry or animal (kg)	Proportionate weights assigned for animal-poultry excreta availability per poultry or animal	
Poultry	0.292	0.292/0.292	= 1
Sheep	2.730	2.730/0.292	= 9
Goat	2.730	2.730/0.292	= 9
Cattle	54.523	54.523/0.292	=187
Buffalo	65.846	65.846/.292	=226

The scores obtained by a respondent farmer for different types and corresponding number of poultry or animals were added together to determine his animal-poultry excreta availability score.

3.5.1.8 Annual family income

Annual family income referred to the total earnings of a respondent and the members of his family from agricultural and non-agricultural sources (business, services, daily labour etc.) during the previous year. It was measured by the total earning of all the members of the family. Annual family income was expressed in '000' taka.

3.5.1.9 Commercialization

Commercialization score of a farmer was determined on the basis of value of crops sold out of the total value of crops raised. As used by Karim and Mahboob (1974), the following formula was followed in computing the commercialization score of a farmer:

$$\text{Commercialization score} = \frac{\text{Value of sold crops}}{\text{Total value of raised crops}} \text{x}100$$

Relevant market price was used in determining the commercialization score of an individual. Commercialization score could range from 0 to 100, while 0 indicating no commercialization and 100 indicating very high commercialization.

3.5.1.10 Credit need

For measuring credit need each respondent was asked to indicate whether he needed any credit during the previous year. If the reply was positive, then he was asked to mention the amount of total credit received by him from different sources. Credit need score was determined in terms of percentage according to the following formula as developed by Kashem (1986):

$$\text{CN} = \frac{\text{TRC - ACR}}{\text{TRC}} \text{x}100$$

Where, CN = Credit need
TRC = Total amount of credit required in Taka
ACR = Total amount of credit actually received in Taka

Credit need score of a respondent could range from 0 to 100, where 0 indicated no credit need and 100 indicated very high credit need.

3.5.1.11 Marketing opportunity

Marketing opportunity of a farmer was considered to be very suitable when the four indicators such as transport facilities, buying price of agricultural inputs, selling price of agricultural produces and storage facilities were very good, very low, very high and very good respectively and vice-versa. In this connection, scoring system was used as follows:

Items	Scores				
Transport facilities	Very good (4)	Good (3)	Fair (2)	Bad (1)	Very bad (0)
Buying price of agricultural inputs	Very low (4)	low (3)	Fair (2)	high (1)	Very high (0)
Selling price of agricultural produces	Very high (4)	high (3)	Fair (2)	low (1)	Very low (0)
Storage facilities	Very good (4)	Good (3)	Fair (2)	Bad (1)	Very bad (0)

Respondents were asked on the above items and they gave responses as perceived by them. Finally marketing opportunity was determined by summing up all the scores of all the responses of a respondent. Thus, marketing opportunity score of a respondent could range from 0 - 16, where 0 indicated very low marketing opportunity and 16 indicated very high marketing opportunity.

3.5.1.12 Benefit obtained from ecological agriculture

For measuring the benefits obtained from ecological agriculture, items containing social, environmental, technical and economical, and psychological benefits were selected after thorough consultation with the extension experts, researchers and from other available sources. A total of 25 items of benefits containing 6 social, 5 environmental, 11 technical and economical, and 3 psychological items were arranged in the scale in order to have real feelings on benefits obtained from ecological agriculture.

The nature of responses of the respondents to the items were ‘high benefit’, ‘medium benefit’, ‘little benefit’ and ‘not at all benefit’ and scores were assigned as 3, 2, 1, 0 respectively. Score of benefits obtained from ecological agriculture of a respondent as perceived by him was determined by adding up all the scores for all the responses of the items of that respondent.

The possible range of score of benefits obtained from ecological agriculture of a respondent was 0 -75, where 0 indicated not at all benefit and 75 indicated very high benefit obtained from ecological agriculture.

3.5.1.13 Cosmopoliteness

Cosmopoliteness referred to the degree to which an individual was oriented external to his own social system. Cosmopoliteness score of a respondent was determined in terms of his extent of visit to 8 different places outside his own social system. The following weights were assigned for measuring cosmopoliteness of a respondent.

Places of visit	Weights for frequencies of visits				
	4	3	2	1	0
1. House of relatives/friends outside own village	>6 times /month	5-6 times /month	3-4 times /month	1-2 times /month	Not at all
2. Local Hat/Bazar	>12 times /month	9-12 times /month	5-8 times /month	1-4 times /month	Not at all
3. Own Upazila headquarter	>6 times /month	5-6 times /month	3-4 times /month	1-2 times /month	Not at all
4. Other Upazilas	>12 times /year	9-12 times /year	5-8 times /year	1-4 times /year	Not at all
5. Own District town	>12 times /year	9-12 times /year	5-8 times /year	1-4 times /year	Not at all
6. Other District (except Divisional city)	>6 times /year	5-6 times /year	3-4 times /year	1-2 times /year	Not at all
7. Divisional/Capital city	>6 times /year	5-6 times /year	3-4 times /year	1-2 times /year	Not at all
8. Forign country	>3 times /life	3 times /life	2 times /life	1time /life	Not at all

Finally cosmopoliteness score of an individual was computed by summing all the scores obtained by him for eight different categories of places. Thus cosmopoliteness score of a respondent could range from 0 to 32, where 0 indicated no cosmopoliteness and 32 indicated very high cosmopoliteness.

3.5.1. 14 Individual local contact

Individual local contact of a respondent was measured in terms of his extent of contact with 3 different types of local individuals. The following weights were assigned for computing individual local contact:

Individuals	Weights for frequencies of contact				
	4	3	2	1	0
1. Neighbour farmers/ friends/relatives	>6 times /month	5-6 times /month	3-4 times /month	1-2 times /month	Not at all
2. Group leaders	>6 times /month	5-6 times /month	3-4 times /month	1-2 times /month	Not at all
3. Seed dealers	>6 times /quarter	5-6 times /quarter	3-4 times /quarter	1-2 times /quarter	Not at all

Finally individual local contact score of a respondent was computed by summing all the scores for contact with 3 types of selected local individuals by that respondent. Thus individual local contact score of a respondent could range from 0 to 12, while 0 indicating no individual local contact and 12 indicating very high individual local contact.

3.5.1.15 NGO contact

NGO (Non-Government Organization) contact of a respondent was measured in terms of his extent of contact with 3 different officials of Proshika NGO. The following weights were assigned for computing NGO contact score:

NGO Officials	Weights for frequencies of contact				
	4	3	2	1	0
1. Unit level NGO Workers	>6 times /quarter	5-6 times /quarter	3-4 times /quarter	1-2 times /quarter	Not at all
2. ADC Level NGO Workers	>6 times /six months	5-6 times /six months	3-4 times /six months	1-2 times /six months	Not at all
3. Central NGO personnel	>6 times /year	5-6 times /year	3-4 times /year	1-2 times /year	Not at all

Finally NGO contact score of a respondent was computed by summing all the scores for contact with 3 selected officials of Proshika (NGO) by that respondent. Thus NGO

contact score of a respondent could range from 0 to 12, while 0 indicating no NGO contact and 12 indicating very high NGO contact.

3.5.1.16 GO contact

GO (Government Organization) contact of a respondent was measured in terms of his extent of contact with 3 different GO officials of the Department of Agricultural Extension (DAE). The following weights were assigned for computing GO contact score:

GO Officials	Weights for frequencies of contact				
	4	3	2	1	0
1. Sub Assistant Agriculture Officer	>6 times /quarter	5-6 times /quarter	3-4 times /quarter	1-2 times /quarter	Not at all
2. Upazilla level Agriculture Officers	>6 times /six months	5-6 times /six months	3-4 times /six months	1-2 times /six months	Not at all
3. District or above Level Agricultural Officers	>6 times /year	5-6 times /year	3-4 times /year	1-2 times /year	Not at all

Finally GO contact score of a respondent was computed by summing all the scores for contact with 3 selected GO officials by that respondent. Thus GO contact score of a respondent could range from 0 to 12, while 0 indicating no GO contact and 12 indicating very high GO contact.

3.5.1.17 Group contact

Group contact of a respondent was measured in terms of his extent of contact with 4 selected group communication media. The following weights were assigned for computing group contact score:

Media	Weights for frequencies of contact				
	4	3	2	1	0
1. Group meeting	>6 times /quarter	5-6 times /quarter	3-4 times /quarter	1-2 times /quarter	Not at all
2. Farmers' field day	>6 times /life	5-6 times /life	3-4 times /life	1-2 times /life	Not at all
3. Method demonstration meeting	>6 times /life	5-6 times /life	3-4 times /life	1-2 times /life	Not at all
4. Result demonstration meeting	>6 times /life	5-6 times /life	3-4 times /life	1-2 times /life	Not at all

Finally group contact score of a respondent was computed by summing all the scores for contact with 4 selected group communication media by that respondent. Thus group contact score of a respondent could range from 0 to 16, while 0 indicating no group contact and 16 indicating very high group contact.

3.5.1.18 Mass contact

Mass contact of a respondent was measured in terms of his extent of contact with 7 selected mass communication media. The following weights were assigned for computing mass contact score:

Media	Weights for frequencies of contact				
	4	3	2	1	0
1. Radio	>6 times /week	5-6 times /week	3-4 times /week	1-2 times /week	Not at all
2. Television	>6 times /week	5-6 times /week	3-4 times /week	1-2 times /week	Not at all
3. Daily newspapers	>6 times /week	5-6 times /week	3-4 times /week	1-2 times /week	Not at all
4. Leaflet/folder	>6 times /year	5-6 times /year	3-4 times /year	1-2 times /year	Not at all
5. Booklets/agricultural magazines	>6 times /year	5-6 times /year	3-4 times /year	1-2 times /year	Not at all
6. Film show	>6 times /life	5-6 times /life	3-4 times /life	1-2 times /life	Not at all
7. Agricultural fair	>6 times /life	5-6 times /life	3-4 times /life	1-2 times /life	Not at all

Finally mass contact score of a respondent was computed by summing all the scores for contact with 7 selected mass communication media by that respondent. Thus mass contact score of a respondent could range from 0 to 28, while 0 indicating no mass contact and 28 indicating very high mass contact.

3.5.1.19 Training exposure

Training exposure was measured by the total number of days that a respondent had undertaken different types of training related to agriculture/ecological agriculture in

his entire life from different organizations. A score of one (1) was assigned for each day of training received.

3.5.1.20 Decision making ability

Decision making ability of a respondent was measured by using a 3-point rating scale. Each respondent was asked to indicate the extent of his decision making ability in each of the six (6) selected items by checking any one of the responses viz. 'decision making by alone', 'decision making with family members', and 'decision making with others outside the family'. The weights were assigned to the responses as 3, 2 and 1 for decision making by alone, decision making with family members and decision making with others outside the family respectively. Finally decision making ability score of a respondent was computed by summing up his all the scores for his responses to all the items. Thus decision making ability scores of the respondents could range from 6 - 18, where 6 indicated very low decision making ability and 18 indicated very high decision making ability.

3.5.1.21 Ecological agricultural knowledge

Knowledge as defined in this study included 'those behaviour and test situations which emphasized the remembering either by recognition or recall of ideas, material or phenomenon' (Bloom *et al*., 1956). This variable indicated the extent of ecological agricultural knowledge of the respondents at the time of interview as evident from their responses to a set of questions logically and scientifically prepared for this purpose. The steps followed in developing the scale for knowledge test for this study are discussed below.

Collection of items: The content of knowledge test is composed of questions called items. Items for the test were collected from different sources, such as, literatures; agricultural scientists of agronomy, horticulture, soil science, agricultural chemistry, entomology, plant pathology, agro-forestry, environmental science, and agricultural extension education of home and abroad; extension personnel; NGO personnel; progressive farmers and researcher's own experience. The questions were designed to

test the ecological agricultural knowledge of the farmers. The items were collected and prepared in relation to nutrient management without chemical fertilizers and pest management without chemical pesticides. Fifty five items were collected initially which appeared to be relevant.

The selection of items was done on the basis of Bloom's (1956) revised taxonomy as devised by Anderson and Krathwohl (2001). The items contained questions each of remembering, understanding, applying, analyzing, evaluating and creating about ecological agriculture. Considering the above mentioned criteria, 36 questions taking 6 from each of remembering, understanding, applying, analyzing, evaluating and creating about ecological agricultural practices were selected out of initially collected 55 questions. A schedule was then prepared with these 36 items (Appendix-V) for administering them to the farmers for item analysis.

Item analysis: The item analysis of a knowledge test usually yields two kinds of information, that is, item difficulty and item discrimination. The index of item difficulty indicates how difficult an item is, whereas, the index of discrimination explores the extent to which an item discriminates the well informed farmers from poorly informed ones.

The items were analyzed on the basis of pre-test data obtained by administering to 24 farmers. The farmers for administering the items were randomly selected and were different from the sample farmers of the present study. Nevertheless these 24 farmers were representative of the total population on the basis of which the final study was conducted. Each of the 36 items had four alternative choices of answers including one right answer. Each one of the 24 respondents, to whom the test was administered, was given one (1) score for right answer and zero (0) score for 'wrong' or no answer with respect to each item. The total number of right answers given by the respondent out of 36 items was the knowledge score secured by him. The maximum score was obviously 36 which could be scored when all the 36 items were answered correctly.

The scores of correct answers against each item of all the 24 respondents were also calculated which are presented in Appendix-VI.

Calculation of difficulty index: Sagar (1983), Choudhury (1998) and Islam (2000) used the following formula to calculate difficulty index of an item:

$$Pi = \frac{ni}{Ni} x100$$

Where,

Pi = Difficulty index in percentage of ith item
ni = Number of farmers giving correct answer to ith item
Ni = Total number of farmers to whom ith item was administered, i.e. 24 in the present study

Actually difficulty index of an item indicates how difficult an item is. But the above formula is fully opposite to the concept of difficulty index. Actually, the value of Pi obtained from the above formula indicates how easy an item is. Because it is measured by the percentage of number of farmers giving correct answer to ith item and total number of farmers to whom ith item was administered. It might be termed as easiness index.

Under the above circumstances the researcher of the present study with slight modification determined difficulty (Pi) index by the following revised formula:

$$Pi = \frac{ni}{Ni} x100$$

Where,

Pi = Difficulty index in percentage of ith item
ni = Number of farmers giving incorrect answer to ith item
Ni = Total number of farmers to whom ith item was administered, i.e. 24 in the present study

All parts of the above two formulae are same, only the meaning of ni is different. However, in the modified formula, the higher was the difficulty index of an item, the more difficult the item was. Therefore, the difficulty indices of all the 36 items were calculated by the formula revised by the present researcher. It was ensured that very difficult and very easy items were eliminated. The underlying assumption in the

statistics of item difficulty was that the difficulty was linearly related to the level of an individual's ecological agricultural knowledge. When a respondent gave correct answer to an item, it was assumed, as Coombs (1950) described, that the item was less difficult than his ability to cope with it. The difficulty indices have been presented in Appendix-VI.

Calculation of discrimination index: The discrimination index can be computed by calculating the phi-coefficient as formulated by Perry and Michael (1951). However, Mehta (1958) developed $E^{1/3}$ method to find out item discrimination emphasizing that this method was analogous to, and hence, a convenient substitute for phi-coefficient. The method developed by Mehta (1958) was used by Singh (1981), Sagar (1983), Ray and Bora (1991), Choudhury (1998) and Islam (2000).

Like Mehta (1958), Singh (1981), Sagar (1983), Ray and Bora (1991), Choudhury (1998) and Islam (2000), the present researcher computed the total scores against all the correct responses of each farmer. The farmers were then arranged in descending order of total scores obtained by them. Then those farmers were divided into 6 equal groups each having 4 farmers as the total number of farmers in the sample for item analysis was 24. These groups were as G_1, G_2, G_3, G_4, G_5 and G_6 respectively. For determination of discrimination index the middle two groups, i.e. G_3, and G_4 were eliminated and kept only extreme four groups with high (G_1 and G_2) and low (G_5 and G_6) scores. Then discrimination index of each item was determined by using following formula:

$$E^{1/3} = \frac{(S_1 + S_2) - (S_5 + S_6)}{N/3}$$

Where, S_1, S_2, S_3, S_4, S_5 and S_6 were the frequencies of correct answer for each item in G_1, G_2, G_3, G_4, G_5 and G_6 groups respectively and N was the total number of farmers in the sample of item analysis.

The discrimination indices of all the 36 items were calculated by the procedure mentioned above and are presented in Appendix-VI.

Example of computation of difficulty and discrimination index: An example of computation of difficulty index and discrimination index of an item in connection with ecological agricultural knowledge is presented below:

Sl. No. of Item	Frequencies of correct answers						Total frequencies		Difficulty Index (Pi)	Discrimination Index ($E^{1/3}$)
	S_1	S_2	S_3	S_4	S_5	S_6	correct answers	incorrect answers		
1.a	2	2	2	2	3	0	11	13	54.17	0.125

Substituting the values for the item number 1.a, the value of difficulty index and that of discrimination index are indicated below:

Difficulty index:

$$\text{Pi} = \frac{\text{ni}}{\text{Ni}} \text{x}100 = \frac{13}{24} \text{x}100 = 54.17$$

Discrimination index:

$$E^{1/3} = \frac{(S_1 + S_2) - (S_5 + S_6)}{N/3} = \frac{(2+2)-(3+0)}{24/3} = \frac{4-3}{8} = \frac{1}{8} = 0.125$$

Final selection of items: Two criteria namely, item difficulty index and item discrimination index were considered for the selection of items in the final format of the ecological agricultural knowledge test.

In the present study items with difficulty index value ranging from 16.67 to 83.33 and discrimination index ranging from 0.125 to 0.875 were included in the final format of ecological agricultural knowledge scale. In this way, 24 items by taking 4 from each of remembering, understanding, applying, analyzing, evaluating and creating which fulfilled both the criteria and these items were selected for the final format of the ecological agricultural knowledge scale (Appendix-VI).

Scoring system: Each item had four alternative answers including one right answer. The respondents were asked to choose the right answer for each item. One (1) score was given for right answer and zero (0) for wrong or no answer against each item. Summation of such scores for all the responses of a farmer was the ecological agricultural knowledge score of that farmer.

3.5.1.22 Problems faced in ecological agriculture

For measuring problems faced in ecological agriculture, items containing social, technical, economical, marketing and psychological problems were selected after thorough consultation with the extension experts, researchers and from other available sources. Twenty four items of problems were selected and arranged in the scale in order to have real feelings on problems faced in ecological agriculture.

The nature of responses of the respondents to the items was ‘serious problem, moderate problem, small problem and not at all problem and the scores were assigned as 3, 2, 1, 0 respectively. Problems faced in ecological agriculture score of a respondent was determined by adding up all the scores for all the responses of the items of that respondent.

The possible range of score of problems faced in ecological agriculture was 0-72, while 0 indicating not at all problems and 72 indicating very serious problems faced in ecological agriculture.

3.5.1.23 Attitude towards ecological agriculture

Thurstone (1946) defined attitude as ‘the degree of positive and negative affect associated with psychological object like symbol, phrase, slogan, person, institution, or ideas towards which people can differ in varying degrees’. In the present study, an attempt was made to develop an attitude scale for measuring the attitude of farmers towards ecological agriculture. Attitude towards ecological agriculture referred to the extent of knowledge, belief and action tendency towards ecological agriculture. Attitude scale in the present study was a combination of the Thurstone’s Technique of

Equal Appearing Interval Scale and Likert's Technique of Summated Ratings Scale (Edwards, 1957) with slight modification. The steps followed in constructing the attitude scale are described below:

Collection of attitude statements: Initially 52 statements related to attitude towards ecological agriculture were collected after thorough consultation with the agricultural scientists and extension experts of Bangladesh and India and from review of available related literatures of home and abroad. Then these statements were carefully examined in the light of 14 criteria suggested by Edwards (1957) for screening.

Judges ratings of the attitude statements: After screening in the light of 14 criteria suggested by Edwards (1957), 30 statements were selected for judges ratings. All the 30 statements together with the 9-point continuum against each statement were given to 30 Judges selected from different related disciplines to make their judgment on the suitability of the statements in connection with attitude of the farmers towards ecological agriculture. Letter to Judges from the Thesis Supervisor of this research appears on Appendix-VII. The Judges comprised of educationist and researchers of different disciplines and extension experts of different organizations. All the 30 Judges replied. As per Thurstone and Chave (1929), responses of three Judges were rejected as their judgments were faulty. So the responses of 27 Judges were retained for selection of statements for the attitude scale.

Calculation of scale values: The scale values (S) for 30 attitude statements that were judged in equal-appearing intervals by 27 Judges were obtained by calculating their medians. The data for each statement were arranged in the three rows as shown with an example of statement no.1.

Statement No.1	Sorting categories								
	1	2	3	4	5	6	7	8	9
Frequencies (f)	5	2	0	0	8	3	2	4	3
Proportions (p)	0.19	0.07	0.00	0.00	0.30	0.11	0.07	0.15	0.11
Cumulative proportions (cp)	0.19	0.26	0.26	0.26	0.56	0.67	0.74	0.89	1.00

The sorting categories 1, 2, 3 etc. were regarded as mid-point of class intervals of 0.5–1.5, 1.5 –2.5, 2.5 – 3.5 and so on.

In the first row, the frequency (f) of the statement in each of the nine categories has been given. In the second row, the proportion of frequencies (p) has been calculated. The proportion was obtained by dividing each frequency by N, i. e. the total number of Judges (27). In the third row, the cumulative proportions (cp), i. e. the proportion of judgments in a given category plus the sum of all the proportions below that category has been shown.

Since the median of the distribution of judgments for each statement was taken as the scale value of the statement, the scale value was calculated from data arranged in the above manner by means of the formula given by Edwadrs (1969).

$$S = l + \frac{(0.50 - \sum pb)}{pw} x\, i$$

Where,

S = The median or scale value of the statement
l = The lower limit of the interval in which the median falls
Σpb = The sum of the proportions below the interval in which the median falls
pw = The proportion within the interval in which the median falls
i = The width of the interval and was assumed to be 1.0

Substituting the values of statement no.1. in the above formula, the scale value was obtained as follows:

$$S = 4.5 + \frac{(0.50 - 0.26}{0.30} x1.00 = 5.3$$

The Scale values (S) of all the 30 statements were calculated by the above formula and presented in Appendix-VIII.

Calculation of Q values: In equal-appearing intervals it is not enough to have the scale values by computing the medians of Judges' responses. The ambiguity, uncertainty or disagreement amongst the Judges in sorting each statement in a particular category had to be found out. This was done by computing the interquartile range Q which was an index of dispersion of the statements on the scale (Edwards, 1969). Statements with large Q values were omitted.

The interquartile range contained the middle 50 percent of the judgments. To determine the Q-values it was necessary to find out two other point measures, the 75^{th} centile (C_{75}) and the 25^{th} centile (C_{25}). An example of working out the values of those two centiles (C_{75} and C_{25}) for statement no.1 is shown below:

$$C_{75} = l + \frac{(0.75 - \sum pb)}{pw} \text{ x } i \quad = 7.5 + \frac{(0.75 - 0.74)}{0.15} \text{ x } 1.00 = 7.57$$

$$C_{25} = l + \frac{(0.25 - \sum pb)}{pw} \text{ x } i \quad = 2.5 + \frac{(0.25 - 0.19)}{0.07} \text{ x } 1.00 = 2.36$$

Where,

l = The lower limit of the interval in which the centile concerned falls
Σpb = The sum of the proportions below the interval in which the centile concerned falls
pw = The proportion within the interval in which the centile concerned falls
i = The width of the interval and was assumed to be 1.0

The interquartile range Q was calculated by taking the difference between C_{75} and $C_{25.}$ Thus, for the first statement, the interquartile range Q was:

$Q = C_{75} - C_{25} = 7.57 - 2.36 = 5.21$

The Q-values of all the 30 statements were calculated by the above method and presented in Appendix-VIII.

Selection of attitude statements on the basis of scale and Q-values: Thurstone and Chave (1929) considered large Q-value primarily as an indication that a statement was ambiguous. Statements with large Q-values were eliminated from the selection of statements. The other criteria for selection of statements were:

- The scale values should have equal-appearing intervals,
- Even representation of the universe of the opinions, and
- There should be more or less equal distribution of favourable and unfavourable attitudes.

In the present study based on the above criteria, 18 statements with scale values ranging from 5.5 to 8.47 and Q-values ranging from 1.31 to 4.02 were included in the selection (Appendix-VIII). These 18 selected statements contained 9 positive and 9 negative statements for attitude towards ecological agriculture.

Analysis of statements as per Likert's Technique of Summated Ratings: Selected 18 statements based on scale values and Q-values were analyzed by using Likert's Technique of Summated Ratings for final selection of statements for measuring attitude towards ecological agriculture. The statements were analyzed on the basis of pre-test data obtained by administering to 24 farmers. The farmers for administering the statements were randomly selected and were different from the sample farmers of the present study. But, these 24 farmers were representative of the research population.

Each of the 18 statements (containing 9 positive and 9 negative) had five alternative choices of responses, viz. 'strongly agree', 'agree', 'undecided', 'disagree' and 'strongly disagree'. Scores were assigned for the alternative responses as 4, 3, 2, 1 and 0 respectively for the positive statements and reverse scores were assigned for the negative statements.

Thus the possible score of attitude towards ecological agriculture of the pretest sample farmers could range from 0-72, while 0 indicating very unfavourable attitude and 72 indicating very favourable attitude towards ecological agriculture.

Analysis of statements consisted of the frequency distribution of scores based upon the responses to all statements of the pretest. The top 25 percent of the respondents with the highest scores (High group) and the bottom 25 percent of the respondents with the lowest scores (Low group) were used as criterion groups to evaluate individual statements. The critical ratio (t-value) was calculated by using the following formula as suggested by Edwards (1957):

$$t = \frac{\overline{X}_H - \overline{X}_L}{\sqrt{\frac{S_H^{\,2}}{n_H} + \frac{S_L^{\,2}}{n_L}}}$$

Where,

$\overline{X}_H$ = The mean score on a given statement for the high group

$\overline{X}_L$ = The mean score on a given statement for the low group

S_H^2 = The variance of the distribution of responses of the high group to the statement

S_L^2 = The variance of the distribution of responses of the low group to the statement

n_H = The number of subject in the high group

n_L = The number of subject in the low group

As $n_H = n_L = n$ (Number of subjects/respondents in each group) and the same percentages of the total number of subjects for the high and low groups were selected, the formula was reformed as:

$$t = \frac{\overline{X}_H - \overline{X}_L}{\sqrt{\frac{\sum (X_H - \overline{X}_H)^2 + \sum (X_L - \overline{X}_L)^2}{n(n-1)}}}$$

where,

$$\sum (X_H - \overline{X}_H)^2 = \sum X_H^2 - \frac{\left(\sum X_H\right)^2}{n}$$

and

$$\sum (X_L - \overline{X}_L)^2 = \sum X_L^2 - \frac{\left(\sum X_L\right)^2}{n}$$

$\sum X_H^2$ = Sum of the squares of the individual scores in high group

$\sum X_L^2$ = Sum of the squares of the individual scores in the low group

The value of 't' was a measure of the extent to which a given statement differentiates between the high and low groups. As suggested by Edwards (1957), there is a thumb rule of rejecting items with 't' values < 1.75. Usually, a t-value equal to or greater than 1.75 indicates that the average responses of the high and low groups to a statement differ significantly.

Finally t-values of all the statements were determined (Appendix-IX). The statements having 't' values ≥ 1.75 were finally selected for the attitude towards ecological agriculture scale. As such 12 statements were selected in the final scale of attitude towards ecological agriculture including 6 positive and 6 negative statements. These selected statements were arranged randomly in the scale in order to have real feelings without any biasness.

Scoring system:

A layout of final selection of statements in the scale of attitude towards ecological agriculture with 't' values≥ 1. 75 is shown in Appendix IX. Finally attitude towards ecological agriculture was measured by using selected 12 statements in relation to ecological agriculture. The selected statements were expressed in positive and negative views towards ecological agriculture. The nature of responses of the respondents to the statements were 'strongly agree', 'agree', 'undecided', 'disagree' and 'strongly disagree' and scores were assigned as 4, 3, 2, 1 and 0 respectively for the positive statements and the reverse scores were given for the negative statements. The scoring method was slightly modified from that of Likert (1932). The possible range of score of attitude towards ecological agriculture was from 0–48, where 0 indicated very highly unfavourable attitude and 48 indicated very highly favourable attitude towards ecological agriculture.

3.5.1.24 Aspiration

According to Haller (1968), an aspiration usually refers to a person's or a group of persons' orientation towards a goal. Muthaya (1971) developed 12-item 'Aspiration ratings for the present and future'. Sagar (1983) constructed a 13-item aspiration scale in his study by picking up 12 items from Muthaya's scale. Islam (2000) used 9 items with slight modification from Sagar's scale. However, the researcher in the present study constructed a 10-item aspiration scale by picking up 8 items from Islam's (2000) scale with some modification. To have clear responses from the farmers, the items (statements) were provided with 5-point response categories weighted from 0 to 4 indicating low to high level of aspiration. Level of aspiration score of a respondent was determined by adding the score for his responses to all the items in the scale. Therefore, total score of a respondent could range from 0 to 40, while 0 indicating no aspiration and 40 very high level of aspiration.

3.5.1.25 Risk orientation

Supe ((1969) defined risk orientation as the degree to which a farmer was oriented towards risk and uncertainty and had the courage to face the problems

in farming. Supe (1969) developed a risk orientation scale according to Likert (1932), which was used by Singh (1981), Ray and Bora (1991), Islam (2000) and Haider (2001). In the present study, risk orientation scale was developed with some modification and addition of previous scales. Twenty two statements were collected after thorough reviewing of literatures and discussion with extension experts and researchers of Bangladesh and India. Then these 22 statements were carefully examined in the light of 14 criteria suggested by Edwards (1957) for screening. After screening 18 statements were selected.

Analysis of statements as per Likert's Technique of Summated Ratings: Likert's Technique of Summated Ratings was used for final selection of statements in connection with risk orientation after screening in the light of 14 criteria suggested by Edwards (1957). The statements were analyzed on the basis of pre-test data obtained by administering to 24 farmers. The farmers for administering the statements were randomly selected from the research population but were different from the sample of the study.

Each of the 18 statements (containing 9 positive and 9 negative) had five alternative choices of responses, viz. 'strongly agree', 'agree', 'undecided', 'disagree' and 'strongly disagree'. Therefore, weights were assigned to the above five alternative responses as 4, 3, 2, 1 and 0 respectively for the positive statements and the weighting system were reversed for the negative statements.

Final selection of statements: **Values of 't' for all 18 the statements were computed by using the same formula as used in the attitude towards ecological agriculture scale (Appendix-X). Twelve statements having 't' values ≥ 1.75 were selected finally for the risk orientation scale. Kashem (1986), Rahman (1990) and Islam (2000) in Bangladesh followed the same rule for such selection of statements. Those 12 statements (containing 7 positive and 5 negative) were arranged randomly in the scale in order to have real feelings without any biasness. Finally risk orientation score of a respondent were determined by adding up the weights**

for his responses to all the 12 statements. Thus, possible risk orientation score of an individual could range from 0 to 48, while 0 indicating no risk orientation and 48 indicating very high risk orientation.

3.5.2 Measurement of dependent variable

Adoption of selected ecological agricultural practices was the dependent variable of the study. Ecological agricultural practices meant the practices that were used by the farmers instead of chemical fertilizers and chemical pesticides. As many as 15 ecological agricultural practices for integrated nutrient management and 15 ecological agricultural practices for integrated pest management for crop production were collected. Thus a total of 30 practices together with the 9-point continuum against each of the practices were given to 34 experts for Judges rating. The Judges were selected from different related disciplines including agronomy, horticulture, plant pathology, entomology, soil science, agri-chemistry, agro-forestry and environmental science of different agricultural universities, research institutes, extension organizations and non-government organizations. Letter to Judges from the Thesis Supervisor of this research appears on Appendix-XI. Judges were requested to mention their opinion in 9-point suitability continuum against each of the practices. Out of 34 judges, 28 replied. Therefore, the responses of 28 Judges were retained for selection of ecological agricultural practices for the study. Suitability index (SI) of each practice was determined by the following formula:

$$SI = 9\times f_9 + 8\times f_8 + 7\times f_7 + 6\times f_6 + 5\times f_5 + 4\times f_4 + 3\times f_3 + 2\times f_2 + 1\times f_1$$

Where,

f_9 = No. of Judges mentioning their opinion as the respective practice was most suitable, i.e. no. of Judges mentioning their opinion in the 9^{th} column of 9-point suitability continuum against the respective practice

f_8 = No. of Judges mentioning their opinion as the respective practice was next to most suitable,

f_7 = No. of Judges mentioning their opinion in the 7^{th} column of 9-point suitability continuum against the respective practice

f_6 = No. of Judges mentioning their opinion in the 6^{th} column of 9-point suitability continuum against the respective practice

f_5 = No. of Judges mentioning their opinion as the respective practice was moderately suitable, i.e. no. of Judges mentioning their opinion in the 5^{th} column of 9-point suitability continuum against the respective practice

f_4 = No. of Judges mentioning their opinion in the 4th column of 9-point suitability continuum against the respective practice

f_3 = No. of Judges mentioning their opinion in the 3rd column of 9-point suitability continuum against the respective practice

f_2 = No. of Judges mentioning their opinion in the 2nd column of 9-point suitability continuum against the respective practice

f_1 = No. of Judges mentioning their opinion as the respective practice was least suitable, i.e. no. of Judges mentioning their opinion in the 1st column of 9-point suitability continuum against the respective practice

Twenty ecological agricultural practices containing 10 for nutrient management and 10 for pest management were selected in descending order of suitability index (SI) for the study (Appendix-XII).

The adoption of a particular ecological agricultural practice by each farmer was then measured by the following formula:

$$A = \sum_{1}^{4} \frac{e_i}{p} 100 M_i$$

Where,

A = Adoption of a particular practice

e_i = Effective area or area (in hectare) actually covered by the practice under respective mode

M_i = weight of respective mode

$i = 1, 2, 3, 4$

p = Potential area or area (in hectare) suitable for the practice

Weight of mode of application of each practice was as follows:

Mode of application of the practice		**Weight**
Mode-1 (M_1):	No use of the practice	0.00
Mode-2 (M_2):	Less use of the practice with large use of chemical fertilizers or chemical pesticides (large use of chemical fertilizers means use of $\geq$50% of the recommended doses of chemical fertilizers and large use of chemical pesticides means use of chemical pesticides for pest control at normal attack.)	0.33
Mode-3 (M_3):	Large use of the practice with less use of chemical fertilizers or chemical pesticides (less use of chemical fertilizers means use of <50% of the recommended doses of chemical fertilizers and less use of chemical pesticides means use of chemical pesticides for pest control only at the time of severe attack.)	0.67
Mode-4 (M_4):	Use of the practice without any chemical fertilizers or chemical pesticides	1.00

Thus, adoption of a particular ecological agricultural practice could range from 0 to 100, where 0 indicated no adoption and 100 indicated very high adoption of that ecological agricultural practice.

Score of adoption of ecological nutrient management practices of each farmer was measured by summing up all the scores of ten selected ecological nutrient management practices. Thus, score of adoption of ecological nutrient management practices of the farmers could range from 0 to 1000, where 0 indicated no adoption and 1000 indicated very high adoption of ecological nutrient management practices.

Similarly, Score of adoption of ecological pest management practices of each farmer was measured by summing up all the scores of ten selected ecological pest management practices for crop production. Thus, score of adoption of ecological pest management practices of the farmers could range from 0 to 1000, where 0 indicated no adoption and 1000 indicated very high adoption of ecological pest management practices.

Composite adoption of ecological agricultural practices of each farmer was then determined by adding up the scores of adoption of ecological nutrient management practices and adoption of ecological pest management practices. Therefore, score of composite adoption of ecological agricultural practices could range from 0 to 2000, where 0 indicated no adoption and 2000 indicated very high adoption of ecological agricultural practices.

3.6 Validity and Reliability of Instruments

To give due attention to the validity and reliability of the instruments used for collecting data is one of the important tasks of research work. A scale possesses validity when it actually measures what it claims to measure. A scale is reliable when it can consistently produces the same results repeatedly when applied to the same sample (Goode and Hatt, 1952). Enough care was taken to prepare the interview schedule in general and the scales in particular for this study. However, validity and reliability of the scales used for measuring ecological agricultural knowledge, attitude

towards ecological agriculture, aspiration, risk orientation and adoption of selected ecological agricultural practices were examined. Validity and reliability of these scales were tested both from pre-test data and a portion of final data. However, validity and reliability of the important scales have been described below.

3.6.1 Validity of ecological agricultural knowledge scale

In the final selection of items for ecological agricultural knowledge scale, care was taken to include items covering the entire universe of relevant behavioural aspects of the farmers with respect to ecological agricultural knowledge. Items were collected through various sources including related publications and specialists of different related disciplines of home and abroad. Thirty six items were pre-tested by administering to 24 farmers of the research population, but with the exclusion of the sample. On the basis of difficulty index and discrimination index, 24 out of 36 items were selected for the final scale. Aforesaid discussion indicates that the content validity was built in the process of constructing the scale. Hence it was assumed that the scores obtained by administering this test measured ecological agricultural knowledge of the respondents as intended.

Again, validity of ecological agricultural knowledge scale was measured by the relationships between the scores of individual items of ecological agricultural knowledge and the composite ecological agricultural knowledge score of 42 farmers by taking 7 from each of 6 upazillas of the study area (based on a portion of final data). The coefficient of correlations between the scores of 24 individual items of ecological agricultural knowledge and the score of composite ecological agricultural knowledge of the scale were found to be 0.436, 0.437, 0.344, 0.493, 0.410, 0.445, 0.432, 0.443, 0.488, 0.486, 0.437, 0.412, 0.486, 0.462, 0.338, 0.523, 0.309, 0.363, 0.479, 0.417, 0.448, 0.307, 0.437, and 0.471 which were significant at 0.000 to 0.05 level with 40 degrees of freedom. On the basis of the procedure followed, it can be assumed that the ecological agricultural knowledge scale had content validity. Therefore, the scale may be taken as valid instrument to measure the ecological agricultural knowledge of the farmers.

3.6.2 Reliability of ecological agricultural knowledge scale

The reliability of ecological agricultural knowledge scale was measured by split-half method. The scale was administered to 42 farmers by taking 7 from each of 6 upazillas of the study area (based on a portion of final data). All the 24 items of the ecological agricultural knowledge scale were divided into 2 equal halves. These two sets of items, each having 12 items, one with odd numbers and the other with even numbers were the major two components of the scale. The coefficient of correlation between the two sets of score was computed and the value was found to be strongly significant (0.748) at 0.000 level with 40 degrees of freedom. The reliability co-efficient, thus obtained indicated that the 'internal consistency' of the ecological agricultural knowledge scale developed for the present study was quite high.

