DETERMINANTS OF ADOPTION, DISCONTINUATION AND REJECTION OF PHEROMONE TRAP: A CASE ON VEGETABLE GROWERS OF BOGURA DISTRICT

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CERTIFICATE

This is to certify that the thesis entitled **"DETERMINANTS OF ADOPTION, DISCONTINUATION AND REJECTION OF PHEROMONE TRAP: A CASE ON VEGETABLE GROWERS OF BOGURA DISTRICT"** submitted to the department of Agricultural Extension and Information System, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka in partial fulfillment of the requirements for the degree of Master of Science (M.S.) in Agricultural Extension, embodies the result of a piece of bona fide research work carried out by **NICE AHMED, Registration No. 14-05948** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

Dated:
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DEDICATED
TO
MY BELOVED
PARENTS

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The Author

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ABBREVIATIONS

GDP	Gross Domestic Product
IPM IL	Integrated Pest Management Innovation Lab
BBS	Bangladesh Bureau of Statistics
USAID	United States Agency for International Development
FAW	Information Communication Technology
FFS	Farmer Field Schools
FAO	Food and Agricultural Organisation
BINA	Bangladesh Institute Nuclear Agriculture
DIT	Diffusion of Innovation Theory
TPB	Theory of Planned Behavior
TAM	Technology Acceptance Model
NGOs	Non-Government Organisations
SD	Standard Deviation
SPSS	Statistical Package for Social Sciences
FS	Farm Size
IPM	Integrated Pest Management
SAAO	Sub-Assistant Agriculture Officer
BADC	Bangladesh Agricultural Development Corporation
BARI	Bangladesh Agricultural Research Institute
BRRI	Bangladesh Rice Research Institute
DAE	Department of Agricultural Extension

EXPLORING THE DETERMINANTS OF ADOPTION, DISCONTINUATION AND REJECTION OF PHEROMONE TRAP: A CASE ON VEGETABLE GROWERS OF BOGURA DISTRICT

NICE AHMED

ABSTRACT

The objectives of this study were to describe the socioeconomic characteristics of the vegetable growers; to assess the rate of adoption, discontinuation and rejection of Pheromone trap and to identify the contributory factors on adoption, discontinuation and rejection of Pheromone trap. The study was conducted with randomly selected 123 vegetable growers in Shibgonj upazila under Bogura district. A pre-tested interview schedule was used to collect data from the respondents during 05 March to 06 April, 2021. Adoption, discontinuation and rejection of Pheromone trap was the dependent variable and it was measured on the basis of scores. A total of 13 selected characteristics of the respondents considered the independent variables of the study. Multinomial logistic regressions analysis was used to examine the contribution of the selected characteristics of the respondents on the dependent variable. The highest proportion (40.6 percent) of the respondent rejected Pheromone trap, while 30.1 percent adopted and continued Pheromone trap and 29.3 percent adopted but discontinued of Pheromone trap. There is a significant contribution of respondents' off-farm income, extension agent contact and use of improved variety with their rejection of Pheromone trap. Again, there is a significant contribution of respondent's farm income, extension agent and trust in dealers of agricultural inputs with their adoption and discontinue of Pheromone trap. The finding play role to design effective Pheromone trap dissemination strategy.

CHAPTER I
INTRODUCTION

1.1 Background of the Study

The crop sector in Bangladesh is dominated by rice, but vegetable production and consumer demand for vegetables have grown in recent years, raising farm incomes and improving diets. Unfortunately, vegetables are attacked by numerous pests, and farmers rely heavily on synthetic chemicals to control them (Hossain et al., 2000; Ahmed et al., 2005; Muriithi et al., 2016). Pesticide use in Bangladesh is six times higher in vegetables (1.12 kg/ha) than in rice (0.20 kg/ha) (Alam, 2013). Excess use of pesticides raises the cost of production and causes harmful effects on health and the environment (Kouser and Qaim, 2013; Muriithi et al., 2016). Integrated pest management (IPM) can potentially play an important role in reducing the reliance on pesticides.

IPM integrates biological, cultural, and chemical pest practices to enhance productivity and minimize pesticide use (Greene et al., 1985; Norton et al., 1999; Harris et al., 2013; Kabir and Rainis, 2015a). The Government of Bangladesh, with assistance of the Food and Agriculture Organization (FAO), introduced vegetable IPM in Bangladesh in 1996 (Kabir and Rainis, 2015b). Since then, various national and international organizations have implemented vegetable IPM programs in Bangladesh. The Integrated Pest Management Innovation Lab (IPM IL) funded by United States Agency for International Development (USAID) began a vegetable IPM program in Bangladesh in 1998 with goals of reducing losses due to pests, raising farmer incomes, and reducing pesticide use (Akter, 2004). In collaboration with the Bangladesh Agricultural Research Institute (BARI), the program has developed and promoted several vegetable IPM technologies such as pheromone traps, grafting, soil amendments, pest-resistant varieties, bio- pesticides, and beneficial insects (Mian et al., 2016).

Pheromones have been used for insect monitoring, mass-trapping and mating disruption of a great diversity of insect pests. The female-produced sex pheromone of S. frugiperda is commercially available in several countries, including Bangladesh. Pheromones have been a useful tool for monitoring male populations (Mitchell et al., 1985, 1989; Adams et

al., 1989; Pair et al., 1989; Gross and Carpenter, 1991; Weber and Ferro, 1991; Malo et al., 2004; Batista-Pereira et al., 2006). Monitoring with pheromone traps is useful because pest pressure varies from farm to farm and over time. Knowledge of when and where adultpests are active and abundant provides a sensitive early-warning system to enable field sampling and/or control measures to be initiated at the appropriate time. Knowing whetheror not pests are present allows the grower to avoid unnecessary pesticide applications or time-consuming sampling, and gives advance warning to protectcrops when moth flights are first detected (Cruz et al., 2010b). Traps catch only adult male moths but the plant damage is inflicted by larvae.

Using Pheromone traps to monitor FAW adults is the best means of deciding on the number of pesticide applications necessary to control the pest in maize (Cruz et al., 2010a). A study of the biology of the FAW (Cruz, 1995) suggests that from egg mass deposition to approximately 10 d after the FAW larvae emerge will be between the third and the fourth instars and still very susceptible to the chemical insecticide, and also susceptible to the action of different species of natural enemies, but before significant plant damage is inflicted. The first application of one pesticide should not be made immediately; rather, only 10 d after the capture of the three or more moths in the trap (Cruz, 2008). If a second or third application is necessary, the pesticide's residual period of action should be considered. For example, for a four-day residual period the second pesticide application should be at least 14 d after the first one. In addition to effectiveness, the choice of the insecticide to be used in an integrated pest management program should present little or no harm to non-target organisms, such as the pest's natural enemies and pollinators.

Vegetables are grown all over the country but at a varied extent. Bogura is one of most important districts in Bangladesh regarding vegetable production. The farmers use chemical pesticides besides some environment friendly technologies such as Pheromone trap to control pest. There is a need to conduct a study on the adoption behavior of Pheromone trap among the vegetable growers. The researcher felt the need and interested to conduct a study on vegetable farmers' adoption behavior of Pheromone trap in Bogura district.

1.2 Statement of the Problem

At present, there are three methods or approaches followed in vegetable cultivation. Those are conventional farming system, IPM and organic method. Organic vegetable cultivation is sound in environmental aspect but have limitation to gain desire production.In a country like Bangladesh where there is no compromise with production, organic method is not good. Therefore, majority of the farmers cultivate vegetable by following either conventional method or IPM practices. In conventional technique of vegetable cultivation, farmers are only use pesticides to control pest. So, in this regard the cost of production becomes high. Benefit obtained from this very lower than other techniques. In IPM technique pesticides are only used when there are no alternatives. Therefore, cost for pesticides is relatively lower than conventional system. Pheromone trap is an effective element of IPM that can reduce the use of chemical pesticides. Therefore, increase the adoption of Pheromone trap can help farmers to reduce cost for vegetable cultivation and keep environment sound. In this regard, the researcher took the present study to get answer of the following questions-

1. What was the adoption, discontinuation and rejection rate of Pheromone trap of the vegetable growers?
2. What were the characteristics of the vegetable farmers'?
3. What were the contribution of the selected characteristics of the farmers to their adoption, discontinuation and rejection of Pheromone trap?

1.3 Specific Objectives of the Study

The following specific objectives were drawn in order to give proper direction to the study:

- To assess the rate of adoption, discontinuation and rejection of Pheromone trap;
- To describe the socioeconomic characteristics of the vegetable growers; and
- To explore the contribution of the selected characteristics of the farmers to their adoption, discontinuation and rejection of Pheromone trap.

1.4 Justification of the Study

There are a number of studies have been conducted on the adoption of IPM for controlling pest. Many of them cover broad aspect of IPM. Some of them focused specific elements of IPM such as biological control, Pheromone trap, manual cleaning, use of botanicals etc. Among these components, studies on the adoption of Pheromone trap are limited. Moreover, those studies ended up by calculating adoption extent of the approach rather investigating post adoption behaviour. So, there is an urgent need to undertake a study on the exploring the determinants of adoption and continue, adoption and discontinue and rejection of Pheromone trap by the vegetable growers.

1.5 Scope of the study

The present study was designed to have an understanding of adoptability of Pheromone trap in vegetable cultivation by the farmers and identifying farmers characteristics on adoption and post-adoption behaviour of this approach. The findings of the study will specifically fit to the study areas and generally applicable of the other areas of Bangladesh where physical, socio-economic, cultural and geographic condition do not differ much from those of the study area. Thus, the findings are expected to be useful to students, researchers, extension workers, and particularly for planners in formulating and designingthe policies to control pest in an environment friendly way. The findings may also be helpful to the field workers of different nation building departments to improve strategies of action to conform environment friendly sustainable production in vegetable sector. Lastly, the researcher believes that the findings and recommendations of this studywill definitely lead to minimize the cost of production for vegetables and simultaneously reducethe risk of environmental damages.

1.6 Assumptions of the Study

An assumption has been defined as “the supposition that an apparent fact or principle is true in light of the available evidence” (Goode, 1945). An assumption is taken as a fact or belief to be true without proof. So, the following assumptions were in mind of the researcher while carrying out this study:

a) The respondents included in the sample were capable of furnishing proper responses to the questions of the interview schedule.
b) Views and opinions furnished by the respondents were the representative views and opinions of the whole population of the study.
c) The responses furnished by the respondents were reliable and they truly expressed their opinions on the analysis the impact of socioeconomic and technological factors on the adoption of pheromone trap.
d) The data collected by the researcher were free from bias.
e) The researcher who acted as the interviewer was well adjusted to the social and cultural environment of the study area. Hence, the respondents furnished their correct opinions without any hesitation.
f) The respondents had almost similar background and seemed to be homogenous to a great extent.
g) The information sought by the researcher revealed the real situation to satisfy the objectives of the study.
h) The findings were useful in choosing the clients as well as for planning execution and evaluation the extension programmer.

1.7 Limitations of the Study

The present study was undertaken to have an understanding of the analysis the impact of socioeconomic and technological factors on the adoption of Pheromone trap: a case study Bogura District and to determine the contribution factors with selected characteristics of the farmers. Considering the time, money and other necessary resources available to the researcher and to make the study manageable and meaningful from the point of view of research, it becomes necessary to impose certain limitations. The limitations were as follows:

i. The study was confined in one union of Shibgonj Upazila under Bogura district.
ii. The study was restricted within the farmers who had some cultivable land under their own cultivation.
iii. The population for the study was kept confined to the heads of the family who regularly cultivated their land.

iv. There were many characteristics of the farmers but in the study only 13 of them were selected for investigation.

v. For information about the study, the researcher depended on the data furnished by the selected respondents during their interview with him.

vi. Major information, facts and figures supplied by the respondents were applicable to the situation prevailing in the locality during the year 2021.

1.8 Definition of Terms

A researcher needs to know the meaning and contents of every term that he uses. It should clarify the issue as well as explain the fact to the investigator and readers. However, for clarity of understanding, a number of key concepts/terms frequently used throughout the study defined are interpreted as follows:

Age

Age of a respondent defined as the span of his/her life and is operationally measured by the number of years from his/her birth to the time of interviewing.

Education

Education referred to the development of desirable knowledge, skill, attitudes, etc. of an individual through the experiences of reading, writing, observation and related matters.

Family size

Family size of a respondent referred to the total members in his/her family including him/her, children and other dependents, which live and eat together in a family unit.

Land size

Land size referred to the total area on which a farmer's family carries on farming operations, the area being estimated in terms of full benefit to the farmer's family.

Annual family income

Annual income referred to the total annual earnings of all the family members of a respondent from agriculture, livestock and fisheries and other accessible sources (business, service, daily working etc.).

Organizational participation

Organization participation of an individual refers to his participation in various organizations as ordinary member, executive committee member or executive officer within a specified period of time.

Contact with extension agent

It referred to an individual's (farmer) exposure to or contact with different communication media, source and personalities being used for dissemination of new technologies.

Integrated pest management (IPM)

According to Food and Agricultural Organization (FAO, 2017) IPM can be defined as "A pest management system that, in the context of the associated environment and the population dynamics of the pest species, utilizes all suitable techniques and methods in a compatible manner as possible and maintains the pest populations at levels below those causing economic injury." In this study, IPM practices means 10 selected IPM practices generally advocate by Department of Agricultural Extension (DAE) and Bangladesh Rice Research Institute (BRRI) to practice in rice cultivation.

Pheromone Trap

A Pheromone trap is a type of insect trap that uses Pheromones to lure insects. Sex Pheromones and aggregating Pheromones are the most common types used.

CHAPTER II

REVIEW OF LITERATURE

The purpose of this Chapter is to review of literature having relevance to the present study. The researcher made an elaborate search of available literature for the above purpose. But there is hardly any study dealing with the relationship of the characteristics of farmers and their adoption. The research attempted to search the literatures on a number of studies. Therefore, the finding of such studies related to the extent of adoption of the farmers and other partial studies have been reviewed in this chapter.

This Chapter is divided into following four major sections:

Section 1: Adoption of IPM practice including Pheromone trap

Section 2: Relationship between Farmer's Socioeconomic Characteristics with them Adoption of IPM

Section 3: Research gap

Section 4: The Conceptual Framework of the Study.

2.1 Adoption of IPM practice including Pheromone trap

Kabir & Rainis (2015) made an attempt to analyze the level of IPM adoption and the intensity of IPM practices by vegetable farmers of Narsingdi district, Bangladesh. A total of 331 vegetable producers were sampled. The results revealed that less than one-third of the farmers (30 %) adopted IPM and they varied in terms of the number or type of practices. They also revealed that use of Pheromone trap placed 2nd position among the farmers regarding use of intensity of IPM practices.

Another study conducted by Fernandez-Cornejo *et al*., (2015) on factors influencing the adoption of Integrated Pest Management (IPM) techniques from individual vegetable producers from Florida, Michigan, and Texas. Farmers who adopt IPM tend to be less risk averse and use more managerial time on farm activities than non-adopters. Adopters are also more likely to operate large, irrigated farms and use more family labor. Locational factors and the type of crop grown are also influential in IPM adoption.

Timprasert et al. (2014) conduct a study and found that farmers had different uncompromising reasons for determining the use of IPM for their insect pest management. Higher costs of insecticides (91%), adverse effects of insecticides on human health and the environment (80%), and a greater risk of insect pests developing resistance to insecticides (28%) were the primary reasons for the adoption of IPM by vegetable growersin the study area. The reasons for the rejection of IPM practice were unsuitability of IPM for a large farm (52%), implementation difficulties (80%) and a greater belief in syntheticinsecticides and their efficacy for target pest control (39%). A comparison between the IPM and the non-IPM farmers showed a significant difference ($P < 0.01$) in farmers' knowledge of pest management, which influenced IPM adoption ornon-adoption. The IPMfarmers had greater knowledge about identifying natural enemies and their beneficial rolein controlling insect pests, about plant extracts and their efficacy in controlling insect pestsand about sticky traps and their efficacy in monitoring natural enemies and controlling insect pests. For example, 24% of IPM farmers had knowledge of natural enemies whereasit was only 4% for the non-IPM farmers. A logistic regressionmodel was fitted which showed that lower cost of pest management, better knowledge on IPM after training and availability of extension services were the factors which influenced farmers' adoption of IPM practice. The non-IPM farmers rejected adoption of IPM due to the common belief that natural enemies would not be effective in controlling insect pests and yields of vegetables would not be increased by practicing IPM.