3.6.3 Validity of attitude towards ecological agriculture scale

The content of the scale was obtained by discussion with agricultural scientists, extension specialists of Bangladesh and India, and review of previous studies made in this connection. Initially 52 statements were collected and 30 statements were carefully screened in the light of 14 criteria suggested by Edwards (1957). The statements indicated different phases of attitude towards ecological agriculture representing a broad universe of opinion collected from different sources. Subsequently, 18 out of 30 statements were selected based on the values of judgments in respect of degree of suitability of the statements made by a team of 27 Judges (Appendix-VII & VIII) from different universities, research institutions and extension personnel. Finally, with the help of Likert's Technique of Summated Ratings, 12 statements were selected for the scale having t values$\geq$1.75 based on pre -test data by administering 24 farmers of the research population. The values of t of the statements have been shown in Appendix-XI. Accordingly, the content validity was built in the process of constructing the scale.

Again, validity of attitude towards ecological agriculture scale was measured by the relationships between the scores of individual items of attitude towards ecological agriculture and the composite attitude towards ecological agriculture score of 42

farmers by taking 7 from each of 6 upazillas of the study area on the basis of a portion of final data. The coefficient of correlations between the score of individual 12 items of attitudes towards ecological agriculture and the score of composite attitude towards ecological agriculture scale were found to be 0.574, 0.383, 0.452, 0.410, 0.341, 0.467, 0.569, 0.543, 0.541, 0.584, 0.519 and 0.435 which were significant at 0.000 to 0.03 level with 40 degrees of freedom. On the basis of the procedure followed, it could be said that the attitude towards ecological agriculture scale had content validity. Therefore, the scale may be taken as valid instrument to measure the attitude towards ecological agriculture of the farmers.

3.6.4 Reliability of attitude towards ecological agriculture scale

The reliability of attitude towards ecological agriculture scale was measured by split-half method. On the basis of a portion of final data of 42 farmers (by taking 7 from each of 6 upazillas), all the 12 statements of attitude towards ecological agriculture scale were divided into 2 equal halves. The scale had two sets of statements each having 6 statements, one with odd numbers and the other with even numbers. The coefficient of correlation between the two sets of scores was computed and the value was found to be significant (0.552) at 0.000 level with 40 d.f. The reliability co-efficient, thus obtained indicated that the ‘internal consistency’ of the attitude towards ecological agriculture scale was high.

3.6.5 Validity of aspiration scale

In collection and selection of items for aspiration scale of this study, care was taken to include the items representing the universe of content of aspiration. The content of the aspiration scale was based on relevant literature and opinion of experts and extension personnel as measures of checks.

Again, validity of aspiration scale was measured by the relationships between the scores of individual items of aspiration and the composite aspiration score of 42 farmers by taking 7 from each of 6 upazillas of the study area. The coefficients of correlation between the scores of individual items and the composite aspiration score

were found to be 0.696, 0.648, 0.605, 0.337, 0.379, 0.740, 0.546, 0.687, 0.821 and 0.345, which were significant at 0.000 to 0.03 level with 40 degrees of freedom. On the basis of the procedure followed, it could be said that the aspiration scale had content validity.

3.6.6 Reliability of aspiration scale

The reliability of aspiration scale was measured by split-half method. On the basis of a portion of final data of 42 farmers (by taking 7 from each of 6 upazillas), all the 10 items of aspiration scale were divided into 2 equal halves. The scale had two sets of items each having 5 items, one with odd numbers and the other with even numbers. The coefficient of correlation between the two sets of score was computed and the value was found to be significant (0.856) at 0.000 level with d.f. 40. The reliability co-efficient, thus obtained indicated that the 'internal consistency' of aspiration scale developed for the present study was high.

3.6.7 Validity of risk orientation scale

The content of the scale was obtained by discussion with agricultural scientists and extension specialists of Bangladesh and India, and review of previous studies made in this connection. Initially 22 statements were collected and 18 were screened carefully in the light of 14 criteria suggested by Edwards (1957). The statements indicating different phases of risk orientation representing a broad universe of opinion collected from different sources. Subsequently, the final selection of statements comprising the scale was made with the help of Likert's Technique of Summated Ratings based on pre-test data by administering 24 farmers of the research population, but the sample was excluded. Values of 't' for all the statements were determined and 12 statements having t values ≥ 1.75 were selected (Appendix-X) in the final scale as suggested by Edwards (1957) and used by Kashem (1986), Rahman (1990), Islam(2000) and many others. Accordingly, the content validity was built in the process of constructing the scale.

Again, validity of risk orientation scale was measured by the relationships between the scores of individual items of risk orientation scale and the composite risk orientation score of 42 farmers by taking 7 from each of 6 upazillas of the study area. The coefficient of correlations between the scores of 12 individual items of risk orientation scale and the composite score of risk orientation scale were found to be 0.541, 0.683, 0.341, 0.541, 0.792, 0.522, 0.758, 0.451, 0.779, 0.831, 0.369 and 0.717 which were significant at 0.000 to 0.03 level with d.f. 40. On the basis of the procedure followed, it could be said that the risk orientation scale had content validity.

3.6.8 Reliability of risk orientation scale

The reliability of risk orientation scale was measured by split-half method. On the basis of a portion of final data of 42 farmers (by taking 7 from each of 6 upazillas of the study area), all the 12 statements of risk orientation scale were divided into 2 equal halves. The scale had two sets of statements each having 6 statements, one with odd numbers and the other with even numbers. The coefficient of correlation between the two sets of score was computed and the value was found to be significant (0.736) at 0.000 level with d.f. 40. The reliability co-efficient, thus obtained indicated that the 'internal consistency' of the risk orientation scale developed for the present study was high.

3.6.9 Validity of adoption of selected ecological agricultural practice scale

The content of the scale was obtained by judgments of relevant judges/experts. Initially 30 items were collected for this scale by taking 15 for nutrient management without chemical fertilizers and 15 for pest management without chemical pesticides after discussion with agricultural scientists, extension specialists and review of previous studies made in this connection. These items were then sent to relevant judges/experts for their judgments. Final selection of items comprising the scale was based on the values of judgments in respect of suitability index of the items made by a team of 28 Judges (Appendix-XI & XII) from different relevant disciplines. As many as 20 items were finally selected by taking 10 for nutrient management without

chemical fertilizers and 10 for pest management without chemical pesticides for the scale. Therefore, the content validity was built in the process of constructing the scale.

Again, validity of adoption of selected ecological agricultural practices scale was measured by the relationships of the scores of adoption of selected nutrient management practices without chemical fertilizers and the scores of adoption of selected pest management practices without chemical pesticides with the composite adoption of selected ecological agricultural practices score of 42 farmers by taking 7 from each of 6 upazillas of the study area. The coefficient of correlation of the scores of adoption of selected nutrient management practices without chemical fertilizers with the composite adoption of selected ecological agricultural practices score was found to be significant (0.932) at 0.000 level having a d.f. of 40. Again the coefficient of correlation of the scores of adoption of selected pest management practices without chemical pesticides with the composite adoption of selected ecological agricultural practices score was found to be significant (0.901) at 0.000 level having a d.f. of 40. On the basis of the above procedure, it could be said that the adoption of selected ecological agricultural practices scale had content validity. Therefore, the scale may be taken as valid instrument to measure the adoption of selected ecological agricultural practices by the farmers.

3.6.10 Reliability of adoption of selected ecological agricultural practice scale

The reliability of adoption of selected ecological agricultural practices scale was measured by split-half method. The scale was administered to 42 farmers by taking 7 from each of 6 upazillas of the study area. All the 20 items of adoption of selected ecological agricultural practices scale were divided into 2 equal halves. The scale had two sets of items each having 10 items, one with odd numbers and the other with even numbers. The coefficient of correlation between the two sets of scores was computed and the value was found to be significant (0.518) at 0.000 level with d.f. 40. The reliability co-efficient, thus obtained indicated that the ‘internal consistency’ of the adoption of selected ecological agricultural practices scale developed for the present study was high.

3.7 Collection of Data

Data were collected by the researcher himself for this study. Proshika personnel helped the researcher to introduce him with the respondents. A letter from the Thesis Supervisor to Proshika authority for necessary help and co-operation to the researcher for data collection appears in Appendix-XIII. However, it was not possible to collect data from 6 farmers in the original sample due to their unavailability at the time of interview despite several attempts to contact them. Therefore, the researcher had to collect data from 6 farmers of the reserve list. Data were collected during the period from February to August, 2006. Several visits were made to conduct the case studies during July to December, 2006. The register books were kept to the farmers for the case study period to record the practices used by the farmers for nutrient and pest management. Respective personnel of the concerned authority helped the researcher to be acquainted with the farmers to whom the case studies were conducted.

3.8 Statement of Hypotheses

Hypothesis may be broadly divided into two categories, namely research hypothesis and null hypothesis.

3.8.1 Research hypothesis

The following research hypothesis was put forward to test contribution/effect of the selected characteristics of the farmers to/on their adoption of ecological agricultural practices. The research hypothesis was: "Twenty five selected characteristics of the farmers have significant contribution and effect to/on their adoption of selected ecological agricultural practices".

3.8.2 Null hypothesis

The aforesaid research hypothesis was converted into null hypothesis for testing the conceptual model of the study. The major hypothesis formulated for testing the conceptual model of the study is presented below:

“There is no contribution and effect of the following selected characteristics of the respondent farmers to/on their adoption of selected ecological agricultural practices.”

The selected characteristics of the respondent farmers were:

Personal: age, education, family size and working family size

Economical: effective land possession, cropping intensity, animal-poultry excreta availability, annual family income, commercialization, credit need, marketing opportunities and benefits obtained from ecological agriculture

Social: cosmopoliteness, individual local contact , NGO contact , GO contact, group contact , mass contact, training exposure, decision making ability, knowledge about ecological agriculture and problem faced in ecological agriculture

Psychological: attitude towards ecological agriculture, aspiration and risk orientation

3.9 Statistical Procedures Used

After collecting the data from the respondents, these were compiled, tabulated and analyzed in accordance with the objectives of the study. Statistical measures such as number and percentage distribution, possible and observed range, mean, standard deviation and co-efficient of variation were used in describing the selected variables. Rank order was also used in some cases. Pearson product moment correlation test was initially done. Full model regression analysis was also done. Due to misleading results from multi-collinearity, stepwise multiple regression was used to find out the contribution of the independent variables to the dependent variable. Finally, path analysis was done to find out the direct and indirect effects of the independent variables on the dependent variable.

CHAPTER 4

ADOPTION OF SELECTED ECOLOGICAL AGRICULTURAL PRACTICES AND RELATED MATTERS

4.1 Extent of Adoption of Selected Ecological Agricultural Practices

Adoption involves decision making with respect to certain ideas, concepts, practices, objects or situations. Lionberger (1965) defined adoption as the integration of an innovation into a farmer's on going operation through repeated and continued use. Similarly, Dasgupta (1989) defined adoption as the integration of an innovation into a farmer's normal farming activity over an extended period of time. According to Rogers (1995), adoption is a decision to use an innovation by an individual and continue to use the innovation.

In this study adoption of selected ecological agricultural practices by the farmers was taken into consideration. Ecological agricultural practices mean agricultural practices without using any chemical fertilizers and chemical pesticides. Adoption of selected ecological agricultural practices by an individual farmer referred to the percentage of land on which the practice(s) were used by him and it was multiplied by the mode of use as mentioned earlier in the Methodology Chapter.

Two dimensions of ecological agricultural practices namely, ecological nutrient management practices and ecological pest management practices were considered in this study. Each of these two dimensions of ecological practices had 10 practices i.e. a total of 20 practices constituted ecological agricultural practices. The possible range of adoption scores for a particular practice was 0 to 100, as indicated in Chapter 3. Therefore, the possible range of adoption scores for each of these two dimensions of ecological agricultural practice was 0 to 1000, as each dimension had 10 practices. Thus, the possible range of composite adoption scores for selected ecological agricultural practices was 0 to 2000, as 20 ecological agricultural practices were selected for the study. Salient features like possible range, observed range, mean, standard deviation and co-efficient of variation of adoption scores of these two

dimensions of ecological agricultural practices along with composite adoption of selected ecological agricultural practices with category wise distribution of the farmers are presented in Table 4.1.

Table 4.1 Salient features and distribution of the farmers according to their extent of adoption of two types of ecological agricultural practices and composite adoption of selected ecological agricultural practices

Dimensions of ecological agricultural practices	Categories	Range		Farmers		Mean	SD	CV
		Possible	Observed	Number	Percent			
Ecological Nutrient management practices	Very low adoption (upto 166.7)	1000	88.3 - 470	24	17	242.11	78.17	32.29%
	Low adoption (166.8 - 333.3)			97	67			
	Medium adoption (above 333.3)			23	16			
	Total			**144**	**100**			
Ecological pest management practices	Very low adoption (upto 166.7)	1000	69.5 - 439	7	5	271.60	68.83	25.34%
	Low adoption (166.8 - 333.3)			106	74			
	Medium adoption (above 333.3)			31	21			
	Total			**144**	**100**			
Composite ecological agricultural practices	Very low adoption (upto 333.3)	2000	157.8 - 899.7	11	8	513.71	133.75	26.04%
	Low adoption (333.4 - 666.7)			113	78			
	Medium adoption (above 666.7)			20	14			
	Total			**144**	**100**			

Brief description of these two dimensions of ecological agricultural practices including composite adoption of selected ecological agricultural practices is presented below:

4.1.1 Extent of adoption of ecological nutrient management practices

Findings indicated that adoption of ecological nutrient management practices scores of the farmers ranged from 88.3 to 470 against the possible range of 0 to 1000. The mean, standard deviation and co-efficient of variation were 242.11, 78.17 and 32.29% respectively. The farmers were classified into three categories on the basis of their adoption of ecological nutrient management practices as shown in Table 4.1.

Majority (67 percent) of the farmers had low adoption as compared to 17 and 16 percent having very low and medium adoption of ecological nutrient management practices respectively. Thus, a great majority (84 percent) of the farmers had very low to low adoption of ecological nutrient management practices. Nobody had high adoption of ecological nutrient management practices. These facts implied that extension educational programmes including training need to be arranged by the

concerned agencies for the farmers in order to achieve desired benefit in respect of ecological nutrient management practices.

4.1.2 Extent of adoption of ecological pest management practices

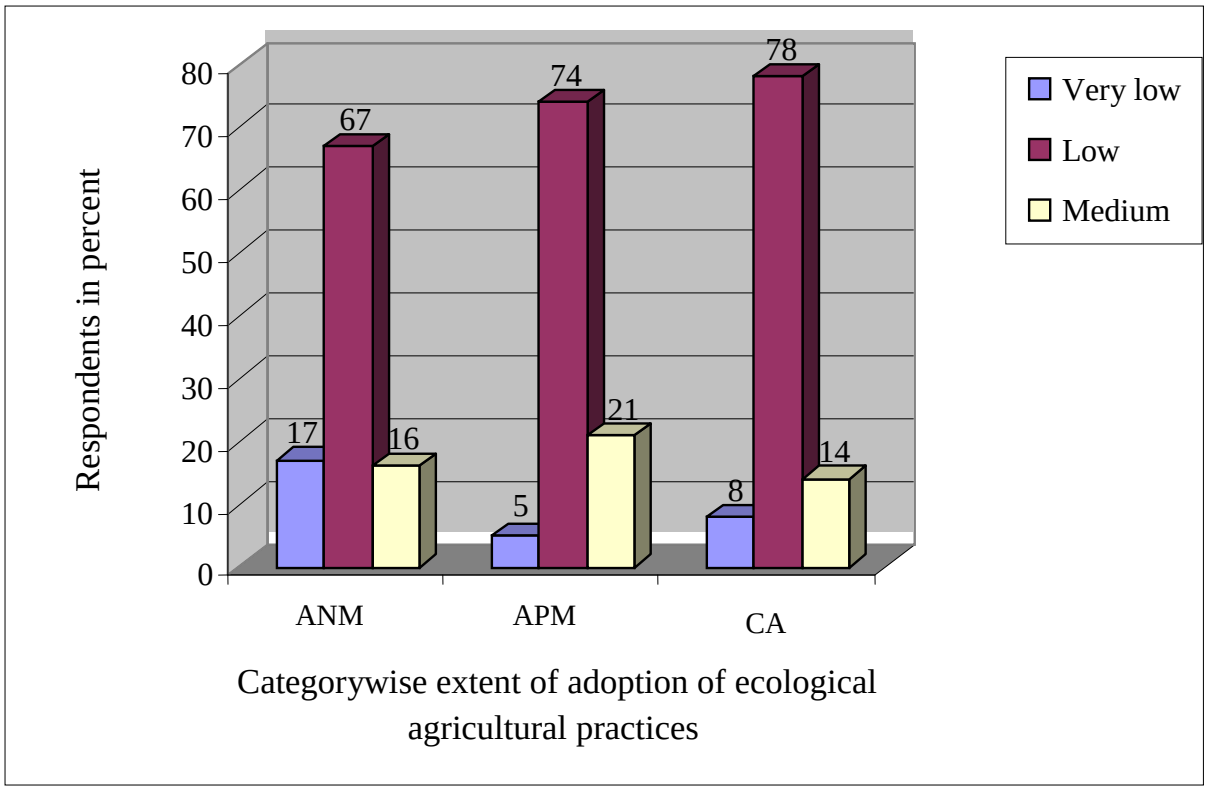
Findings indicated that adoption of ecological pest management practices scores of the farmers ranged from 69.5 to 439 against the possible range of 0 to 1000. The mean, standard deviation and co-efficient of variation were 271.60, 68.83 and 25.34% respectively. The farmers were classified into three categories on the basis of their adoption of ecological pest management practices as shown in Table 4.1.

Majority (74 percent) of the farmers had low adoption as compared to 5 and 21 percent having very low and medium adoption of ecological pest management practices respectively. Thus, a great majority (79 percent) of the farmers had very low to low adoption of ecological pest management practices. Nobody had high adoption of ecological pest management practices. These facts implied that training and non-formal educational programmes need to be organized by the concerned agencies for the farmers in order to achieve desired benefit in respect of ecological pest management practices.

4.1.3 Extent of composite adoption of selected ecological agricultural practices

Findings indicated that composite adoption of selected ecological agricultural practices scores of the farmers ranged from 157.8 to 899.7 against the possible range of 0 to 2000. The mean, standard deviation and co-efficient of variation were 513.71, 133.75 and 26.04% respectively. The farmers were classified into three categories on the basis of their composite adoption of selected ecological agricultural practices as shown in Table 4.1.

Majority (78 percent) of the farmers had low composite adoption, while 8 and 14 percent had very low and medium composite adoption of selected ecological agricultural practices respectively. Thus, an overwhelming majority (86 percent) of the farmers had very low to low composite adoption of selected ecological agricultural practices. Nobody had high composite adoption of selected ecological agricultural practices. Figure 4.1 may be seen for better understanding.



ANM = Adoption of ecological nutrient management practices
APM = Adoption of ecological pest management practices
CA = Composite adoption of selected ecological agricultural practices

Fig. 4.1 Bar-graph showing the category wise extent of adoption of selected ecological agricultural practices

Foregoing discussion indicated a gloomy situation as far as the extent of adoption of ecological nutrient management practices, ecological pest management practices and composite adoption of ecological agricultural practices were concerned. This implied that more and more motivational programmes including training and non-formal educational programmes need to be arranged by the concerned agencies for the farmers in order to achieve desired benefit with regard to selected ecological agricultural practices.

4.1.4 Comparative extent of adoption of selected ecological agricultural practices

Attempt has been made in this section to compare the extent of adoption of different ecological agricultural practices with the help of Adoption Index (AI). Adoption index for each of the practices was determined by using the following formula:

$$AI = A_n \times 0 + A_l \times 1 + A_m \times 2 + A_h \times 3$$

Where,

AI = Adoption Index
A_n = Percent of farmers having no adoption
A_l = Percent of farmers having low adoption
A_m = Percent of farmers having medium adoption
A_h = Percent of farmers having high adoption

The possible range of adoption scores of each ecological agricultural practice was 0 to 100. Based on this consideration, adoption score of 0, upto 33.3, 33.4 to 66.7, and above 66.7 were considered as no, low, medium and high adoption respectively for each practice. Thus, the possible range of adoption indices (AIs) of the practices could range from 0 to 300, where 0 indicated no adoption and 300 indicated highest adoption.

In order to have a comparative understanding, based on descending order of adoption index (AI), rank order was made among ecological nutrient management practices and ecological pest management practices separately as shown in Table 4.2.

4.1.4.1 Comparative adoption of ten ecological nutrient management practices

Among ten ecological nutrient management practices, adoption of cowdung ranked first followed by crop residue/weed fertilizer, compost, poultry excreta, farm yard manure, water hyacinth, quick compost/oil cake, green manure, and liquid organic fertilizers. Nobody used biofertilizers in their pulses crop fields.

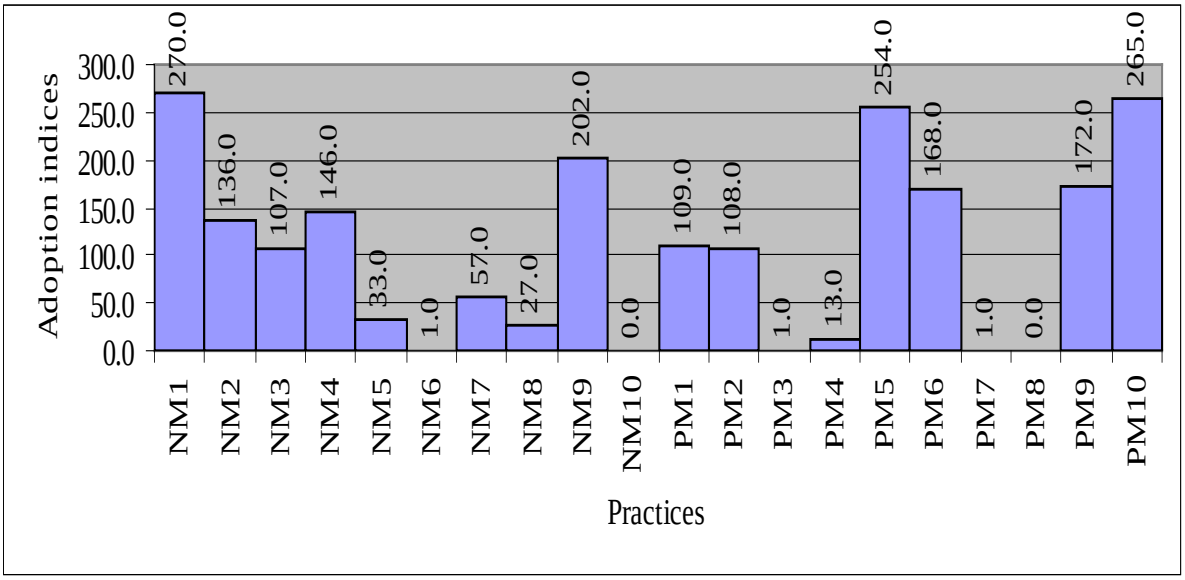
4.1.4.2 Comparative adoption of ten ecological pest management practices

Among ten ecological pest management practices, adoption of proper weeding and eradication of insect/disease attacked plants/plant parts ranked first followed by use of quality seed, crop rotation, pest control by ash, pest control by hand/hand net, putting tree branches in the field, botanical pesticides (neem: *Azadirachta indica*, nishinda: *Vitex negundo*, biskatali: *Polygonum orientale*, garlic: *Allium sativum* extract etc.), beneficial insects and light trap. Nobody used pest resistant varieties in their crop fields.

Table 4.2 Comparative adoption of ecological agricultural practices

Practices		% of farmers having				Adoption Index (AI)	Rank Order
		No adoption (A_n)	low adoption (A_l)	medium adoption (A_m)	high adoption (A_h)		
Ecological nutrient management practices	1. Cowdung	0	2	26	72	270	1
	2. Poultry excreta	12	43	42	3	136	4
	3. Farm yard manure	46	11	33	10	107	5
	4. Compost	38	8	24	30	146	3
	5. Quick compost /Oil cake	77	16	4	3	33	7
	6. Liquid organic fertilizers	99	1	0	0	1	9
	7. Water hyacinth	62	21	15	2	57	6
	8. Green manure	78	17	5	0	27	8
	9. Crop residue/ weed fertilizer	6	21	38	35	202	2
	10. Biofertilizer	100	0	0	0	0	10
Ecological pest management practices	1. Pest control by hand/hand net	32	32	31	5	109	5
	2. Putting tree branches in the field	27	39	33	1	108	6
	3. Light trap	99	1	0	0	1	8.5
	4. Botanical pesticides (neem, nishinda, biskatali, garlic extract etc.)	90	7	3	0	13	7
	5. Use of quality seed	0	3	40	57	254	2
	6. Pest control by ash	7	33	45	15	168	4
	7. Beneficial insects	99	1	0	0	1	8.5
	8. Pest resistant varieties	100	0	0	0	0	10
	9. Crop rotation	1	36	53	10	172	3
	10. Proper weeding and eradication of insect/ disease attacked plants/plant parts	0	3	29	68	265	1

For having a better understanding, attempt has been made to show the adoption index of each practice in a bar graph (Fig.4.2).



NM1=Cowdung
NM2=Poultry excreta
NM3=Farm yard manure
NM4=Compost
NM5=Quick compost/oil cake
NM6=Liquid organic fertilizer
NM7=Water hyacinth
NM8=Green manure
NM9=Crop residues/weed fertilizer
NM10=Biofertilizer

PM1=Pest control by hand/hand net
PM2=Putting branches in the field
PM3=LIght trap
PM4= Botanical pesticides (neem, nishinda, biskatali, garlic extract etc.)
PM5=Use of quality seed
PM6= Ash
PM7= Beneficial insects
PM8=Pest resistant varieties
PM9=Crop rotation
PM10=Proper weeding and eradication of insect/disease attacked plants/plant parts

Fig. 4.2 Bar-graph showing practice wise extent of adoption of selected ecological agricultural practices

4.2 Adoption of Selected Ecological Agricultural Practices in Different Combinations

Attempt has been made to find out the number and percent distribution of the respondent farmers on the basis of adoption of selected ecological agricultural practices in different combinations as shown in Table 4.3.

Data contained in Table 4.3 revealed that in case of ecological nutrient management practices, there were 34 combinations which were used by the farmers. Fourteen percent of the farmers used combination No. 24 which includes cowdung, poultry excreta, compost and crop residues/weed fertilizer followed by 13 per cent of the farmers using combination No. 16 which includes cowdung, poultry excreta, farm yard manure and crop residues/ weed fertilizer.

Table 4.3 Distribution of the farmers on the basis of adoption of selected ecological agricultural practices in different combinations

	Combination No.	Combination of practices used	Farmers	
			Number	Percent
Ecological nutrient management practices	1.	NM1+NM2	2	1
	2.	NM1+NM2+NM3	2	1
	3.	NM1+NM2+NM3+NM4+NM5+NM6+NM9	2	1
	4.	NM1+NM2+NM3+NM4+NM5+NM7+NM9	5	4
	5.	NM1+NM2+NM3+NM4+NM5+NM7+NM8+NM9	2	1
	6.	NM1+NM2+NM3+NM4+NM5+NM8+NM9	4	3
	7.	NM1+NM2+NM3+NM4+NM5+NM9	2	1
	8.	NM1+NM2+NM3+NM4+NM7+NM8+NM9	1	1
	9.	NM1+NM2+NM3+NM4+NM7+NM9	2	1
	10.	NM1+NM2+NM3+NM4+NM8+NM9	3	2
	11.	NM1+NM2+NM3+NM4+NM9	5	4
	12.	NM1+NM2+NM3+NM5+NM7+NM9	3	2
	13.	NM1+NM2+NM3+NM5+NM9	2	1
	14.	NM1+NM2+NM3+NM7+NM9	16	11
	15.	NM1+NM2+NM3+NM8+NM9	2	1
	16.	NM1+NM2+NM3+NM9	19	13
	17.	NM1+NM2+NM4	2	1
	18.	NM1+NM2+NM4+NM5+NM7+NM9	5	4
	19.	NM1+NM2+NM4+NM5+NM9	5	4
	20.	NM1+NM2+NM4+NM7+NM8+NM9	9	6
	21.	NM1+NM2+NM4+NM7+NM9	6	4
	22.	NM1+NM2+NM4+NM8	1	1
	23.	NM1+NM2+NM4+NM8+NM9	4	3
	24.	NM1+NM2+NM4+NM9	20	14
	25.	NM1+NM2+NM9	2	1
	26.	NM1+NM3	2	1
	27.	NM1+NM3+NM4+NM7+NM8+NM9	3	2
	28.	NM1+NM3+NM4+NM7+NM9	1	1
	29.	NM1+NM3+NM7+NM9	1	1
	30.	NM1+NM3+NM9	1	1
	31.	NM1+NM4+NM7+NM9	1	1
	32.	NM1+NM4+NM8+NM9	3	2
	33.	NM1+NM4+NM9	4	3
	34.	NM1+NM4+NM9	2	2
		Total	**144**	**100**
Ecological pest management practices	1.	PM1+PM2+PM4+PM5+PM6+PM7+PM8+PM10	1	1
	2.	PM1+PM2+PM4+PM5+PM6+PM9+PM10	8	5
	3.	PM1+PM2+PM4+PM5+PM7+PM9+PM10	1	1
	4.	PM1+PM2+PM5+PM6+PM9+PM10	65	45
	5.	PM1+PM2+PM5+PM9+PM10	7	5
	6.	PM1+PM2+PM5+PM10	2	1
	7.	PM1+PM5+ PM6+PM9+PM10	14	10
	8.	PM2+PM5+ PM6+PM9+PM10	21	14
	9.	PM4+PM5+ PM6+PM9+PM10	4	3
	10.	PM4+PM5+ PM9+PM10	1	1
	11.	PM5+PM6+ PM9+PM10	20	14
		Total	**144**	**100**

NM1=Cowdung
NM2=Poultry excreta
NM3=Farm yard manure
NM4=Compost
NM5=Quick compost/Oil cake
NM6=Liquid organic fertilizer
NM7=Water hyacinth
NM8=Green manure
NM9=Crop residues/weed fertilizer
NM10=Biofertilizer

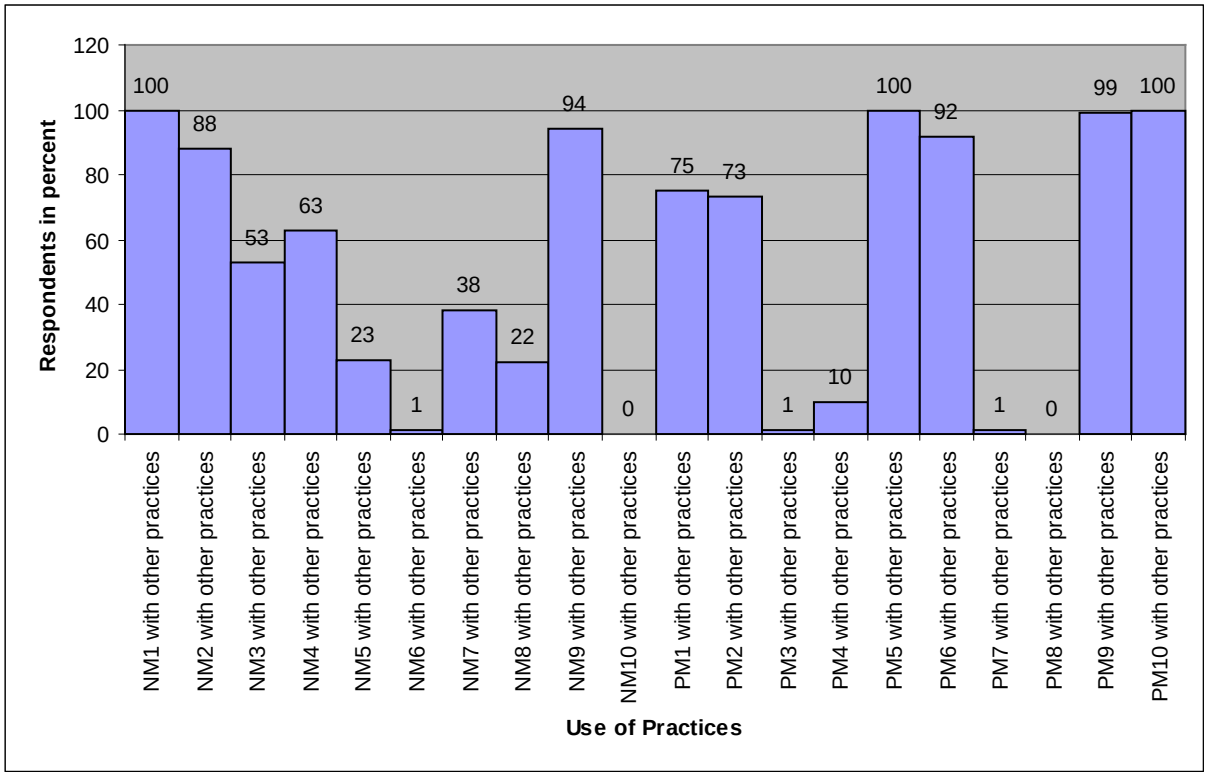
PM1=Pest control by hand/hand net
PM2=Putting tree branches in the field
PM3=Light trap
PM4= Botanical pesticides (neem, nishinda, biskatali, garlic extract etc.)
PM5=Use of quality seed
PM6= Ash
PM7= Beneficial insects
PM8=Pest resistant varieties
PM9=Crop rotation
PM10=Proper weeding and eradication of insect/disease attacked plants/plant parts

The third important combination used by the respondent farmers was combination No.14 which includes cowdung, poultry excreta, farm yard manure, water hyacinth and crop residues/weed fertilizer.

In case of ecological pest management practices, there were 11 combinations which were used by the farmers. Forty five percent of the farmers used combination No. 4 which includes pest control by hand/hand net, putting tree branches in the field, quality seeds, ash, crop rotation, and proper weeding and eradication of insect/disease attacked plants/plant parts followed by 14 per cent of the farmers (21 farmers) using combination No. 8 which includes putting tree branches in the field, quality seeds, ash, crop rotation, and proper weeding and eradication of insect/disease attacked plants/plant parts. Another 14 percent of the farmers (20 farmers) used combination No. 11. being the third most important (very nearer to second important) combination which includes quality seeds, ash, crop rotation, and proper weeding and eradication of insect/disease attacked plants/plant parts.

Above findings were somewhat complex to understand. On the basis of this consideration, an attempt was made to find out the distribution of respondent farmers on the basis of use of each ecological practice with other practices (Fig. 4.3).

Data contained in Fig. 4.3 revealed that in case of ecological nutrient management practices, all (100%) the farmers used cowdung with other practices followed by crop residues/weed fertilizers (94%) and poultry excreta (88%). Nobody used biofertilizer individually or with other practices. It might be due to the fact that cowdung, crop residues/weed fertilizers and poultry excreta were available in the study area and those were easy to use.



NM1=Cowdung	PM1=Pest control by hand/hand net
NM2=Poultry excreta	PM2=Putting tree branches in field
NM3=Farm yard manure	PM3=LIght trap
NM4=Compost	PM4= Botanical pesticides (neem, nishinda, biskatali, garlic extract etc.)
NM5=Quick compost/Oil cake	PM5=Quality seed
NM6=Liquid organic fertilizer	PM6= Ash
NM7=Water hyacinth	PM7= Beneficial insects
NM8=Green manure	PM8=Pest resistant varieties
NM9=Crop residues/weed fertilizer	PM9=Crop rotation
NM10=Biofertilizer	PM10=Proper weeding and eradication of insect/disease attacked plants/plant parts

Fig. 4.3 Bar-graph showing percentage distribution of the farmers on the basis of use of individual ecological agricultural practices with other selected practices

In case of ecological pest management practices, all (100%) the farmers used quality seeds and proper weeding and eradication of insect/disease attacked plants/plant parts with other ecological practices followed by crop rotation (99%) and ash (92%). Nobody used pest resistant varieties individually or with other practices. It might be due to the fact that the concerned authority in the study area suggested the respondents to use quality seeds and ash and also to perform proper weeding and eradication of insect/disease attacked plants/plant parts.

4.3 Modes of Adoption of Ecological Agricultural Practices and Area Coverage

Only two respondent farmers were found absolute ecological farmers who practised fully ecological agricultural practices without using any chemical fertilizer and chemical pesticide in their 100% land. But their score of adoption of selected ecological agricultural practices was not higher because they usually used only three ecological agricultural practices namely, cowdung, quality seeds, and proper weeding and eradication of insect/disease attacked plants/plant parts out of 20 selected ecological agricultural practices.

Most of the farmers of the study area were using selected ecological agricultural practices for cultivating some specific types of crops in some particular land. Some were using the mixture of chemical and ecological agricultural practices for their crop production. Some were using absolute ecological agricultural practices in some portion of land and mixing types of practices in other portion of their land for the same crop. Actually the respondents were transferring their agricultural practices from chemical to ecological phases gradually. From these viewpoints, four modes of application of ecological agricultural practices were considered for this study. These were:

- **Mode-I** **:** No use of ecological agricultural practices i.e. absolute use of chemical fertilizers and chemical pesticides without ecological agricultural practices,

- **Mode-II** **:** Less use of ecological agricultural practices with large use of chemical fertilizers and chemical pesticides (large use of chemical fertilizers means use of $\geq$50% of the recommended doses of chemical fertilizers and large use of chemical pesticides means use of chemical pesticides for pest control at normal attack.),
- **Mode-III** **:** Large use of ecological agricultural practices with less use of chemical fertilizers and chemical pesticides (less use of chemical fertilizers means use of <50% of the recommended doses of chemical fertilizers and less use of chemical pesticides means use of chemical pesticides for pest control only at the time of severe attack.), and
- **Mode-IV** **:** Use of absolute ecological agricultural practices i.e. use of ecological agricultural practices without any chemical fertilizers and chemical pesticides

On the basis of the above modes individually or in combination, the percent distribution of the respondent farmers are shown in Fig. 4.4.