Prudent et al. (2007) small holders' acceptance of innovations depends largely on the approach used to take their needs and constraints into account. The adoption of integrated pest management (IPM) strategies by smallholders can lead to a reduction in pesticide use in cotton, as soon as the recommended cropping practices are adapted to local conditions and associated with a threshold-based use of chemicals. To achieve this goal, farmers need to be trained on the biological basis of IPM. To ensure effective and rational implementation of IPM by farmers, it is essential to overcome constraints associated with pest scouting, identifying and preserving beneficial insects, and gaining access to the right inputs on time.

Our paper is an attempt to use such a participatory method as a tool to explore farmers' needs and constraints when smallholders are asked to adopt an integrated approach to cotton pest management.

Mauceri et al., (2007) conducted a study on potato farmers in Ecuador rely on chemical inputs to manage pests and optimize yields. Integrated pest management techniques lower production costs, reduce pesticide exposure, and improve long-term agricultural sustainability. Public extension does not, however, exist in Ecuador, and cost-effective means of communicating complex messages to producers are needed. We analyze cost-effectiveness of alternative dissemination methods, including farmer field schools (FFS), field days, pamphlets, and word-of-mouth transmission. Field days and pamphlets have strong impacts on adoption, especially considering their low costs.

Hollingsworth and Coli (2001) survey data from sweet corn, strawberry, apple, and potato growers in nine northeastern U.S. states were used to assess relative levels of adoption of integrated pest management (IPM). Grower adoption of an IPM system was measured by assigning numerical values for completion of specific management practices, and summing the number of practice points. Practices included those for management of soil, nutrients, weeds, diseases and insects, and education. Numerical scores were used to describe IPM adoption as a continuum, with growers classified as low, moderate, or high adopters based on their completion of practices. The relative level of IPM adoption variedamong crops and states. Forty-nine percent of sweet corn growers were found to be moderateto high-level IPM adopters, while 76% of strawberry growers, 90% of potato growers, and 69% of apple growers were moderate- to high-level adopters,respectively. Variation among states with respect to adoption of IPM is described and discussed.

Fernandez-Cornejo and Ferraioli (1999) the impact of adopting integrated pest management (IPM) techniques is examined for peach producers in eight states accounting for most of the U.S. production. The method accounts for self-selectivity, simultaneity,

and the pesticide demand equations are theoretically consistent with a restricted-profit function. Biological pest management techniques tend to reduce pesticide use and pesticide toxicity substantially, while pesticide-efficiency techniques (using scouting and economic thresholds) have an increasing effect on pesticide use and toxicity, and cultural techniques have an insignificant effect on pesticide use and toxicity.

Rakshit et al. (2011) determined the impact of Pheromone trap among the sweet gourd cultivars who adopted Pheromone trap. They found that the farmers who adopted Pheromone trap to control pest in sweet gourd cultivation were financially benefited compare to the farmers who do not adopt the approach. They also noticed that adoption of Pheromone trap has started by the farmers in 2008 and it was gradually increased among them.

2.2 Relationship between Farmers' Characteristics and Their Adoption of IPM

2.2.1 Age and adoption

Haque et al. (2016) conducted a study on determinants of rice farmers' adoption of integrated pest management practices in Bangladesh and found there was no significant relationship between age and adoption of IPM. A similar finding was also observed by Gogoi and Gogoi (1989) and Kashem (2003) in case of the adoption of IPM Practices. Khan (2019) and Jahan (2017) also found non-significant relationship between age and adoption but in case of other technologies. However, study conducted by Khan (2003), Rahman (2004) and Singh and Rajendra (2005) observed a difference finding from the above-mentioned scholars. They found a significant and positive relationship between age of the farmers and their adoption of IPM Practices.

2.2.2 Education and Adoption

Alam (2000), Haque (2003), Islam (2002), and Okoro & Obibuaka, observed that there were significant and positive relationship between education of the farmers and their adoption of IPM Practices. Haque et al., (2016) found opposite findings that is there was no significant relationship between education and adoption of IPM.

Khan (2019) conducted a study on adoption of hybrid rice production technologies by the farmers of Kalai upazila under Joypurhat district. He found that education of the farmers had a positive significant relationship with their adoption of hybrid rice production technologies. Another study by Jahan (2017) on the adoption of sunflower cultivation techniques in Bangladesh. She found that education of the farmers had significant contribution with their adoption of improved practices of sunflower production.

2.2.3 Family size and Adoption

Haque et al. (2016) conducted a study on determinants of rice farmers' adoption of integrated pest management practices in Bangladesh and found there was no significant relationship between family size and adoption of IPM. However, a different finding mentioned by Sardar (2002) that the family size of the farmers had significant positive relationship with their adoption of IPM practices.

Jahan (2017) investigated on "Socio-Economic Determinants of Adoption of Sunflower Production by the Farmers of Patuakhali sadar upazila" in Bangladesh. She found that family size of the farmers had no significant contribution with their adoption of improved practices of sunflower production. Hossain (2003) revealed that family size of the farmers had a significant and positive relationship with their adoption of modern Boro rice cultivation practices. Hossain (1999) conducted a study to determine the farmers' perception of the effects of agro-chemicals on environment. He found no relationship between the farmer's family sizes with their adoption of fertilizer. Chowdhury (1997) conducted a research study on adoption of selected BINA technologies by the farmers of Boira union in Mymensingh district. He observed that family size of the farmers had positive and significant relationship with the adoption of selected BINA technologies.

2.2.4 Land size and Adoption

Haque et al., (2016) conducted a study on determinants of rice farmers' adoption of integrated pest management practices in Bangladesh and found there was no significant relationship between farm size and adoption of IPM. Islam (2002) conducted a study on adoption of modem agricultural technologies by the farmers of Sandwip. He observed that farm size of the farmers had a positive significant relationship with their adoption of

modem agricultural technologies. Technologies by the farmers under PETRRA project of RDRS. He found that farm size of the farmers had a positive significant relationship with their adoption of IPM practices.

Aurangozeb (2002) conducted a study on adoption of integrated homestead farming technologies by the rural women in RDRS. He found that there had no relationship between homestead area and their adoption of integrated homestead farming technologies.

2.2.5 Farm income and adoption

Sardar (2002) conducted a study on adoption of IPM practices by the farmers under PETRRA project of RDRS. He found that the annual income of the farmers had no relationship with their adoption of IPM practices. Aurangozeb (2002) conducted a study on adoption of integrated homestead farming technologies by the rural women in RDRS. He found that there was a positive significant relationship between annual income of the respondents and their adoption of integrated homestead farming Technologies.

Rahman (2001) conducted an investigation on knowledge; attitude and adoption of Alok-6201 hybrid rice fry the farmers of sadar upaziia in Mymensingh district. He observed that there was a significant positive relationship between annual income of the farmers and their adoption of Alok-6201 hybrid rice by the farmers of Dewangonj upazila in Jamalpur district. He observed that there was a significant positive relationship between annual income of the farmers and their adoption of modem sugarcane cultivation practices.

2.2.6 Number of vegetables grown and adoption

Kabir and Rainis, (2015) conducted a study on the adoption and intensity of integrated pest management (IPM) vegetable farming in Bangladesh: an approach to sustainable agricultural development and found there was no significant relationship between use of improved variety and adoption of IPM.

2.2.7 Farm experience and adoption

There was no available review of literature about farm experience and adoption.

2.2.8 Time spends on vegetables cultivation and adoption

Kabir and Rainis, (2015) conducted a study on the adoption and intensity of integrated pest management (IPM) vegetable farming in Bangladesh: an approach to sustainable agricultural development and found there was no significant relationship between farm hours and adoption of IPM.

2.2.9 Contact with extension agent and Adoption

Haque et al., (2016) conducted a study on determinants of rice farmers' adoption of integrated pest management practices in Bangladesh and found there was significant relationship between extension contact and adoption of IPM. However, in case of other practices like Khan (2019) conducted a study on adoption of hybrid rice production technologies by the farmers of Kalai upazila under Joypurhat district. He found that extension media contact of the farmers had a positive significant relationship with their adoption of hybrid rice production technologies.

Islam (2002) conducted a study on adoption of modem agricultural technologies by the farmers of Sandwip. He found that extension media, contact of the farmers had no significant relationship with their adoption of modem agricultural technologies. Aurangozeb (2002) conducted a study on adoption of integrated homestead farming technologies by the rural women in RDRS. He found that there was a positive significant relationship between contact with extension media of the respondents and their adoption of integrated homestead farming technologies.

Sardar (2002) conducted a study on adoption of IPM practices by the farmers under PETRRA project of RDRS. He observed that contact with RDRS personnel of the farmers had a positive significant relationship with their adoption of IPM practices.

2.2.10 Use of improved variety and adoption

Kabir and Rainis, (2015) conducted a study on the adoption and intensity of integrated pest management (IPM) vegetable farming in Bangladesh: an approach to sustainable

agricultural development and found there was a significant and positive relationship between use of improved variety and adoption of IPM.

2.2.11 Trust in dealers of agricultural inputs and adoption

There was no available review of literature about trust in pesticides dealers and adoption.

2.3 Research gap

There were lots of research on the adoption of IPM but very few researchers were so far conducted to specifically focus on the adoption and post adoption behavior of Pheromone trap. The present study would ascertain the rate of adoption, discontinuation and rejection of Pheromone trap among the vegetable farmer. Besides, the present study would explore the determinants of adoption and continue, adoption and discontinuation and rejection of Pheromone trap among the vegetable growers of Bogura district.

2.4 The Conceptual Framework of the Study

This study is concerned with the exploring the determinants of adoption, discontinuation and rejection of Pheromone trap: a case on vegetable growers of Bogura district. Thus, the adoption, post adoption behavior and rejection were the main focus of the study and 13 selected characteristics of the farmers were considered as those might have relationship with adoption. To select 13 independent variables/farmers characteristics, theresearcher looked the Diffusion of Innovation Theory (DIT) (Rogers, 2003), the Theory of Planned Behavior (TPB) (Ajzen, 1991) and Technology Acceptance Model (TAM) (Davis, 1989). It is not possible to deal with all the factors/characteristics in a singlestudy. Therefore, it was necessary to limit the factors, which included age, education, land size, family size, farm income, off farm income, vegetable cultivation area, number of vegetables grown, farm experience, time spends in vegetable cultivation, extension agent, use of improved variety and trust in dealers of agricultural inputs. The conceptual framework of the study has been presented in Fig. 2.1.

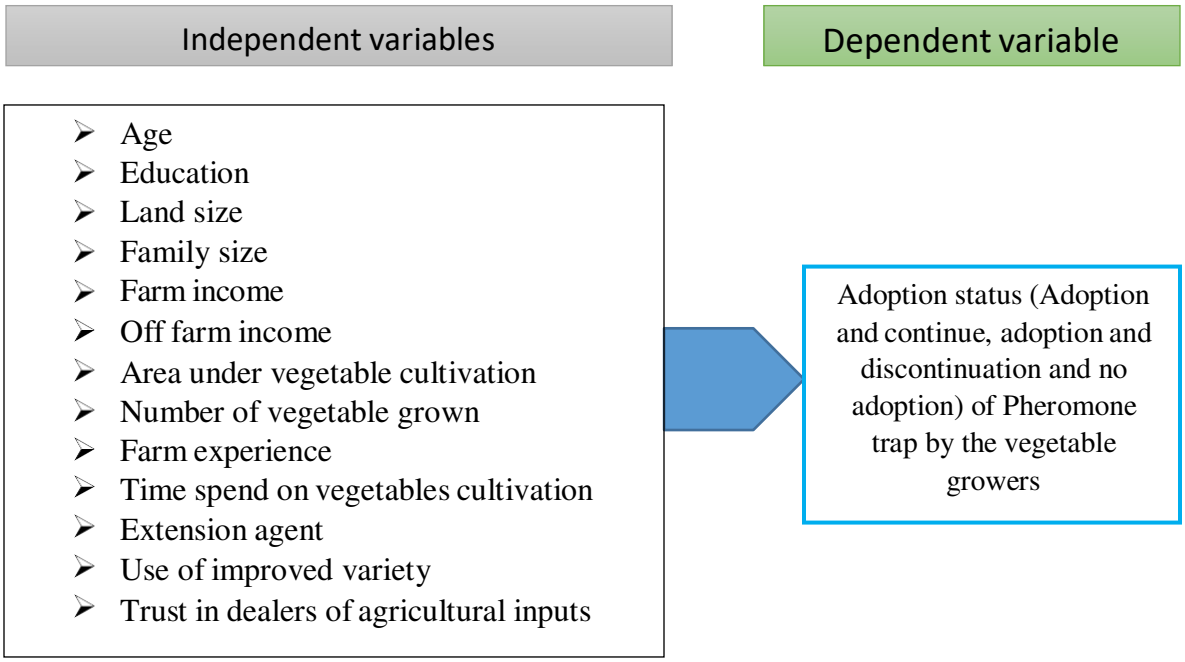

Figure 2.1 The conceptual framework of the study

CHAPTER III
METHODOLOGY

Methodology enables the researcher to collect valid information. It is impossible to conduct research work smoothly without proper methodology and it is very difficult to address the objectives with a scientific manner. It requires a very careful consideration onthe part of the researcher to collect valid and reliable data and to analyze the same for meaningful conclusion. A sequential description of the methodology was followed in conducting this research work has been presented in this chapter.

3.1 Locale of the Study

The study was conducted in Shibganj Upazila under Bogura district. Shibganj upazila has 12 unions and out of 12 unions, Mokamtola union was selected purposively as the locale of the study. Out of 15 villages of the union, three villages of the union were selected randomly as locale of the study. Shibganj Upazila has a total area of 314.92 square kilometres (121.59 sq mi). It is the northernmost upazila of Bogra District. It borders Rangpur Division to the north, Sonatala and Gabtali upazilas to the east, Bogra Sadar and Kahaloo upazilas to the south, Dupchanchia Upazila to the southwest, and Joypurhat District to the west. The Karatoya River flows south through the upazila. A map of Bogra District showing Shibganj upazila and a map of Shibganj Upazila showing the study area presented in Figure 3.1 and 3.2 respectively.