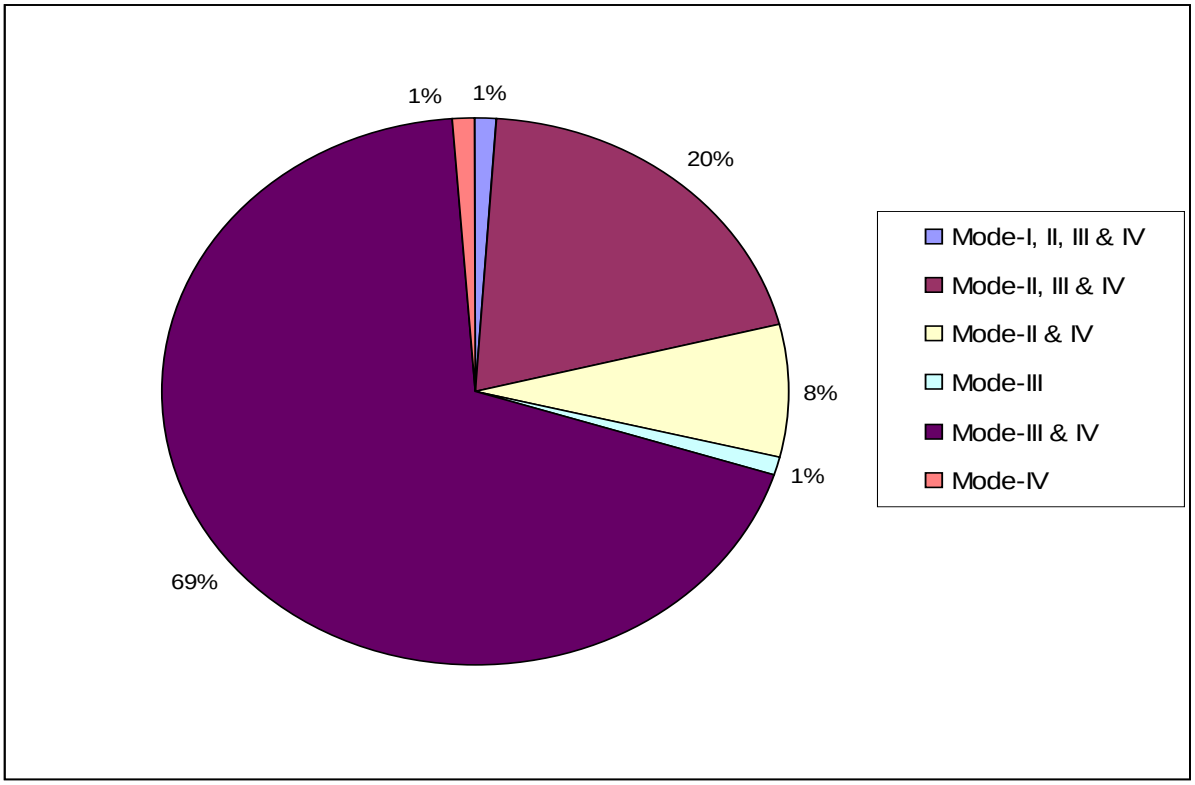


Fig. 4.4 Pie-graph showing percentage distribution of respondent farmers on the basis of modes of use of ecological agricultural practices individually or in combinations

Fig. 4.4 revealed that most (69%) of the respondent farmers used Mode-III & IV combinedly followed by 20 percent of the respondent farmers using Mode-II, III & IV combinedly. The third most important was Mode-II & IV combinedly which was used by eight percent respondents. One percent farmers used Mode-I, II, III & IV combinedly. Another one percent respondent used Mode-III and last one percent respondent used Mode-IV or absolutely ecological agricultural practices.

The respondents had a total of 147.95 hectares of total cropped area on which they cultivated different types of crops under the above four modes round the year. Types of crops cultivated and modes of application of selected ecological agricultural practices with area coverage are presented in Table 4.4 and described below:

Mode-I

In 0.32 hectares of land, the respondents cultivated amon and boro rice (*Oryza sativa*) only by using chemical fertilizers and chemical pesticides. They never used any ecological agricultural practices in these fields (Table 4.4).

Mode-II

The respondents cultivated amon and boro rice (*Oryza sativa*), wheat (*Triticum aestivum*), chilli (*Capsicum spp.*), onion (*Allium cepa*), tomato (*Lycopersicon esculentum*), Brinjal (*Solanum melongena*), and banana (*Musa spp.*) with less use of ecological agricultural practices and large use of chemical fertilizers and chemical pesticides in 15.7 hectares of land (Table 4.4).

Mode-III

The respondents cultivated aus, aman and boro rice (*Oryza sativa*), wheat (*Triticum aestivum*), jute (*Corchorus spp.*), sweet potato (*Ipomea batatus*), oilseeds, chilli (*Capsicum spp.*), onion (*Allium cepa*) along with 30 other crops with large use of ecological agricultural practices and less use of chemical fertilizers and chemical pesticides in 61.41 hectares of land (Table 4.4).

Table 4.4 Crop wise modes of application of selected ecological agricultural practices with area coverage

Sl. No.	Name of Crops	Mode-I		Mode-II		Mode-III		Mode-IV		Total area of the crop (ha) (3+5+7+9)
		Area (ha)	% of Total (3÷11) ×100	Area (ha)	% of Total (5÷11) ×100	Area (ha)	% of Total (7÷11) ×100	Area (ha)	% of Total (9÷11) ×100	
1	2	3	4	5	6	7	8	9	10	11
1	Aus*	0.00	0.00	0.00	0.00	0.39	100.00	0.00	0.00	0.39
2	Amon**	0.16	0.76	3.66	17.27	13.84	65.26	3.54	16.70	21.21
3	Boro***	0.16	0.57	10.43	36.95	17.63	62.48	0.00	0.00	28.22
4	Wheat	0.00	0.00	0.51	20.49	1.76	71.32	0.20	8.18	2.47
5	Jute	0.00	0.00	0.00	0.00	8.96	90.11	0.98	9.89	9.95
6	Sweet potato	0.00	0.00	0.00	0.00	0.06	12.56	0.40	87.44	0.45
7	Pulses	0.00	0.00	0.00	0.00	0.00	0.00	0.63	100.00	0.63
8	Oilseeds	0.0	0.00	0.00	0.00	0.61	66.92	0.30	33.08	0.91

Sl. No.	Name of Crops	Mode-I		Mode-II		Mode-III		Mode-IV		Total area of the crop (ha) (3+5+7+9)
		Area (ha)	% of Total (3÷11) ×100	Area (ha)	% of Total (5÷11) ×100	Area (ha)	% of Total (7÷11) ×100	Area (ha)	% of Total (9÷11) ×100	
1	2	3	4	5	6	7	8	9	10	11
		0								
9	Chilli	0.00	0.00	0.22	6.60	0.12	3.64	2.98	89.76	3.32
10	Onion	0.00	0.00	0.07	2.19	0.13	3.90	3.13	93.91	3.33
11	Garlic	0.00	0.00	0.00	0.00	0.05	4.38	1.16	95.62	1.21
12	Turmeric	0.00	0.00	0.00	0.00	0.08	2.53	3.12	97.47	3.20
13	Ginger	0.00	0.00	0.00	0.00	0.08	15.64	0.44	84.36	0.52
14	Coriander	0.00	0.00	0.00	0.00	0.01	1.28	0.62	98.72	0.63
15	Potato	0.00	0.00	0.00	0.00	2.39	61.44	1.50	38.56	3.90
16	Papaya	0.00	0.00	0.00	0.00	0.01	1.79	0.66	98.21	0.67
17	Tomato	0.00	0.00	0.11	2.32	3.40	75.12	1.02	22.56	4.52
18	Brinjal	0.00	0.00	0.50	6.36	4.07	51.51	3.32	42.12	7.89
19	Bottle gourd	0.00	0.00	0.00	0.00	0.28	5.91	4.38	94.09	4.66
20	Sweet gourd	0.00	0.00	0.00	0.00	0.13	3.16	4.10	96.84	4.24
21	Wax gourd	0.00	0.00	0.00	0.00	0.24	6.42	3.54	93.58	3.79
22	Bean	0.00	0.00	0.00	0.00	0.23	5.51	3.96	94.49	4.20
23	Indian spinach	0.00	0.00	0.00	0.00	0.03	3.31	0.94	96.69	0.97
24	Lal shak	0.00	0.00	0.00	0.00	0.34	9.03	3.47	90.97	3.81
25	Amaranth	0.00	0.00	0.00	0.00	0.33	8.44	3.56	91.56	3.89
26	Spinach	0.00	0.00	0.00	0.00	0.00	0.00	0.26	100.00	0.26
27	Radish	0.00	0.00	0.00	0.00	0.33	19.71	1.35	80.29	1.68

Sl. No.	Name of Crops	Mode-I		Mode-II		Mode-III		Mode-IV		Total area of the crop (ha) (3+5+7+9)
		Area (ha)	% of Total (3÷11) ×100	Area (ha)	% of Total (5÷11) ×100	Area (ha)	% of Total (7÷11) ×100	Area (ha)	% of Total (9÷11) ×100	
1	2	3	4	5	6	7	8	9	10	11
28	Pointed gourd	0.00	0.00	0.00	0.00	0.45	52.60	0.40	47.40	0.85
29	Cabbage	0.00	0.00	0.00	0.00	0.67	32.54	1.39	67.46	2.05
30	Cauliflower	0.00	0.00	0.00	0.00	0.79	33.10	1.60	66.90	2.38
31	Snake gourd	0.00	0.00	0.00	0.00	0.27	9.70	2.52	90.30	2.79
32	Teasle gourd	0.00	0.00	0.00	0.00	0.08	3.02	2.60	96.98	2.68
33	Okra	0.00	0.00	0.00	0.00	0.40	24.83	1.20	75.17	1.60
34	Bitter gourd	0.00	0.00	0.00	0.00	0.05	2.18	2.20	97.82	2.25
35	Ridged gourd	0.00	0.00	0.00	0.00	0.04	3.95	0.97	96.05	1.01
36	Sponge gourd	0.00	0.00	0.00	0.00	0.11	24.51	0.35	75.49	0.46
37	Carrot	0.00	0.00	0.00	0.00	0.00	0.00	0.32	100.00	0.32
38	Cucumber	0.00	0.00	0.00	0.00	0.66	20.01	2.62	79.99	3.28
39	Pineapple	0.00	0.00	0.00	0.00	0.93	95.88	0.04	4.12	0.97
40	Banana	0.00	0.00	0.20	10.80	1.38	73.85	0.29	15.35	1.87
41	Fruit	0.00	0.00	0.00	0.00	0.03	1.25	2.52	98.75	2.55
42	Timber	0.00	0.00	0.00	0.00	0.05	3.17	1.62	96.83	1.67
43	Bamboo	0.00	0.00	0.00	0.00	0.00	0.00	0.32	100.00	0.32
Grand Total		**0.32**	**0.22**	**15.70**	**10.61**	**61.41**	**41.51**	**70.52**	**47.66**	**147.95**

Note: Column 4 = (Column 3 / Column11)×100 Column 6 = (Column 5 / Column11) ×100

Column 8 = (Column 7 / Column11) ×100 Column 10 = (Column 9 / Column11) ×100

Column 11 = Column 3 + Column 5 + Column 7 + Column 9

*Varieties of rice cultivated during March to August, **Varieties of rice cultivated during usually June to December and ***Varieties of rice cultivated during November to May in each year

Mode-IV

The respondents cultivated amon rice (*Oryza sativa*), wheat (*Triticum aestivum*), jute (*Corchorus spp*.), sweet potato (*Ipomea batatus*), pulses, oilseeds, chilli (*Capsicum spp*.), onion (*Allium cepa*), garlic (*Allium sativum*) along with 32 other crops with the use of absolute ecological agricultural practices in 70.52 hectares of land (Table 4.4). In case of cultivation of pulses, spinach (*Beta vulgaris*), carrot (*Daucus carota*) they used absolute ecological agricultural practices in their 100 percent land for those crops. In case of bamboo garden they never used any external inputs like organic or inorganic fertilizers and pesticides, that type of bamboo cultivation was also treated as ecological agricultural practice.

Attempt has also been made to show the percent of land distribution under the above mentioned mode of application of ecological nutrient management and ecological pest management practices for crop production in Fig. 4.5.

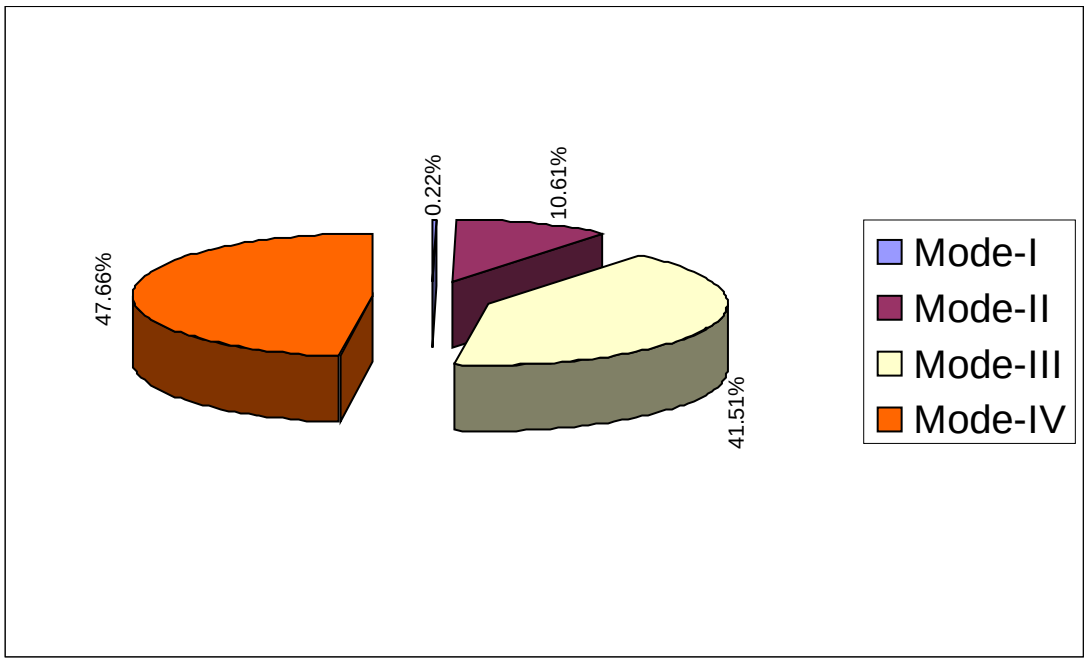


Fig. 4.5 Pie-graph showing percent land distribution under different modes of application of nutrient and pest management practices for crop production

About half (47.66 per cent) of the lands of the farmers were cultivated by application of Mode-IV, i.e. by using fully ecological agricultural practices as compared to 10.61 and 41.51 per cent land by using Mode II & III respectively. Only 0.22 percent of lands were cultivated by using fully chemical method. It was quite logical that most (52.12 per cent) of the lands of the farmers were cultivated by the mixture of ecological and chemical practices. It was due to the fact that the farmers were not dependent on fully ecological practices or fully chemical practices.

4.4 Benefit obtained from Ecological Agriculture

In order to measure the benefits obtained from ecological agriculture by the farmers, the researcher used 25 items of benefits by taking 6 social, 5 environmental, 11 technical-cum-economical and 3 psychological aspects. In respect of each item, each farmer was asked to indicate how much benefit he obtained by indicating in favour of any of the four responses such as high benefit, moderate benefit, low benefit and not at all benefit obtained. The weights were assigned to the above responses as 3, 2, 1 and 0 respectively. The Benefit Index (BI) for each of the items was computed by using the following formula:

$$BI = B_h \times 3 + B_m \times 2 + B_l \times 1 + B_n \times 0$$

Where,
BI = Benefit Index
B_h = Number of farmers who indicated high benefit
B_m = Number of farmers who indicated moderate benefit
B_l = Number of farmers who indicated low benefit
B_n = Number of farmers who indicated not at all benefit

As the total number of respondent farmers was 144, the BI of each of the items thus could range from zero (0) to 432. But, to express the benefit index (BI) in a meaningful way, it was necessary to convert and standardize the benefit index (BI) by using the formula as indicated below:

$$\text{Standardized benefit index (SBI)} = \frac{\text{Computed benefit index}}{\text{Possible highest benefit index}} \text{x}100$$

The SBI of each of the items of benefit could range from 0 to 100, where zero (0) indicated no benefit and 100 indicated very high benefit obtained from ecological agriculture.

In order to understand comparative benefit of different items, these 25 items were arranged in rank order (Table 4.5) according to the Standardized Benefit Index (SBI) obtained against each of the items. Rank order was also made in respect of social, environmental, technical-cum-economical, and psychological aspects separately (Table 4.5) and discussed below:

4.4.1 Comparative benefits of ecological agriculture among all the 25 selected benefit items

Data in Table 4.5 showed that on the basis of Standardized Benefit Index (SBI) among all the 25 selected benefit items, increase in the of use of local resources ranked first followed by increase of soil microbial activity and fertility. The third important item of benefits was increase of cropping intensity. The next seven important benefit items in descending order were increase of production of vegetables, fruits and trees; development of decision making ability; development of counseling ability; increase of integrated crop management; increase of product quality; decrease of human diseases; and development of human health environment. However, the remaining benefit items were relatively less important in respect of benefits obtained from ecological agriculture.

4.4.2 Comparative benefits of ecological agriculture among 6 selected social benefit items

Data in Table 4.5 showed that on the basis of Standardized Benefit Index (SBI) among 6 selected social benefit items, development of decision making ability ranked first followed by development of counseling ability; development of participation in meeting and training; development of employment opportunity; development of knowledge and skill; and development of organizational participation and extension contact.

4.4.3 Comparative benefits of ecological agriculture among 5 selected environmental benefit items

Data in Table 4.5 showed that on the basis of Standardized Benefit Index (SBI) among 5 selected environmental benefit items, development of human health environment ranked first followed by decrease of air and water pollution; development of environment for animal and bird health; decrease of crop pest; and increase of beneficial insects, earth worm, frog etc.

Table 4.5 Benefits obtained from ecological agriculture with rank order

Items of benefit	Number of respondents obtained				BI	SBI	*Rank Order	**Rank Order
	High benefit	Moderate benefit	Low benefit	Not at all benefit				
Social benefits								
1. Development of knowledge and skill	5	60	79	0	214	49.5	5	17
2. Development of organizational participation and extension contact	2	63	79	0	211	48.8	6	19
3. Development of employment opportunity	4	63	77	0	215	49.8	4	16
4. Development of participation in meeting and training	0	75	69	0	219	50.7	3	15
5. Development of counseling ability	45	82	17	0	316	73.1	2	6
6. Development of decision making ability	41	93	10	0	319	73.8	1	5
Environmental benefits								
7. Decrease of air and water pollution	2	114	28	0	262	60.6	2	11
8. Development of human health environment	2	116	26	0	264	61.1	1	10
9. Development of environment for animal and bird health	3	111	30	0	261	60.4	3	12
10. Decrease of crop pests	2	82	57	3	227	52.5	4	14
11. Increase of beneficial insects, earth worm, frog etc.	0	74	65	5	213	49.3	5	18
Technical-cum-economic benefits								
12. Increase of integrated crop management	32	94	18	0	302	69.9	5	7
13. Increase of cropping intensity	51	86	7	0	332	76.9	3	3
14. Increase in the use of local resources	69	68	7	0	350	81.0	1	1
15. Increase of soil microbial activity and fertility	63	78	3	0	348	80.6	2	2
16. Increase of production of vegetables, fruits and trees	49	84	9	2	324	75.0	4	4
17. Increase of poultry rearing	1	10	66	67	89	20.6	10	24
18. Increase of cow and goat rearing	0	10	79	55	99	22.9	9	23
19. Increase of fish culture	0	10	54	80	74	17.1	11	25
20. Decrease of production cost	7	105	24	8	255	59.0	8	13
21. Increase of product quality	10	116	18	0	280	64.8	6	8
22. Decrease of human diseases	18	97	29	0	277	64.1	7	9

Psychological benefits								
23. Positive development of human conduct	2	44	88	10	182	42.1	2	21
24. Development of social norms and values	2	27	90	25	150	34.7	3	22
25. Positive development of human food habit	9	38	88	9	191	44.2	1	20
Total					5974	1382.9		

*Among social, environmental, technical & economical, and psychological benefit separately
**Among all the 25 benefit items

4.4.4 Comparative benefits of ecological agriculture among 11 selected technical-cum-economical benefit items

Data in Table 4.5 showed that on the basis of Standardized Benefit Index (SBI) among 11 selected technical & economical benefit items, increase in the use of local resources ranked first followed by increase of soil microbial activity and fertility; increase of cropping intensity; increase of production of vegetables, fruits and trees; increase of integrated crop management; increase of product quality; decrease of human diseases; decrease of production cost; increase of cow and goat rearing; increase of poultry rearing; and increase of fish culture.

4.4.5 Comparative benefits of ecological agriculture among 3 selected psychological benefit items

Findings indicated that on the basis of Standardized Benefit Index (SBI) among 3 selected psychological benefit items, positive development of human food habit ranked first followed by positive development of human conduct and development of social norms and values (Table 4.5).

4.4.6 Comparative benefits among 4 broad types of benefits

Attempts have been made to compare among benefits obtained from 4 broad types of benefits. The selected 4 different types of benefit were social, environmental, technical-cum-economical, and psychological. As items of each of the 4 different types of benefit were not equal, the comparison was made on the basis of Average Standardized Benefit Index (ASBI). ASBI for each type of benefit was determined by using the following formula:

$$\text{ASBI} = \frac{\sum \text{SBI}}{\text{N}}$$

Where,

ASBI = Average standardized benefit index for a particular type of benefit
ΣSBI = Total standardized benefit index obtained from the items of that type of benefit
N = Number of items of that type of benefit

Rank order was made on the basis of average standardized benefit index (ASBI) among the four types of benefits (Table 4.6). Findings presented in Table 4.6 indicated that social benefits ranked first followed by technical & economical benefit, environmental benefit and psychological benefit.

Table 4.6 Comparative average standardized benefit index (ASBI) of social, environmental, technical-cum-economical, and psychological aspects

Types of benefits	ΣSBI	Number of items (N)	Average Benefit Index (ASBI)	Rank order
Social	345.7	6	57.62	1
Technical-cum-Economical	631.9	11	57.45	2
Environmental	283.9	5	56.78	3
Psychological	121.0	3	40.33	4
Total	**1382.5**	**25**	**55.30**	

From Table 4.6, it was observed that social, environmental and technical-cum-economical benefits were more or less same, but higher than psychological benefit. It might be due to the fact that, farmers of the study area perceived more social, environmental and technical-cum-economical benefits from ecological agricultural practices. As farmers of the study area were organized by Proshika groups, they were conscious about ecological agricultural practices.

4.5 Problems Faced by the Farmers in Ecological Agriculture

In order to measure the problems faced by the farmers in ecological agriculture by the farmers the researcher used 24 items of problems by taking 4 social, 7 technical, 5 economical, 5 marketing, and 3 psychological problem items. In respect of each item, each farmer was asked to indicate how much problem he faced by indicating in favour of any of the four responses such as serious problem, moderate problem, less problem and not at all problem faced. The weights were assigned to the above responses as 3,

2, 1 and 0 respectively. The Problem Index (PI) for each of the item was computed by using the following formula:

$$PI = P_s \times 3 + P_m \times 2 + P_l \times 1 + P_n \times 0$$

Where,

PI = Problem Index
P_s = Number of farmers who faced serious problem
P_m = Number of farmers who faced moderate problem
P_l = Number of farmers who faced less problem
P_n = Number of farmers who faced no problem at all

As the total number of respondent farmers was 144, the PI of each of the item thus could range from zero (0) to 432. But, to express the problem index (PI) in a meaningful way, it was necessary to convert and standardize the problem index (PI) by using the formula as indicated below:

$$\text{Stabdardized problem Index (SPI)} = \frac{\text{Computed problem index}}{\text{Possible highest problem index}} \text{x}100$$

The SPI of each of the items of problem could range from 0 to 100, where zero (0) indicated no problem and 100 indicated very serious problem faced.

In order to understand comparative different problem items, these 24 items were arranged in rank order (Table 4.7) according to the Standardized Problem Index (SPI) obtained against each of the items. Rank order was also made in respect of social, technical, economical, marketing, and psychological problems separately (Table 4.7) and discussed below:

4.5.1 Comparative problems faced by the farmers in ecological agriculture involving all the 24 selected problem items

Table 4.7 showed that on the basis of Standardized Problem Index (SPI) among all the 24 selected problem items, lack of farm animal ranked first followed by poor adoption of ecological agriculture by maximum farmers. Uncertainty of pest control in case of severe attack was the third important problem faced by the farmers. The next seven important problems in descending order were poor plant nutrient in organic manure, lack of information and publicity, poor extension service, lack of proper organization, low production, need excess labour, and lower price of organic

product. However, other problems were relatively less important. For having a better understanding, attempt has been made to show the standardized problem index (SPI) of each item with rank order in Table 4.8.

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Table 4.7 Problems faced by the farmers in ecological agriculture with rank order

Items of problem	Number of respondents faced				PI	SPI	*Rank Order	**Rank Order
	Serious Problem	Moderate problem	Less problem	Not at all problem				
Social problems								
1. Lack of information and publicity	18	97	25	4	273	63.2	2	5
2. Lack of proper organization	9	108	27	0	270	62.5	4	7
3. Poor extension service	6	115	23	0	271	62.7	3	6
4. Poor adoption of ecological agriculture by maximum farmers	128	15	1	0	415	96.1	1	2
Technical problems								
5. Difficult to collect ingredients of compost and to prepare it	0	20	65	59	105	24.3	4	15
6. Difficult to prepare green manure	0	4	52	88	60	13.9	7	18
7. Difficult to collect ingredients of botanical pesticide and to prepare it	0	10	103	31	123	28.5	3	14
8. Difficult to prepare light trap	2	4	84	54	98	22.7	5	16
9. Difficult to maintain crop rotation	1	2	61	80	68	15.7	6	17
10. Poor plant nutrient in organic manure	38	66	30	10	276	63.9	2	4
11. Uncertainty of pest control in case of severe attack	46	64	26	8	292	67.6	1	3
Economic problems								
12. Lack of farm animal	132	11	0	1	418	96.8	1	1
13. Low production	16	100	18	10	266	61.6	2	8
14. Need excess time	0	21	16	107	58	13.4	5	19
15. Need excess labour	10	51	68	15	200	46.3	3	9
16. Lower price of organic product	0	50	77	17	177	41.0	4	10
Marketing problems								
17. Poor and inadequate roads for transportation	2	5	36	101	52	12.0	1	20
18. Difficult to move to a distance place	0	7	27	110	41	9.5	3	22
19. Lack of proper transport	0	7	20	117	34	7.9	5	24
20. Undesirable involvement of middle men	0	7	22	115	36	8.3	4	23
21. Lack of storage facilities	0	7	34	103	48	11.1	2	21
Psychological problems								
22. Criticism from family members	0	24	90	30	138	31.9	3	13
23. Criticism from relatives and neighbouring farmers	1	36	86	21	161	37.3	2	12
24. Criticism from fertilizer and pesticide dealers	7	35	81	21	172	39.8	1	11
Total					**4052**	**938**		

*Among social, technical, economical, marketing, and psychological problem separately

**Among all the 24 problem items

4.5.2 Comparative problems faced by the farmers involving 4 selected social problem items

Data in Table 4.7 showed that on the basis of Standardized Problem Index (SPI) among 4 selected social problem items, poor adoption of ecological agriculture by maximum farmers ranked first followed by lack of information and publicity, poor extension service, and lack of proper organization.

4.5.3 Comparative problems faced by the farmers involving 7 selected technical problem items

Data in Table 4.7 showed that on the basis of Standardized Problem Index (SPI) among 7 selected technical problem items, uncertainty of pest control in case of severe attack ranked first followed by poor plant nutrient in organic manure, difficult to collect ingredient of botanical pesticides and to prepare it, difficult to collect ingredient of compost and to prepare it, difficult to prepare light trap, difficult to maintain crop rotation, and difficult to prepare green manure.

4.5.4 Comparative problems faced by the farmers involving 5 selected economical problem items

Table 4.7 showed that on the basis of Standardized Problem Index (SPI) among 5 selected economical problem items, lack of farm animal ranked first, followed by low production, need excess labour, lower price of organic product, and need excess time.

4.5.5 Comparative problems faced by the farmers involving 5 selected marketing problem items

Table 4.7 showed that on the basis of Standardized Problem Index (SPI) among 5 selected marketing problem items, poor and inadequate roads for transportation ranked first followed by lack of storage facilities, difficult to move to a distance place, undesirable involvement of middle men, and lack of proper transport.

4.5.6 Comparative problems faced by the farmers involving 3 selected psychological problem items

Findings indicated in Table 4.7 that on the basis of Standardized Problem Index (SPI) among 3 selected psychological problem items, criticism from fertilizer and pesticide dealers ranked first followed by criticism from relatives and neighbouring farmers and criticism from family members.

4.5.7 Comparative problems faced by the farmers involving 5 broad types of problems

Attempts have been made to compare the problems faced by the farmers in 5 selected types. The selected 5 different types of problems were social, technical, economical, marketing, and psychological problem. As the items of each of 5 different types of problem were not equal, the comparison was made on the basis of Average Standardized Problem Index (ASPI). The ASPI for each type of problem was determined by using the following formula:

$$ASPI = \frac{\sum SPI}{N}$$

Where,

ASPI = Average standardized problem index for a particular type of problem

ΣSPI = Total standardized problem index obtained from the items of that type of problem

N = Number of items of that type of problem

Rank order was made on the basis of average standardized problem index (ASPI) among the types of problems (Table 4.8). Findings presented in the Table 4.8 indicated that social problem ranked first followed by economical problem, psychological problem, technical and marketing problem.

Table 4.8 Comparative average standardized problem index (ASPI) of social, technical, economical, marketing and psychological problems

Types of problems	ΣSPI	Number of items (N)	Average Standardized Problem Index (ASPI)	Rank order
Social	284.5	4	71.13	1
Economical	259.1	5	51.82	2
Psychological	109.0	3	36.33	3
Technical	236.6	7	33.80	4
Marketing	48.8	5	9.76	5
Total	**938.0**	**24**	**39.08**	

From Table 4.8, it was observed that social and economical problems were comparatively higher than technical, marketing and psychological problems in adopting ecological agricultural practices. The possible cause might be due to the fact that farmers of the study area were organized by Proshika groups. Subsequently, they were supported by technical and marketing facilities of Proshika and consciousness

were built up to minimize psychological problems of ecological agricultural practices. Social and economical problems were perceived higher by the respondent farmers. Therefore it may be suggested that the concerned authority should pay more attention to take necessary action for minimizing these problems.

4.6 Case Studies of a Successful Ecological Farmer and a Successful ICM Farmer

Yin (1984) defined case study as an empirical inquiry that investigates a contemporary phenomenon within its real-life context, when the boundaries between phenomenon and context are not clearly evident, and in which multiple sources of evidence are used. It is a method of comprehensive study of a social unit, which may be a person, a family, a group, an institution, an organization or a community. It places emphasis on the full analysis of a limited number of events, conditions or situations and their interrelations. Some sociologist termed case studies as 'social microscope' mostly as an example of a general phenomenon, or of a general proposition (Jary and Jary, 1991).

Respondents of this study were practising ecological agriculture by the suggestion of Proshika. On the other hand, extension provider of the Government of Bangladesh like Department of Agricultural Extension (DAE) has been promoting environment-friendly Integrated Farming System (IFS) Including Integrated Plant Nutrient System (IPNS) or Integrated Nutrient Management (INM) for judicious integrated use of chemical and non-chemical fertilizers, and Integrated Pest Manegement (IPM) for judicious integrated use of chemical and non-chemical pest management practices in the lands of the farmers of Bangladesh. Recently, DAE termed this Integrated Farming System as Integrated Crop Management (ICM) which includes INM and IPM. There might be some basic differences between ecological agriculture of Proshika and ICM of DAE in respect of purpose, method and outcome. Therefore, the researcher of this study felt the necessity to compare the purpose, method and outcome of these two types of agricultural practices of these two organizations by conducting two case studies. The objectives of these case studies were to make a comparison of ecological agriculture of PROSHIKA with Integrated Crop Management (ICM) of DAE with reference to purpose, method and outcome.

One case study on a successful ecological farmer of Proshika and another case study on a successful ICM farmer of DAE were conducted. Proshika and DAE personnel helped the researcher to select respective respondents for case studies. Personnel of concerned organizations also helped the researcher to introduce him with the respective respondents. Interview guide (appears in Appendix-III) and video cassette player were used for conducting the case studies. One register book was kept to each of these two farmers, who were selected as the subjects of the case studies for recording their practices for nutrient and pest management for a period of six months from July to December, 2006. Format of register book is shown in Appendix-IV.

Data were collected by the researcher himself for this purpose. To build rapport and motivation in the interview situations, the researcher attempted to provide conditions that maximized trust, maintained respondent's interest, and minimize status differences. Several visits were made to conduct the case studies during July to December, 2006.

4.6.1 Case study I: Malek as a successful ecological farmer

Pirojpur is a remote village of Modhupur Upazilla under Tangail district. It is 8 kms away from the Upazilla headquarter. Abdul Malek is a farmer of this village. He was 35 years old. He had education with nine years of schooling. He was engaged with Proshika activities for six years since 2001. He received one week training on ecological agriculture from Proshika.

He stated that before engaging with proshika activities he used chemical fertilizers and pesticides in his crop fields. After receiving ecological agricultural training, he started ecological agricultural practices on his own land. With the help of ecological agricultural knowledge and motivational progarmmes of Proshika he started his agricultural operations newly and successfully continued the practices. Consequently, he was selected as an ecological agricultural resource person by Proshika. He suggested other group members of Proshika and neighbouring farmers to use ecological agricultural practices on their land. Some profile of this case study may be seen in Pictures 4.1, 4.2 and 4.3.

Picture 4.1 The researcher is conducting case study on Malek

Picture 4.2 Malek is near to a compost pit inside his banana garden

Picture 4.3 Malek is in his papaya garden

He stated that he was able to regain his lost soil health with his untiring labour in the agricultural field by adopting ecological agricultural method. His family members also helped him. Now he is a model ecological agricultural farmer of Proshika. At present he passes his family life nicely with his family members. At present, Mr. Malek cultivates seasonal vegetables (summer and winter), banana, papaya and rice in his land. Malek stated that within six years he increased his wealth. By his untiring labour, he improved his living house, kitchen and cowshed. He purchased an irrigation machine with electric motor. Malek and his family members were very satisfied with his present ecological agricultural practices. All the farmers of that locality are inspired by the success of Malek. Being a model of successful ecological farmers, many personnel of Proshika and donor agencies visited Malek's farm and home several times. As stated by Malek, the purpose, methods and outcome of ecological agriculture are presented below:

Purposes

Malek reported that ecological agriculture had mainly the following purposes:

- To improve soil health by maintaining environment friendly practices
- To apply environment friendly management of pest
- To improve human health
- To protect the environment

Methods

Malek stated that after receiving ecological agricultural training he used mainly manures in stead of chemical fertilizers such as cowdung, compost, farm yard manures and water hyacinth for his crop cultivation. In case of vegetable cultivation, he also depended mainly on manures. In case of cereal crop like rice cultivation he used very little amount of chemical fertilizers with large amount of manures. Malek never used any chemical pesticide in vegetable fields. He used a very little amount of chemical pesticide in rice field at the time of severe pest attack. He mainly used mechanical, cultural, biological methods for pest control. Sometimes he used botanical pesticides like neem, nishinda, biskatali, etc. for pest control. He never used any chemicals for weed control. He controlled weeds only by cultural operations.

Outcomes

Malek stated that by using ecological method of agriculture, he could lower his production cost without decreasing of his production. With this method of cultivation he was satisfied as he could feed his family nutritious and tasty food. Another important point is that he could improve his soil health and environment. But in practical situation, most of the farmers used chemical pesticides for severe attack in rice field. He therefore had to use a trace amount of chemical pesticides in rice field in case of very severe pest attack. He thought that if he did not do so, the rice production could decrease. However, Malek was able to overcome his previous losses of soil health, increase his wealth and profit by minimizing the production cost.

4.6.2 Case study II: Mahmuda as a successful ICM farmer

Integrated Crop Management (ICM) means agricultural farming operations by applying both chemical and non-chemical inputs like fertilizers and pesticides judiciously. The DAE is promoting Integrated Pest Management (IPM) practices to the farmers of Bangladesh and established Farmers' Field School (FFS) to provide training to the farmers on IPM. After receiving IPM training, the farmers established different IPM club in different places of Bangladesh. Though the title of this training is IPM training, courses on integrated plant nutrient management are also included in this training. Recently DAE has termed this judicious integration of chemical and non-chemical inputs like fertilizers and pesticides in agricultural crop field as Integrated Crop Management (ICM). Case study on a successful ICM farmer of Kilgati village of Muktagacha Upazilla under Mymensingh district supervised by DAE is presented below:

Khilgati is a remote village of Muktagacha Upazilla under Mymensingh district, 6 kms away from the Upazilla headquarter. Mahmuda, a female farmer of 40 years, is a resident of this village, who studied upto class-VIII. In 1999, she went to Dhaka with a capital of Tk. 7,00, 000.00 (Taka seven hundred thousand) which was managed by selling some of her land, giving lease some of her lands to others and taking a credit of Tk. 2,00,000.00 (Taka two hundred thousand). She established a nut-bolt factory in Dhaka with this money. But unfortunately she had a stumbling loss of this total seven lakh Taka of this factory. She came back home in 2003. After returning home she was almost assetless, but she was not disappointed. She made contact with upazilla agricultural office. The Sub Assistant Agricultural Officer of Khilgati Block selected her as a participant of Farmers Field School (FFS). She took Integrated Pest Management (IPM) training in 2004 from the FFS.

After receiving IPM training from FFS, she was selected as a Field Trainer of FFS on IPM. She started INM and IPM practices on her own land with new zeal and aspiration. She also suggested her neighbouring farmers to use INM and IPM on their land. With the help of IPM knowledge and motivational progarmmes of DAE she started her agricultural operations with new zeal and aspirations.

She was able to regain her lost money with her untiring labour in the agricultural field. Her husband also helped her. Now she is a model farmer of the Department of Agricultural Extension (DAE). At present she passes her family life happily with her husband, two sons and a daughter.

Now she cultivates seasonal vegetables in one acre (0.4 hectare) of land and established a fisheries project in one acre (0.4 hectare) of land. She cultivates rice in rest of her land. In 2006, she cultivated bean, bottle gourd, tomato, cabbage, cauliflower, brinjal and other vegetables in 60 decimals (0.24 hectare) of land and earned Tk. 90,000.00 (Taka ninety thousands). Beside this, she cultivated puishak (Indian spinach) in a plot of 40 decimals (0.16 hectare) and earned another Tk. 90,000.00 (Taka ninety thousands).

Mahmuda stated that within three years she made repayment of the credit of Tk. 2,00,000.00 (Taka two hundred thousand), purchased a land by Tk. 1,75,000.00 (Taka one hundred seventy five thousand) and recovered her lands by Tk,1,30,000.00 (Taka one hundred thirty thousands) which were previously given to others on lease. All the farmers of that locality were inspired by the success of Mahmuda. She is a model of success to the personnel of DAE also. Personnel of DAE and donor agencies visited Mahmuda's farm and home several times. Some of her activities are presented in picture 4.4, 4.5, 4.6 and 4.7.

Picture 4.4 The researcher is conducting case study on Mahmuda in front of her husband

Picture 4.5 Mahmuda, her husband, daughter, the researcher and concerned Sub Assistant Agriculture Officer in her vegetable field

Picture 4.6 Mahmuda is preparing seed bed with her husband

Picture 4.7 Mahmuda is preparing compost in her compost shed and her husband stands beside the compost shed

Mahmuda stated that she never received training on Integrated Nutrient Management (INM), but received IPM training. Topics related to INM were included in the topics of IPM Training. As IPM and INM are include in ICM, the purpose, methods and outcome of ICM are presented below based on Mahmud's report:

Purposes

Mahmuda reported that ICM had mainly the following purposes:

- To maintain soil fertility with balance of nutrient
- To integrate management of pest
- To improve human health
- To protect the environment

Methods

Mahmuda expressed that after receiving training she used balanced fertilizers for her crop cultivation including less amount of chemical fertilizers and large amount of non-chemical fertilizers. In case of vegetable cultivation, she used very less amount of chemical fertilizers, and depended mainly on non-chemical fertilizers. In case of cereal crop like rice cultivation, she used balanced fertilizers including chemical fertilizers like urea, TSP and MP, and non-chemical fertilizers like cowdung, compost, household waste, water hyacinth etc. Mahmuda never used any chemical pesticide in her vegetable fields. She used a little amount of chemical pesticides in rice field at the time of severe pest attack. She mainly used mechanical, cultural, biological methods for pest control. Sometimes, she used botanical pesticides like neem, nishinda, biskatali, etc. for pest control. She never used any chemicals for weed control. She controlled weeds only by cultural operations.

Outcomes

Mahmuda stated that by using ICM, she could minimize her production cost and could increase her production. With this method of cultivation she was satisfied socially and could produce healthy, nutritious and tasty foods without disturbing the soil health and environment. As a result she could feed her family healthy, nutritious and tasty food. She was able to overcome her previous losses, increase her wealth and maximize her profit by the use of ICM in her agricultural fields.

4.6.3 Comparison between ecological agriculture of PROSHIKA and ICM of DAE with reference to purpose, method and outcome

On the basis of the above two case studies, following comparison were made between ecological agriculture of PROSHIKA and ICM of DAE with reference to purpose, method and outcome:

Basis of comparison	Ecological agriculture of PROSHIKA	ICM of DAE
Purpose	• To improve soil health by maintaining environment-friendly practices • To apply environment friendly management of pests • To improve human health • To protect the environment	• To maintain soil fertility with balance of nutrients • To integrate management of pest • To improve human health • To protect the environment.
Method	**Theoretical** • Plant nutrient management by fully non-chemical method • Pest management by fully non-chemical method • Weed control only by cultural method **Practical situation** • In practical situation, there was a very little use of chemical fertilizers and pesticides in rice field	• Plant nutrient management by judiciously using balanced fertilizers including chemical and non-chemical fertilizers • Pest management by a combination of mechanical, cultural, biological methods and by using pest resistant varieties. Chemical pesticides should be used at the time of severe pest attack • Weed control only by cultural method
Outcome	• Decreased production cost substantially • Increased net benefit • Produced more healthy, nutritious and tasty food than ICM based farming • Improved human health than ICM based farming • Improved environment than ICM based farming	• Decreased production cost substantially • Increased production • Produced more healthy, nutritious and tasty food than chemical based farming • Improved human health than chemical based farming • Improved environment than chemical based farming

4.6.4 Concluding remarks

In practical situation the ecological farmer (subject for case study I) used some little amount of chemical fertilizers in rice fields, because the neighbouring farmers used large amount of chemical fertilizers and he used a little amount of chemical pesticides in case of severe pest attack in rice field. If he did not do so, the yield might fall. But in case of other crop cultivation, he followed the rules of ecological agriculture strictly. Here, it may be noted that there is difference between theoretical and practical situation of ecological agriculture.

The theoretical concept of ecological agriculture could not always be maintained by the ecological farmers. Ecological farmers used this method in some portion of their field for some types of crops. Probably in most of the cases, they could not use this method in cent percent of their lands for all types of crop. Cent percent ecological agriculture was not possible for a small portion of lands of few farmers as chemical inputs can be contaminated by air and water from the surrounding lands of other farmers.

In case of case study II, the subject farmer used judiciously balanced fertilizers including chemical and non-chemical fertilizers for plant nutrient management. She also used all possible methods of non-chemical practices for pest control. At the time of severe pest attack she used judiciously chemical pesticides.

From the above two case studies, it can be concluded that ecological agricultural practices are better for our environment, but it may decrease cereal crop production. To keep environment healthy, as well as maintaining production, we are to stand in between ecological agriculture of Proshika and ICM of DAE. Motivational programmes from the concerned government and non-government organizations can improve this situation.

For strengthening both of these programmes, the following suggestions are provided:

- More nutritious non-chemical fertilizers should be introduced by the concerned authorities so that the farmers could use these instead of chemical fertilizers.

- The concerned authorities should stand in between ecological agriculture and ICM so that the yield might not fall, and on the other hand, the environment might be protected.

CHAPTER 5

CHARACTERISTICS PROFILE OF THE FARMERS

Certain attributes or characteristics form an integral part in the development of human behaviour. These include the individual's personal, economic, social and psychological characteristics. It can be postulated that these characteristics influence decision making relating to an actual behaviour in the individual's life. Conceptualization and measurement of these characteristics help in understanding and predicting the human behaviour within certain limits of probability. It may also be assumed that these characteristics play significant roles in the adoption behaviour of an individual. The purpose of this chapter is to describe the 25 selected characteristics of the respondent farmers as was indicated in the objectives of the study. Some of the salient features including measuring unit, possible range and observed range of these 25 selected characteristics of the farmers have been presented in Table 5.1.

Table 5.1 Measuring unit, possible range and observed range of the selected characteristics of the respondent farmers

Characteristics	Measuring unit	Possible Range	Observed Range
Personal			
Age	Years	Unknown	18-70
Education	Schooling years	Unknown	0-12
Family Size	Number	Unknown	2-11
Working family size	Score	Unknown	2-9
Economical			
Effective land possession	Hectare	Unknown	0.18-1.17
Cropping intensity	Score (Percent)	Unknown	130-267
Animal-poultry excreta availability	Score	Unknown	5-957
Annual family income	'000' Taka	Unknown	27-272
Commercialization	Score (Percent)	0-100	37.6-92.1
Credit need	Score (Percent)	0-100	0-100
Marketing opportunity	Score	0-16	2-13
Benefit obtained from ecological agriculture	Score	0-75	12-62
Social			
Cosmopoliteness	Score	0-32	4-25
Individual local contact	Score	0-12	2-11
NGO contact	Score	0-12	1-6
GO contact	Score	0-12	0-7
Group contact	Score	0-16	1-6
Mass contact	Score	0-28	1-10
Training exposure	Score	Unknown	1-20
Decision making ability	Score	6-18	7-17
Ecological agricultural knowledge	Score	0-24	8-23
Problem faced in ecological agriculture	Score	0-72	14-56
Psychological			

Attitude towards ecological agriculture	Score	0-48	27-44
Aspiration	Score	0-40	8-34
Risk orientation	Score	0-48	11-44

The 25 selected characteristics of the farmers have been described in 4 sections of this chapter. Procedure followed in measuring the characteristics have been described in Chapter 3. For describing the characteristics of the farmers, they were classified into suitable categories according to each of the characteristics. Category wise number and percentage distribution have been used to describe the characteristics (Table 5.2 to 5.5).

5.1 Personal Characteristics

A person may possess many personal characteristics. Four personal characteristics of the respondent farmers namely age, education, family size and working family size were selected for the present study. Categories, number and percent distribution of these four selected personal characteristics have been presented in Table 5.2 and discussed below:

Table 5.2 Distribution of the respondent farmers according to their personal characteristics (N=144)

Charac-teristics	Categories	Number	Percent	Mean	SD	CV
Age (years)	Young (upto 30)	31	22	38.31	9.38	24.48%
	Middle-aged (31 t0 50)	101	70			
	Old (above 50)	12	8			
		144	**100**			
Education (schooling years)	Illiterate (0)	15	10	5.58	3.82	68.46%
	Can sign only (0.5)	23	16			
	Primary (1 to 5)	33	23			
	Secondary (6 to 10)	68	47			
	Above secondary (11 to 12)	5	4			
		144	**100**			
Family size (number)	Small family (upto 4)	35	24	5.78	1.63	28.20%
	Medium family (5 to 7)	88	61			
	Large family (above 7)	21	15			
		144	100			
Working family size (scores)	Small working family (upto 3)	53	37	3.92	1.42	36.22%
	Medium working family (4 to 5)	66	46			
	Large working family (above 5)	25	17			
		144	**100**			

Age

Age of the respondent farmers was determined by the number of years from their birth to the time of interview. The age of the farmers ranged from 18 years to 70 years, the mean being 38.31 with standard deviation of 9.38 and co-efficient of variation 24.48%. The respondents of the study area were classified into three categories on the basis of their age (years) as young, middle-aged and old (Table 5.2).

Data contained in the Table 5.2 indicated that the majority (70 percent) of the farmers were middle-aged compared to 22 percent being young and 8 percent old. Findings indicated that a large proportion (78 percent) of the farmers were middle-aged to old. However, age of the respondent farmers was positively related with their adoption of ecological agricultural practices (r = 0.179, significant at 0.032 level).

Education

Schooling years of the farmers ranged from zero (0) to 12.0, the mean being 5.58 with standard deviation of 3.82 and co-efficient of variation 68.46%. The farmers were classified into five categories according to their level of education as illiterate, can sign only, primary education, secondary education and above secondary education (Table 5.2).

Data presented in the Table 5.2 expressed that the highest proportion (47 percent) of the farmers had secondary level education, while 23 percent and 4 percent had primary education and higher secondary level education respectively. Twenty six percent of the farmers could sign only or were illiterate. A great majority (74 percent) of the respondents had education from primary to above secondary level. These findings indicate that the respondents had relatively higher level of education than the national average adult (15+) literacy rate of population which is 50.3 percent (BBS, 2004). The possible reason was that the respondent farmers were guided by Proshika which might have some contribution for the higher rate of literacy. However, education of the respondent farmers was positively associated with their adoption of ecological agricultural practices (r = 0.181, significant at 0.030 level).

Family size

Family size of the farmers was found to range from 2 to 11 with mean, standard deviation and co-efficient of variation of 5.78, 1.63 and 28.20% respectively. According to family size of the farmers, they were classified into three categories as small family, medium family and large family (Table 5.2).

Data furnished in Table 5.2 indicated that the highest proportion (61 percent) of the farmers had medium family size compared to 24 percent small family and 15 percent large family. Data also indicated that average family size (5.78) of the farmers were higher than the national average of 4.9 (BBS, 2004). A great majority (76 percent) of the farmers of the study area had medium and large families. However, family size of the respondent farmers was not related with their adoption of ecological agricultural practices. But, family size and adoption of ecological agricultural practices are associated according to chi-square test.

Working family size

Working family size of the farmers was found to range from 2 to 9 with mean, standard deviation and co-efficient of variation of 3.92, 1.42 and 36.22% respectively. According to the working family size scores of the farmers, they were classified into three categories as small working family, medium working family and large working family (Table 5.2).

Data furnished in Table 5.2 indicate that the highest proportion (46 percent) of the respondent farmers had medium working family size compared to 37 percent having small working family size and 17 percent large working family size. Data also reveal that majority (63 percent) of the farmers had either medium or large working family size. Large working family could perform better than small working family in practicing ecological agriculture. However, working family size of the respondent farmers was positively related with their adoption of ecological agricultural practices ($r = 0.323$, significant at 0.000 level).

5.2 Economical Characteristics

An individual farmer may have many economical characteristics. Eight economical characteristics of the farmers namely effective land possession, cropping intensity, animal-poultry excreta availability, annual family income, commercialization, credit need, marketing opportunity, and benefit perceived from ecological agriculture, were selected for the present study. Categories, number and percent distribution of these 8 selected economical characteristics have been presented in Table 5.3 and discussed below:

Table 5.3 Distribution of the respondent farmers according to their economical characteristics (N=144)

Characteristics	Categories	Number	Percent	Mean	SD	CV
Effective land possession (hectares)	Marginal farmer (upto 0.2)	8	6	0.52	0.25	48.08%
	Small farmer (0.21 to 1.00)	130	90			
	Medium farmer (above 1.00)	6	4			
		144	**100**			
Cropping intensity (scores)	Upto national average (upto 185)	38	26	208.35	33.12	15.90%
	Above national average (above 185)	106	74			
		144	**100**			
Animal-poultry excreta Availability (scores)	Low (upto 275)	49	34	404.17	257.04	63.60%
	Medium (276 to 532)	58	40			
	High (above 532	37	26			
		144	**100**			
Annual family income (‘000’ taka)	Low (upto 60)	55	38	69.41	27.44	39.53%
	Medium (60.1 to 120)	85	59			
	High (above 120)	4	3			
		144	**100**			
Commercialization (scores)	Low (upto 50)	3	2	70.16	9.48	13.51%
	Medium (50.1 to 75)	91	63			
	High (above 75)	50	35			
		144	**100**			
Credit need (scores)	No credit need (0)	43	30	64.39	45.11	70.06%
	Low credit need (upto 33.3)	4	3			
	Medium credit need (33.4 to 66.7)	9	6			
	High credit need (above 66.7)	88	61			
		144	**100**			
Marketing opportunity (scores)	Low (upto 5)	63	44	5.89	2.83	48.05%
	Medium (6 to 10)	71	49			
	High (above 10)	10	7			
		144	**100**			

Benefit obtained from ecological agriculture (scores)	Low (upto 25) Medium (26 to 50) High (above 50)	13 107 24 **144**	9 74 17 **100**	41.49	10.23	24.65%

Effective land possession

Effective land possession of a respondent referred to his total area of land in terms of ownership and benefit obtained from the land. Detailed procedure of measurement has been mentioned in Chapter 3 of this dissertation. Effective land possession of the respondents were found to range from 0.18 hectare to 1.17 hectares with an average of 0.52 hectare, standard deviation of 0.25 and co-efficient of variation of 48.08%. Depending on the effective land possession, the farmers were classified into three categories such as: marginal farmers, small farmers and medium farmers (Table 5.3) in accordance with the instruction given by DAE (1999).

Data furnished in Table 5.3 indicated that the highest proportion (90 percent) of the respondents were small farmers, while 6 and 4 percent were marginal and medium farmers respectively on the basis of effective land possession. Nobody had large effective land possession. Thus, an overwhelming majority (96 percent) of the farmers belonged to the category of small to marginal effective land possession. However, effective land possession of the respondent farmers had no relationship with their adoption of ecological agricultural practices.

Cropping intensity

Procedure for measurement of cropping intensity of the respondent farmers is described in Chapter 3 of this dissertation. Cropping intensity of the respondents was found to range from 130% to 267% with an average of 208.35%, standard deviation of 33.12 and co-efficient of variation of 15.90%. Depending on the cropping intensity, the farmers were classified into two categories, viz. upto national average and above

national average, while national average cropping intensity comes to 185% (Table 5.3).

Data furnished in Table 5.3 indicated that the higher proportion (74 percent) of the farmers had cropping intensity above national average as compared to 26 percent having cropping intensity below or upto national average. The farmers were ecological farmers and ecological farming encourages the farmers to produce more types of crops in their field. These might be the reasons for higher cropping intensity of the farmers of the study area. However, cropping intensity of the respondent farmers was positively related with their adoption of ecological agricultural practices (r = 0.263, significant at 0.001 level).

Animal-poultry excreta availability

Animal-poultry excreta availability scores of the farmers were found to range from 5 to 957 with an average of 404.17, standard deviation of 257.04 and co-efficient of variation of 63.60%. Depending on the animal-poultry excreta availability, the farmers were classified into three categories as low (< Mean - 0.5 sd i.e. upto 275), medium (Mean $\pm$ 0.5 sd i.e. 276 to 532) and high (>Mean + 0.5 sd i.e. above 532) which is shown in Table 5.3.

Data furnished in Table 5.3 indicated that 34, 40 and 26 percent of the farmers had low, medium and high animal-poultry excreta availability. Thus, about three-fourth (74 percent) of the farmers had medium to low animal-poultry excreta availability. Animal-poultry excreta are the main source of organic manure for practicing ecological agriculture. However, animal-poultry excreta availability of the respondent farmers was positively related with their adoption of ecological agricultural practices (r = 0.692, significant at 0.000 level).

Annual family income

It was found that annual family income of the farmers ranged from Tk. 27 thousand to Tk. 272 thousand with mean, standard deviation and co-efficient of variation of 69.41,

27.44 and 39.53% respectively. On the basis of annual family income, the respondent farmers were classified into three categories, such as, low annual family income, medium annual family income and high annual family income (Table 5.3).

Data presented in Table 5.3 showed the distribution of the farmers on the basis of their annual family income. It indicated that the highest proportion (59 percent) of the farmers belonged to medium annual family income group, 38 percent belonged to low annual family income group and 3 percent high income group. However, annual family income of the respondent farmers had no significant relationship with their adoption of ecological agricultural practices.

Commercialization

Commercialization of the farmers was found to range from 37.6 to 92.1 score against the possible range of zero (0) to 100 score with mean, standard deviation and co-efficient of variation of 70.16, 9.48 and 13.51% respectively. On the basis of commercialization, the respondent farmers were classified into three categories as low commercialization, medium commercialization and high commercialization (Table 3.5).

Data presented in Table 5.3 show the distribution of the farmers on the basis of their commercialization. It indicated that highest proportion (63 percent) of the farmers belonged to medium commercialization group compared to 2 and 35 percent low and high commercialization group respectively. Thus, all most cent percent (98 percent) of the respondents had medium to high commercialization. The respondent farmers were ecological farmers and ecological farming encourages the farmers to produce more types of crops in their field. As a result the commercialization score of the respondents might be higher. However, commercialization of the respondent farmers was positively related to their adoption of ecological agricultural practices (r = 0.295, significant at 0.000 level).

Credit need

It was found that credit need of the farmers ranged from zero (0) to 100 score against the possible range of zero (0) to 100 score with mean, standard deviation and co-efficient of variation of 64.39, 45.11 and 70.06% respectively. On the basis of credit need, the respondent farmers were classified into four categories such as, no credit need, low credit need, medium credit need and high credit need (Table 5.3).

Data presented in Table 5.3 showed the distribution of the farmers on the basis of their credit need. It indicated that the highest proportion (61 percent) of the farmers belonged to high credit need group, while 30, 3 and 6 percent were no, low and medium credit need group respectively. Thus, two-third (67 percent) of the respondent had medium to high credit need and one-third (33 percent) had no to low credit need. However, credit need of the respondent farmers had negative relationship with their adoption of ecological agricultural practices (r = -0.294, significant at 0.000 level).

Marketing opportunity

Marketing opportunity score of the farmers was found to range from 2 to 13 against the possible range of Zero (0) to 16 with mean, standard deviation and co-efficient of variation of 5.89, 2.83 and 48.05% respectively. On the basis of marketing opportunity, the respondent farmers were classified into three categories such as, low marketing opportunity, medium marketing opportunity and high marketing opportunity (Table 5.3).

Data presented in Table 5.3 showed the distribution of the farmers on the basis of their marketing opportunity. It indicated that the highest proportion (49 percent) of the farmers belonged to medium marketing opportunity group, while 44 and 7 percent were low and high marketing opportunity group respectively. Thus, an overwhelming majority (93 percent) of the respondents had medium to low marketing opportunities. However, there existed no relationship between marketing opportunities and adoption of ecological agricultural practices of the respondent. But, according to chi-square

test, marketing opportunities and adoption of ecological agricultural practices were associated.

Benefits obtained from ecological agriculture

Benefits obtained from ecological agriculture score of the farmers was found to range from 12 to 62 against the possible range of Zero (0) to 75 with mean, standard deviation and co-efficient of variation of 41.49, 10.23 and 24.65% respectively. On the basis of benefits obtained from ecological agriculture, the respondent farmers were classified into three categories as low benefit obtained, medium benefit obtained and high benefit obtained from ecological agriculture (Table 5.3).

Data presented in Table 5.3 indicated that the highest proportion (74 percent) of the farmers belonged to medium benefits obtained from ecological agriculture, while 9 and 17 percent had low and high benefits obtained from ecological agriculture group respectively. Thus, majority (83 percent) of the farmers obtained low to medium benefits from ecological agriculture. However, benefit obtained from ecological agricultural practices of the respondent farmers was positively related with their adoption of ecological agricultural practices ($r = 0.776$, significant at 0.000 level).

5.3 Social Characteristics

An individual farmer may have many social characteristics. Ten social characteristics of the respondent farmers were selected for the present study. Categories, number and percent distribution of these 10 selected social characteristics have been presented in Table 5.4 and discussed below:

Cosmopoliteness

The range of the computed cosmopoliteness scores of the farmers was from 4 to 25 against the possible range of zero (0) to 32. The mean, standard deviation and co-efficient of variation were 11.05, 4.72 and 42.71% respectively. On the basis of the cosmopoliteness scores the farmers were grouped into three categories such as, low cosmopoliteness, mdium cosmopoliteness and high cosmopoliteness (Table 5.4).

Data furnished in Table 5.4 indicated that nearly half (47 percent) of the farmers had medium cosmopoliteness as compared to 50 percent having low cosmopoliteness and 3 percent high cosmopoliteness. Data also indicate that 97 percent of the farmers were under low to medium cosmopoliteness. However, cosmopoliteness of the respondent farmers was positively related to their adoption of ecological agricultural practices (r = 0.502, significant at 0.000 level).

Individual local contact

Individual local contact scores of the farmers of the study area ranged from 2 to 11, against the possible score of zero (0) to 12. The mean, standard deviation and co-efficient of variation were 5.18, 2.03 and 39.19% respectively. According to the farmers' individual local contact scores, they were classified into three categories as low contact, medium contact and high contact (Table 5.4).

Table 5.4 Distribution of the respondent farmers according to their social characteristics (N=144)

Characteristics	Categories	Number	Percent	Mean	SD	CV
Cosmopoliteness (scores)	Low (upto 10)	68	47	11.05	4.72	42.71%
	Medium (11 to 21)	72	50			
	High (above 21)	4	3			
		144	**100**			
Individual local contact (scores)	Low (upto 4)	59	41	5.18	2.03	39.19%
	Medium (5 to 8)	75	52			
	High (above 8)	10	7			
		144	**100**			
NGO contact (scores)	Very low (upto 2)	73	51	2.65	1.46	55.09%
	Low (3 to 4)	56	39			
	Medium (above 4)	15	10			
		144	**100**			
GO contact (scores)	Very low (upto 2)	93	65	2.06	1.41	68.45%
	Low (3 to 4)	41	28			
	Medium (above 4	10	7			
		144	**100**			
Group contact (scores)	Very low (upto 2)	129	89	1.51	1.16	76.82%
	Low (3 to 5)	8	6			
	Medium (above 5)	7	5			
		144	**100**			
Mass contact (scores)	Very low (upto 4)	64	44	4.84	1.87	38.63%
	Low (5 to 9)	72	50			
	Medium (above 9)	8	6			

		144	**100**			
Training exposure (scores)	Low (upto 4) Medium (5 to 8) High (above 8)	65 55 24	45 38 17	6.20	4.12	66.45%
		144	**100**			
Decision making ability (scores)	Low (upto 9) Medium (10 to 14) High (above 14)	48 78 18	33 54 13	11.57	2.36	20.40%
		144	**100**			
Ecological agricultural knowledge (scores)	Low (upto 8) Medium (9 to 16) High (above 16)	7 96 41	5 67 28	14.69	4.23	28.79%
		144	**100**			
Problems faced in ecological agriculture (scores)	Low (upto 24) Medium (25 to 48) High (above 48)	42 98 4	29 68 3	28.14	7.20	25.59%
		144	**100**			

Data presented in Table 5.4 indicated that majority (52 percent) of the farmers of the study area had the medium individual local contact, while 41 and 7 percent had low and high individual local contact respectively. The data also reveal that 93 percent of the respondent farmers had either medium or low individual local contact. Items of local contact include neighbour/friends/relatives, group leader and seed dealer. Their contact with neighbour was high and contact with group leader was moderate and contact with seed dealer was low. These were the reasons for the above findings. Though there was no relationship between individual local contact and adoption of ecological agricultural practices by the respondent farmers, but according to chi-square test, both the variables were significantly associated.

NGO contact

NGO (Non-government Organization) contact scores of the farmers of the study area ranged from 1 to 6, against the possible score of zero (0) to 12. The mean, standard deviation and co-efficient of variation were 2.65, 1.46 and 55.09% respectively. According to the farmers' NGO contact scores, they were classified into three categories as very low contact, low contact and medium contact (Table 5.4).

Data presented in Table 5.4 indicated that majority (51 percent) of the farmers of the study area had very low NGO contact, while 39 and 10 percent had low and medium

NGO contact respectively. Nobody had high NGO contact. The data also reveal that 90 percent of the respondent farmers had very low to low NGO contact. However, there was a positive relationship between NGO contact and adoption of ecological agricultural practices (r = 0.198, significant at 0.017 level).

GO Contact

GO (Government Organization) contact scores of the farmers of the study area ranged from 0 to 7, against the possible score of zero (0) to 12. The mean, standard deviation and co-efficient of variation were 2.06, 1.41 and 68.45% respectively. According to the farmers' GO contact scores, they were classified into three categories as very low contact, low contact and medium contact (Table 5.4).

Data presented in Table 5.4 indicated that majority (65 percent) of the farmers of the study area had very low GO contact, while 28 and 7 percent had low and medium GO contact respectively. Nobody had high GO contact. The data also reveal that 93 percent of the respondent farmers had very low to low GO contact. However, there existed a positive relationship between GO contact and adoption of ecological agricultural practices (r = 0.329, significant at 0.000 level).

Group contact

Group contact score of the farmers of the study area ranged from 1 to 6 against possible scores of zero (0) to 16. The mean, standard deviation and co-efficient of variation were 1.51, 1.16 and 76.82% respectively. Based on observed group contact scores, the respondent farmers were classified into three categories as very low contact, low contact and medium contact (Table 5.4).

Data presented in Table 5.4 showed the distribution of the respondent farmers on the basis of their group contact scores. Findings indicated that the highest proportion (89 percent) of the respondent farmers had very low group contact, while 6 and 5 percent had low and medium group contact respectively. The data also revealed that majority (95 percent) of the farmers had very low to low group contact. Nobody had high group contact. Though there was no relationship between group contact and adoption of

ecological agricultural practices of the respondent farmers, but according to chi-square test group contact and adoption were associated.

Mass contact

Mass contact scores of the respondents of the study area ranged from 1 to 10 against the possible score of zero (0) to 28. The mean, standard deviation and co-efficient of variation were 4.84, 1.87 and 38.63% respectively. On the basis of the computed mass contact scores, the respondents were classified into three categories as very low contact, low contact and medium contact (Table 5.4).

Data furnished in Table 5.4 revealed that half (50 percent) of the respondents had low mass contact while 44 and 6 percent had very low and medium mass contact. The data also revealed that an overwhelming majority (94 percent) of the farmers had very low to low mass contact. Nobody had high mass contact. However, mass contact of the respondent farmers was positively related to their adoption of ecological agricultural practices ($r = 0.294$, significant at 0.000 level).

Training exposure

Training exposure scores ranged from 1 to 20, the mean being 6.20, standard deviation 4.12 and co-efficient of variation 66.45%. Based on the training exposure scores, the farmers were classified into three categories as low training exposure (< mean - 0.5 sd i.e. upto 4), medium training exposure (mean $\pm$ 0.5 sd i.e. 5 to 8) and high training exposure (> mean + 0.5 sd i.e. above 8) which is shown in Table 5.4.

Table 5.4 showed the distribution of the farmers according to their training exposure. The data indicated that majority (45 percent) of the respondents had low training exposure, while 38 and 17 percent had medium and high training exposure respectively. The data also revealed that an overwhelming majority (83 percent) of the respondent farmers had low to medium training exposure. However, training exposure of the respondent farmers had a positive relationship with their adoption of ecological agricultural practices ($r = 0.587$, significant at 0.000 level).

Decision making ability

Decision making ability scores of the farmers ranged from 7 to 17 against the possible range of 6 to 18, the mean being 11.57, standard deviation of 2.36 and co-efficient of variation 20.40%. Based on the decision making ability scores, the farmers were classified into three categories as low decision making ability, medium decision making ability and high decision making ability (Table 5.4).

Table 5.4 indicated that majority (54 percent) of the respondents had medium decision making ability, while 33 and 13 percent had low and high decision making ability respectively. The data also revealed that an overwhelming majority (87 percent) of the respondent farmers had low to medium decision making ability. However, there was a positive relationship between decision making ability and adoption of ecological agricultural practices (r = 0.579, significant at 0.000 level).

Ecological agricultural knowledge

The procedure followed in computing ecological agricultural knowledge of the farmers has been described in Chapter 3. Ecological agricultural knowledge scores of the farmers of the study area ranged from 8 to 23 against the possible range of zero (0) to 24. The mean, standard deviation and co-efficient of variation were 14.69, 4.23 and 28.79% respectively. According to the ecological agricultural knowledge score, the farmers were classified into three categories as low knowledge, medium knowledge and high knowledge in ecological agriculture (Table 5.4).

Data contained in Table 5.4 indicated that two-third (67 percent) of the farmers had medium ecological agricultural knowledge, while 5 and 28 percent had low and high ecological agricultural knowledge respectively. The data again revealed that the overwhelming majority (72 percent) of the farmers had either low or medium ecological agricultural knowledge. However, there was a positive relationship between ecological agricultural knowledge and adoption of ecological agricultural practices (r = 0.782, significant at 0.000 level).

Problem faced in ecological agriculture

Problem faced in ecological agriculture score of the farmers was found to range from 14 to 56 against the possible range of Zero (0) to 72 with mean, standard deviation and co-efficient of variation of 28.14, 7.20 and 25.59% respectively. On the basis of problem faced in ecological agriculture, the respondent farmers were classified into three categories as low problem faced, medium problem faced and high problem faced in practicing ecological agriculture (Table 5.4).

Data presented in Table 5.4 indicated that highest proportion (68 percent) of the farmers faced medium problem in ecological agriculture compared to 29 and 3 percent having low and high problem faced in ecological agriculture. Thus, majority (71 percent) of the respondent faced medium to high problem in ecological agriculture. However, problem faced in ecological agriculture had a negative relationship with adoption of ecological agricultural practices of the farmers (r = -0.612, significant at 0.000 level).

5.4 Psychological Characteristics

An individual farmer may possess many psychological characteristics. Three psychological characteristics of the respondent farmers namely attitude towards ecological agriculture, aspiration, and risk orientation were selected for the present study. Categories, number and percent distribution of these three selected psychological characteristics have been presented in Table 5.5 and discussed below:

Table 5.5 Distribution of the respondent farmers according to their psychological characteristics (N=144)

Characteristics	Categories	Number	Percent	Mean	SD	CV
Attitude towards ecological agriculture (scores)	Low favourable (25 to 32)	51	35	34.63	4.36	12.59%
	Medium favourable (33 to 40)	79	55			
	High favourable (41 to 48)	14	10			
		144	**100**			
Aspiration (scores)	Low (upto 13)	50	35	15.88	4.79	30.16%
	Medium (14 to 26)	88	61			
	High (27 to 40)	6	4			
		144	**100**			
Risk orientation (scores)	Low (upto 16)	17	12	29.52	8.19	27.74%
	Medium (17 to 32)	62	43			
	High (33 to 48)	65	45			
		144	**100**			

Attitude towards ecological agriculture

The procedure followed in computing the respondent farmers' attitude towards ecological agriculture has been described in Chapter 3. The computed attitude towards ecological agriculture scores of the respondent farmers ranged form 27 to 44 against possible scores of zero (0) to 48. The mean, standard deviation and co-efficient of variation were 34.63, 4.36 and 12.59% respectively. There were 12 statements in attitude towards ecological agriculture scale. Some respondents have negative attitude towards some statements. But nobody had composite negative attitude towards ecological agriculture. On the basis of the computed attitude towards ecological agriculture scores, the farmers were classified into three categories as low favourable attitude, medium favourable attitude and high favourable attitude towards ecological agriculture (Table 5.5).

Data entered in the Table 5.5 indicated that the highest proportion (55 percent) of the farmer had medium favourable attitude towards ecological agriculture as compared to 35 and 10 percent having low and high favourable attitude towards ecological agriculture respectively. The data also revealed that the most (90 percent) of the respondent farmers had low to medium favourable attitude towards ecological agriculture. However, attitude towards ecological agriculture of the respondent farmers had a positive relationship with their adoption of ecological agricultural practices ($r = 0.764$, significant at 0.000 level).

Aspiration

The computed aspiration scores of the respondent farmers ranged from 8 to 34 against possible scores of zero (0) to 40. The mean, standard deviation and co-efficient of variation were 15.88, 4.79 and 30.16% respectively. Based on the aspiration scores, the farmers were classified into three categories as low aspiration, medium aspiration and high aspiration (Table 5.5).

Data presented in Table 5.5 indicated that the highest proportion (61 percent) of the respondents had medium level of aspiration as compared to 35 percent having low aspiration and 4 percent high aspiration. The data also reveal that the most (96

percent) of the farmers had low to medium aspiration. But, there was no significant relationship between aspiration and adoption of ecological agricultural practices.

Risk Orientation

The observed range of risk orientation score of the respondents was 11 to 44 against possible scores of zero (0) to 48 with the mean, standard deviation and co-efficient of variation of 29.52, 8.19 and 27.74% respectively. On the basis of the computed risk orientation scores, the farmers were classified into three categories as low risk orientation, medium risk orientation and high risk orientation (Table 5.5).

Data contained in the Table 5.5 indicated that the highest proportion (45 percent) of the respondent farmers had high risk orientation as compared to 12 and 43 percent having low and medium risk orientation. The data also reveal that more than half (55 percent) of the farmers had low to medium risk orientation. However, risk orientation had a positive relationship with adoption of ecological agricultural practices by the farmers (r = 0.700, significant at 0.000 level).

CHAPTER 6

CONTRIBUTION AND EFFECT OF SELECTED CHARACTERISTICS OF THE FARMERS TO/ON ADOPTION OF SELECTED ECOLOGICAL AGRICULTURAL PRACTICES

The purpose of this chapter is to examine the contribution and effect of selected characteristics of the farmers to/on their adoption of selected ecological agricultural practices. Adoption is a multivariate phenomenon involving interaction of many factors. Past studies on adoption have brought to light a good number of characteristics of an individual that affect the adoption behaviour. For this study 25 characteristics of the farmers were selected as the independent variables.

Adoption of ecological agricultural practices (Y) was the dependent variable of this study. The procedure followed in measuring the dependent and independent variables have already been discussed in Chapter 3. Research and null hypotheses have been stated for testing the contribution/effect of the selected characteristics of the farmers to/on their adoption of selected ecological agricultural practices (Chapter 3). Pearson product moment correlation test was initially run to test the relationships between all the selected characteristics of the farmers and their adoption of selected ecological agricultural practices.

Correlation analysis showed that out of 25 characteristics of the farmers, 18 had significant relationship with their adoption of selected ecological agricultural practices. The characteristics, or in other words, independent variables, viz., age, education, working family size, cropping intensity, animal-poultry excreta availability, commercialization, benefit obtained from ecological agriculture, cosmopoliteness, NGO contact, GO contact, mass contact, training exposure, decision making ability, ecological agricultural knowledge, attitude towards ecological agriculture, and risk orientation of the farmers had significant positive relationship with their adoption of selected ecological agricultural practices. But, the variables, viz., credit need and problem faced in ecological agriculture of the farmers had significant negative relationship with their adoption of selected ecological agricultural practices.

Results of Pearson Product Moment correlation test of selected characteristics of the farmers with their adoption of selected ecological agricultural practices have been shown in Appendix-XIV.

6.1 Contribution of the Selected Characteristics of the Farmers to Their Adoption of Selected Ecological Agricultural Practices

The independent variables in isolation would not give a comprehensive picture of the contribution of independent variables to the adoption of selected ecological agricultural practices (Y). The different characteristics of the respondents may interact together to make a combined contribution to the adoption of selected ecological agricultural practices. Keeping this fact in view linear multiple regression analysis was used to assess the contribution of the independent variables to adoption of selected ecological agricultural practices.

Full model multiple regression analyses were initially run by involving the following sets of independent variables with adoption of ecological agricultural practices (Y) as the dependent variable.

Set-I: **All the selected 25 independent variables i.e. age (X_1), education (X_2), family size (X_3), working family size (X_4), effective land possession (X_5), cropping intensity (X_6), animal-poultry excreta availability (X_7), annual family income (X_8), commercialization (X_9), credit need (X_{10}), marketing opportunities (X_{11}), benefit obtained from ecological agriculture (X_{12}), cosmopoliteness (X_{13}), individual local contact (X_{14}), NGO contact (X_{15}), GO contact (X_{16}), group contact (X_{17}), mass contact (X_{18}), training exposure (X_{19}), decision making ability (X_{20}), ecological agricultural knowledge (X_{21}), problem faced in ecological agriculture (X_{22}), attitude towards ecological agriculture (X_{23}), aspiration (X_{24}), and risk orientation (X_{25})**

Set-II: **Significant 18 variables by Pearson product moment correlation i.e. age (X_1), education (X_2), working family size (X_4), cropping intensity (X_6), animal-poultry excreta availability (X_7), commercialization (X_9), credit need (X_{10}), benefit obtained from ecological agriculture (X_{12}), cosmopoliteness (X_{13}), NGO contact (X_{15}), GO contact (X_{16}), mass contact (X_{18}), training exposure (X_{19}), decision making ability (X_{20}), ecological agricultural knowledge (X_{21}), problem faced in ecological agriculture (X_{22}), attitude towards ecological agriculture (X_{23}), and risk orientation (X_{25})**

Set-III: **Only selected 4 personal variables i.e. age (X_1), education (X_2), family size (X_3), and working family size (X_4)**

Set-IV: **Only selected 8 economical variables i.e. effective land possession (X_5), cropping intensity (X_6), animal-poultry excreta availability (X_7), annual family income (X_8), commercialization (X_9), credit need (X_{10}), marketing opportunities (X_{11}), and benefit obtained from ecological agriculture (X_{12})**

Set-V: **Only selected 10 social variables i.e. cosmopoliteness (X_{13}), individual local contact (X_{14}), NGO contact (X_{15}), GO contact (X_{16}), group contact (X_{17}), mass contact (X_{18}), training exposure (X_{19}), decision making ability (X_{20}), ecological agricultural knowledge (X_{21}) and problem faced in ecological agriculture (X_{22})**

Set-VI: **Only selected 3 psychological variables i.e. attitude towards ecological agriculture (X_{23}), aspiration (X_{24}), and risk orientation (X_{25})**

Set-VII: By involving all the significant variables after running set-I to set-VI

It was observed that the full model regression results of almost all the sets were misleading due to the existence of interrelationships among the independent variables. It was evident from correlation matrix showing the interrelationships among the

independent variables and existence of contradiction in the sign of correlation co-efficients and regression co-efficients.