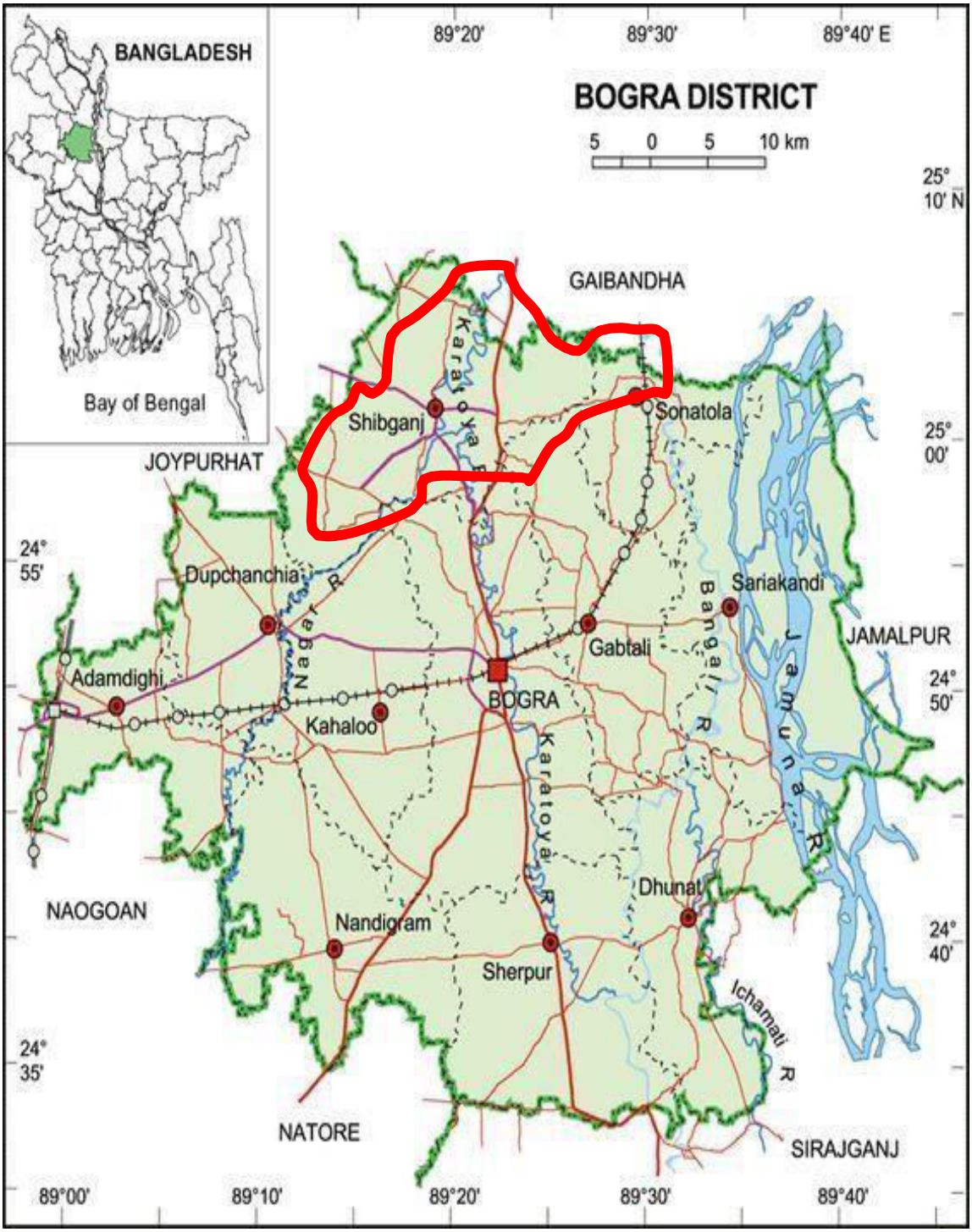

Figure 3.1: A map of Bogura district showing Shibganj Upazila

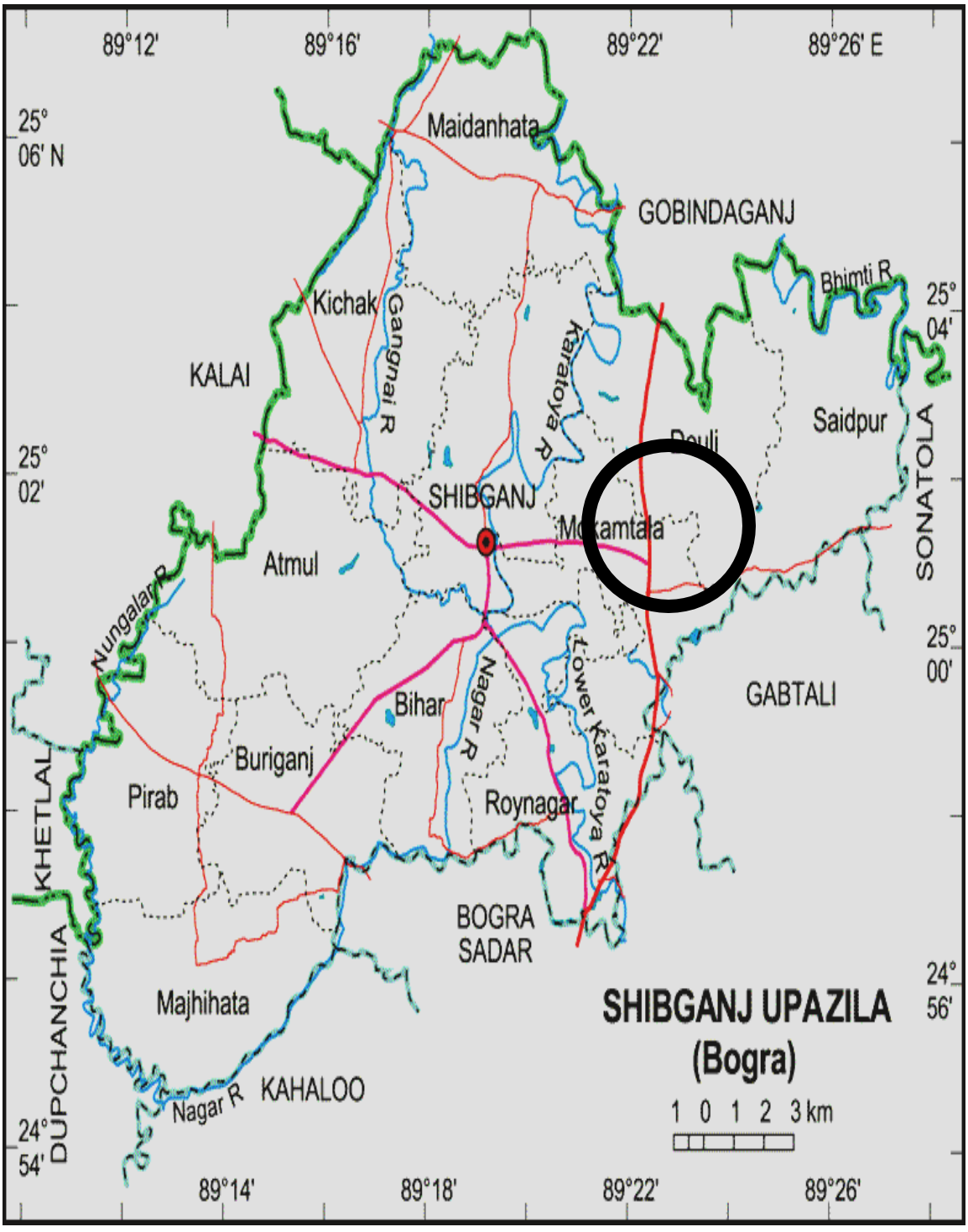

Figure 3.2: A map of Shibganj Upazila showing the study area

3.2 Distribution of the Population, Sample size and Reserve list

There were 822 vegetative growers of the selective villages which constituted the population of the study. Three separate list of vegetable farmers where collected from the local SAAO. By taking 15% of the population, a total of 123 vegetables farmers were selected proportionally and randomly from the population of three villages as the sample of the study. A reserve list of 13 vegetable farmers (considering 10% of the sample) was also prepared by the same method so that the respondents of this list could be used for interview if the respondents included in the original sample were not available at the time of conduction of interview. The distribution of the population sample and number of respondents in the reserve list are given in Table 3.1.

Table 3.1 Distribution of the farmers according to population, sample size and reserve list

Name of unions	Name of villages	Population of farmers	Sample size (15%)	Number of farmers included in the reserve list (10%)
Mokamtola	Rahbol	380	57	6
	Boalmari	239	36	4
	Khamarpara	203	30	3
Total		**822**	**123**	**13**

3.3 Measurement of Variables

The variable is a characteristic, which can assume varying or different values in successive individual cases. A research work usually contains at least two important variables viz. independent and dependent variables. An independent variable is that factor which is manipulated by the researcher in his attempt to ascertain its relationship to an observed Phenomenon. A dependent variable is that factor which appears, disappears or varies as the researcher introduces, removes or varies the independent variable. In the scientific research, the selection and measurement of variable constitute a significant task. At last, the researcher had selected 13 independent variables and one dependent variable. The independent variables were: age, education, land size, family size, farm income, off farm income, vegetable cultivation area, number of vegetables grown, farm experience, time spends in vegetable cultivation, extension with agent, use of improved variety and trust in

dealers of agricultural inputs. The dependent variable of this study was the "adoption and continue, discontinuation and rejection of Pheromone trap. The methods and procedures in measuring the variables of this study are presented below:

3.4 Measurement of Independent Variables

Thirteen characteristics of the vegetable farmers mentioned above constitute the independent variables of this study. Measuring procedures of these variables are described below:

3.4.1 Age

Age of respondent farmers was measured by the period of time from their birth to the time of conducting interview and it was measured in terms of complete years on the basisof their response. A score of one (1) was assigned for each year of age. This variable appearsin item number one (1) in the interview schedule as presented in Appendix- A.

3.4.2 Education

Education was measured by assigning score against each successful year of schooling by a respondent. One score was given for passing each level in an educational institution. For example, if a respondent passed the final examination of class five or equivalent examination, his/her education score was given as five (5). Each respondent of can't read & write was given a score of zero (0). A person not knowing reading or writing but being able to sign only was given a score of 0.5. If a farmer did not go to school but took non-formal education, his educational status was determined as the equivalent to a formal school student. This variable appears in item number two (2) in the interview schedule as presented in Appendix- A.