Droper and Smith (1981) suggested running stepwise multiple regression analysis to insert variables in turn until the regression equation is satisfactory. Therefore, in order to avoid the misleading results due to the problem of multi-collinearity and to determine the best explanatory variables, the method of step-wise multiple regression was employed by involving the above mentioned 7 sets of independent variables with the adoption of selected ecological agricultural practices. The objective of the step wise multiple regression models were to find out the contribution of the variables, which were significant only. Results of these 7 sets of step wise multiple regression analysis in the form of table or equation have been discussed below:

Set-I

All the selected 25 independent variables of this study were fitted together in this set of step wise multiple regression with adoption of ecological agricultural practices as the dependent variable. Table 6.1 revealed the summarized results of step-wise multiple regression analysis of the farmers' adoption of selected ecological agricultural practices with their 25 independent variables. It was observed that out of 25 independent variables only 10 variables namely animal-poultry excreta availability (X_7), annual family income (X_8), commercialization (X_9), benefit obtained from ecological agriculture (X_{12}), individual local contact (X_{14}), NGO contact (X_{15}), training exposure (X_{19}), ecological agricultural knowledge (X_{21}), attitude towards ecological agriculture (X_{23}), and risk orientation (X_{25}) were entered into regression equation.

Table 6.1 Summary of stepwise multiple regression analysis showing the contribution of all the 25 independent variables to the adoption of selected ecological agricultural practices

Variables entered	Standardized Partial 'b' coefficient	Value of 't' (with probability level)	Adjusted R^2	Increase in R^2	Variation explained in percent
Ecological agricultural knowledge (X_{21})	0.263	4.618 (0.000)	0.609	0.609	60.9
Benefit obtained from ecological agriculture (X_{12})	0.198	3.240 (0.002)	0.718	0.109	10.9
Attitude towards ecological agriculture (X_{23})	0.169	2.844 (0.005)	0.764	0.046	4.6
Individual local contact (X_{14})	- 0.271	-5.261 (0.000)	0.792	0.028	2.8
Training exposure (X_{19})	0.156	3.362 (0.001)	0.802	0.010	1.0
NGO contact (X_{15})	0.120	2.179 (0.031)	0.809	0.007	0.7
Annual family income (X_8)	- 0.178	-4.022 (0.000)	0.815	0.006	0.6
Animal-poultry excreta availability (X_7)	0.170	3.048 (0.003)	0.823	0.008	0.8
Commercialization (X_9)	0.128	2.774 (0.006)	0.831	0.008	0.8
Risk orientation (X_{25})	0.106	2.022 (0.045)	0.835	0.004	0.4
		Total		**0.835**	**83.5**

Multiple R = 0.920
R-square = 0.846
Adjusted R - square = 0.835
F-ratio = 73.148 at 0.000 level of significance

The remaining variables i.e. age (X_1), education (X_2), family size (X_3), working family size(X_4), effective land possession (X_5), cropping intensity (X_6), credit need (X_{10}), marketing opportunities (X_{11}), cosmopoliteness (X_{13}), GO contact (X_{16}), group contact (X_{17}), mass contact (X_{18}), decision making ability (X_{20}), problem faced in ecological agriculture (X_{22}), and aspiration (X_{24}) were not entered into the regression equation.

Data presented in Table 6.1 indicated that the multiple R, R^2 and adjusted R^2 in the step-wise multiple regression analysis were 0.920, 0.846 and 0.835 respectively, and the corresponding F-ratio of 73.148 was significant at 0.000 level. The regression equation so obtained is presented below:

$$Y = 106.901 + 0.263X_{21} + 0.198X_{12} + 0.169X_{23} - 0.271X_{14} + 0.156X_{19} + 0.120X_{15} - 0.178X_8 + 0.170X_7 + 0.128X_9 + 0.106X_{25}$$

Adjusted $R^2 = 0.835$
F-ratio = 73.148
Constant = 106.901

This indicated that the whole model of 25 variables explained 83.5 percent of the total variation in adoption of selected ecological agricultural practices of the respondents. But since the standardized regression coefficients (Beta weight) of 10 variables

formed the equation and were significant, it might be assumed that whatever contribution was there, it was due to these 10 variables.

Set-II

Eighteen independent variables were fitted together in this set of step-wise multiple regression with adoption of selected ecological agricultural practices as the dependent variable. It was observed that out of 18 independent variables only 3 variables namely benefit obtained from ecological agriculture (X_{12}), ecological agricultural knowledge (X_{21}) and attitude towards ecological agriculture (X_{23}) were entered into regression equation. The regression equation so obtained is presented below:

$Y = 67.233 + 0.290X_{21} + 0.381X_{12} + 0.322X_{23}$ Adjusted R^2 = 0.764

F-ratio = 155.292
Constant = 67.233

This indicated that the whole model of 18 variables explained 76.4 percent of the total variation in adoption of ecological agricultural practices of the farmers. But since the standardized regression coefficients of 3 variables formed the equation and were significant, it might be assumed that whatever contribution was there, it was due to these 3 variables.

Set-III

Only selected 4 personal variables i.e. age (X_1), education (X_2), family size (X_3), and working family size (X_4) under this set were fitted together into step-wise multiple regression as the independent variables with adoption of ecological agricultural practices (Y) as the dependent variable. It was observed that out of 4 independent variables 3 variables namely education (X_2), family size (X_3) and working family size (X_4) were entered into the regression equation. The regression equation so obtained is presented below:

$Y = 460.461 + 0.746X_4 - 0.531X_3 + 0.154X_2$ Adjusted R^2=0.204

F-ratio = 13.192
Constant = 460.461

This indicated that the whole model of 4 independent variables explained 20.4 percent of the total variation in adoption of ecological agricultural practices of the farmers. But since the standardized regression coefficient of 3 variables formed the equation and were significant, it might be assumed that whatever contribution was there, it was due to these 3 variables.

Set-IV

Only selected 8 economical variables were fitted together as the independent variables in this Set-IV of step-wise multiple regression with adoption of ecological agricultural practices (Y) as the dependent variable. It was observed that out of 8 independent variables only 4 variables namely animal-poultry excreta availability (X_7), annual family income (X_8), commercialization (X_9), and benefit obtained from ecological agriculture (X_{12}) were entered into the regression equation. The regression equation so obtained is presented below:

$Y = 100.486 + 0.498X_{12} + 0.371X_7 - 0.241X_8 + 0.148X_9$ Adjusted R^2=0.678

F-ratio = 176.31
Constant = 100.486

This indicated that the whole model of 8 independent variables explained 67.8 percent of the total variation in adoption of ecological agricultural practices of the farmers. But since the standardized regression coefficient of 4 variables formed the equation and were significant, it might be assumed that whatever contribution was there, it was due to these 4 variables.

Set-V

Only selected 10 social variables under Set-V were fitted together in step-wise multiple regression as the independent variables with adoption of ecological agricultural practices (Y) as the dependent variable. It was observed that out of 10 independent variables only 5 variables namely individual local contact (X_{14}), NGO contact (X_{15}), training exposure (X_{19}), decision making ability (X_{20}) and ecological agricultural knowledge (X_{21}) were entered into regression equation. The regression equation so obtained is presented below:

$$Y = 155.974 + 0.516X_{21} + 0.293X_{19} - 0.345X_{14} + 0.216X_{20} + 0.144X_{15}$$

Adjusted R^2=0.735
F-ratio = 80.272
Constant = 155.974

This indicated that the whole model of 10 independent variables explained 73.5 percent of the total variation in adoption of ecological agricultural practices of the farmers. But since the standardized regression coefficient of 5 variables formed the equation and were significant, it might be assumed that whatever contribution was there, it was due to these 5 variables.

Set-VI

Only selected 3 psychological variables under Set-VI i.e. attitude towards ecological agriculture (X_{23}), aspiration (X_{24}) and risk orientation (X_{25}) were fitted together in step-wise multiple regression as independent variables with adoption of ecological agricultural practices (Y) as the dependent variable. It was observed that out of 3 independent variables, 2 variables, namely, attitude towards ecological agriculture (X_{23}) and risk orientation (X_{25}) were entered into the regression equation which is presented below:

$$Y = 169.704 + 0.535X_{23} + 0.352X_{25}$$

Adjusted R^2=0.651
F-ratio = 134.144
Constant = 169.704

This indicated that the whole model of 3 variables explained 65.1 percent of the total variation in adoption of ecological agricultural practices of the farmers. But since the

standardized regression coefficient of 2 variables formed the equation and were significant, it might be assumed that whatever contribution was there, it was due to these 2 variables.

Set-VII (Final model)

After running above six sets of stepwise multiple regression analysis, it was found that 14 individual variables, namely education (X_2), family size (X_3), working family size (X_4), animal-poultry excreta availability (X_7), annual family income (X_8), commercialization (X_9), benefit obtained from ecological agriculture (X_{12}), individual local contact (X_{14}), NGO contact (X_{15}), training exposure (X_{19}), decision making ability (X_{20}), ecological agricultural knowledge (X_{21}), attitude towards ecological agriculture (X_{23}), and risk orientation (X_{25}) were significant in either one or more sets. Attempt has been made to run stepwise multiple regression analysis by these 14 independent variables with adoption of selected ecological agricultural practices (Y) as the dependent variable. Table 6.2 revealed the summarized results of step-wise multiple regression analysis of the farmers' adoption of selected ecological agricultural practices with these 14 independent variables. It was observed that out of 14 independent variables only 10 variables, namely, animal-poultry excreta availability (X_7), annual family income (X_8), commercialization (X_9), benefit obtained from ecological agriculture (X_{12}), individual local contact (X_{14}), NGO contact (X_{15}), training exposure (X_{19}), ecological agricultural knowledge (X_{21}), attitude towards ecological agriculture (X_{23}), and risk orientation (X_{25}) were entered into regression equation. It was also found that result of this set of stepwise multiple regression analysis was exactly same as the result of set 1 (Table 6.1 and Table 6.2).

Data presented in Table 6.2 indicated that the multiple R, R^2 and adjusted R^2 in the step-wise multiple regression analysis were 0.920, 0.846 and 0.835 respectively, and the corresponding F-ratio of 73.148 was significant at 0.000 level. The regression equation so obtained is presented below:

$$Y = 106.901 + 0.263X_{21} + 0.198X_{12} + 0.169X_{23} - 0.271X_{14} + 0.156X_{19} + 0.120X_{15} - 0.178X_{8} + 0.170X_{7} + 0.128X_{9} + 0.106X_{25}$$

Adjusted $R^2 = 0.835$
F-ratio = 73.148
Constant = 106.901

Table 6.2 Summary of stepwise multiple regression analysis showing the contribution of all the significant variables after running Set-I to Set-VI of stepwise multiple regression analysis to the adoption of selected ecological agricultural practices

Variables entered	Standardized partial 'b' coefficient	Value of 't' (with probability level)	Adjusted R^2	Increase in R^2	Variation explained in percent
Ecological agricultural knowledge (X_{21})	0.263	4.618 (0.000)	0.609	0.609	60.9
Benefit obtained from ecological agriculture (X_{12})	0.198	3.240 (0.002)	0.718	0.109	10.9
Attitude towards ecological agriculture (X_{23})	0.169	2.844 (0.005)	0.764	0.046	4.6
Individual local contact (X_{14})	- 0.271	-5.261 (0.000)	0.792	0.028	2.8
Training exposure (X_{19})	0.156	3.362 (0.001)	0.802	0.010	1.0
NGO contact (X_{15})	0.120	2.179 (0.031)	0.809	0.007	0.7
Annual family income (X_8)	- 0.178	-4.022 (0.000)	0.815	0.006	0.6
Animal-poultry excreta availability (X_7)	0.170	3.048 (0.003)	0.823	0.008	0.8
Commercialization (X_9)	0.128	2.774 (0.006)	0.831	0.008	0.8
Risk orientation (X_{25})	0.106	2.022 (0.045)	0.835	0.004	0.4
		Total		**0.835**	**83.5**

Multiple R = 0.920
R-square = 0.846
Adjusted R - square = 0.835
F-ratio = 73.148 at 0.000 level of significance

This indicated that the whole model of 14 independent variables explained 83.5 percent of the total variation in adoption of ecological agricultural practices of the farmers. But since the standardized regression coefficient of 10 variables formed the equation and were significant, it might be assumed that whatever contribution was there, it was due to these 10 variables.

Results of stepwise multiple regression analysis of this set again indicated that the ecological agricultural knowledge (X_{21}) of the farmers was by far the most important characteristic which strongly and positively influenced their adoption of selected ecological agricultural practices. Benefit obtained from ecological agriculture (X_{12}), and attitude towards ecological agriculture (X_{23}) also had remarkable positive

influence upon adoption of selected ecological agricultural practices by the farmers. Training exposure (X_{19}), NGO contact (X_{15}), animal-poultry excreta availability (X_7), commercialization (X_9), and risk orientation (X_{25}) had somewhat positive influence upon the adoption of ecological agricultural practices by the farmers. Individual local contact (X_{14}) and annual family income (X_8) had somewhat negative influence upon the adoption of ecological agricultural practices by the farmers. Since the rest 4 variables or characteristics of the farmers did not enter into the regression model, it was inferred that these 4 characteristics either had multi-collinearity problem or had minimum contribution to the total explained variation of 83.5 percent.

Analysis of data presented in different Tables (Table 6.1 and Table 6.2) and regression equations indicated that in different combinations, standardized partial regression co-efficient of 14 independent variables were significant out of 25 independent variables with adoption of selected ecological agricultural practices as the dependent variable. It was observed that regression co-efficient between some of these 14 independent variables and adoption of selected ecological agricultural practices as dependent variable had different probability levels (0.000 to 0.045) in different sets. It could logically happen due to the existence of interrelationship among the different independent variables. Similar observations were experienced by different researchers like Supe and Singh (1972), Pathak and Mazumdar (1978), Pathak (1981), Hossain (1987), and Karim and Mahboob (1992). Result of set-I and Set-VII was exactly same and the result of set-VII was treated as the final model which may otherwise be considered as the best explanatory model.

On the basis of set-VII of stepwise regression analysis, contributions of significant 10 independent variables to adoption of selected ecological agricultural practices as the dependent variable are presented below in order of importance.

Ecological agricultural knowledge (X_{21})

It was found from correlation matrix (Appendix-XIV) that farmers having higher ecological agricultural knowledge tended to be characterized by older age, larger family size, larger working family size, higher cropping intensity, higher animal-poultry excreta availability, higher commercialization, lower credit need, higher benefit obtained from ecological agriculture, higher cosmopoliteness, higher NGO contact, higher GO contact, higher mass contact, higher training exposure, higher decision making ability, lower problem faced in ecological agriculture, more favourable attitude towards ecological agriculture and higher risk orientation.

The co-efficient of correlation also showed significant positive relationship between ecological agricultural knowledge (X_{21}) of the respondents and their adoption of selected ecological agricultural practices (Appendix-XIV).

Step-wise multiple regression analysis (Set-VII) indicated that ecological agricultural knowledge of the farmers had strongly significant and positive influence on their adoption of selected ecological agricultural practices. Ecological agricultural knowledge was by far found to be the most important positive contributor to the adoption of selected ecological agricultural practices.

Knowledgeable person could understand the merits and demerits of anything easily in a short time. By the motivational programme of Proshika (NGO), the farmers could improve their ecological agricultural knowledge. Therefore, farmers having high ecological agricultural knowledge could easily adopt ecological agricultural practices. This might be the reason for ecological agricultural knowledge having the positive influence on adoption of ecological agricultural practices. This was supported by the studies of Masram (1999), Asaduzzaman (2002), Islam (2003), Rabbany (2003) and Hamidi (2004).

Benefit obtained from ecological agriculture (X_{12})

Correlation matrix (Appendix-XIV) revealed that farmers who obtained more benefits from ecological agricultural practices tended to be characterized by

older age, large family size, large working family size, larger effective land possession, higher cropping intensity, higher animal-poultry excreta availability, higher commercialization, lower credit need, higher cosmopoliteness, higher training exposure, higher decision making ability, more ecological agricultural knowledge, lesser problem faced in ecological agriculture, more favourable attitude towards ecological agriculture and higher risk orientation. However, there existed a positive relationship between benefit obtained from ecological agriculture as perceived by the farmers and their adoption of ecological agricultural practices (Appendix-XIV).

Step wise multiple regression analysis (Set-VII) indicated that benefit obtained from ecological agricultural practices by the farmers had a strongly significant and positive influence on their adoption of selected ecological agricultural practices and it was found to be the second important contributor.

It is quite logical that the farmers who perceived more benefit from ecological agricultural practices would like to adopt the same in a larger scale. This might be the reason for the existence of positive contribution to adoption of selected ecological agricultural practices.

Attitude towards ecological agriculture (X_{23})

Correlation matrix (Appendix-XIV) revealed that farmers having highly favourable attitude towards ecological agriculture were characterized by older age, more education, larger working family size, larger effective land possession, higher cropping intensity, higher animal-poultry excreta availability, higher commercialization, lower credit need, higher benefit obtained from ecological agriculture, higher cosmopoliteness, higher individual local contact, higher NGO contact, higher GO contact, higher mass contact, more training exposure, higher decision making ability, more ecological agricultural knowledge, lesser problem faced in ecological agriculture, more aspiration and higher risk orientation. However, correlation analysis indicated a positive relationship between farmers'

attitude towards ecological agriculture and their adoption of ecological agricultural practices (Appendix-XIV).

Step-wise multiple regression analysis (Set-VII and Table 6.2) indicated that attitude towards ecological agriculture of the respondents had remarkable significant and positive influence on their adoption of selected ecological agricultural practices and it was found to be the third important contributor.

It is quite logical that the farmers having more favourable attitude towards ecological agriculture would like to adopt the same in a larger scale. This might be the reason for attitude towards ecological agriculture having the positive contribution to adoption of ecological agricultural practices. Islam (1996) found that attitude towards the use of indigenous technical knowledge (ITK) had significant positive relationship with use of ITK and considerable contribution to use of ITK. Nuruzzaman (2000) and Hamidi (2004) also found positive significant relationship between attitude towards integrated pest management (IPM) and adoption of the same.

Individual local contact (X_{14})

Pearson product moment correlation co-efficient (Appendix-XIV) revealed that the farmers having more individual local contact were characterized by larger effective land possession, more annual family income, higher commercialization, higher cosmopoliteness, higher NGO contact, higher GO contact, higher group contact, higher training exposure, more decision making ability, more favourable attitude towards ecological agricultural practices and more aspiration.

Step-wise multiple regression analysis (Set-VII) indicated that individual local contact of the respondents had significant and negative influence on their adoption of selected ecological agricultural practices and it was found to be the fourth important contributor. Actually mass farmers of the study area as well as Bangladesh did not adopt ecological agricultural practices. General farmers thought that high agricultural production was not possible without use of

chemical fertilizers and chemical pesticides. They sometimes made criticism to the ecological agricultural farmers. Again chemical fertilizer and pesticide dealers always made criticism to the ecological farmers. These neighbouring farmers and chemical fertilizer/pesticide dealers are the main sources of local individual contact. Therefore, the farmers having greater contact to the local individual sources, obviously had lower adoption of ecological agricultural practices. This might be the reason for individual local contact having the negative influence on adoption of ecological agricultural practices. Islam (2002) did not find any significant relationship between extension contact and adoption of ecological agricultural practices. Hamidi (2004) found a significant relationship between the individual extension contact of the farmers and their adoption of IPM practices in rice cultivation.

Training exposure (X_{19})

Correlation matrix (Appendix-XIV) revealed that farmers having more training exposure were characterized by more education, larger working family size, higher cropping intensity, higher animal-poultry excreta availability, higher annual family income, higher commercialization, higher benefit obtained from ecological agriculture, higher cosmopoliteness, higher individual local contact, higher NGO contact, higher GO contact, higher mass contact, higher decision making ability, more ecological agricultural knowledge, lesser problem faced in ecological agriculture, more favourable attitude towards ecological agriculture, more aspiration and higher risk orientation. However, the co-efficient of correlation showed significant positive relationship between farmers' training exposure and their adoption of ecological agricultural practices (Appendix-XIV).

Step-wise multiple regression analysis indicated that training exposure of the respondents had significant and positive influence on their adoption of selected ecological agricultural practices and it was found to be the fifth important contributor.

Training makes a man efficient and suitable to perform his job properly. Some NGOs of Bangladesh like Proshika were providing various types of training on ecological agricultural practices in the present study area including other areas of Bangladesh to their target people. The farmers of the present study were the group members of Proshika. The farmers who received more training on this matter obviously had higher adoption of ecological agricultural practices. This might be the reason for training exposure having the positive influence on adoption of ecological agricultural practices. Islam (2002) did not find any significant relationship between training exposure and adoption of ecological agricultural practices. But Hamidi (2004) found a significant positive relationship between training experience of the farmers and the adoption of IPM practices in rice cultivation. Again Asaduzzaman (2002) found a significant relationship between training exposure of the farmers and their adoption of selected homestead agricultural technologies.

NGO contact (X_{15})

Correlation matrix (Appendix-XIV) revealed that farmers having more NGO contact were characterized by larger effective land possession, higher animal-poultry excreta availability, higher annual family income, higher commercialization, higher benefit obtained from ecological agriculture, higher cosmopoliteness, higher individual local contact, higher GO contact, higher group contact, higher mass contact, higher training exposure, higher decision making ability, more ecological agricultural knowledge, lesser problem faced in ecological agriculture, more favourable attitude towards ecological agriculture, higher aspiration and more risk orientation.

Step-wise multiple regression analysis indicated that NGO contact of the farmers was an important contributor, and had significant and positive influence on their adoption of selected ecological agricultural practices. The co-efficient of

correlation also showed significant positive relationship between the concerned variables (Appendix-XIV).

Some NGOs of Bangladesh like Proshika were promoting ecological agricultural practices in the present study area including other areas of Bangladesh. The farmers of the present study were the group members of Proshika. The farmers having more contact with this NGO obviously had higher adoption of ecological agricultural practices. This might be the reason for NGO contact having the positive influence on adoption of ecological agricultural practices. Islam (2002) did not find any significant relationship between extension contact and adoption of ecological agricultural practices. Hamidi (2004) found a significant relationship between the communication exposure of the farmers and their adoption of IPM practices in rice cultivation.

Annual family income (X_8)

Pearson product moment correlation co-efficient (Appendix-XIV) revealed that farmers having higher annual family income tended to be characterized by larger working family size, larger effective land possession, higher animal-poultry excreta availability, higher commercialization, higher cosmopoliteness, higher individual local contact, more NGO contact, more GO contact, more training exposure and lesser problem faced in ecological agriculture.

Step-wise multiple regression analysis indicated that annual family income of the respondents was an important contributor and had significant but negative influence on their adoption of selected ecological agricultural practices.

Actually farmers having more family income had the capacity to buy high cost chemical inputs for their crop production. As they had large land size, they thought that collection and use of inputs for ecological agriculture were complex and burden to them. This might be the reason for annual family income having the negative influence on adoption of ecological agricultural practices. Islam (1996) also found that annual income having significant negative relationship with the use of indigenous technical knowledge and having considerable

contribution to use of the same. Faruque (2002) and Sardar (2002) found no relationship of family income with adoption of indigenous technical knowledge and that of integrated pest management. On the other hand some researchers like Islam (2002), Sheheli (2003), Aurangozeb (2002), Ahmed (2002), Rahman (2003), Islam (2003), Rabbany (2003) and Hamidi (2004) found significant positive relationship between the concerned variables.

Animal-poultry excreta availability (X_7)

According to correlation matrix (Appendix-XIV) farmers having available animal-poultry excreta tended to be characterized by older age, larger working family size, larger effective land possession, higher cropping intensity, more annual income, higher commercialization, lower credit need, higher benefit obtained from ecological agriculture, higher cosmopoliteness, more NGO contact, more GO contact, higher mass contact, more training exposure, higher decision making ability, more ecological agricultural knowledge, lesser problem faced in ecological agriculture, more favourable attitude towards ecological agriculture and more risk orientation.

Step-wise multiple regression analysis indicated that animal-poultry excreta availability of the farmers was an important contributor and had significant and positive influence on their adoption of selected ecological agricultural practices. The co-efficient of correlation value between the concerned variables was also significant.

Animal-poultry excreta were the main input sources of ecological agricultural practices. Farmers having much animal-poultry excreta could easily use these excreta in their agricultural field. This might be the reason for animal-poultry excreta having the positive influence on adoption of ecological agricultural practices. Islam (2003) found that cattle rearing had significant positive relationship with composite adoption of organic manures and had significant contribution to the same. Islam (2003) again found that poultry rearing had the significant positive relationship with composite adoption of organic manures.

Commercialization (X_9)

It was found from the correlation results (Appendix-XIV) that farmers having higher commercialization tended to be characterized by more education, larger effective land possession, higher animal-poultry excreta availability, more annual family income, higher benefit obtained from ecological agriculture, higher cosmopoliteness, more individual local contact, more NGO contact, more GO contact, more mass contact, more training exposure, higher decision making ability, more ecological agricultural knowledge, lesser problem faced in ecological agriculture, more favourable attitude towards ecological agriculture, higher aspiration and more risk orientation.

Step-wise multiple regression analysis indicated that commercialization of the farmers was an important contributor and had significant and positive influence on their adoption of selected ecological agricultural practices. The co-efficient of correlation value also supported this relationship between the concerned variables (Appendix-XIV).

The farmers producing various types of crops could make their commercialization score high and ecological farmers could produce these crops easily. This might be the reason for commercialization having the positive contribution to adoption of ecological agricultural practices.

Risk orientation (X_{25})

Correlation matrix (Appendix-XIV) revealed that farmers having high risk orientation tended to be characterized by larger working family size, higher cropping intensity, higher animal-poultry excreta availability, higher commercialization, lower credit need, higher benefit obtained from ecological agriculture, higher cosmopoliteness, higher NGO contact, higher GO contact, higher mass contact, more training exposure, higher decision making ability, more ecological agricultural knowledge, lesser problem faced in ecological agriculture and more favourable attitude towards ecological agriculture.

Step-wise multiple regression analysis indicated that risk orientation was the 10th important contributor among the 10 significant characteristics of the farmers and had significant and positive influence on their adoption of selected ecological agricultural practices. The co-efficient of correlation value also supported this relationship between the concerned variables (Appendix-XIV).

Some farmers thought that there were some risks in ecological agriculture. It is quite logical that the farmers having more orientation towards risk could adopt ecological agriculture in a larger scale. This might be the reason for risk orientation having the positive contribution to adoption of ecological agricultural practices. Hamidi (2004) found positive significant relationship between risk orientation and adoption of integrated pest management practices.

6.2 Direct and Indirect Effects of the Selected Characteristics of the Farmers

In the present study Pearson product moment correlation test, full model linear multiple regression and stepwise multiple regression were conducted. It is not possible to find out the direct effects and indirect effects separately by these tests. But, in path analysis, it is possible to get direct effects and indirect effects separately.

Path coefficient is simply a standardized partial regression coefficient and as such measures the direct influence of one variable upon another and permits the separation of the correlation coefficient into components of direct and indirect effects (Dewey and Lu, 1959). This allows the direct effect of an independent variable and its indirect effect through other variables on the dependent variable (Sasmal and Chakrabarty, 1978).

Path coefficient analysis was employed in order to obtain clear understanding of the direct and indirect effects of selected independent variables. Path analysis was done involving the significant variables of final model of step-wise multiple regression analysis (set-VII).

Path coefficients showing the direct and indirect effects of significant 10 independent variables of final model (set-VII) of step-wise multiple regression analysis on the farmers' adoption of selected ecological agricultural practices have been presented in Table 6.3.

Analysis of data furnished in Table 6.3 indicated that among the independent variables, individual local contact (X_{14}) had the highest direct effect (-0.271) in the

negative direction followed by ecological agricultural knowledge (X_{21}) in the positive direction on farmers' adoption of selected ecological agricultural practices. Benefit obtained from ecological agriculture (X_{12}), animal-poultry excreta availability (X_7), attitude towards ecological agriculture (X_{23}), training exposure (X_{19}), commercialization (X_9) and NGO contact (X_{15}) had appreciable positive direct effect while annual family income (X_8) had appreciable negative direct effect on adoption of ecological agricultural practices by the farmers. Risk orientation (X_{25}) had the lowest direct effect (0.106) in the positive direction on farmers' adoption of selected ecological agricultural practices.

Here, it may be mentioned that without path co-efficient analysis it is not possible to know the indirect effects of an independent variable through other variables on the dependent variable. Therefore, emphasis has been given on the indirect effects which have been obtained from path co-efficient analysis (Table 6.3).

The variable attitude towards ecological agriculture (X_{23}) had the highest (0.595) total indirect effect followed by risk orientation (X_{25}), benefit obtained from ecological agriculture (X_{12}), animal-poultry excreta availability (X_7), ecological agricultural knowledge (X_{21}) and training exposure (X_{19}). Individual local contact (X_{14}), annual family income (X_8) and commercialization (X_9) had appreciable total indirect effect while the variable NGO contact (X_{15}) had the lowest (0.078) total indirect effect on adoption of selected ecological agricultural practices.

Table 6.3 Path coefficients showing the direct and indirect effects of 10 significant independent variables of Set-VII of stepwise multiple regression analysis on the farmers' adoption of selected ecological agricultural practices

Independent variables	Variables through which indirect effects are channeled	Indirect effects	Total indirect effect	Direct effect
Attitude towards ecological agriculture (X_{23})	Ecological agricultural knowledge (X_{21})	: 0.190		
	Benefit obtained from ecological agriculture (X_{12})	: 0.121		
	Animal-poultry excreta availability (X_7)	: 0.113		
	Training exposure (X_{19})	: 0.091		
	Risk orientation (X_{25})	: 0.069		
	Individual local contact (X_{14})	: - 0.048		
	NGO contact (X_{15})	: 0.040		
	Commercialization (X_9)	: 0.033		
	Annual family income (X_8)	: - 0.014	0.595	0.169
Risk orientation (X_{25})	Ecological agricultural knowledge (X_{21})	: 0.179		
	Benefit obtained from ecological agriculture (X_{12})	: 0.130		
	Attitude towards ecological agriculture (X_{23})	: 0.110		
	Animal-poultry excreta availability (X_7)	: 0.107		
	Training exposure (X_{19})	: 0.070		
	Individual local contact (X_{14})	: - 0.033		
	Commercialization (X_9)	: 0.027		
	NGO contact (X_{15})	: 0.026		
	Annual family income (X_8)	: - 0.022	0.594	0.106
Benefit obtained from ecological agriculture (X_{12})	Ecological agricultural knowledge (X_{21})	: 0.180		
	Animal-poultry excreta availability (X_7)	: 0.117		
	Attitude towards ecological agriculture X_{23})	: 0.104		
	Training exposure (X_{19})	: 0.082		
	Risk orientation (X_{25})	: 0.070		
	Commercialization (X_9)	: 0.050		
	Annual family income (X_8)	: - 0.026		
	NGO contact (X_{15})	: 0.020		
	Individual local contact (X_{14})	: - 0.019	0.578	0.198
Animal-poultry excreta availability (X_7)	Ecological agricultural knowledge (X_{21})	: 0.155		
	Benefit obtained from ecological agriculture (X_{12})	: 0.136		
	Attitude towards ecological agriculture (X_{23})	: 0.113		
	Training exposure (X_{19})	: 0.070		
	Risk orientation (X_{25})	: 0.067		
	Annual family income (X_8)	: - 0.041		
	Individual local contact (X_{14})	: - 0.039		
	NGO contact (X_{15})	: 0.032		
	Commercialization (X_9)	: 0.029	0.522	0.170
Ecological agricultural knowledge (X_{21})	Benefit obtained from ecological agriculture (X_{12})	: 0.135		
	Attitude towards ecological agriculture (X_{23})	: 0.122		
	Animal-poultry excreta availability (X_7)	: 0.100		
	Training exposure (X_{19})	: 0.082		
	Risk orientation (X_{25})	: 0.072		
	Individual local contact (X_{14})	: - 0.036		0.263

Independent variables	Variables through which indirect effects are channeled	Indirect effects	Total indirect effect	Direct effect
	NGO contact (X_{15})	: 0.031	0.519	
	Commercialization (X_9)	: 0.029		
	Annual family income (X_8)	: - 0.016		
Training exposure (X_{19})	Ecological agricultural knowledge (X_{21})	: 0.138	0.431	0.156
	Benefit obtained from ecological agriculture (X_{12})	: 0.104		
	Attitude towards ecological agriculture (X_{23})	: 0.099		
	Individual local contact (X_{14})	: - 0.081		
	Animal-poultry excreta availability (X_7)	: 0.077		
	NGO contact (X_{15})	: 0.049		
	Risk orientation (X_{25})	: 0.048		
	Annual family income (X_8)	: - 0.041		
	Commercialization (X_9)	: 0.038		
Individual local contact (X_{14})	NGO contact (X_{15})	: 0.088	0.227	-0.271
	Annual family income (X_8)	: - 0.055		
	Training exposure (X_{19})	: 0.047		
	Ecological agricultural knowledge (X_{21})	: 0.036		
	Commercialization (X_9)	: 0.030		
	Attitude towards ecological agriculture (X_{23})	: 0.030		
	Animal-poultry excreta availability (X_7)	: 0.025		
	Benefit obtained from ecological agriculture (X_{12})	: 0.013		
	Risk orientation (X_{25})	: 0.013		
Annual family income (X_8)	Individual local contact (X_{14})	: - 0.083	0.176	-0.178
	Commercialization (X_9)	: 0.070		
	Animal-poultry excreta availability (X_7)	: 0.039		
	NGO contact (X_{15})	: 0.036		
	Training exposure (X_{19})	: 0.036		
	Benefit obtained from ecological agriculture (X_{12})	: 0.028		
	Ecological agricultural knowledge (X_{21})	: 0.023		
	Attitude towards ecological agriculture (X_{23})	: 0.014		
	Risk orientation (X_{25})	: 0.013		
Commer-cialization (X_9)	Annual family income (X_8)	: - 0.097	0.167	0.128
	Benefit obtained from ecological agriculture (X_{12})	: 0.077		
	Individual local contact (X_{14})	: - 0.063		
	Ecological agricultural knowledge (X_{21})	: 0.060		
	Training exposure (X_{19})	: 0.046		
	Attitude towards ecological agriculture (X_{23})	: 0.043		
	Animal-poultry excreta availability (X_7)	: 0.039		
	NGO contact (X_{15})	: 0.039		
	Risk orientation (X_{25})	: 0.023		
NGO contact (X_{15})	Individual local contact (X_{14})	: - 0.200	0.078	0.120
	Ecological agricultural knowledge (X_{21})	: 0.069		
	Training exposure (X_{19})	: 0.063		
	Attitude towards ecological agriculture (X_{23})	: 0.057		
	Annual family income (X_8)	: - 0.053		
	Animal-poultry excreta availability (X_7)	: 0.046		
	Commercialization (X_9)	: 0.041		
	Benefit obtained from ecological agriculture (X_{12})	: 0.033		
	Risk orientation (X_{25})	: 0.022		

On the basis of path analysis, the independent variables having indirect effects on adoption of selected ecological agricultural practices have been presented below in descending order.

Attitude towards ecological agriculture (X_{23})

Path analysis showed that attitude towards ecological agriculture (X_{23}) had the highest total indirect effect (0.595) and a positive direct effect of 0.169 (Table 6.3) on adoption of ecological agricultural practices. The indirect effect was mostly channeled positively through ecological agricultural knowledge (X_{21}), benefit obtained from ecological agriculture (X_{12}) and animal-poultry excreta availability (X_7). The indirect effect of attitude towards ecological agriculture (X_{23}) was somewhat positively channeled through training exposure (X_{19}) and risk orientation (X_{25}). There were negligible indirect effect of attitude towards ecological agriculture (X_{23}) on adoption of ecological agricultural practices through individual local contact (X_{14}), NGO contact (X_{15}), commercialization (X_9) and annual family income (X_8).

It may be inferred that other variables remaining constant, attitude towards ecological agriculture (X_{23}) was a determinant of the farmers' adoption of selected ecological agricultural practices.

Risk orientation (X_{25})

Path analysis showed that risk orientation (X_{25}) had the 2nd highest total indirect effect (0.594) and a positive direct effect of 0.106 (Table 6.3) on adoption of selected ecological agricultural practices. The indirect effect was mostly and positively channeled through ecological agricultural knowledge (X_{21}), benefit obtained from ecological agriculture (X_{12}), attitude towards ecological agriculture (X_{23}) and animal-poultry excreta availability (X_7). The indirect effect of risk orientation (X_{25}) was somewhat positively channeled through training exposure (X_{19}). There were negligible indirect effect of risk orientation (X_{25}) on adoption of ecological agricultural practices through individual local contact (X_{14}), commercialization (X_9), NGO contact (X_{15}) and annual family income (X_8).

It may be inferred that other variables remaining constant, risk orientation (X_{25}) had an influence on the adoption of selected ecological agricultural practices and was a determinant of the farmers' adoption of selected ecological agricultural practices.

Benefit obtained from ecological agriculture (X_{12})

Path analysis revealed that benefit obtained from ecological agriculture (X_{12}) had the 3rd total indirect effect (0.578) in descending order and a positive direct effect of 0.198 (Table 6.3) on adoption of selected ecological agricultural practices. The indirect effect was mostly and positively channeled through ecological agricultural knowledge (X_{21}), animal-poultry excreta availability (X_7), and attitude towards ecological agriculture (X_{23}). The indirect effect of benefit obtained from ecological agriculture (X_{12}) was somewhat positively channeled through training exposure (X_{19}), risk orientation (X_{25}) and commercialization (X_9). Negligible indirect effects of benefit obtained from ecological agriculture (X_{12}) on adoption of ecological agricultural practices were exit through annual family income (X_8), NGO contact (X_{15}) and individual local contact (X_{14}).

It may be inferred that other variables remaining constant, benefit obtained from ecological agriculture (X_{12}) had an influence on the adoption of selected ecological agricultural practices and was a determinant of the farmers' adoption of selected ecological agricultural practices.

Animal-poultry excreta availability (X_7)

In terms of descending order, animal-poultry excreta availability (X_7) had the 4th total indirect effect (0.522) and a positive direct effect of 0.170 (Table 6.3) on adoption of selected ecological agricultural practices. The indirect effect was mostly channeled through ecological agricultural knowledge (X_{21}), benefit obtained from ecological agriculture (X_{12}) and attitude towards ecological agriculture (X_{23}) in the positive direction. The indirect effect of animal-poultry excreta availability (X_7) was somewhat positively channeled through training exposure (X_{19}) and risk orientation (X_{25}). Negligible indirect effects of animal-poultry excreta availability (X_7) were exit through annual family income (X_8), individual local contact (X_{14}), NGO contact (X_{15})

and commercialization (X_9) on the adoption of selected ecological agricultural practices.

It may be inferred that other variables remaining constant, animal-poultry excreta availability (X_7) had an influence on the adoption of selected ecological agricultural practices and was an important determinant of the farmers' adoption of selected ecological agricultural practices.

Ecological agricultural knowledge (X_{21})

Path analysis revealed that ecological agricultural knowledge (X_{21}) had the 5th total indirect effect (0.519) and a positive direct effect of 0.263 (Table 6.3) on adoption of selected ecological agricultural practices. The indirect effect was mostly channeled positively through benefit obtained from ecological agriculture (X_{12}), attitude towards ecological agriculture (X_{23}) and animal-poultry excreta availability (X_7). The indirect effect of ecological agricultural knowledge (X_{21}) was somewhat positively channeled through training exposure (X_{19}) and risk orientation (X_{25}). There were negligible indirect effects of ecological agricultural knowledge (X_{21}) on adoption of ecological agricultural practices through individual local contact (X_{14}), NGO contact (X_{15}), commercialization (X_9) and annual family income (X_8).

It may be inferred that other variables remaining constant, ecological agricultural knowledge (X_{21}) had an influence on the adoption of selected ecological agricultural practices and was a determinant of the farmers' adoption of selected ecological agricultural practices.

Training exposure (X_{19})

It was found from the path analysis that training exposure (X_{19}) had the 6th total indirect effect (0.431) in descending order and a positive direct effect of 0.156 (Table 6.3) on adoption of selected ecological agricultural practices. The indirect effect was mostly channeled positively through ecological agricultural knowledge (X_{21}) and benefit obtained from ecological agriculture (X_{12}). The indirect effect of training

exposure (X_{19}) was somewhat positively channeled through attitude towards ecological agriculture (X_{23}) and animal-poultry excreta availability (X_7) and negatively through individual local contact (X_{14}). There were negligible indirect effects of training exposure (X_{19}) on adoption of ecological agricultural practices through NGO contact (X_{15}), risk orientation (X_{25}), annual family income (X_8) and commercialization (X_9).

It may be inferred that other variables remaining constant, training exposure (X_{19}) had an influence on the adoption of selected ecological agricultural practices and was a determinant of the farmers' adoption of ecological agricultural practices.

Individual local contact (X_{14})

It was observed from path analysis that individual local contact (X_{14}) had the 7th total indirect effect (0.227) and a negative direct effect of -0.271 (Table 6.3) on adoption of selected ecological agricultural practices. Somewhat indirect effects of individual local contact (X_{14}) on adoption of ecological agricultural practices were channeled positively through NGO contact (X_{15}) and negatively through annual family income (X_8). There were negligible indirect effects of individual local contact (X_{14}) on adoption ecological agricultural practices through other variables, namely, training exposure (X_{19}), ecological agricultural knowledge (X_{21}), commercialization (X_9), attitude towards ecological agriculture (X_{23}), animal-poultry excreta availability (X_7), benefit obtained from ecological agriculture (X_{12}) and risk orientation (X_{25}).

It may be inferred that other variables remaining constant, individual local contact (X_{14}) had an influence on the adoption of selected ecological agricultural practices and was a determinant of the farmers' adoption of selected ecological agricultural practices.

Annual family income (X_8)

Path analysis revealed that annual family income (X_8) had the 8th total indirect effect (0.176) and a negative direct effect of -0.178 (Table 6.3) on adoption of selected ecological agricultural practices. Somewhat indirect effects of annual family income

(X_8) were channeled positively through commercialization (X_9) and negatively through individual local contact (X_{14}). There were negligible indirect effects of annual family income (X_8) on adoption of ecological agricultural practices through animal-poultry excreta availability (X_7), NGO contact (X_{15}), training exposure (X_{19}), benefit obtained from ecological agriculture (X_{12}), ecological agricultural knowledge (X_{21}), attitude towards ecological agriculture (X_{23}) and risk orientation (X_{25}).

It may be inferred that other variables remaining constant, annual family income (X_8) had an influence on the adoption of selected ecological agricultural practices and was a determinant of the farmers' adoption of selected ecological agricultural practices.

Commercialization (X_9)

Path analysis revealed that commercialization (X_9) had the 9th total indirect effect (0.167) and a positive direct effect of 0.128 (Table 6.3) on adoption of selected ecological agricultural practices. Somewhat indirect effects of commercialization (X_9) were channeled negatively through annual family income (X_8) and individual local contact (X_{14}) and positively through benefit obtained from ecological agriculture (X_{12}) and ecological agricultural knowledge (X_{21}). There were negligible indirect effects of commercialization (X_9) on adoption of ecological agricultural practices through training exposure (X_{19}), attitude towards ecological agriculture (X_{23}), animal-poultry excreta availability (X_7), NGO contact (X_{15}) and risk orientation (X_{25}).

It may be inferred that other variables remaining constant, commercialization (X_9) had an influence on the adoption of selected ecological agricultural practices and was a determinant of the farmers' adoption of selected ecological agricultural practices.

NGO contact (X_{15})

It was found from path analysis that NGO contact (X_{15}) had the lowest total indirect effect (0.078) and a positive direct effect of 0.120 (Table 6.3) on adoption of selected ecological agricultural practices. The indirect effect was mostly channeled negatively through individual local contact (X_{14}). Somewhat indirect effects were channeled

positively through ecological agricultural knowledge (X_{21}), training exposure (X_{19}) and attitude towards ecological agriculture (X_{23}) and negatively through annual family income (X_8). There were negligible indirect effect of NGO contact (X_{15}) on adoption of ecological agricultural practices through other variables, namely, animal-poultry excreta availability (X_7), commercialization (X_9), benefit obtained from ecological agriculture (X_{12}) and risk orientation (X_{25}).

It may be inferred that other variables remaining constant, NGO contact (X_{15}) had an influence on the adoption of selected ecological agricultural practices and was a determinant of the farmers' adoption of selected ecological agricultural practices.

CHAPTER 7

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

7.1 Summary

7.1.1 Introduction

Ecological agriculture is the combination of agricultural practices without using any chemical fertilizers and chemical pesticides. Organic, mechanical, physical and cultural practices of agriculture are mainly used in ecological agriculture. The crop land of Bangladesh has been losing its fertility due to long uses of anti-natural practices like chemical fertilizers and chemical pesticides. The anti-natural practices increase the cost of production in one hand, and decrease the microbial activities in the soil, on the other. This creates new hazardous situation in the entire crop production system including health hazards in Bangladesh.

In order to regain the lost ecological status, it is high time to start the ecological agriculture without further delay. Chemical fertilizers and chemical pesticides not only contaminate surface water, they also affect fish population and human health as well. Some NGOs became very much concerned about the devastating effect of indiscriminate use of chemical fertilizers and pesticides since long, and earnestly felt the need for developing an alternative agricultural strategy that is sustainable, productive and environment-friendly. Since 1976, Proshika has been working towards development of this alternative strategy and termed it as “Ecological Agriculture”. The methods of ecological agriculture are based on modern ecological science combined with time-tested indigenous knowledge, giving emphasis on the mode of cultivation.

Now-a-days, the government extension providers of Bangladesh like Department of Agricultural Extension (DAE) are providing Integrated Farming System (IFS) including Integrated Plant Nutrient System (IPNS) or Integrated Nutrient Management (INM) and Integrated Pest Management (IPM) for crop production in several extension programmes of Bangladesh. Recently, DAE is using a term named ‘Integrated Crop Management (ICM)’ in which crops are cultivated with the judicious

combination of chemical and non-chemical inputs for plant nutrient and pest management.

Proshika as well as other NGOs and some private extension providers provide various types of training courses on ecological agriculture for their group members in order to increase their ecological agricultural knowledge and to make a favourable attitude towards these activities. Sometimes, Proshika provides credit facility to its group members for practicing ecological agriculture and help them for marketing their ecologically produced organic products. But very little research work has so far been done to determine the extent of adoption of selected ecological agricultural practices by the target farmers of Proshika as well as other NGOs and extension providers. Therefore, it was imperative for the researcher to conduct the present research entitled "Adoption of Selected Ecological Agricultural Practices by the Farmers".

7.1.2 Objectives of the study

7. To determine and describe the extent of adoption of selected ecological agricultural practices by the farmers. The selected ecological agricultural practices included:
    a. Ecological nutrient management (nutrient management without chemical fertilizers), and
    b. Ecological pest management (pest management without chemical pesticides);
8. To determine and describe the characteristics profile of the farmers;
9. To explore the contributions of the selected factors of the farmers to their extent of adoption of selected ecological agricultural practices;
10. To determine the perception of the farmers on the extent of benefits obtained from ecological agricultural practices;
11. To determine and describe the problems faced by the farmers in using ecological agricultural practices;
12. To make a comparison between Integrated Crop Management (ICM) of DAE and Ecological Agriculture of PROSHIKA with reference to purpose, method and outcome

7.1.3 Methodology

Since the introduction of ecological agriculture as an alternative to chemical intensive agriculture by Proshika, 761,845 farmers were successfully practising ecological agriculture and brought 92019 hectares (227,286 acres) of land under this programme in 196 Area Development Centers (ADCs) of Bangladesh. An ADC usually covered one or two Upazilla(s) of Bangladesh. In 2001 Proshika introduced a sister programme of ecological agriculture entitled “Organic Vegetable Production and Marketing” to promote the consumption of organic vegetables in 10 ADCs out of 196. However, the Proshika personnel reported that emphasis had been laid on marketing of organic products to six ADCs out of these 10 ADCs. These six ADCs namely, Ghatail and Madhupur under Tangail district, Muktagacha under Mymensingh district, Pakundia under Kishoreganj district, and Belabo and Raipura under Narsingdi District were selected as the study area. It was reported by PROSHIKA that a total of 569 farmers from ten Area Development Centers (ADCs) had been involved in producing organic vegetables covering 196.4 hectares (485 acres) of land in the reported year. But a total of 478 farmers of the aforesaid six ADCs had been involved in producing organic vegetables. These 478 farmers of six areas were selected as the population of the present study. Considering the time and fund constraints, data were collected from the sample rather than the entire population. Thirty percent of the farmers from each ADC were selected randomly and hence, a total of 144 farmers were selected as the sample for the present study. Data were collected during the period of February to August, 2006.

Besides, interviewing the respondents, two case studies were conducted taking one successful farmer from DAE and another successful farmer from Proshika for a comparative study between them with reference to purpose, method and outcome. Several visits were made and necessary procedures were followed to conduct the case studies during July to December, 2006.

7.1.4 Statement of hypotheses

The null hypothesis formulated for testing the conceptual model of the study was:

"There is no contribution and effect of the selected 25 characteristics of the farmers to/on their adoption of selected ecological agricultural practices."

7.1.5 Adoption of ecological agricultural practices

Extent of adoption of selected ecological agricultural practices

Ecological agricultural practices had two dimensions, namely, ecological nutrient management and ecological pest management practices. Major findings on the extent of adoption of these two dimensions of ecological agricultural practices and composite adoption of ecological agricultural practices are as follows:

Computed adoption of ecological nutrient management practices score of the farmers ranged from 88.3 to 470.0 against the possible range of 0 to 1000. The mean, standard deviation and co-efficient of variation were 242.11, 78.17 and 32.29 percent respectively. Majority (67 per cent) of the farmers had low adoption compared to 17 and 16 percent having very low and medium adoption of ecological nutrient management practices respectively. Nobody had high adoption of ecological nutrient management practices.

The adoption of ecological pest management practices score of the farmers ranged from 69.5 to 439.0 against the possible range of 0 to 1000. The mean, standard deviation and co-efficient of variation were 271.60, 68.83 and 25.34 percent respectively. Majority (74 percent) of the farmers had low adoption compared to 5 and 21 percent very low and medium adoption of ecological pest management practices respectively. Nobody had high adoption of ecological pest management practices.

The adoption of ecological agricultural practices score of the farmers ranged from 157.8 to 899.7 against the possible range of 0 to 2000. The mean, standard deviation and co-efficient of variation were 513.71, 133.75 and 26.04 percent respectively. Majority (78 percent) of the farmers had low adoption compared to 8 and 14 percent having very low and medium adoption of composite ecological agricultural practices respectively. Nobody had high adoption of ecological agricultural practices.

Comparative adoption of selected ecological agricultural practices

Among ten ecological nutrient management practices, adoption of cowdung ranked first followed by crop residue/weed fertilizer, compost, poultry excreta, farm yard manure, water hyacinth, quick compost/oil cake, green manure, and liquid organic fertilizers. Nobody used biofertilizers in their pulses crop fields.

Among ten ecological pest management practices, adoption of proper weeding and eradication of insect/disease attacked plants/plant parts ranked first followed by use of quality seed, crop rotation, pest control by ash, pest control by hand/hand net, putting tree branches in the field, botanical pesticides (neem: *Azadirachta indica*, nishinda: *Vitex negundo*, biskatali: *Polygonum orientale*, garlic: *Allium sativum* extract etc.), beneficial insects and light trap. Nobody used pest resistant varieties in their crop fields.

Adoption of selected ecological agricultural practices in different combinations

In case of ecological nutrient management practices, there were 34 combinations which were used by the farmers. The farmers used the combination to a relatively higher level (14 percent), which included cowdung, poultry excreta, compost and crop residues/weed fertilizer followed by the combination, which included cowdung, poultry excreta, farmyard manure and crop residues/weed fertilizer. The third important combination used by the respondent farmers was cowdung, poultry excreta, farmyard manure, water hyacinth and crop residues/weed fertilizer.

In case of ecological pest management practices, there were 11 combinations which were used by the farmers. The farmers were relatively high (45 percent) in using the combination, which included pest control by hand/hand net, putting branches in the field, use of quality seeds, ash, crop rotation, and proper weeding and eradication of insect/disease attacked plants/plant parts followed by the combination, which included putting tree branches in the field, use of quality seeds, ash, crop rotation, and proper weeding and eradication of insect/disease attacked plants/plant parts and the combination which included use of quality seeds, ash, crop rotation, and proper weeding and eradication of insect/disease attacked plants/plant parts.

In case of ecological nutrient management practices, all (100%) the farmers used cowdung with other practices followed by crop residues/weed fertilizers (94%) with other practices and poultry excreta (88%) with other practices. Nobody used biofertilizer individually or with other practices.

In case of ecological pest management practices, all (100%) the farmers used quality seeds, and proper weeding and eradication of insect/disease attacked plants/plant parts with other practices followed by crop rotation (99%) with other practices and ash (92%) with other practices. Nobody used pest resistant varieties individually or with other practices.

Modes of adoption of ecological agricultural practices and area coverage

Most (69%) of the farmers used Mode-III (large ecological practices with less chemical practices) and Mode-IV (absolute ecological agricultural practices) combinedly followed by Mode-II (less ecological practices with large chemical practices), Mode-III (large ecological practices with less chemical practices) and Mode-IV (absolute ecological agricultural practices) combinedly. One percent farmers used Mode-I, II, III & IV combinedly. Another one percent farmer used Mode-IV or absolutely ecological agricultural practices.

The farmers had a total of 147.95 hectares of total cropped area on which they cultivated different types of crops with different levels of ecological agricultural practices round the year. In 0.32 hectares (0.22% of total lands) of land, the farmers cultivated amon and boro rice only by using chemical fertilizers and chemical pesticides. They never used any ecological agricultural practices in these fields. The farmers cultivated amon and boro rice, wheat, chilli, onion, tomato, brinjal, and banana with less use of ecological agricultural practices and large use of chemical fertilizers and chemical pesticides in 15.7 hectares (10.61% of total lands) of land. The farmers cultivated aus, aman and boro rice, wheat, jute, sweet potato, oilseeds, chilli, onion along with 30 other crops with large use of ecological agricultural practices and

less use of chemical fertilizers and chemical pesticides in 61.41 hectares (41.51% of total lands) of land.

The farmers cultivated amon rice, wheat, jute, sweet potato, pulses, oilseeds, chilli, onion, garlic along with 32 other crops with the use of absolute ecological agricultural practices in 70.52 hectares (47.66% of total lands) of land. In case of cultivation of pulses, spinach and carrot, they used absolute ecological agricultural practices in their 100 percent land. In case of bamboo garden they never used any external inputs like organic or inorganic fertilizers and pesticides. That type of bamboo cultivation was also treated as ecological agricultural practice. It was found that more than half (52.12 percent) of the lands of the farmers were cultivated by the mixture of ecological and chemical practices.

Benefit obtained from ecological agriculture

To have a clear understanding about comparative benefit of 25 items, rank order was arranged based on the Standardized Benefit Index (SBI) obtained against each of the items. Rank order was also made in respect of social, environmental, technical & economical, and psychological benefits separately.

On the basis of SBI among all the 25 selected benefit items, increase in the use of local resources ranked first followed by increase of soil microbial activities and fertility. The third important item of benefits was increase of cropping intensity. The next seven important benefit items in descending order were increase of production of vegetables, fruits and trees; development of decision making ability; development of counseling ability; increase of integrated crop management; increase of product quality; decrease of human diseases; and development of human health environment.

On the basis of SBI among 6 selected social benefit items, development of decision making ability ranked first followed by development of counseling ability; development of participation in meeting and training; development of employment;

development of knowledge and skill; and development of organizational participation and extension contact.

The computed SBI indicated that among 5 selected environmental benefit items, development of human health environment ranked first followed by decrease of air and water pollution; development of environment for animal and bird health; decrease of crop pest; and increase of beneficial insects, earth worm, frog etc.

Among 11 selected technical and economical benefit items, increase in the use of local resources ranked first followed by increase of soil microbial activity and fertility; increase of cropping intensity; increase of production of vegetables, fruits and trees; increase of integrated crop management; increase of product quality; decrease of human diseases; decrease of production cost; increase of cow and goat rearing; increase of poultry rearing; and increase of fish culture.

Among 3 selected psychological benefit items, positive change of human food habit ranked first followed by positive change of human conduct and development of social norms and values based on SBI.

It was also evident that among the types of benefits, social benefits ranked first followed by technical and economical benefit, environmental benefit and psychological benefit on the basis of Average Standardized Benefit Index (ASBI).

Problems faced by the farmers in ecological agriculture

Twenty four items of problems faced by the farmers in ecological agriculture was arranged in rank order according to the Standardized Problem Index (SPI) obtained against each of the items. Rank order was also made in respect of social, technical, economical, marketing, and psychological problems separately.

On the basis of SPI, among the entire 24 selected problem items, lack of farm animal ranked first followed by poor adoption of ecological agriculture by maximum farmers.

The third important problem faced by the farmers was uncertainty of pest control in case of severe attack. The next seven important problems in descending order were poor plant nutrient in organic manure, lack of information and publicity, poor extension service, lack of proper organization, low production, need excess labour, and lower price of organic product.

On the basis of SPI among 4 selected social problem items, lack of adoption of ecological agriculture by majority farmers ranked first followed by lack of information and publicity, poor extension service, and lack of proper organization.
Among 7 selected technical problem items, uncertainty of pest control in case of severe attack ranked first, followed by poor plant nutrient in organic manure, difficult to collect ingredient of botanical pesticides and to prepare it, difficult to collect ingredient of compost and to prepare it, difficult to prepare light trap, difficult to maintain crop rotation, and difficult to prepare green manure.

Based on SPI among 5 selected economical problem items, lack of farm animal ranked first followed by low production, need excess labour, lower price of organic product, and need excess time.

According to SPI, poor and inadequate roads for transportation ranked first, among 5 selected marketing problem items followed by lack of storage facilities, difficult to move to a distance place, undesirable involvement of middle men, and lack of proper transport.

Among 3 selected psychological problem items, criticism from fertilizer and pesticide dealers ranked first, followed by criticism from relatives and neighbouring farmers and criticism from family members.

Findings indicated that social problem ranked first, followed by economical, psychological, technical and marketing problem on the basis of Average Standardized Problem Index (ASPI) among different types of problems.

7.1.6 Characteristics profile of the farmers

Personal characteristics

Age of the farmers ranged from 18 years to 70 years, the mean being 38.31. Majority (70 per cent) of the farmers were middle-aged compared to 22 percent being young and 8 per cent old.

Schooling years of the farmers ranged from zero (0) to 12.0, the mean being 5.58. Highest proportion (47 percent) of the farmers had secondary level of education and 4 percent had above secondary level of education. Finding also showed that 23 percent of the respondents had primary level of education, 16 percent were able to put signature only, while 10 percent of the farmers were illiterate.

Family size of the farmers was found to range from 2 to 11 with a mean of 5.78. Data indicated that the highest proportion (61 percent) of the respondent farmers had medium family size compared to 24 percent having small family and 15 percent large family.

Working family size of the farmers was found to range from 2 to 9 with a mean of 3.92. Data indicated that the highest proportion (46 percent) of the respondent farmers had medium effective family size compared to 37 percent having small effective family and 17 percent large effective family size.

Economical characteristics

Effective land possession of the respondents was found to range from 0.18 hectare to 1.17 hectares with an average of 0.52 hectare. Data indicated that the highest proportion (90 percent) of the farmers had small effective land possession, while 6 and 4 percent had marginal and medium effective land possession respectively. Nobody had large effective land possession.

Against the possible range of 0 to 100 percent, cropping intensity of the respondents was found to range from 130 to 267 percent with an average of 208.35 percent. Data indicated that the higher proportion (74 percent) of the farmers had cropping intensity above national average, while 26 percent had cropping intensity below or upto national average.

The score of animal-poultry excreta availability of the farmers was found to range from 5 to 957 with an average of 404.17. Data indicated that 34, 40 and 26 percent of the farmers had low, medium and high animal-poultry excreta availability. Thus, about three-fourth (74 percent) of the respondent had low to medium animal-poultry excreta availability.

Annual family income of the farmers was found to range from Tk. 27 thousand to Tk. 272 thousand with a mean of Tk. 69.41 thousand. Data indicated that the highest proportion (59 percent) of the farmers belonged to medium annual family income group compared to 38 percent having low annual family income and 3 percent high income.

Commercialization of the farmers was found to range from 37.6 to 92.1 percent against the possible range of zero (0) to 100 per cent with a mean of 70.16 percent. Data indicated that the highest proportion (63 percent) of the farmers belonged to medium commercialization group compared to 2 and 35 percent having low and high commercialization group respectively. Thus, majority (98 percent) of the respondent had medium to high commercialization score.

Credit need of the farmers was found to range from Zero (0) to 100 percent against the possible range of zero (0) to 100 percent with a mean of 64.39. Data indicated that the highest proportion (61 percent) of the farmers belonged to high credit need group compared to 30, 3 and 6 percent having no, low and medium credit need. Thus, two-third (67 percent) of the respondent had medium to high credit need, while one-third (33 percent) had no to low credit need.

Marketing opportunity score of the farmers was found to range from 2 to 13 against the possible range of zero (0) to 16 with a mean of 5.89. Data indicated that the highest proportion (49 percent) of the farmers belonged to low marketing opportunity group compared to 44 and 7 percent having medium and high marketing opportunity respectively.

Benefits obtained from ecological agriculture score of the farmers was found to range from 12 to 62 against the possible range of zero (0) to 75 with a mean of 41.49. Data indicated that highest proportion (74 percent) of the farmers obtained medium benefits from ecological agriculture compared to 9 percent and 17 percent who obtained low and high benefit respectively from ecological agriculture.

Social characteristics

The observed range of the computed cosmopoliteness scores of the respondents was from 4 to 25 against the possible range of zero (0) to 32, while the mean was 11.05. Data indicated that half (50 percent) of the farmers had medium cosmopoliteness as compared to 47 percent low cosmopoliteness, and 3 percent high cosmopoliteness.

The observed individual local contact scores of the farmers ranged from 2 to 11, against the possible score of zero (0) to 12. The mean score was 5.18. Data indicated that majority (52 percent) of the farmers of the study area had the medium individual local contact compared to 41 and 7 percent having low and high individual local contact respectively.

The observed NGO (Non-government Organization) contact scores of the farmers ranged from 1 to 6, against the possible score of zero (0) to 12. The mean score was 2.65. Data indicated that majority (51 percent) of the farmers of the study area had very low NGO contact compared to 39 and 10 percent having low and medium NGO contact respectively. Nobody had high NGO contact.

Observed GO (Government Organization) contact scores of the farmers ranged from 0 to 7, against the possible score of zero (0) to 12. The mean score was 2.06. Data

indicated that majority (65 percent) of the farmers of the study area had very low GO contact compared to 28 and 7 percent having low and medium GO contact respectively. Nobody had high GO contact.

The observed group contact score of the farmers of the study area ranged from 1 to 6 against possible scores of zero (0) to 16. The mean score was 1.51. Findings indicated that the highest proportion (89 percent) of the respondent farmers had very low group contact, while 6 and 5 percent had low and medium group contact respectively.

The observed mass contact scores of the farmers ranged from 1 to 10 against the possible score of zero (0) to 28. The mean score was 4.84. Data revealed that half (50 percent) of the respondents had low mass contact while 44 and 6 percent had very low and medium mass contact respectively. Nobody had high mass contact.

Training exposure scores ranged from 1 to 20, the mean being 6.20. Data indicated that majority (45 percent) of the respondents had low training exposure compared to 38 and 17 percent having medium and high training exposure respectively.

Decision making ability scores of the farmers ranged from 7 to 17 against the possible range of 6 to 18, the mean being 11.57 score. Findings indicated that majority (54 percent) of the respondents had medium decision making ability compared to 33 and 13 percent having low and high decision making ability respectively.

The observed ecological agricultural knowledge scores of the farmers ranged from 8 to 23 against the possible range of zero (0) to 24. The mean score was 14.69. Data indicated that two-third (67 percent) of the respondent farmers had medium ecological agricultural knowledge compared to 5 and 28 percent having low and high ecological agricultural knowledge respectively.

Problem faced in ecological agriculture score of the farmers was found to range from 14 to 56 against the possible range of zero (0) to 72 with a mean of 28.14. Data indicated that the highest proportion (68 percent) of the farmers belonged to medium problem faced in ecological agriculture group, while 29 and 3 percent faced low and high problem in ecological agriculture respectively.

Psychological characteristics

The computed attitude towards ecological agriculture scores of the farmers ranged from 27 to 44 against possible range of zero (0) to 48. The mean score was 34.63. Data indicated that the highest proportion (55 percent) of the respondent farmer had medium favourable attitude towards ecological agriculture as compared to 35 and 10 percent having low and high favourable attitude respectively towards ecological agriculture.

The computed aspiration scores of the respondent farmers ranged from 8 to 34 against the possible range of zero (0) to 40. The mean score was 15.88. Data indicated that the

highest proportion (61 percent) of the respondents had medium level of aspiration, while 35 percent had low aspiration and only 4 percent had high aspiration.

The observed range of risk orientation score of the farmers was 11 to 44 against the possible range of zero (0) to 48 with the mean score of 29.52. Data indicated that the highest proportion (45 percent) of the farmers had high risk orientation as compared to 12 and 43 percent having low and medium risk orientation respectively.

7.1.7 Contribution and effects of the selected characteristics of the farmers to/on their adoption of ecological agricultural practices

Stepwise multiple regression analysis was used to assess the contribution of the selected characteristics of the farmers to their adoption of selected ecological agricultural practices. Stepwise multiple regression analysis was run with seven different sets of independent variables with adoption of selected ecological agricultural practices as the dependent variable.

Analysis of data regarding contribution of the selected characteristics of the farmers indicated that in different combinations, standardized partial beta co-efficient of 14 independent variables were significant out of 25independent variables with adoption of selected ecological agricultural practices. Then, stepwise multiple regression analysis was run with the significant 14 independent variables. For exploring extent of contribution, the 10 independent variables were entered into regression equation out of these 14 independent variables. These 10 independent variables combinedly explained 83.5 percent of the total variation. The contributions and effects of these independent variables were as follows:

Contributions of farmers' selected characteristics

In terms of explanation, ecological agricultural knowledge was found to be by far the most important positive contributor to the adoption of selected ecological agricultural practices.

Benefit obtained from ecological agricultural practices by the farmers was found to be the second important positive contributor to their adoption of selected ecological agricultural practices.

Attitude towards ecological agriculture of the farmers was found to be the 3rd important positive contributor to their adoption of selected ecological agricultural practices.

Individual local contact of the farmers was found to be the 4th important negative contributor to their adoption of ecological agricultural practices.

Step wise multiple regression analysis revealed that training exposure of the farmers was found to be the 5th important positive contributor to their adoption of selected ecological agricultural practices.

Animal-poultry excreta availability of the farmers was found to be the 6th important positive contributor to their adoption of selected ecological agricultural practices.

Commercialization of the farmers was found to be the 7th important positive contributor to their adoption of selected ecological agricultural practices.

NGO contact of the farmers was found to be the 8th important positive contributor to their adoption of selected ecological agricultural practices.

Annual family income of the farmers was found to be the 9th important negative contributor to their adoption of selected ecological agricultural practices.

Risk orientation of the farmers was found to be comparatively less important positive contributor to their adoption of selected ecological agricultural practices.

Indirect effects of the farmers' selected characteristics

Path coefficients showed the direct and indirect effects of significant variables on the farmers' adoption of selected ecological agricultural practices. In different regression model, standardized 'b' coefficients of the independent variables indicated the direct effects of the variables contained in the path analysis. Therefore, for further understanding, it is important to describe the indirect effects of the independent variables.

The indirect effects of independent variables (which were significant in final model of step-wise regression analysis) on adoption of selected ecological agricultural practices based on path analysis are presented below in descending order:

Path analysis showed that attitude towards ecological agriculture had the highest total indirect effect (0.595) with a positive direct effect of 0.169 on adoption of ecological agricultural practices. The indirect effect was mostly channeled positively through ecological agricultural knowledge, benefit obtained from ecological agriculture and animal-poultry excreta availability.

Path analysis showed that risk orientation had the 2nd highest total indirect effect (0.594) and a positive direct effect of 0.106 on adoption of selected ecological agricultural practices. The indirect effect was mostly and positively channeled through ecological agricultural knowledge, benefit obtained from ecological agriculture, attitude towards ecological agriculture and animal-poultry excreta availability.

Path analysis revealed that benefit obtained from ecological agriculture had the 3rd total indirect effect (0.578) in descending order and a positive direct effect of 0.198 on adoption of selected ecological agricultural practices. The indirect effect was mostly and positively channeled through ecological agricultural knowledge, animal-poultry excreta availability, and attitude towards ecological agriculture.

The animal-poultry excreta availability had the 4th total indirect effect (0.522) and a positive direct effect of 0.170 on adoption of selected ecological agricultural practices.

The indirect effect was mostly channeled through ecological agricultural knowledge, benefit obtained from ecological agriculture and attitude towards ecological agriculture in the positive direction.

Path analysis revealed that ecological agricultural knowledge had the 5th total indirect effect (0.519) and a positive direct effect of 0.263 on adoption of selected ecological agricultural practices. The indirect effect was mostly channeled positively through benefit obtained from ecological agriculture, attitude towards ecological agriculture and animal-poultry excreta availability.

The training exposure had the 6th total indirect effect (0.431) in descending order and a positive direct effect of 0.156 on adoption of selected ecological agricultural practices. The indirect effect was mostly channeled positively through ecological agricultural knowledge and benefit obtained from ecological agriculture.

It was observed from path analysis that individual local contact had the 7th total indirect effect (0.227) and a negative direct effect of -0.271 on adoption of selected ecological agricultural practices. Somewhat indirect effects of individual local contact on adoption of ecological agricultural practices were channeled positively through NGO contact and negatively through annual family income.

Path analysis revealed that annual family income had the 8th total indirect effect (0.176) and a negative direct effect of -0.178 on adoption of selected ecological agricultural practices. Somewhat indirect effects of annual family income were channeled positively through commercialization and negatively through individual local contact.

Path analysis revealed that commercialization had the 9th total indirect effect (0.167) and a positive direct effect of 0.128 on adoption of selected ecological agricultural practices. Somewhat indirect effects of commercialization were channeled negatively through annual family income and individual local contact and positively through benefit obtained from ecological agriculture and ecological agricultural knowledge.

It was found from path analysis that NGO contact had the lowest total indirect effect (0.078) and a positive direct effect of 0.120 on adoption of selected ecological agricultural practices. The indirect effect was mostly channeled negatively through individual local contact. Somewhat indirect effects were channeled positively through ecological agricultural knowledge, training exposure and attitude towards ecological agriculture and negatively through annual family income.

7 .2 Conclusions

On the basis of the findings, discussion and logical interpretation, the following conclusions were drawn:

1. Most (84 percent) of the farmers had very low to low adoption of selected ecological nutrient management practices, 79 percent had very low to low adoption of ecological pest management practices, while 86 percent had very low to low composite adoption of ecological agricultural practices. Nobody had high adoption of selected ecological agricultural practices, while only a small proportion (14 percent) had medium adoption. These facts led to the conclusion that adoption of ecological nutrient management practices and ecological pest management practices by the farmers in terms of ecological dimensions are yet far from the desired level of satisfaction.
2. The farmers used mainly cowdung, crop residues/weed fertilizers, compost, poultry excreta, farmyard manure and water hyacinth for plant nutrient management without chemical fertilizers. Very few farmers used quick compost/oil cake, green manure and liquid organic fertilizers. Nobody used biofertilizers in their pulse crop fields. Cowdung, crop residues/weed fertilizers, poultry excreta and water hyacinth were the main component of compost and farmyard manure. Crop residues/weed fertilizers might be available from their crop field and water hyacinth might be available from local water bodies. Therefore, it may be concluded that it is not only necessary to increase availability of cowdung and poultry excreta, but also publicity of biofertilizers need to be

increased for pulse crops cultivation aimed at wider adoption of ecological agricultural practices.

3. For pest management without chemical pesticides, the farmers adopted mainly proper weeding and eradication of insect/disease attacked plants/plant parts, quality seeds, crop rotation, ash, hand-net and putting tree branches in fields. Very few farmers used botanical pesticides, beneficial insects and light trap. Nobody used pest resistant varieties for crop cultivation. Therefore, it may be concluded that motivational work need to be increased so that the farmers could understand the benefits of using botanical pesticides, beneficial insects, light trap and pest resistant varieties for crop cultivation.

4. The farmers cultivated 47.66% of their land with absolute ecological agricultural practices. Therefore, it may be concluded that necessary motivational programmes need to be taken by the concerned authorities so that the farmers could increase their land under ecological agricultural practices gradually.

5. On the basis of Average Standardized Benefit Index (ASBI), social benefits ranked first followed by technical-cum-economical benefit, environmental benefit and psychological benefit. On the basis of Standardized Benefit Index (SBI) among the 25 selected benefit items, increase in the use of local resources ranked first followed by increase of soil microbial activity and fertility; increase of cropping intensity; increase of production of vegetables, fruits and trees; development of decision making ability; development of counseling ability and increase of integrated crop management etc. One would, therefore, conclude that the above seven benefit items were more important in comparison with the remaining 18 benefit items in terms of perception of benefit by the farmers.

6. On the basis of Average Standardized Problem Index (ASPI), social problem ranked first followed by economical, psychological, technical and marketing problems. On the basis of Standardized Problem Index (SPI) among the 24 selected problem items, lack of farm animal ranked first followed by poor adoption of ecological agriculture by maximum farmers, uncertainty of pest control in case of severe attack, poor plant nutrient in organic manure, lack of information and publicity, poor extension service, lack of proper organization, etc.

Therefore, it may be concluded that the above seven problem items were more important in comparison with the rest 17 problem items.

7. About three-fourth (74 percent) of the farmers had low to medium animal-poultry excreta availability. Correlation test showed that animal-poultry excreta availability of the farmers had positive significant relationship with their adoption of selected ecological agricultural practices. Step wise multiple regression analysis indicated that animal-poultry excreta availability of the farmers had significant and positive effect on adoption of selected ecological agricultural practices by the farmers. Again path analysis indicated that animal-poultry excreta availability of the farmers had positive indirect effect mostly through ecological agricultural knowledge, benefits obtained from ecological agricultural knowledge and attitude towards ecological agriculture on their adoption of selected ecological agricultural practices. Farmers having much animal-poultry excreta could easily use their animal-poultry excreta in their agricultural field. It may be concluded that high animal-poultry excreta availability of the farmers would be helpful for more adoption of selected ecological agricultural practices.

8. Highest proportion (59 percent) of the farmers belonged to medium annual family income group, 38 percent belonged to low annual family income and only 3 percent high annual family income group. But step wise multiple regression analysis indicated that annual family income of the respondent farmers had significant and negative effect on their adoption of selected ecological agricultural practices. Again path analysis indicated that annual family income of the farmers had somewhat indirect effect positively through commercialization and negatively through individual local contact on their adoption of selected ecological agricultural practices. Actually farmers having higher family income had the capacity to buy high cost chemical inputs and they could use easily those chemical inputs in their large sized crop fields. But, collection and use of ecological agricultural practices were very much laborious, complex and burden to them for their large fields. This means that the higher the annual family income of the farmers, the lower was their adoption of selected ecological agricultural

practices. Therefore, it may be concluded that motivational works would be helpful for more adoption of ecological agricultural practices in a situation where misunderstanding and inappropriate perception prevailed about ecological agricultural practices among the farmers having high annual family income.

9. Almost cent percent (98 percent) of the farmers had medium to high commercialization score. Various types of crop produced by the farmers increased their commercialization score. Correlation analysis revealed that commercialization of the respondent farmers had significant positive relationship with their adoption of selected ecological agricultural practices. Step wise multiple regression analysis indicated that commercialization of the farmers had significant and positive effect on their adoption of selected ecological agricultural practices. Again path analysis indicated that commercialization of the farmers had somewhat indirect effect negatively through annual family income and individual local contact and positively through benefit obtained from ecological agriculture and ecological agricultural knowledge on their adoption of selected ecological agricultural practices. This means that the higher the commercialization of the respondent farmers, the higher was their adoption of ecological agricultural practices. Therefore, it may be concluded that more commercialization of the farmers was helpful for better adoption of ecological agricultural practices.