3.4.3 Farm size

Land size was calculated based on total cultivated land by the framers. The data was first recorded in terms of local measurement unit i.e., decimal and then converted into hectare. The total area, thus, obtained is considered as his land size score (assigning a score of one for each hectare of land). This variable appears in item number four (4) in the interview schedule as presented in Appendix -A.

3.4.4 Family size

Family size was operationally measured by assigning a score of one for each member of the family who jointly involved in working and ate together. The members included the respondent himself, his wife, children and other dependent members. This variable appears in item number three (3) in the interview schedule as presented in Appendix-A.

3.4.5 Farm income

Farm income of a respondent referred to the total earning by his/her and other members of her/his family from agriculture, livestock, poultry, fisheries, and other sources during a year. It was expressed in Taka. In measuring this variable, total earning of an individual respondent was converted into score. A score of one (01) was given for every one (01) thousand ('000') taka. This variable appears in item number 5 in the interview scheduleas presented in Appendix-A.

3.4.6 Off farm income

Off farm income of a respondent was measured on the basis of total yearly earning from other sources (service, business, daily labor etc.) by the respondent himself and other family members. The value of all the income except agricultural products encompassing service, day labor and others etc. were taken into consideration. For calculation a score, of one (1) was assigned for each one thousand takas of income. This variable appears in item number 8 in the interview schedule as presented in Appendix-A.

3.4.7 Vegetable cultivation area

Vegetable cultivation area of a respondent was measured in terms of area covered by vegetable cultivation area by the respondent. It was expressed in decimal. This variable appears in item number 7 in the interview schedule as presented in Appendix-A.

3.4.8 Number of vegetables grown

The number of the farmers was measured on the basis of the number types of grown vegetable grown all year round on their vegetable field. This variable appears in item number 8 in the interview schedule as presented in Appendix-A.

3.4.9 Farm experience

A measuring score of one (1) was assigned for each year of working experience of a respondent either in his own farm or to that of his parents, or others farm. This variable appears in item number 9 in the interview schedule as presented in Appendix-A.

3.4.10 Time spends on vegetables cultivation

Time spend on vegetable cultivation by the vegetables growers was measured by total hours per day. This variable appears in item number 10 in the interview schedule as presented in Appendix-A.

3.4.11 Contact with extension agent

Contact of a respondent with extension agent was measured based on their having or not contact with SAAO in a crop growing season for agricultural purpose. The farmers who had contact with SAAO was given a score of 1 and those who had no contact at all was given 0 (Abdollahzadesh et al., 2017). Thus, the extension agent score range of a respondent was from 0 to 1. This variable appears in item number 11 in the interview schedule as presented in Appendix-A.

3.4.12 Use of improved variety

Use of improved variety of a respondent was measured by respondent's use or not uses status of improved variety (Kabir and Rainis, 2015). The farmers who cultivated vegetable with improve variety was given a score of 1 and those who used local variety was given a score of 0. This variable appears in item number 12 in the interview schedule as presented in Appendix-A.

3.4.13 Trust in dealers of agricultural inputs

The trust in dealers of agricultural inputs of a respondent was measured with eleven selected agreements. A scale was developed arranging the weights for 0, 1, 2, 3 and 4 for the responses for strongly disagree, disagree, no comment, agree and strongly agree with this agreement respectively. Four statements were fixed to measure trust in pesticide dealers. Trust in dealers of agricultural inputs (pesticide) score of the respondents could range from 0 to 16, while '0' indicating no trust in dealers of agricultural inputs and '16'

indicating trust in dealers of agricultural inputs (Appendix-A).

3.5 Measurement of dependent variable

In the context of using Pheromone trap to monitor vegetable pest there were three types of farmers. Some of them adopted and continued Pheromone Trap, while others discontinued the approach. However, a portion of the farmers also rejected the approach. Therefore, farmers' adoption status (adoption and continue, adoption and discontinue and no adoption) of Pheromone trap was the dependent variable of this study. It is a categorical variable but by name. A scale was developed to the weights for 0, 1 and 2 for the responses for rejection/no adoption, adoption and discontinue and adoption and continue respectively. Adoption, discontinuation and rejection of Pheromone trap score of the respondents could range from 0 to 2, while '0' indicating no adoption, of Pheromone trap '1'and '2' indicating adoption and continue of Pheromone trap (Appendix- A).

3.6 Instrument for collection of data

In order to collect reliable and valid information from the respondents, an interview schedule was prepared for collection of data from respondents keeping the objectives of the study in mind. The question and statements contained in the schedule were simple, direct and easily understandable by the farmers. Simple and direct question, different scales, closed and open form statements and questions were included in the interview schedule to obtain necessary information. The draft interview schedule was prepared in accordance with the objective of the study. The interview schedule was pre-tested with 10 respondents of the farmers in the study area during 5 February to 11 February, 2021.

The draft interview schedule was pretested in actual field situation before finalizing it for collection of data. The pre-test was helpful to identify inappropriate questions and statements in the draft schedule. Necessary addition, alternation and adjustments were made in the schedule on the basis of the experience of the pretest. The interview schedule was then printed in its final form. An English version of the interview schedule has been shown in Appendix-A.

3.7 Data collection

Data were collected personally by the researcher himself through personal interview schedule from the sampled farm families of the selected villages. Before starting the collection of data; the researcher met the respective Upazila Agriculture Officer (UAO), Additional Agriculture Extension Officer (AAEO) and the concerned Sub-Assistant Agriculture Office (SAAO). The researcher also discussed the objectives of the present study with the respondents and above-mentioned officers and requested them to provide actual information. A rapport was established with the rural people so that they feel easy to answer the questions. The researcher took all possible care to establish rapport with the respondents so that they would not feel any indecision while starting the interview. Very good cooperation was obtained from the field extension workers and the local leaders. No serious difficulty was faced by the researcher during the collection of data. The interviews were made individually in the places of respondents. Questions were asked in direct manner so that the respondents could easily understand the questions. Whenever a respondent faced difficulty in understanding any questions, care was taken to explain the same clearly with a view to enabling him to answer it properly.

Before going to the respondents' home for interviewing they were informed verbally to ensure their availability at home as per schedule date and time. In the case of failure to collect information from the respondents due to their other business, a revisit was made with prior to appointments. Data were collected during 05 March to 06 April, 2021.

3.8 Compilation of Data

After completion of field survey, data recorded in the interview schedules were coded, compiled, tabulated and analyzed in accordance with the objectives of the study. In this process, all the responses in the interview schedule were given numerically coded values. Local units were converted into standard units and qualitative data were converted into quantitative ones by means of suitable scoring whenever necessary. All the collected data were checked and cross-checked before transplanting to the master sheets. To facilitate tabulation, the collected data were properly coded and transferred from interview schedule to a master sheet. Tabulation and cross tabulation were done on the basis of categorization developed by the researcher.

3.9 Categorization of Data

For describing the various independent and dependent variables the respondents were classified into various categories. In developing categories, the researcher was guided by the nature of data and general consideration prevailing on the social system. The procedures have been discussed while describing the variable in the sub-sequent sections of next chapter.

3.10 Processing of Data

The collected raw data were analyzed thoroughly to detect errors and exclusions. Qualitative data were converted into quantitative data by means of suitable scoring whenever necessary. For this the collected data were given numerical coded values. The obtained data were then compiled on a master sheet and then tabulated and analyzed with keeping the objectives of the study in mind. A wide range of relevant theories and empirical researches were collected and reviewed. The researcher contacted different relevant sources such as books, journals, articles, theses, abstracts, and internet to set a concrete research plan and to outline the research background.

3.11 Hypothesis of the Study

According to Karlinger (1973), a hypothesis is a conjectural statement of the relation between two or more variables. Hypotheses are always in declarative sentence form and they hypotheses are divided into two categories: (a) Research hypothesis and (b) Null hypothesis.

3.11.1 Research hypothesis

Based on review of literature and development of conceptual framework, the following research hypothesis was formulated: “Each of the thirteen (13) selected characteristics (age, education, land size, family size, farm income, off farm income, area under vegetable cultivation, number of vegetables grown, farm experience, time spends in vegetable cultivation, extension agent, use of improved variety and trust in dealers of agricultural inputs had significant contribution to their adoption status of Pheromone trap.