10. Majority (83 percent) of the farmers obtained low to medium benefits from ecological agriculture. Correlation test showed that the farmers' benefit obtained from ecological agriculture had significant positive relationship with their adoption of ecological agricultural practices. Step wise multiple regression analysis indicated that benefit obtained from ecological agricultural practices had significant and positive effect on adoption of ecological agricultural practices by the farmers. Again path analysis inferred that benefit obtained from ecological agriculture had positive indirect effect mostly through ecological agricultural knowledge, animal-poultry excreta availability and attitude towards ecological agriculture on adoption of selected ecological agricultural practices. This means that the higher the benefit obtained from ecological agricultural practices by the

farmers, the higher was their adoption of selected ecological agricultural practices and it was quite logical. Therefore, it may be concluded that the farmers getting more benefit from ecological agriculture were more likely to adopt ecological agricultural practices.

11. Most (93 percent) of the farmers had either medium or low individual local contact. Step-wise multiple regression analysis indicated that individual local contact of the farmers had significant and negative effect on their adoption of selected ecological agricultural practices. Again path analysis indicated that individual local contact of the farmers had somewhat indirect effect positively through NGO contact and negatively through annual family income on their adoption of selected ecological agricultural practices. This means that the lower the individual local contact of the respondent farmers, the higher was their adoption of selected ecological agricultural practices. Items of local contact included neighbour/friends/relatives, group leader and input dealer. Most of the neighbouring farmers/friends/relatives were cultivating crops with chemical inputs. Moreover, input dealers were fully in favour of chemical farming and they sometimes made criticism to the ecological agricultural farmers. Therefore, it may be concluded that the farmers having lesser individual local contact were more likely to adopt ecological agricultural practices.
12. Most (90 percent) of the farmers of the study areas had very low to low NGO contact. Correlation test revealed that NGO contact of the respondent farmers had significant positive relationship with their adoption of selected ecological agricultural practices. Step-wise multiple regression analysis indicated that NGO contact of the respondents had significant positive effect on their adoption of selected ecological agricultural practices. Again, path analysis indicated that NGO contact of the farmers had negative indirect effect mostly through individual local contact. NGO contact of the farmers had somewhat indirect effects positively through ecological agricultural knowledge, training exposure and attitude towards ecological agriculture and negatively through annual family income on their

adoption of selected ecological agricultural practices. This means that the higher the NGO contact of the respondent, the higher was their adoption of selected ecological agricultural practices. As the group members of Proshika, the respondents of this study were receiving necessary information about ecological agriculture and this was the reason of this finding. Therefore, it may be concluded that more NGO contact of the farmers was helpful for better adoption of ecological agricultural practices.

13. An overwhelming majority (83 percent) of the farmers had low to medium training exposure. Correlation test showed that training exposure of the respondent farmers had significant positive relationship with their adoption of selected ecological agricultural practices. Step-wise multiple regression analysis indicated that training exposure of the respondents had significant and positive effect on their adoption of selected ecological agricultural practices. Path analysis showed that training exposure of the farmers had positive indirect effect mostly through ecological agricultural knowledge and benefit obtained from ecological agriculture on their adoption of selected ecological agricultural practices. This means that the respondent who received more training on ecological agriculture or related matters obviously had higher adoption of selected ecological agricultural practices. Therefore, it may be concluded that the training exposure of the farmers was helpful for their adoption of ecological agricultural practices.

14. An overwhelming majority (72 percent) of the farmers had either low or medium ecological agricultural knowledge. Correlation test showed that ecological agricultural knowledge of the farmers had significant positive relationship with their adoption of selected ecological agricultural practices. Step wise multiple regression analysis indicated that ecological agricultural knowledge of the farmers had significant and positive effect on their adoption of ecological agricultural practices. Again, path analysis indicated that ecological agricultural knowledge of the farmers had positive indirect effect mostly through benefit obtained from ecological agriculture, attitude towards ecological agriculture and animal-poultry excreta availability on their adoption of selected ecological agricultural practices.

This means that farmers having high ecological agricultural knowledge were more likely to adopt ecological agricultural practices to a higher extent. Actually knowledgeable person could understand the merits and demerits of ecological agriculture easily in a short time. By the motivational programme of Proshika, the farmers could improve their ecological agricultural knowledge. Therefore, it may be concluded that ecological agricultural knowledge of the farmers was helpful for their adoption of ecological agricultural practices.

15. Most (90 percent) of the farmers had low to medium favourable attitude towards ecological agriculture. Correlation test showed that attitude towards ecological agriculture of the farmers had significant positive relationship with their adoption of selected ecological agricultural practices. Step wise multiple regression analysis indicated that attitude towards ecological agriculture of the farmers had significant and positive effect on their adoption of selected ecological agricultural practices. Again, path analysis showed that attitude towards ecological agriculture of the farmers had positive indirect effect mostly through ecological agricultural knowledge, benefit obtained from ecological agriculture and animal-poultry excreta availability on their adoption of selected ecological agricultural practices. It was quite logical that the farmers having more favourable attitude towards ecological agriculture would like to adopt the same in a larger scale. Therefore, it may be concluded that attitude towards ecological agriculture was an important factor for their adoption of ecological agricultural practices.

16. More than half (55 per cent) of the farmers had low to medium risk orientation. Correlation analysis showed that risk orientation of the farmers had significant positive relationship with their adoption of selected ecological agricultural practices. Step wise multiple regression analysis indicated that risk orientation of the farmers had significant and positive effect on their adoption of ecological agricultural practices. Again, path analysis indicated that risk orientation of the farmers had positive indirect effect mostly through ecological agricultural knowledge, benefit obtained from ecological agriculture, attitude towards

ecological agriculture and animal-poultry excreta availability on their adoption of selected ecological agricultural practices. It is quite logical that the farmers having more orientation towards risk could adopt ecological agriculture in a larger scale. Therefore, it may be concluded that risk orientation of the farmers was helpful for their adoption of ecological agricultural practices.

17. From the case study findings, it was revealed that in practical situation the ecological farmer used some little amount of chemical fertilizers in a situation where neighbouring farmers used large amount of chemical fertilizers. Again he used a little amount of chemical pesticides in case of severe pest attack in the rice field. According to him, if he did not do so, the yield might fall. But in case of other crop cultivation he followed the rules of ecological agriculture strictly. But, it was found that the DAE farmer was practicing Integrated Crop Management (ICM) by using judiciously the integration of chemical and non-chemical inputs for crop production. Therefore, it may be concluded that the wisest policy was to stand in between the two systems of farming and proceed gradually and steadily towards adoption and diffusion of the ecological agricultural practices.

7.3 Recommendations

7.3.1 Recommendations for policy implication

On the basis of findings and conclusions of the study, the following recommendations are made:

1. Most (84 percent) of the farmers had low to very low adoption of ecological nutrient management practices, 79 percent had low to very low adoption of ecological pest management practices and 86 percent had low to very low composite adoption of ecological agricultural practices. Nobody had high adoption of ecological agricultural practices. It is, therefore, recommended that more and more motivational programme including training and non-formal education should be arranged by the concerned agencies for the farmers in order to achieve desired benefit in respect of ecological agricultural practices.

2. Cowdung and poultry excreta were the main component of compost and farmyard manure, while the farmers used mainly cowdung, crop residues/weed fertilizers, compost, poultry excreta, farmyard manure and water hyacinth for plant nutrient management without chemical fertilizers. Therefore, it may be recommended that concerned authorities should ensure cattle and/or poultry for each farmer by providing credit for the purpose. Moreover, necessary steps should be taken by the concerned authorities to popularize quick compost/oil cake, green manure and liquid organic fertilizers and specially biofertilizers for pulse crop cultivation.

3. In addition to proper weeding and eradication of insect/disease attacked plants/plant parts the farmers used quality seeds, crop rotation, ash, hand net and putting tree branches in the fields for pest management without using chemical pesticides. Very few farmers used botanical pesticides, beneficial insects and light trap. Nobody used pest resistant varieties for crop cultivation. Therefore, it may be recommended that more motivational work through training, field trip, group discussion, workshop etc. should be organized by the concerned authorities so that the farmers could understand the benefits of using these practices.

4. The farmers cultivated 47.66% of their land with absolute ecological agricultural practices. Therefore, it may be recommended that attempt should be taken by the concerned authorities so that the farmers could be motivated to increase their adoption of selected ecological agricultural practices gradually to cover more area.

5. On the basis of Average Standardized Benefit Index (ASBI), social benefits ranked first followed by technical-cum-economical benefit, environmental benefit and psychological benefit. Among the 25 selected benefit items, increase in the use of local resources ranked first followed by increase of soil microbial activity and fertility; increase of cropping intensity; increase of production of vegetables, fruits and trees etc. Therefore, it may be recommended that motivational programmes should be taken by the concerned authority so that the farmers could perceive all types of benefits of using ecological agricultural practices.

6. Social problem ranked first followed by economical, psychological, technical and marketing problems based on Average Standardized Problem Index (ASPI). Again, on the basis of Standardized Problem Index (SPI) among the 24 selected problem items, lack of farm animal ranked first followed by poor adoption of ecological agriculture by maximum farmers, uncertainty of pest control in case of severe attack, poor plant nutrient in organic manure and other problem items. Therefore, it may be recommended that steps should be taken by the concerned authorities so that the farmers could minimize their problems regarding social, economical, psychological, technical and marketing problems of using ecological agricultural practices. Credit should be provided for buying cattle and/or poultry by the farmers with minimum interest rate. New methods for pest control in case of severe attack and new organic manure with high plant nutrient should be introduced by concerned research organizations.

7. About three-fourth (74 percent) of the farmers had low to medium animal-poultry excreta availability and this characteristic of the farmers had positive significant contribution to their adoption of selected ecological agricultural practices. Animal-poultry excreta might be the main source of organic manure for practicing ecological agriculture. Therefore, it may be recommended that the concerned authorities should pay more attention to provide low interest credit and adequate technical support to the farmers so that they could rear large number of farm animals and poultry birds and ultimately could adopt ecological agricultural practices in a large scale.

8. Most (93 percent) of the farmers had either medium or low individual local contact. Individual contact of the respondent farmers had significant negative contribution to their adoption of selected ecological agricultural practices. Most of the neighbouring farmers/friends/relatives were cultivating crops with chemical inputs, while input dealers were fully in favour of chemical farming and they were the intermediaries of individual local contact. Therefore, it may be recommended that large national and local motivational campaign including training and technical support should be provided by the concerned government

extension providers like Department of Agricultural Extension (DAE), other GOs, NGOs and private extension providers to strengthen their extension delivery mechanism in connection with ecological farming in a larger scale.

9. Most (90 percent) of the respondent farmers of the study areas had very low to low NGO contact, while NGO contact of the farmers had significant positive contribution to their adoption of selected ecological agricultural practices. As the group members of Proshika, the farmers of this study were receiving necessary information about ecological agriculture. Therefore, it may be recommended that concerned NGO should increase the contact with the farmers to bring them into ecological agricultural practices in a larger scale for the ultimate goal of attaining more sustainable agricultural development.

10. An overwhelming majority (83 percent) of the farmers had low to medium training exposure, while training exposure of the farmers had significant positive contribution to their adoption of selected ecological agricultural practices. Training makes a man efficient to perform his job properly. The farmers receiving more training on ecological agriculture or related issues obviously had higher adoption of selected ecological agricultural practices. Therefore, it may be recommended that the concerned authorities should offer necessary training on ecological agriculture and related matters for the farmers to provide current information about ecological agriculture so that they could understand the benefits of ecological agricultural practices and ultimately perform better in adopting the same.

11. A great majority (72 percent) of the farmers had either medium or low ecological agricultural knowledge, while this character of the farmers had significant positive contribution to their adoption of selected ecological agricultural practices. Actually a knowledgeable person could understand the merits and demerits of ecological agriculture easily in a short time and by the training programme of NGOs, the farmers could improve their ecological agricultural knowledge. Therefore, it may be recommended that the concerned authorities should arrange various types of training programme for their target people so that

they could improve their ecological agricultural knowledge in various issues related to ecological farming.

12. An overwhelming majority (90 percent) of the farmers had medium to low favourable attitude towards ecological agriculture, while attitude towards ecological agriculture of the farmers had significant positive contribution to their adoption of selected ecological agricultural practices. Farmers having more favourable attitude towards ecological agriculture would like to adopt the same in a larger scale. Therefore, it may be recommended that the respective authority should arrange motivational programme and necessary training for the farmers so that they could understand the benefits of ecological agricultural practices and develop high favourable attitude towards ecological agriculture.

13. More than half (55 per cent) of the farmers had medium to low risk orientation, while risk orientation of the farmers had significant positive contribution to their adoption of selected ecological agricultural practices. Farmers having more orientation towards risk could adopt ecological agriculture in a larger scale. Therefore, it may be recommended that necessary attempts should be made by the concerned authorities to orient the farmers with various adverse situations so that the farmers could increase their ability of risk orientation.

14. From the evidence of two case studies, it could be recommended that more organic fertilizers having high content of plant nutrients should be introduced by the concerned authorities so that the farmers could use these instead of chemical fertilizers. Again more efficient ecological pest management practices should be introduced so that the farmers could use those practices instead of chemical pesticides.

15. From the observation of case studies, it was also recommended that the concerned authorities should stand in between ecological agriculture and Integrated Crop Management (ICM) so that the yield might not fall, and on the other hand, the environment might be protected. Ecological agricultural practices should be used gradually so that agricultural production system should reach to a sustainable position without disturbing the environment.

16. From the overall situation of existing ecological agricultural practices in the country, it is recommended that for increasing public awareness, mass media, workshops, pilot farms, on-firm trials etc. should play an integrated roles to give priority on this issue in particular.

7.3.2 Recommendations for future study

On the basis of scope and limitations of the present study and the observations made by the researcher, the following recommendations have been made for further study:

1. This study was conducted in selected six upazillas of four districts of Bangladesh, namely, Mymensingh, Tangail, Kishoreganj and Narsingdi. It is recommended that such studies should be conducted in other areas of Bangladesh.
2. Factors of the farmers were many and varied, but in the present study only 25 factors on personal, economical, social and psychological aspects were taken into consideration. Obviously, there are other variables which cause variations in the adoption of ecological agricultural practices. Further research should be conducted involving other variables.
3. There were many and vast subject-matter areas of ecological agriculture like, crops, livestock, fisheries, etc. but in the present study, ecological agriculture related to only crops was considered. Further research is needed in connection with adoption of ecological agriculture related to livestock, fisheries, agro-forestry etc.
4. There were many ecological nutrient management practices for crop production, but only 10 ecological nutrient management practices were considered for this study. Further research is needed to determine the adoption of other ecological nutrient management practices for crop production.
5. There were many ecological pest management practices for crop production, but only 10 ecological pest management practices were considered for this study. Further research is needed to determine the adoption of other ecological pest management practices for crop production.

6. This study identified the social, technical-cum-economical, environmental and psychological benefits of ecological agricultural practices. Further research is needed to identify other benefits of ecological agriculture.
7. This study identified the social, economical, psychological, technical and marketing problems of ecological agricultural practices. Further research is needed to identify other problems of ecological agriculture.
8. This study identified the problems of selected ecological agricultural practices only. Further research is needed to identify and solve other problems of ecological agricultural practices by promoting GOs, NGOs and private extension providers separately.
9. Unlike chemical fertilizers, organic fertilizers usually have low content of plant nutrients. This goes against the use of organic fertilizers. Therefore, research should be conducted to explore organic fertilizers having high content of NPK and other nutrients.
10. In case of severe pest attack, it is difficult to control pest by botanical pesticides or by other ecological pest control practices. Therefore, further research should be conducted to explore better ecological practices having high capacity to control pest at the time of severe attack.

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APPENDIX I

English Version of the Interview Schedule for Data Collection
in connection with PhD Research Programme on Adoption of Selected Ecological Agricultural Practices by the Farmers

Department of Agricultural Extension Education
Bangladesh Agricultural University, Mymensingh

Sl. No: .....

Name of the respondent:
Address:

Upazilla/ADC	District
Muktagacha	Mymensingh
Madhupur	Tangail
Ghatail	
Pakundia	Kishoreganj
Belabo	Narsingdi
Raipura	

Please provide the following information. Your information will be kept restricted and these will be used in research purpose only. Please put tick mark (✓)wherever necessary.

1. Age
How old are you? ---------- years.

2. Education
Please state your educational level.
a) Can not read and write. ☐
b) Can not read and write but can sign only. ☐
c) ☐ class.
d) Did not read in school but can read and write a little. My level of education is equivalent to class ☐

3. Family size/working family size
State the number of your family members

Sex	Number of family members according to age				
	≤6 years	>6 years -12 years	>12 years -18 years	>18 years	Total
Male					
Female					

Total					

4. Effective land possession/cropping intensity

Please furnish the following information about your land area.

Nature of land	Land Possession		Cropped area									
			Single cropped area		Double Cropped area		Triple Cropped area		Net Cropped area		Total Cropped area	
	Local unit	Hectare	Local	Hectare	Local unit	Hectare	Local unit	Hectare	Local unit	Hectare	Local unit	Hectare
Homestead non-agricultural land												
Homestead agricultural land												
Own land under own cultivation												
Land taken from others on lease												
Land taken from others as half-share basis												
Land given to others as half-share basis												
Total												

Cropping intensity: ..... %

5. Animal-poultry excreta availability

Please mention the number of your farm animals and poultry with excreta availability

Name of animal/poultry	Number of animal/poultry	Score	Total score
Buffalo		226	
Cow		187	
Goat		9	
Sheep		9	
Duck		1	
Hen/cock		1	
Total			

6. Annual family income

Please state your annual family income in the previous year.

Sl. No.	Income source	Annual family income (Taka)
1	Agriculture	

2	Farm animals (cow, buffalo, goat, sheep etc.)	
3	Poultry	
4	Fisheries	
5.	Service	
6.	Business	
7.	Others (please specify .....)	
Total		

7. Commercialization

Please mention the following information.

Name of crops		Total yield (Kgs)	Unit price (Tk./Kg)	Value of total yield (Tk.)	Quantity of sold crop (Kgs)	Value of sold crop (Tk)
Agronomic crop	Aus rice					
	Amon rice					
	Boro rice					
	Wheat					
	Jute					
	Sweet potato					
	Pulses					
	Oilseeds					
Spices	Chilli					
	Onion					
	Garlic					
	Turmeric					
	Zinger					
	Coriander					
Vegetables	Potato					
	Papaya					
	Tomato					
	Brinjal					
	Bottle gourd					
	Sweet gourd					
	Cucumin					
	Bean					
	Indian Spinach					
	Red Amaranth					
	Amaranth					
	Spinach					
	Radish					
	Bitter gourd					
	Cabbage					
	Cauliflower					
	Snake gourd					

Name of crops		Total yield (Kgs)	Unit price (Tk./Kg)	Value of total yield (Tk.)	Quantity of sold crop (Kgs)	Value of sold crop (Tk)
	Kakrol					
	Ladies finger					
	Korola					
	Jhinga					
	Dundol					
	Carrot					
	Cucumber					
Others	Pineapple					
	Banana					
	Other fruits					
	Timber					
	Bamboo					
Total						

Commercialization: ..... %

8. Types of crops grown and area coverage under ecological agricultural practices

Please mention the types of crop grown by you in the previous year including area coverage under chemical to ecological agricultural practices.

Name of crops		Area coverage								
		Full chemical practices		Large chemical (≥ 50% of Recommended doses) with less ecological practices		Less chemical (<50% of Recommended doses) with large ecological practices		Full ecological practices		Total land for the crop (ha)
		ha	%x 0.00	ha	%x 0.33	ha	%x 0.67	ha	%x 1.00	
Agronomic crops	Aus rice									
	Amon rice									
	Boro rice									
	Wheat									
	Jute									
	Sweet potato									
	Pulses									
	Oilseeds									
Spices	Chilli									
	Onion									
	Garlic									
	Turmeric									
	Zinger									
	Coriander									
Vegetables	Potato									
	Papaya									
	Tomato									
	Brinjal									
	Bottle gourd									
	Sweet gourd									
	Cucumin									
	Bean									

Name of crops		Area coverage								
		Full chemical practices		Large chemical (≥ 50% of Recommended doses) with less ecological practices		Less chemical (<50% of Recommended doses) with large ecological practices		Full ecological practices		Total land for the crop (ha)
		ha	%x 0.00	ha	%x 0.33	ha	%x 0.67	ha	%x 1.00	
	Indian Spinach									
	Red amaranth									
	Amaranth									
	Spinach									
	Radish									
	Bitter gourd									
	Cabbage									
	Cauliflower									
	Snake gourd									
	Kakrol									
	Ladies finger									
	Korola									
	Jhinga									
	Dundol									
	Carrot									
	Cucumber									
Others	Pineapple									
	Banana									
	Other fruits									
	Timber									
	Bamboo									
Grand Total										

9. Adoption of selected ecological agricultural practices

Please mention the extent of your adoption of the following selected ecological agricultural practices in the previous year.

Ecological agricultural practices	Usable land (hac.)	Used land								Total score
		Not at all use		less use with large amount of chemical (≥50% of Recommended doses)		Large use with less amount of chemicals (<50% of Recommended doses)		Full use without any chemicals		
		ha	%x0.00	ha	%x0.33	ha	%x0.67	ha	%x1.00	
Nutrient management without chemical fertilizers										
1. Cowdung										
2. Poultry excreta										
3. Farm yard manure										
4. Compost										
5. Quick compost /Oil cake										
6. Liquid organic fertilizers										

7. Water hyacinth										
8. Green manure										
9. Crop residence/ weed fertilizer										
10. Biofertilizer										
Pest management without chemical pesticides										
1. Pest control by hand/hand net										
2. Putting tree branches in the field										
3. Light trap										
4. Botanical pesticides (neem, nishinda, biskatali, garlic extract etc.)										
5. Use of quality seed										
6. Pest control by ash										
7. Beneficial insects										
8. Pest resistant varieties										
9. Crop rotation										
10. Proper weeding and eradication of insect/disease attacked plants/ plant parts										

10. Credit need

Did you have any need for credit last in the previous year? Yes ( ) No ( )
If yes, mention the amount of credit need. Tk. .....
If you received any credit please provide the following information.

Source of credit	Amount of money (Tk.)
a) Merchant/creditor/money-lender	
b) Relatives	
c) Bank	
d) NGO (.....)	
e) Others (please specify .....)	
Total	

11. Marketing opportunity

Please give information about the extent of your facilities in connection with purchase of agricultural inputs, sale and storage of agricultural produces along with transportation facilities.

Items	Degree of facilities				
Buying price of agricultural inputs	Very low ( )	Low ( )	Medium ( )	High ( )	Very high ( )
Selling price of agricultural produces	Very high ( )	High ( )	Medium ( )	Low ( )	Very low ( )
Storage facilities of agricultural produces	Very good ( )	Good ( )	Medium ( )	Bad ( )	Very bad ( )
Transportation of produces	Very good ( )	Good ( )	Medium ( )	Bad ( )	Very bad ( )

12. Cosmopoliteness

Please state the extent of your visit in the following places in the previous year.

Places of visit	Extent of visit with weights for frequencies				
	4	3	2	1	0
1. House of relatives/friends outside own village	>6 times /month ( )	5-6 times /month ( )	3-4 times /month ( )	1-2 times /month ( )	Not at all ( )
2. Local Hat/Bazar (Market)	>12 times /month ( )	9-12 times /month ( )	5-8 times /month ( )	1-4 times /month ( )	Not at all ( )
3. Own Upazila headquarter	>6 times /month ( )	5-6 times /month ( )	3-4 times /month ( )	1-2 times /month ( )	Not at all ( )
4. Other Upazilas	>12 times /year ( )	9-12 times /year ( )	5-8 times /year ( )	1-4 times /year ( )	Not at all ( )
5. Own District town	>12 times /year ( )	9-12 times /year ( )	5-8 times /year ( )	1-4 times /year ( )	Not at all ( )
6. Other District (except Divisional city),	>6 times /year ( )	5-6 times /year ( )	3-4 times /year ( )	1-2 times /year ( )	Not at all ( )
7. Divisional/Capital city,	>6 times /year ( )	5-6 times /year ( )	3-4 times /year ( )	1-2 times /year ( )	Not at all ( )
8. Foreign country	>3 times /life ( )	3 times /life ( )	2 times /life ( )	1time /life ( )	Not at all ( )

13. Individual local contact

Please state the extent of your contact with the following local individuals.

Individuals	Extent of contact with weights for frequencies				
	4	3	2	1	0
1. Neighbour farmers/ friends/relatives	>6 times /month ( )	5-6 times /month ( )	3-4 times /month ( )	1-2 times /month ( )	Not at all ( )
2. Group leaders	>6 times /month ( )	5-6 times /month ( )	3-4 times /month ( )	1-2 times /month ( )	Not at all ( )
3. Input dealers	>6 times /quarter ( )	5-6 times /quarter ( )	3-4 times /quarter ( )	1-2 times /quarter ( )	Not at all ( )

14. NGO contact

Please state the extent of your contact with the following NGO personnel.

NGO personnel	Extent of contact with weights for frequencies				
	4	3	2	1	0
1. Unit level NGO Workers	>6 times /quarter ( )	5-6 times /quarter ( )	3-4 times /quarter ( )	1-2 times /quarter ( )	Not at all ( )
2. ADC Level NGO Workers	>6 times /six months ( )	5-6 times /six months ( )	3-4 times /six months ( )	1-2 times /six months ( )	Not at all ( )
3. Central NGO personnel	>6 times /year ( )	5-6 times /year ( )	3-4 times /year ( )	1-2 times /year ( )	Not at all ( )

15. GO Contact

Please state the extent of your contact with the following GO personnel.

GO personnel	Extent of contact with weights for frequencies				
	4	3	2	1	0
1. Sub Assistant Agriculture Officers	>6 times /quarter ( )	5-6 times /quarter ( )	3-4 times /quarter ( )	1-2 times /quarter ( )	Not at all ( )
2. Upazilla level Agriculture Officers	>6 times /six months ( )	5-6 times /six months ( )	3-4 times /six months ( )	1-2 times /six months ( )	Not at all ( )
3. District or above Level Agricultural Officers	>6 times /year ( )	5-6 times /year ( )	3-4 times /year ( )	1-2 times /year ( )	Not at all ( )

16. Group contact

Please state the extent of your contact with the group media.

Media	Extent of contact with weights for frequencies				
	4	3	2	1	0
1. Group meeting	>6 times /quarter ( )	5-6 times /quarter ( )	3-4 times /quarter ( )	1-2 times /quarter ( )	Not at all ( )
2. Farmers' field day	>6 times /life ( )	5-6 times /life ( )	3-4 times /life ( )	1-2 times /life ( )	Not at all ( )
3. Method demonstration meeting	>6 times /life ( )	5-6 times /life ( )	3-4 times /life ( )	1-2 times /life ( )	Not at all ( )
4. Result demonstration meeting	>6 times /life ( )	5-6 times /life ( )	3-4 times /life ( )	1-2 times /life ( )	Not at all ( )

17. Mass contact

Please state the extent of your contact with the mass media.

Media	Extent of contact with weights for frequencies				
	4	3	2	1	0
1. Radio	>6 times /week ( )	5-6 times /week ( )	3-4 times /week ( )	1-2 times /week ( )	Not at all ( )
2. Television	>6 times /week ( )	5-6 times /week ( )	3-4 times /week ( )	1-2 times /week ( )	Not at all ( )

Media	Extent of contact with weights for frequencies				
	4	3	2	1	0
3. Daily newspapers	>6 times /week ( )	5-6 times /week ( )	3-4 times /week ( )	1-2 times /week ( )	Not at all ( )
4. Leaflet/folder	>6 times /year ( )	5-6 times /year ( )	3-4 times /year ( )	1-2 times /year ( )	Not at all ( )
5. Booklets/ agricultural magazines	>6 times /year ( )	5-6 times /year ( )	3-4 times /year ( )	1-2 times /year ( )	Not at all ( )
6. Film show	>6 times /life ( )	5-6 times /life ( )	3-4 times /life ( )	1-2 times /life ( )	Not at all ( )
7. Agricultural fair	>6 times /life ( )	5-6 times /life ( )	3-4 times /life ( )	1-2 times /life ( )	Not at all ( )

18. Training exposure

Did you receive any kind of agricultural/ecological agricultural training in the last five years?

Yes ☐ No ☐

If yes please furnish the following information

SL. No.	Title of training course	Duration (days)	Conducting organization and place
1			
2			
3			
4			
5			
Total			

19. Decision making ability

Please mention the extent of your decision making ability by putting tick mark (√) in appropriate column.

Items of decision making	Extent of decision making		
	Able to make self decision	Able to make decision with family members	Able to make decision with outsiders of the family
a) Adoption agricultural technology	( )	( )	( )
b) Buying of agricultural inputs	( )	( )	( )
c) Selling of agricultural products	( )	( )	( )

d) Family affairs	( )	( )	( )
d) Education of children	( )	( )	( )
e) Participation in social activities	( )	( )	( )

20. Benefit obtained from ecological agriculture

Please mention the extent of our benefit from ecological agriculture as perceived by you in connection with the following items.

Items of benefit	Extent of benefit obtained			
	Large benefit	Moderate benefit	Less benefit	Not at all benefit
Social benefits				
1. Development of knowledge and skill				
2. Development of organizational participation and extension contact				
3. Development of employment opportunity				
4. Development of participation in meeting and training				
5. Development of counseling ability				
6. Development of decision making ability				
Environmental benefits				
7. Decrease of air and water pollution				
8. Development of human health environment				
9. Development of environment for animal and bird health				
10. Decrease of crop pest				
11. Increase of beneficial insects, earth worm, frog etc.				
Technical & economic benefits				
12. Increase of integrated crop management				
13. Increase of cropping intensity				
14. Increase in the use of local resources				
15. Increase of soil microbial activity and fertility				
16. Increase of production of vegetables, fruits and trees				
17. Increase of poultry rearing				
18. Increase of cow and goat rearing				
19. Increase of fish culture				
20. Decrease of production cost				
21. Increase of product quality				
22. Decrease of human diseases				
Psychological benefits				
23. Positive development of human				

Items of benefit	Extent of benefit obtained			
	Large benefit	Moderate benefit	Less benefit	Not at all benefit
conduct				
24. Development of social norms and values				
25. Positive development of human food habit				

21. Ecological agricultural knowledge

Please answer the following questions.

Item No.	Items of Ecological Agricultural Knowledge Test
Remembering	
1.a	Which of the following is beneficial insect? ☐ Lady bird beetle ☐ Fruit and shoot borer ☐ Aphid
1.b	Which of the following is green manuring crop? ☐ Maize ☐ Dhancha ☐ Mustard
1.c	Which of the following is the best component for compost? ☐ Water hyacinth ☐ Oil cake ☐ Cowdung
1.d	Which of the following is botanical pesticide? ☐ Tobacco extract ☐ Mango seed extract ☐ Azola
Understanding	
2.a	Which is the cause for increasing air pollution? ☐ Use of chemical fertilizer and pesticides in the crop field ☐ Use of organic manure and botanical pesticides in the crop field ☐ Both of the above
2.b	How can you produce ecological agricultural crops? ☐ By using chemical fertilizer and pesticides in the crop field ☐ By using organic manure and botanical pesticides in the crop field ☐ Don't know
2.c	Why rice produces higher yield if it is cultivated after pulse cultivation? ☐ Nodules formed in the root of pulse crops add nitrogen in the soil ☐ Nodules formed in the root of pulse crops add phosphorus in the soil ☐ Nodules formed in the root of pulse crops add potash in the soil
2.d	What nutrient adds to soil from the nodules formed in root of bean and the nutrient works as the substitute of what type of fertilizer? ☐ Nitrogen, which is the substitute of urea fertilizer ☐ Phosphorus, which is the substitute of TSP fertilizer ☐ Potash, which is the substitute of MP fertilizer
Applying	

3.a	How insects can be controlled by light trap? ☐ By killing flying insects accumulated in the light trap ☐ All types of insects can accumulate in the light trap, then these should be killed ☐ No insect can be controlled by light trap
3.b	How mulching can help in crop cultivation? ☐ Protect temperature ☐ Protect moisture ☐ Both
3.c	When green manuring crops are to be mixed in the soil? ☐ At seeding stage ☐ Before flowering stage ☐ At adult stage
3.d	How bio-fertilizers are used? ☐ By mixing with other fertilizers ☐ By mixing with seeds ☐ None of the above
Analyzing	
4.a	It is becoming hard to control pest even after use of high doses of chemical pesticides, why? ☐ Pests are becoming resistant to chemical pesticides ☐ Impure pesticides ☐ Both of the above
4.b	Soils of Bangladesh are becoming hard nowadays, why? ☐ Excess use of chemical fertilizers ☐ Use of manures ☐ Both of the above
4.c	Why fish species are decreasing day by day? ☐ Use of chemical fertilizers and pesticides in the crop field ☐ Use of manure in the crop field ☐ None of the above
4.d	How beneficial insects can help in agriculture? ☐ By eating harmful insects ☐ Help in pollination ☐ Both of the above
Evaluating	
5.a	What is the demerit of using chemical fertilizer in the crop field? ☐ Create toxicity in the soil ☐ Decrease soil microbial activity ☐ Both of the above
5.b	What is the demerit of using chemical pesticide in the crop field? ☐ Create toxicity in the soil ☐ Decrease soil microbial activity ☐ Both of the above
5.c	What is the advantage of crop rotation? ☐ Increase soil fertility ☐ Decrease pest attack ☐ Both
5.d	What is the demerit of decreasing of trees and plants? ☐ Create environmental pollution ☐ Decrease crop productivity

	☐ Both of the two
Creating	
6.a	How can you control aphid from bean field? ☐ By applying ash on the bean plant ☐ By putting bamboo in the field ☐ By putting tree branches in the field
6.b	How can you increase soil fertility? ☐ By using manure in the field ☐ By using only chemical fertilizers in the field ☐ None of the above
6.c	What do you do with the crop residues and weeds? ☐ It is mixed in the soil as fertilizers ☐ It is thrown to other places without any use ☐ It is used as fuel
6.d	How can you control virus diseases of crops? ☐ By eradication and destruction of virus attacked plants ☐ By spraying pesticides ☐ None of the above

22. Problems faced in ecological agriculture

Please indicate the extent of problems faced by you in ecological agriculture

Items of problem	Extent of problem faced			
	Large Problem	Moderate problem	Less problem	Not at all problem
Social problems				
1. Lack of information and publicity				
2. Lack of proper organization				
3. Poor extension service				
4. Poor adoption of ecological agriculture by maximum farmers				
Technical problems				
5. Difficult to collect ingredients of compost and to prepare it				
6. Difficult to prepare green manure				
7. Difficult to collect ingredients of botanical pesticide and to prepare it				
8. Difficult to prepare light trap				
9. Difficult to maintain crop rotation				
10. Poor plant nutrient in organic manure				
11. Uncertainty of pest control in case of severe attack				
Economic problems				
12. Lack of farm animal				

Items of problem	Extent of problem faced			
	Large Problem	Moderate problem	Less problem	Not at all problem
13. Low production				
14. Need excess time				
15. Need excess labour				
16. Lower price of organic product				
Marketing problems				
17. Poor and inadequate roads for transportation				
18. Difficult to move to a distance place				
19. Lack of proper transport				
20. Undesirable involvement of middle men				
21. Lack of storage facilities				
Psychological problems				
22. Criticism from family members				
23. Criticism from relatives and neighbouring farmers				
24. Criticism from fertilizer and pesticide dealers				

23. Attitude towards ecological agriculture

Please state your degree of agreement with the following statements

Sl. No.	Statements	Extent of agreement				
		Strongly agree	Agree	Undecided	Disagree	Strongly disagree
+1	Despite problems in ecological agriculture, it is better for crop production.					
-2	Ecological pest control is difficult and non-profitable to farmers.					
+3	Most of the pest can be controlled by clean cultivation.					
-4	The use of chemical fertilizers in crop field should not be reduced.					
+5	Farmers should not hesitate to participate in ecological agricultural practices.					
-6	Ecological agriculture is not profitable in relation to crop production.					

-7	Benefits of chemical fertilizer are larger than its harmful effects.					
-8	It is not possible to get high production by using organic manures only.					
+9	Water is being polluted by using chemical pesticide which is harmful to fishes.					
-10	Without use of chemical pesticides, it is not possible to get good quality crops.					
+11	It is not logical to use chemical fertilizers though it is necessary for present high production.					
+12	Human diseases are increasing due to increased use of chemical fertilizers.					

24. Aspiration

Please state your level of aspiration on the following items by putting tick mark (√) in appropriate column.

Aspiration statements	Extent of aspiration				
1. What level you expect your sons to reach in their education?	No education ( )	Primary level ( )	Secondary level ( )	Higher Secondary level ( )	Graduate or above level ( )
2. What level you expect your daughters to reach in their education?	No education ( )	Primary level ( )	Secondary level ( )	Higher Secondary level ( )	Graduate or above level ( )
3. What level you expect your sons to reach in their occupation?	Own occupation ( )	Improved cultivation ( )	Small business or service ( )	Big business/ good service/ respectable occupation ( )	Most respectable service/ occupation ( )
4. What is your aspiration in respect to increase your own land in the next three years?	None ( )	≤ 25% ( )	>25% to 50% ( )	>50% to 75% ( )	> 75% ( )
5. What is your aspiration in respect to increase your crop production in the next three years?	None ( )	≤ 25% ( )	>25% to 50% ( )	>50% to 75% ( )	> 75% ( )
6. What is your expectation with regard to purchase of agricultural implements/machines in the next three years?	None ( )	Small agricultural implements ( )	Thresher ( )	Shallow tube well ( )	Power tiller ( )
7. What is your aspiration in respect to increase your income in the next three years?	None ( )	≤ 25% ( )	>25% to 50% ( )	>50% to 75% ( )	> 75% ( )
8. What is your	None	Slight	One tin roof	One	More than

Aspiration statements	Extent of aspiration				
aspiration with regard to house alteration or construction in the next three years?	( )	improvement of present house ( )	house ( )	building/ more than one tin roof houses ( )	one building ( )
9. What your expectation with regards to purchase of recreational instruments in the next three years?	None ( )	Radio ( )	Two-in-one/ cassette player ( )	Television ( )	Television with VCP ( )
10. What level/post you expect to reach in your group or higher coordination committee in the next three years?	None ( )	Executive officer of Primary group ( )	Executive officer ofVillage coordination committee ( )	Executive officer ofUnion coordination committee ( )	Executive officer of above union coordination committee ( )

25. Risk orientation

Please state your degree of agreement with the following statements

Sl. No.	Statements	Extent of agreement				
		Strongly agree	Agree	Undecided	Disagree	Strongly disagree
+1	A farmer who is willing to take greater risk than the average farmers usually does better financially.					
+2	A farmer should grow more crops to avoid greater risk instead of growing one or two crops.					
-3	I think a farmer will be looser if he adopts new and uncertain technology.					
-4	It is better for a farmer to adopt new farming method after most others have used them with success.					
+5	I want to adopt new farming method though it has risk and uncertainty.					
-6	It is good for a farmer to take risks when he knows his chance of success is fairly high.					
+7	Trying a new method in farming by a farmer involves risk but it should be appreciated.					
-8	Farmers should be satisfied with what they have than taking risk.					
+9	A farmer must take risk if he wants to adopt good technology as there is risk in every sphere of life.					

Sl. No.	Statements	Extent of agreement				
		Strongly agree	Agree	Undecided	Disagree	Strongly disagree
+10	A farmer should take risk if he wants to develop his economic status.					
-11	To take risk for the hope of greater benefit is a sign of foolishness.					
+12	"One can't prosper in life without taking risk"- I agree with this statement.					

Thank your for your cooperation.

_____
Signature of the Interviewer
Date:

APPENDIX II

Letter from the Head, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh, to the the Head, Division of Agricultural Extension, Indian Agricultural Research Institute, New Delhi; Head, Department of Agricultural Extension, Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India and others seeking necessary help and co-operation to the researcher in connection with PhD research work

From
Professor Md. Afzal Hossain
Head
Department of Agricultural Extension Education
Bangladesh Agricultural University
Mymensingh, Bangladesh

Date: 11.09.2005

To
.....
.....
.....

Dear Sir

My best regards to you. I would like to introduce Mr. Md. Sekender Ali, an Assistant Professor, Department of Agricultural Extension & Information System, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh. Now he is a Ph.D. student of the Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh, Bangladesh. He has been doing his Ph.D. research work under the Supervision of Professor Dr. A. S. M. Ziaul Karim of this Department. He is working on "Adoption of Selected Ecological Agricultural Practices by the Farmers". He has already prepared a tentative research proposal and draft interview schedule for his study. Now it is necessary to improve his research instruments. I think your valuable advice, comments, criticisms and constructive suggestions as well as library consultation and literature review in your institute would definitely improve the quality of his study.

I would be very happy if you kindly provide him necessary administrative support including access to library facilities for literature review and dormitory facility in your institution. He will bear necessary expenditure.

Thank you very much in advance for your anticipated co-operation.

Sincerely yours.

Professor Md. Afzal Hossain
Head

APPENDIX III

Interview Guide for Conducting the Case Studies

For case study-I (Ecological Farmer of Proshika):

Department of Agricultural Extension Education
Bangladesh Agricultural university, Mymensingh

Name of the respondent:
Address:

Please provide information regarding the following aspects. Your information will be kept restricted and these will be used for research purpose only.

1. How many years you are involved with Proshika activities?
2. Mention your income generating activities.
3. How many years you are practising ecological agriculture as suggested by Proshika?
4. Mention your level of satisfaction with ecological agricultural practices
   - personal level:
   - family level:
   - social level:
5. Give a Briefing about your successful works.
6. Compare your present financial condition with previous one.
7. Mention your changes of assets after adopting ecological agricultural practices
8. Compare your present social status with previous one.
9. What measures do you use for plant nutrient?
10. How do you control harmful insects for crop production?
11. How do you control plant diseases?
12. How do you control weeds?
13. Provide your opinion on "every farmer should adopt ecological agricultural practices".
14. Why most of the farmers are not adopting ecological agricultural practices?
15. Please explain about ecological agriculture with its merits and demerits.

Thank you for your cooperation.

Signature of the interviewer with date:

For case study-II (IFS Farmer of DAE):

Department of Agricultural Extension Education
Bangladesh Agricultural university, Mymensingh

Name of the respondent:
Address:

Please provide information regarding the following aspects. Your information will be kept restricted and these will be used in research purpose only.

1. How many years you are involved with DAE activities?
2. Mention your income generating activities.
3. How many years you are practising IPM and IPNS as suggested by DAE?
4. Mention your level of satisfaction with IPM and IPNS.
   - personal level:
   - family level:
   - social level:
5. Give a briefing about your successful works.
6. Compare your present financial condition with previous one.
7. Mention your changes of assets after adopting IPM and IPNS.
8. Compare your present social status with previous one.
9. What measures do you use for plant nutrient?
10. How do you control harmful insects for crop production?
11. How do you control plant diseases?
12. How do you control weeds?
13. Provide your opinion on "every farmer should adopt IPM and IPNS".
14. Why most of the farmers are not adopting IPM and IPNS?
15. Please explain about IPM and IPNS with their merits and demerits.

Thank you for your cooperation.

Signature of the interviewer with date:

APPENDIX IV
Format of Register Book for Conducting the Case Studies

Please record your activities for plant nutrient and pest management in this book.
Name of the farmer:
Address:

Date of use	Name of crop	Land size	Plant nutrient management				Crop pest management			
			Use of chemical fertilizers		Use of non-chemical practices		Use of chemical pesticides		Use of non-chemical practices	
			Name	Quantity	Name	Quantity	Name	Quantity	Name	Quantity

Signature of the farmer with submission date:

APPENDIX V

Pre-test Items of Ecological Agricultural Knowledge Test

Item No.	Items of Ecological Agricultural Knowledge Test
Remembering	
1.a	Which of the following is beneficial insect? ☐ Lady bird beetle ☐ Fruit and shoot borer ☐ Aphid
1.b	Which of the following is green manuring crop? ☐ Maize ☐ Dhancha ☐ Mustard
1.c	Which of the following is the best component for compost? ☐ Water hyacinth ☐ Oil cake ☐ Cowdung
1.d	Which of the following is botanical pesticide? ☐ Tobacco extract ☐ Mango seed extract ☐ Azola
1.e	Which of the following is tungro virus resistant rice variety? ☐ BR29 ☐ Chandina ☐ Mala
1.f	Which of the following is necessary to prepare bio-fertilizer? ☐ General soil ☐ Nutrient fixing bacteria ☐ Alcohol
Understanding	
2.a	Which is the cause for increasing water pollution? ☐ Use of chemical fertilizer and pesticides in the crop field ☐ Use of organic manure and botanical pesticides in the crop field ☐ Both of the above
2.b	Which is the cause for increasing air pollution? ☐ Use of chemical fertilizer and pesticides in the crop field ☐ Use of organic manure and botanical pesticides in the crop field ☐ Both of the above
2.c	How azola can help in rice cultivation? ☐ Add nitrogen in the soil ☐ Don't add any nutrient in the soil ☐ Don't know
2.d	How can you produce ecological agricultural crops? ☐ By using chemical fertilizer and pesticides in the crop field ☐ By using organic manure and botanical pesticides in the crop field ☐ Don't know
2.e	Why rice produces higher yield if it is cultivated after pulse cultivation? ☐ Nodules formed in the root of pulse crops add nitrogen in the soil ☐ Nodules formed in the root of pulse crops add phosphorus in the soil ☐ Nodules formed in the root of pulse crops add potash in the soil
2.f	What nutrient adds to soil from the nodules formed in root of bean and the nutrient works as the substitute of what type of fertilizer? ☐ Nitrogen, which is the substitute of urea fertilizer ☐ Phosphorus, which is the substitute of TSP fertilizer

	☐ Potash, which is the substitute of MP fertilizer
Applying	
3.a	How insects can be controlled by light trap? ☐ By killing flying insects accumulated in the light trap ☐ All types of insects can accumulate in the light trap, then these should be killed ☐ No insect can be controlled by light trap
3.b	How mulching can help in crop cultivation? ☐ Protect temperature ☐ Protect moisture ☐ Both
3.c	When green manuring crops are to be mixed in the soil? ☐ At seeding stage ☐ Before flowering stage ☐ At adult stage
3.d	How bio-fertilizers are used? ☐ By mixing with other fertilizers ☐ By mixing with seeds ☐ None of the above
3.e	Bio-fertilizers can be used in which types of crops? ☐ Pulse crops ☐ Rice ☐ Maize
3.f	How can you apply azola in the rice field? ☐ By mixing in the soil after growing in the rice field ☐ By spraying ☐ Don't know
Analyzing	
4.a	Why soil fertility is decreasing nowadays? ☐ Excess use of chemical fertilizers ☐ Use of manure ☐ Less use of chemical fertilizers
4.b	For same amount of production ☐ doses of chemical fertilizers are to be increased each year ☐ doses of chemical fertilizers are to be same each year ☐ doses of chemical fertilizers are to be decreased each year
4.c	It is becoming hard to control pest even after use of high doses of chemical pesticides, why? ☐ Pests are becoming resistant to chemical pesticides ☐ Impure pesticides ☐ Both of the above
4.d	Soils of Bangladesh are becoming hard nowadays, why? ☐ Excess use of chemical fertilizers ☐ Use of manures ☐ Both of the above
4.e	Why fish species are decreasing day by day? ☐ Use of chemical fertilizers and pesticides in the crop field ☐ Use of manure in the crop field ☐ None of the above
4.f	How beneficial insects can help in agriculture? ☐ By eating harmful insects ☐ Help in pollination

	☐ Both of the above
Evaluating	
5.a	What is the demerit of using chemical fertilizer in the crop field? ☐ Create toxicity in the soil ☐ Decrease soil microbial activity ☐ Both of the above
5.b	What is the demerit of using chemical pesticide in the crop field? ☐ Create toxicity in the soil ☐ Decrease soil microbial activity ☐ Both of the above
5.c	What is the advantage of crop rotation? ☐ Increase soil fertility ☐ Decrease pest attack ☐ Both
5.d	What is the demerit of decreasing of trees and plants? ☐ Create environmental pollution ☐ Decrease crop productivity ☐ Both of the two
5.e	What is the effect of inter cropping? ☐ Increase production ☐ Decrease production ☐ None of the two
5.f	What is the benefit of vermicompost? ☐ Earth worm works as natural plough ☐ There is no benefit of vermicompost ☐ Don't know
Creating	
6.a	How can you increase soil microbial activity? ☐ By using organic manure in the field ☐ By using chemical fertilizers in the field ☐ None of the above
6.b	How can you control aphid from bean field? ☐ By applying ash on the bean plant ☐ By putting bamboo in the field ☐ By putting tree branches in the field
6.c	How can you increase soil fertility? ☐ By using manure in the field ☐ By using only chemical fertilizers in the field ☐ None of the above
6.d	What do you do with the crop residues and weeds? ☐ It is mixed in the soil as fertilizers ☐ It is thrown to other places without any use ☐ It is used as fuel
6.e	How can you control virus diseases of crops? ☐ By eradication and destruction of virus attacked plants ☐ By spraying pesticides ☐ None of the above
6.f	How can you control insect by mechanical method? ☐ By killing insect after collection

☐

	By using ash in the field ☐ None of the above

APPENDIX VI

Difficulty Indices and Discrimination Indices of the 36 Items of Ecological Agricultural Knowledge Test

Sl.No. of Items	Frequencies of correct answers given by each group of respondents (each group containing 8 farmers)						Total frequencies of (N=24)		Difficulty index (P)	Discrimination Index ($E^{1/3}$)
	G_1	G_2	G_3	G_4	G_5	G_6	correct answers	Wrong answers		
1.a	2	2	2	2	2	1	11	13	54.17*	0.125*
1.b	4	4	3	3	3	3	20	4	16.67*	0.250*
1.c	2	2	4	3	2	1	14	10	41.67*	0.125*
1.d	4	4	2	2	3	2	17	7	29.17*	0.375*
1.e	2	1	0	0	0	0	3	21	87.50	0.375
1.f	0	1	0	0	0	0	1	23	95.83	0.125
2.a	4	4	4	3	4	4	23	1	4.17	0.000
2.b	4	4	4	3	1	1	17	7	29.17*	0.750*
2.c	0	1	0	0	1	0	2	22	91.66	0.000
2.d	4	4	4	4	1	1	18	6	25.00*	0.750*
2.e	3	3	0	0	0	0	6	18	75.00*	0.750*
2.f	4	3	1	1	0	0	9	15	62.50*	0.875*
3.a	3	3	2	2	2	1	13	11	45.83*	0.375*
3.b	3	3	4	4	1	0	15	9	37.50*	0.625*
3.c	4	4	3	3	3	3	20	4	16.67*	0.250*
3.d	2	1	0	0	1	0	4	20	83.33*	0.250*
3.e	2	1	0	0	0	0	3	21	87.50	0.375
3.f	0	1	0	0	1	0	2	22	91.67	0.000
4.a	4	4	4	4	3	2	21	3	12.50	0.375
4.b	4	4	4	4	3	2	21	3	12.50	0.375
4.c	1	1	2	2	1	0	7	17	70.83*	0.125*
4.d	1	1	2	1	1	0	6	18	75.00*	0.125*
4.e	2	2	1	1	1	0	7	17	70.83*	0.375*
4.f	4	3	4	3	3	3	20	4	16.67*	0.125*
5.a	4	3	3	3	1	0	14	10	41.67*	0.750*
5.b	3	2	2	1	1	0	9	15	62.50*	0.500*
5.c	3	3	3	2	1	1	13	11	45.83*	0.500*
5.d	3	2	4	3	0	0	12	12	50.00*	0.625*
5.e	2	2	1	1	2	2	10	14	58.33	0.000
5.f	4	4	3	3	4	3	21	3	12.50	0.125
6.a	4	4	4	4	4	3	23	1	4.17	0.125
6.b	3	3	3	3	3	2	17	7	29.17*	0.125*
6.c	3	3	1	1	0	0	8	16	66.67*	0.750*
6.d	3	2	3	2	1	0	11	13	54.17*	0.500*
6.e	3	3	4	4	3	2	19	5	20.83*	0.125*
6.f	2	2	2	2	2	2	12	12	50.00	0.000

* Items selected for the study

APPENDIX VII

Letter to Judges from the Thesis Supervisor of this research for Judgments of 30 statements of Attitude Scale together with the 9-point continuum against each of the statements

From Date: 27.12.2005
Dr. A.S.M. Ziaul Karim
Professor, Department of Agricultural Extension Education
Bangladesh Agricultural University, Mymensingh

To
.....
.....

Subject: **Construction of Scale for Attitude towards Ecological Agriculture**

Dear Sir

This is in connection with the study of one of my Ph.D. student, Mr. Md. Sekender Ali. He has undertaken a research study on "Adoption of Ecological Agricultural Practices by the Farmers".

Probably, you will agree with me that ecological agriculture constitutes the agricultural practices without using any chemicals like chemical fertilizers and chemical pesticides. The anti-natural agricultural practices degrade the soil and ecological balance in many ways resulting poor output. The anti-natural agricultural practices increase the cost of production in one hand and decrease the microbial activities in the soil, on the other, which creates new hazardous situation in the entire crop production system including health hazards. In this connection, it can be said that the lands, water, and animal resources on earth have already been damaged to a great extent.

This study requires suggestions from Judges for selection of items/statements for measuring farmers' attitude towards ecological agriculture. This would be very helpful to design and prepare research instrument for the study. In this regard, I have the pleasure to inform you that you have been selected as one of the Judges for selecting and rating of attitude statements. In order to enable you to offer your valuable suggestions, a list of statements on farmers' attitudes towards ecological agricultural practices have been enclosed. These statements may please be viewed with reference to ecological agriculture. Here, it may be mentioned that it will also be highly appreciated if you include statements on farmers' attitude towards ecological agriculture. Please return this material back at your earliest convenience after completing the work.

With personal regards

Sincerely yours,

Dr. A.S.M. Ziaul Karim
Professor

Enclosed:
1. Instruction for rating

Judge/Expert No. .....

Instruction for rating

Please rate the extent of suitability of the following statements regarding the farmers' attitude towards ecological agricultural practices. Please mention the numbers by putting tick (√) mark against each appropriate column.

Sl. No.	Statements	Least suitable								Most suitable
		1	2	3	4	5	6	7	8	9
-1	There are risks in ecological agriculture.									
-2	Ecological agriculture is not profitable in relation to crop production.									
+3	Ecological agriculture is suitable for all types of farmers.									
-4	Income from cultivation through ecological agricultural practices does not compensate the trouble taken.									
+5	Farmers should not hesitate to participate in ecological agricultural practices.									
-6	It is not possible to get high production by using organic manures.									
-7	Chemical fertilizer is necessary for high production.									
+8	The rate of chemical fertilizers is to be increased year after year for the same production.									
+9	Human diseases are increasing due to increased use of chemical fertilizers.									
+10	Despite problems in ecological agriculture, it is better for crop production.									
-11	Benefits of chemical fertilizer are larger than its harmful effects.									
+12	Pests develop resistance by continuous use of chemical pesticides.									
+13	Chemical fertilizer is harmful to soil or environment.									
+14	Ecological agriculture helps the farmers to increase their knowledge about improved methods of soil nutrient management.									
-15	The food problem of our country can be									

Sl. No.	Statements	Least suitable							Most suitable
		1	2	3	4	5	6	7	8	9
	solved by using chemical fertilizers.									
-16	The use of chemical fertilizers in crop field should not be reduced.									
-17	It is profitable to use chemical pesticides.									
-18	Without use of chemical pesticides, it is not possible to get good quality crops.									
+19	Beneficial insects and frogs are decreasing day by day due to use of chemical pesticides.									
-20	There is no alternative of using chemical pesticides to protect crops from pest attack.									
+21	Water is polluted by using chemical pesticides which is harmful to fishes.									
-22	Benefits of chemical pesticides are larger than its harmful effects.									
+23	Light is a good method to control flying insects.									
+24	Most of the pest can be controlled by clean cultivation.									
-25	Ecological pest control is hard and non-profitable to farmers.									
+26	It is not logical to use chemical fertilizer though it is necessary for present high production.									
-27	Production cost is not high in using chemical pesticides.									
+28	Chemical pesticides are harmful to soil or environment.									
+29	Ecological agriculture helps the farmers to increase their knowledge about improved methods of plant protection.									
-30	Crops are prone to disease and pest, which can not be controlled easily by ecological agricultural practices.									

_____

Signature of the Judge/Expert with date
Address:

APPENDIX - VIII

Scale-values and Q-values of 30 Statements of Attitude towards Ecological Agriculture

Sl. No.	Statements	Scale-values	Q-values
-1	There are risks in ecological agriculture.	5.30	5.21
-2	Ecological agriculture is not profitable in relation to crop production.	7.14*	3.25*
+3	Ecological agriculture is suitable for all types of farmers.	6.17	4.59
-4	Income from cultivation through ecological agricultural practices does not compensate the trouble taken.	5.50*	3.46*
+5	Farmers should not hesitate to participate in ecological agricultural practices.	7.02*	2.77*
-6	It is not possible to get high production by using organic manures.	7.77*	2.56*
-7	Chemical fertilizer is necessary for high production.	7.21	4.11
+8	The rate of chemical fertilizers is to be increased year after year for the same production.	5.68	5.41
+9	Human diseases are increasing due to increased use of chemical fertilizers.	8.47*	1.37*
+10	Despite problems in ecological agriculture, it is better for crop production.	5.77*	3.18*
-11	Benefits of chemical fertilizer are larger than its harmful effects.	7.41*	3.92*
+12	Pests develop resistance by continuous use of chemical pesticides.	6.23	4.27
+13	Chemical fertilizer is harmful to soil or environment.	4.75	4.90
+14	Ecological agriculture helps the farmers to increase their knowledge about improved methods of soil nutrient management.	7.39*	2.77*
-15	The food problem of our country can be solved by using chemical fertilizers.	4.95	5.62
-16	The use of chemical fertilizers in crop field should not be reduced.	6.61*	3.93*
-17	It is profitable to use chemical pesticides.	5.93	4.53
-18	Without use of chemical pesticides, it is not possible to get good quality crops.	7.95*	2.71*
+19	Beneficial insects and frogs are decreasing day by day due to use of chemical pesticides.	8.09*	1.31*
-20	There is no alternative of using chemical pesticides to protect crops from pest attack.	6.00	5.77
+21	Water is polluted by using chemical pesticides which is harmful to fishes.	8.23*	1.84*
-22	Benefits of chemical pesticide are larger than its harmful	5.41	4.86

Sl. No.	Statements	Scale-values	Q-values
	effects.		
+23	Light is a good method to control flying insects.	5.17	4.59
+24	Most of the pest can be controlled by clean cultivation.	6.39*	3.61*
-25	Ecological pest control is hard and non-profitable to farmers.	6.36*	3.69*
+26	It is not logical to use chemical fertilizer though it is necessary for present high production.	8.24*	2.45*
-27	Production cost is not high in using chemical pesticides.	7.50*	4.02*
+28	Chemical pesticides are harmful to soil or environment.	5.41	5.61
+29	Ecological agriculture helps the farmers to increase their knowledge about improved methods of plant protection.	7.17*	3.77*
-30	Crops are prone to disease and pest, which can not be controlled easily by ecological agricultural practices.	6.37*	4.00*

*Selected statements on the basis of Scale-values and Q-values

APPENDIX IX

Critical Ratio (t-values) for Attitude towards Ecological Agriculture Statements

Sl.No.	Statements	t-values
-1	Income from cultivation through ecological agricultural practices does not compensate the trouble taken.	0.859
+2	Despite problems in ecological agriculture, it is better for crop production.	4.251*
-3	Ecological pest control is hard and non-profitable to farmers.	8.500*
-4	Crops are prone to disease and pest, which can not be controlled easily by ecological agricultural practices.	1.677
+5	Most of the pest can be controlled by clean cultivation.	3.115*
-6	The use of chemical fertilizers in crop field should not be reduced.	3.310*
+7	Farmers should not hesitate to participate in ecological agricultural practices.	4.028*
-8	Ecological agriculture is not profitable in relation to crop production.	3.523*
+9	Ecological agriculture helps the farmers to increase their knowledge about improved methods of plant protection.	1.342
+10	Ecological agriculture helps the farmers to increase their knowledge about improved methods of soil nutrient management.	1.342
-11	Benefits of chemical fertilizer are larger than its harmful effects.	2.449*
-12	Production cost is not high in using chemical pesticides.	0.730
-13	It is not possible to get high production by using organic manures.	2.160*
-14	Without use of chemical pesticides, it is not possible to get good quality crops.	5.960*
+15	Beneficial insects and frogs are decreasing day by day due to use of chemical pesticides.	1.342
+16	Water is polluted by using chemical pesticides which is harmful to fishes.	2.240*
+17	It is not logical to use chemical fertilizer though it is necessary for present high production.	2.240*
+18	Human diseases are increasing due to increased use of chemical fertilizers.	6.710*

*Statements selected for final attitude towards ecological agriculture scale

APPENDIX X

Critical Ratio (t-values) for Risk Orientation Statements

Sl.No.	Statements	t-values
+1	A farmer who is willing to take greater risk than the average farmers usually does better financially.	4.97*
+2	A farmer should grow more crops to avoid greater risk instead of growing one or two crops.	3.18*
+3	Trying a new method in farming by a farmer involves risk but it should be appreciated.	3.18*
-4	It is better for a farmer to adopt new farming method after most others have used them with success.	4.03*
+5	I want to adopt new farming method though it has risk and uncertainty.	3.87*
-6	It is good for a farmer to take risks when he knows his chance of success is fairly high.	3.21*
-7	A farmer should involve himself in small scale business to overcome agricultural risk.	1.51
+8	A farmer should take more chance in making a big profit rather than to be satisfied with a smaller but less risky profit.	1.20
-9	I think a farmer will be looser if he adopts new and uncertain technology.	2.30*
-10	Farmers should be satisfied with what they have than taking risk.	3.47*
+11	A farmer must take risk if he wants to adopt good technology as there is risk in every sphere of life.	2.24*
+12	A farmer should take risk if he wants to develop his economic status.	2.24*
-13	To take risk for the hope of greater benefit is a sign of foolishness.	5.07*
-14	The value of agricultural products is very flexible. So it is better to sell those just immediate after harvesting.	1.57
-15	It is better to stop artificial insemination, as because it is risky to the life of animal.	1.17
-16	I want to rear poultry by traditional method, as because it is safe and risk free.	0.00
+17	I want to adopt ecological agriculture for environmental protection, though it may reduce production.	1.17
+18	"One can't prosper in life without taking risk"- I agree with this statement.	2.27*

*Statements selected for risk orientation scale

APPENDIX-XI

Letter from the Thesis Supervisor to the Judges requesting them to mention their opinion for 9-point suitability continuum against each of the Ecological Agricultural Practices

From
Dr. A.S.M. Ziaul Karim
Professor, Department of Agricultural Extension Education
Bangladesh Agricultural University, Mymensingh

Date: 29.11.2005

To
.....
.....

Subject: **Selection of Items for Ecological Agricultural Practices**

Dear Sir

This is in connection with the study of one of my Ph.D. student, Mr. Md. Sekender Ali who has undertaken a research study on "Adoption of Ecological Agricultural Practices by the Farmers". This study requires from Judges/Experts for selection of items in connection with ecological agricultural practices. This would be helpful to design and prepare research instrument for the study.

Probably, you will agree with me that ecological agriculture is the agricultural practices constituting nutrient management without chemical fertilizers and pest management without chemical pesticides. The anti-natural agricultural practices degrade the soil and ecological balance in many ways resulting poor output. The anti-natural agricultural practices increase the cost of production in one hand and decrease the microbial activities in the soil, on the other, which creates new hazardous situation in the entire crop production system including health hazards. In this connection, it can be said that the lands, water, and animal resources on earth have already been damaged to a great extent.

In this regards, I have the pleasure to inform you that you have been selected as one of the Judges/Experts for selecting and rating of items for ecological agricultural practices. In order to enable you to offer your valuable suggestions, a list of items on the ecological agricultural practices have been enclosed. These items may please be viewed with reference to ecological agriculture. Here, it may be mentioned that it will also be highly appreciated if you suggest for further inclusion of items on ecological agricultural practices. Please return this material back at your earliest convenience after completing your task.

With personal regards

Sincerely yours,

Dr. A.S.M. Ziaul Karim
Professor

Enclosed:
1. Instruction for rating

Judge/Expert No. .....

Instruction for rating

Please rate the extent of suitability of the following items regarding ecological agricultural practices Please mention the numbers by putting tick mark (√) against each appropriate column.

Sl. No.	Statements	Least suitable								Most suitable
		1	2	3	4	5	6	7	8	9
Ecological nutrient management (Nutrient management without chemical fertilizers)	1. Cowdung									
	2. Poultry excreta									
	3. Farm yard manure									
	4. Compost									
	5. Quick compost/oil cake									
	6. Vermi-compost									
	7. Liquid organic fartilizers									
	8. Bio-fertilizers									
	9. Water hyacinth									
	10. Green manure									
	11. Crop residues/weed fertilizers									
	12 Azola									
	13.Mulching									
	14. Kitchen waste									
	15. Sewage									
Ecological pest management (Pest management without chemical pesticides)	1. Pest resistant varieties									
	2. Quality seed									
	3. Pest control by hand/hand net									
	4. Light trap									
	5. Putting tree branches in the field									
	6. Planting tree on dyke									
	7. Barrier crop									
	8. Beneficial insects									
	9. Proper weeding and eradication of pest attacked plants/plants parts									
	10. Cattle urine									
	11. Sex pheromone									
	12. Ash									
	13. Insect repellent									
	14. Botanical pesticides: neem, nishinda, biskatali etc.									
	15. Crop rotation									

_____

Signature of the Judge/Expert with date
Address:

APPENDIX XII

Suitability Index (SI) of Each of the Ecological Agricultural Practices

Items		Suitability Index (SI)	Rank order
Ecological nutrient management (Nutrient management without chemical fertilizers)	1. Cowdung	231	1
	2. Poultry excreta	208	2
	3. Farm yard manure	206	3
	4. Compost	201	4
	5. Quick compost/oil cake	151	5
	6. Vermi-compost	78	13
	7. Liquid organic fartilizers	148	6
	8. Bio-fertilizers	129	10
	9. Water hyacinth	147	7
	10. Green manure	145	8
	11. Crop residues/weed fertilizers	135	9
	12 Azola	89	12
	13.Mulching	110	11
	14. Kitchen waste	70	14
	15. Sewage	45	15
Ecological pest management (Pest management without chemical pesticides)	1. Pest resistant varieties	175	8
	2. Quality seed	199	5
	3. Pest control by hand/hand net	226	1
	4. Light trap	219	3
	5. Putting tree branches in the field	221	2
	6. Planting tree on dyke	65	13
	7. Barrier crop	91	12
	8. Beneficial insects	182	7
	9. Proper weeding and eradication of pest attacked plants/plants parts	131	10
	10. Cattle urine	102	11
	11. Sex pheromone	42	14
	12. Ash	190	6
	13. Insect repellent	29	15
	14. Botanical pesticides: neem, nishinda, biskatali etc.	201	4
	15. Crop rotation	153	9

APPENDIX - XIII

Letter from the Thesis Supervisor to Proshika Authority for Necessary Help and Co-operation to the Researcher for Data Collection

From
Dr. A.S.M. Ziaul Karim
Professor
Department of Agricultural Extension Education
Bangladesh Agricultural University
Mymensingh, Bangladesh

Date: 27.12.2005

To
President
Proshika
I/1, Gha, Mirpur-2, Dhaka

Attention: Director (Natural Resources)

Subject: **Data Collection for Ph.D. Research Work**

Dear Sir

I would like to introduce Mr. Md. Sekender Ali, an Assistant Professor, Department of Agricultural Extension & Information System, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh. Now he is a Ph.D. student of the Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh, Bangladesh. He has been doing his Ph.D. research work under my supervision. He is working on "Adoption of Ecological Agricultural Practices by the Farmers". In this connection, he needs to collect data from ecological farmers of Proshika as per schedule attached herewith. Date(s) of the schedule may be rearranged if necessary at the time of action.

I would be very happy if you kindly provide him necessary administrative support including introduction to ecological farmers organized by Proshika along with dormitory facility in your respective local offices.

With personal regards

Sincerely yours,

Dr. A.S.M. Ziaul Karim
Professor

Enclosed:
1. Time Schedule of Data collection

Time Schedule of Data collection

Activity	Place/ADC	Number of farmers to be interviewed	Date
Pretest	Belabo	06	28-29 December, 2005
	Raypura	06	30-31 December, 2005
	Muktagacha	06	02-03 January, 2006
	Madhupur	06	04-05 January, 2006
Final Collection of Data	Ghatail	15	01-09 February, 2006
	Pakundia	15	15-25 February, 2006
	Madhupur	17	03-12 March, 2006
	Muktagacha	12	17-26 March, 2006
	Raypura	18	03-12 April, 2006
	Belabo	20	17-26 April, 2006
	Ghatail	10	03-12 May, 2006
	Pakundia	15	17-26 May, 2006
	Madhupur	17	02-11 June, 2006
	Muktagacha	12	15-24 June, 2006
Case study	Any suitable ADC	One successful ecological farmer	August, 2006 to February 2007

APPENDIX XIV

Correlation Matrix among the Variables of the Study

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
X_1	1.000								
X_2	0.006^{NS}	1.000							
X_3	0.430**	0.059^{NS}	1.000						
X_4	0.438**	0.078^{NS}	0.821**	1.000					
X_5	-0.079^{NS}	0.072^{NS}	-0.054^{NS}	0.016^{NS}	1.000				
X_6	-0.047^{NS}	-0.114^{NS}	0.014^{NS}	0.188*	-0.012^{NS}	1.000			
X_7	0.170*	0.137^{NS}	0.228**	0.424**	0.249**	0.207*	1.000		
X_8	-0.026^{NS}	0.216**	0.190*	0.287**	0.457**	0.064^{NS}	0.232**	1.000	
X_9	0.035^{NS}	0.190*	0.042^{NS}	0.091^{NS}	0.378**	-0.024^{NS}	0.228**	0.547**	1.000
X_{10}	-0.224**	0.073^{NS}	-0.102^{NS}	-0.237**	-0.145^{NS}	-0.109^{NS}	-0.336**	0.041^{NS}	-0.065^{NS}
X_{11}	0.167*	0.008^{NS}	0.099^{NS}	0.065^{NS}	0.051^{NS}	0.013^{NS}	0.069^{NS}	-0.005^{NS}	-0.128^{NS}
X_{12}	0.167*	0.069^{NS}	0.207*	0.408**	0.084^{NS}	0.273**	0.688**	0.144^{NS}	0.389**
X_{13}	0.219**	0.256**	0.215**	0.372**	0.166*	0.267**	0.524**	0.244**	0.222**
X_{14}	0.071^{NS}	-0.041^{NS}	0.000^{NS}	0.031^{NS}	0.265**	-0.028^{NS}	0.145^{NS}	0.309**	0.233**
X_{15}	-0.053^{NS}	0.145^{NS}	-0.081^{NS}	-0.003^{NS}	0.336**	0.082^{NS}	0.271**	0.298**	0.322**
X_{16}	0.205*	0.366**	0.304**	0.386**	0.066^{NS}	0.146^{NS}	0.296**	0.169*	0.165*
X_{17}	0.191*	0.200*	-0.021^{NS}	-0.048^{NS}	0.113^{NS}	0.116^{NS}	0.029^{NS}	0.120^{NS}	0.058^{NS}
X_{18}	0.117^{NS}	0.350**	0.080^{NS}	0.101^{NS}	0.260**	0.156^{NS}	0.293**	0.093^{NS}	0.190*
X_{19}	0.142^{NS}	0.219**	0.114^{NS}	0.306**	0.161^{NS}	0.223**	0.452**	0.229**	0.297**

X_{20}	0.125^{NS}	0.141^{NS}	0.135^{NS}	0.332**	0.281**	0.206*	0.645**	0.152^{NS}	0.214**
X_{21}	0.280**	0.130^{NS}	0.193*	0.398**	0.115^{NS}	0.278**	0.587**	0.088^{NS}	0.230**
X_{22}	-0.133^{NS}	-0.153^{NS}	-0.160^{NS}	-0.378**	-0.293**	-0.138^{NS}	-0.563**	-0.229**	-0.258**
X_{23}	0.216**	0.229**	0.056^{NS}	0.295**	0.216**	0.227**	0.666**	0.081^{NS}	0.255**
X_{24}	0.020^{NS}	0.140^{NS}	-0.045^{NS}	0.038^{NS}	0.251**	0.073^{NS}	-0.013^{NS}	0.209*	0.211*
X_{25}	0.145^{NS}	0.077^{NS}	0.117^{NS}	0.394**	0.153^{NS}	0.205*	0.628**	0.125^{NS}	0.214*
Y	0.179*	0.181*	0.091^{NS}	0.323**	0.087^{NS}	0.263**	0.692**	-0.002^{NS}	0.295**

Correlation Matrix Contd.

	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}
X_{10}	1.000							
X_{11}	-0.160^{NS}	1.000						
X_{12}	-0.261**	-0.128^{NS}	1.000					
X_{13}	-0.112^{NS}	0.181*	0.437**	1.000				
X_{14}	0.058^{NS}	0.065^{NS}	0.066^{NS}	0.350**	1.000			
X_{15}	0.001^{NS}	0.050^{NS}	0.165*	0.436**	0.738**	1.000		
X_{16}	-0.100^{NS}	0.170*	0.143^{NS}	0.511**	0.175*	0.259**	1.000	
X_{17}	0.144^{NS}	0.252**	-0.065^{NS}	0.188*	0.293**	0.290**	0.193*	1.000
X_{18}	0.014^{NS}	0.198*	0.070^{NS}	0.314**	0.105^{NS}	0.252**	0.480**	0.458**
X_{19}	-0.106^{NS}	-0.051^{NS}	0.526**	0.509**	0.299**	0.406**	0.467**	0.107^{NS}
X_{20}	-0.321**	0.085^{NS}	0.477**	0.553**	0.165*	0.253**	0.366**	-0.045^{NS}
X_{21}	-0.292**	0.047^{NS}	0.682**	0.550**	0.137^{NS}	0.261**	0.367**	0.041^{NS}
X_{22}	0.348**	-0.112^{NS}	-0.511**	-0.473**	-0.105^{NS}	-0.214*	-0.293**	0.045^{NS}
X_{23}	-0.366**	0.112^{NS}	0.612**	0.590**	0.176*	0.335**	0.412**	0.078^{NS}
X_{24}	-0.033^{NS}	0.182*	-0.017^{NS}	0.281**	0.190*	0.282**	0.246**	0.014^{NS}
X_{25}	-0.217**	0.071^{NS}	0.658**	0.515**	0.120^{NS}	0.207*	0.189*	0.021^{NS}
Y	-0.294**	-0.069^{NS}	0.776**	0.502**	-0.044^{NS}	0.198*	0.329**	-0.054^{NS}

Correlation Matrix Contd.

	X_{18}	X_{19}	X_{20}	X_{21}	X_{22}	X_{23}	X_{24}	X_{25}	Y
X_{18}	1.000								
X_{19}	0.337**	1.000							
X_{20}	0.236**	0.315**	1.000						
X_{21}	0.299**	0.525**	0.564**	1.000					
X_{22}	-0.196*	-0.329**	-0.788**	-0.654**	1.000				
X_{23}	0.386**	0.586**	0.674**	0.720**	-0.749**	1.000			
X_{24}	0.184*	0.194*	0.205*	0.159^{NS}	-0.116^{NS}	0.217**	1.000		
X_{25}	0.217**	0.451**	0.582**	0.680**	-0.645**	0.651**	0.031^{NS}	1.000	
Y	0.294**	0.587**	0.579**	0.782**	-0.612**	0.764**	0.036^{NS}	0.700**	1.000

^{NS}Not significant

***Significant at 0.05 level**

****Significant at 0.01 level**

X_1 = Age	**X_{14} = Individual local contact**
X_2 = Education	**X_{15} = NGO contact**
X_3 = Family size	**X_{16} = GO contact**
X_4 = Working family size	**X_{17} = Group contact**
X_5 = Effective land possession	**X_{18} = Mass contact**
X6 = Cropping intensity	**X_{19} = Training exposure**
X_7 = Animal-poultry excreta availability	**X_{20} = Decision making ability**
X_8 = Annual family income	**X_{21} = Ecological agricultural knowledge**
X_9 = Commercialization	**X_{22} = Problem faced in ecological agriculture**
X_{10} = Credit need	**X_{23} = Attitude towards ecological agriculture**
X_{11} = Marketing opportunities	**X_{24} = Aspiration**
X_{12} = Benefit obtained from ecological agriculture	**X_{25} = Risk orientation**
X_{13} = Cosmopoliteness	**Y = Adoption of ecological agricultural Practices**