However, when a researcher tries to perform statistical tests, then it becomes necessary to formulate null hypothesis.

3.11.2 Null hypothesis

A null hypothesis states that there is no contribution of the independent variables to between the dependent variables. The following null hypothesis was formulated to explore the contribution of the selected characteristics of farmers to their adoption status of Pheromone trap. Hence, in order to conduct tests,the earlier research hypothesis was converted into null form as follows: “There is no contribution of the selected characteristics of the farmersto their adoption status of Pheromone trap.”

3.12 Statistical Analysis

Data collected from the respondents were analyzed and interpreted in accordance with the objectives of the study. The analysis of data was performed using statistical treatment with SPSS (Statistical Package for Social Sciences) computer program, version 20. Statistical measures as a number, range, mean, standard deviation was used in describing the variables whenever applicable. Multinomial logistic regressions analysis was used to determine the contribution of farmers’ characteristics with regard to their adoption and post-adoption behavior of pheromone trap. Throughout the study the 0.01 and 0.05 levels of probability were used as the basis of rejection or accepting a null hypothesis.

CHAPTER IV

RESULTS AND DISCUSSION

In this chapter the findings of this study have been discussed in relation to the present findings and also to those found in other studies. The study investigated the adoption, discontinuation and rejection of Pheromone trap. In accordance with the objectives of the study, presentation of the findings has been made in three sections. The first sections deal about selected characteristics of the farmers. The second section deals with extent of adoption, discontinuation and rejection of Pheromone trap and the third section deals with contribution of the selected characteristics of the farmers on their adoption, discontinuation and rejection of Pheromone trap.

4.1 Selected Characteristics of the Farmers

Thirteen characteristics of the farmers were selected for this research. The characteristics include: age, education, land size, family size, farm income, off farm income, area under vegetable cultivation, number of vegetables grown, farm experience, time spends in vegetable cultivation, extension agent, use of improved variety and trust in dealers of agricultural inputs. Some descriptive statistics of these features are given in Table 4.1. Data contained in the Table 4.1 reveal the salient features of the characteristics of the farmers in order to have an overall picture of these characteristics at a glance. However, for ready reference, separate Tables are provided while presenting categorizations, discussing and /or interpreting results concerning each of the characteristics in this chapter.

Table 4.1 The salient features of the selected characteristics of the farmers

Categories	Measuring Unit	Range		Mean	S D
		Possible	observed		
Age	Years	-	22-76	46.09	10.28
Education	Year of schooling	-	00-16	4.94	3.84
Land size	Acres	-	.30-8.58	2.11	1.88
Family size	Members	-	2-11	4.87	1.5
Farm income	('000' Tk.)	-	35-1528	353.47	247.97
Off farm income	('000' Tk.)	-	0-700	64.65	82.09
Area under vegetable cultivation	Decimal	-	9.04-83.90	39.61	13.74
Number of vegetables grown	Number	-	2-8	4.42	1.06
Farm Experience	Years	-	3-50	24.98	11.17
Time spends in vegetable cultivation	Hours	-	1-8	5.00	1.36
Extension agent	Score	0-1	0-1	.75	.43
Use of improved variety	Score	0-1	0-1	.89	.30
Trust in dealers of agricultural inputs	Score	0-16	4-15	9.48	1.81

4.1.1 Age

Age of the farmers ranged from 22 to 76 years, the average being 46.09 years and the standard deviation, 10.28. On the basis of age, the farmers were classified into three categories: "young" (up to 35), "middle aged" (36-50) and "old" (above 50). The distribution of the vegetable growers according to their age is shown in Table 4.2.

Table 4.2 Distribution of the farmers according to their age

Categories	Basis (years)	Numbers	Percent
Young age	Up to 35	30	24.4
Middle age	36 to 50	29	23.6
Old age	Above 50	64	52
Total		123	100

Table 4.2 showed that the highest proportion 52 percent of the vegetable growers fell in the "old aged" category, while 24.4 percent of them fell in the "young aged" category and 23.6 percent in the "middle aged" category. The findings indicate that a large proportion

(85.6) of the farmers were middle to old aged. The middle to old aged farmers were generally more involved in farm activities than the younger that might be due to the energetic, enthusiastic nature of middle to old aged farmers.

4.1.2 Education

The education scores of the farmers ranged from 0 to 16. The average was 4.94 and the standard deviation was 3.84. On the basis of their educational scores, the vegetable growers were classified into four categories, namely "illiterate (0-0.5), primary (1-5), secondary (6-10) and above secondary (above 10). The distribution of the farmers according to their education is shown in Table 4.3.

Table 4.3 Distribution of the farmers according to their education

Categories	Basis of Categorization	Numbers	Percent
Illiterate	0	23	18.7
Primary	1-5	53	43.1
Secondary	6-10	38	30.9
Above secondary	Above 10	9	7.3
Total		123	100

Table 4.3 indicated that the majority (43.1 percent) of the vegetable growers were primary level of education compared to 18.7 percent of them having illiterate. About 30.9percent of the farmers were secondary of level education, while 7.3 percent of the farmerswere above secondary level of education. Majority of the farmers had primary level of education and the least number had above secondary level of education. This might be due to the fact that the farmers enter their profession by inheritance and felt less necessary to gain formal education for farming.

4.1.3 Farm size

The land size of the respondents varied from .30 to 8.58 de. The average farm size was 2.11 de with a standard deviation of 1.88 acre. The respondents were classified into the following three categories based on their farm size: "small farm"," medium farm" and "large farm". The distribution of the farmers according to their farm size is shown in Table 4.4.

Table 4.4 Distribution of the farmers according to their farm size

Categories	Basis of category (Amount of land)	Numbers	Percent
Small	Up to 2.47 acres	93	75.6
Medium	>2.47 to 7.41 acres	24	19.5
Large	>7.41 acres	2	4.9
Total		123	100

Table 4.4 indicated that more than half (75.6 percent) of the farmers possessed small farms compared to above 19.5 percent of them having medium farms and 4.9 percent large farms. Thus, the overwhelming majority 96.1 percent of the farmers were the owners of small to medium farms. Majority of the farmers were under small farmer's category which is consistent with national scenario. Due to the land fragmentation systemand the increasing rate of population, the amount of cultivable land or land size is decreasing gradually in Bangladesh.

4.1.4 Family size

The family size of the vegetable growers ranged from 2 to 11 members. The average was 4.87 with a standard deviation of 1.5. On the basis of their family size the farmers were classified into the following three categories: "small family" (up to 4), "medium family" (5-8) and "large family" (above 8). Table 4.5 contains the distribution of the vegetable growers according to their family size.

Table 4.5 Distribution of the farmers according to their family size

Categories	Basis of categorization	Numbers	Percent
Small family	Up to 4	48	39
Medium family	5 to 8	73	59.4
Large family	>8	2	1.6
Total		123	100

Table 4.5 showed that the majority of the 59.4 percent of the vegetable growers had "medium family" of 5 to 8 members compared to more different than 39 percent of them having "small family" of up to 4 members. The proportion of "large family" was only 1.6 percent (Table 4.3). Thus majority (98.4 percent) of the vegetable growers had medium to small families. Because of livelihood expense and some other reasons farmers like other

professions think to keep small their family size.

4.1.5 Farm income

Farm income score of the respondents ranged from 35 to 1528 (in thousands) with an average of 353.47 and standard deviation 247.97. On the basis of the annual income, the respondents were classified into three categories as shown in Table 4.6.

Table 4.6 Distribution of the farmers according to their farm income

Categories	Basis of categorization	Numbers	Percent
Low	Up to 150	34	27.6
Medium	>150 to 500	58	47.2
High	>500	31	25.2
Total		123	100

Data presented in Table 4.6 indicate that the highest proportion (47.2 percent) of the respondent had medium annual income, while (27.6 percent) had low income and (25.2 percent) had high income. As a result, the most (74.8 percent) of the respondents in the study area were low to medium income earners.

The average income of the respondents in the study area was much higher than the average per capita income of the country i.e., 2552 U.S. dollar (BBS, 2021). This might be due to the fact that the respondents in the study area engage to cultivate various crops. The soil status and environment also allow them to cultivate 3 to 4 types of crops per year.

4.1.6 Off farm income

Off farm income score of the respondents ranged from 0 to 700 (in thousands) with an average of 64.65 and standard deviation 82.09. On the basis of the off-farm income, the respondents were classified into four categories as shown in Table 4.7.

Table 4.7 Distribution of the farmers according to them of farm income

Categories	Basis of categorization	Numbers	Percent
No	0	23	18.7
Small	Up to 50	54	43.9
Medium	>50 to 100	30	24.4
Large	>100	16	13
Total		123	100

Data presented in Table 4.7 indicate that the highest proportion (43.9 percent) of the respondent had small off farm income, while (18.7 percent) had no of farm income, (24.4 percent) had medium off farm income and 13 percent of the farmers had large off farm income. As a result, the most (68.3 percent) of the respondents in the study area were small to medium income earners. However, a portion of the farmers had no off-farm income. Probably these farmers solely expense their livelihood based on agriculture only.

4.1.7 Vegetable cultivation area

The vegetable land of the respondents varied from 9.04 to 83.90 de. The average farm size was 39.61 hectare with a standard deviation of 13.74. The respondents were classified into the following three categories based on their farm size: "small farm", " medium farm" and " large farm". The distribution of the farmers according to their vegetable land is shown in Table 4.8.

Table 4.8 Distribution of the farmers according to their vegetable land

Categories	Numbers	Percent
Small	47	38.2
Medium	72	58.5
Large	4	3.3
Total	**123**	**100**

Table 4.8 indicated that more than half (58.5 percent) of the farmers possessed medium vegetable land compared to 38.2 percent of them having small vegetable land and 3.3 percent large vegetable land. Thus, the overwhelming majority 96.7 percent of the farmers were the owners of small to medium vegetable land.

4.1.8 Number of vegetables grown

Vegetable grown scores of the farmers ranged from 2 to 8 with an average of 4.42 and standard deviation of 1.06. On the basis of their vegetable grown, the respondents were classified into three categories namely, less, moderate and high number grown. The scale used for computing the vegetable grown score of a respondent is given Table 4.9.

Table 4.9 Distribution of the farmers according to their number of vegetables

Categories	Basis of categorization	Numbers	Percent
Less	Up to 3	21	17.1
Moderate	4 to 6	98	79.5
High	>6	4	3.4
Total		123	100

Data contained in the Table 4.9 indicated that the highest proportion (79.5%) of the respondents had moderate vegetable grown type as compared to (17.1%) and (3.4%) having less and high vegetable grown respectively. The vegetables that were cultivated bythe farmers were brinjal, okra, chili, potato, cucurbits, carrot, tomato etc.

4.1.9 Farm experience

The experience score of the respondents ranged from 3 to 50. The mean score was 24.98 with the standard deviation 11.17. On the basis of experience, the respondents were classified into three categories namely, low experience, medium experience and high experience, as shown in Table 4.10.

Table 4.10 Distribution of the farmers according to their farm experience

Categories	Basis of categorization	Numbers	Percent
Low	Up to17	29	23.6
Moderate	18 to 34	63	51.2
High	>34	31	25.2
Total		123	100

Data contained in the Table 4.10 revealed that the majority (51.2%) of the farmers had moderate experience as compared to (23.6%) and (25.2%) having low and high experience respectively. The majority (86.4%) of the respondents had moderate to high experience in vegetable cultivation. From the findings it can be said that farmers were engaged with vegetable cultivation since long.

4.1.10 Time spent in vegetable cultivation

Time spends in vegetable farm by the farmers varied from 1 to 8 hrs per week with an average of 5 and standard deviation of 1.36. Based on their time spends in vegetable farm, the farmers were classified into three categories namely less time spend (up to 3hrs), moderate time spend (3 to 6hrs) and high time spend (above 6hrs). The distribution

of the vegetable farmers according to their time spend in vegetable cultivation is presented in Table 4.11.

Table 4.11 Distribution of the farmers according to their time spend

Categories	Basis of categorization	Numbers	Percent
Less	3 hrs.	13	10.6
Moderate	>3 to 6	90	73.1
High	>6	20	16.3
Total		123	100

Data presented in Table 4.11 indicates that majority (73.1 percent) of the respondents had moderate time spend against 10.6 percent of the respondents had less time spend and 16.3 percent had high time spend in vegetable cultivation. The findings indicate that majority of the farmers depend on agriculture and thus spend much time on their main profession.

4.1.11 Contact with extension agent

Extension agent scores of the farmers ranged from 0 to 1. The farmers who had contact at least once in a season with the extension agent to discuss about crop management were given 1 otherwise the score was 0. On the basis of their agent contact, the respondents were classified into two categories namely, having contact and no contact. The scale used for computing the contact score of a respondent is given Table 4.12.

Table 4.12 Distribution of the farmers according to their extension agent

Categories	**Basis of categorization**	**Numbers**	**Percent**
Having contact	1	92	74.8
No contact	0	31	25.2
Total		123	100

Data contained in the Table 4.12 indicated that the highest proportion (74.8%) of the respondents had extension contact and (25.2%) having no extension contact. Due to a poor ratio between extension agent and farmers, sometimes it is difficult for the agent to make contact with each farmer in a season. From this Table, it is observed that majorityof the farmers had contact. Finding also revealed that one-fourth of the farmers had no contact which demands for recruiting more extension agent.

4.1.12 Use of improved variety

The improved variety score of the respondents varied from 0 to 1. The respondents were classified into two categories based on their improved variety scores: user and non-user. Some farmers were improved variety users while others were local variety user. The categories and the distribution of the farmers according to their improved variety are shown in table 4.13.

Table 4.13 Distribution of the farmers according to their improved variety

Categories	Basis of categorization	Numbers	Percent
Improved variety user	1	110	89.4
Local variety user	0	13	10.6
Total		123	100

Data contained in the Table 4.13, revealed that the majority (89.4%) of the farmers had yes as compared to 10.6% having no. Most of the farmers used improved verity for vegetable cultivation. They collected seed from various public and private organizations. On the other hand, few farmers cultivated vegetables by their own seed collection.

4.1.13 Trust in dealers of agricultural inputs

Trust in dealers of agricultural inputs score varied from 4 to 15 with an average of 9.48 and standard deviation of 1.81. Based on their trust in inputs dealers, the farmers were classified into three categories namely disagree (up to 5), neutral (6 to 10) and agree (above 10). The distribution of the vegetable farmers according to their trust dealers of agricultural inputs is presented in Table 4.14.

Table 4.14 Distribution of the farmers according to their trust in agricultural input dealer

Categories	Basis of categorization	Numbers	Percent
Disagree	UP to 5	35	18.5
Neutral	6 to 10	85	49.1
Agree	>10	3	32.4
Total		123	100

Data contained in the Table 4.14 revealed that the majority (49.1%) of the farmers had neutral as compared to (18.5%) and (32.4%) having disagree and agree respectively. The majority (81.5%) of the respondents had agreed to neutral regarding trust in pesticide dealer. The result also indicates that about one-fifth of the farmers don't trust the pesticide dealers about pest management suggestions.

4.2 Adoption, discontinuation and rejection of Pheromone trap

The vegetable farmers 3 characteristics such as adoption and continue, adoption and discontinuation and rejection of pheromone trap was the dependent variable of the study. The score of the respondents could range from 0 to 2 with an average of 0.84 and standard deviation 0.83. On the basis of the score, the respondents were classified into three categories as shown in Table 4.15.

Table 4.15 Distribution of the farmers according to their adoption

Categories	Basis of categorization	Numbers	Percent
Adoption and continue	2	37	30.1
Adoption and discontinue	1	36	29.3
Rejection	0	50	40.6
Total		123	100

Data presented in Table 4.15 indicate that the highest proportion (40.6 percent) of the respondent rejected Pheromone trap, while 30.1 percent had adoption and continue Pheromone trap and 29.3 percent had adoption and discontinue of Pheromone trap. The majority of farmers were far away to accept Pheromone trap while the number of farmers' name adopter and discontinuer were almost same. Probably because of some barriers a proportion of the farmers did not use or discontinued the trap.

4.3 Multinomial logistic regression showing contributory factors on the adoption and discontinue behavior

In order to estimate the factors significantly contributing vegetable growers' adoption and continue, adoption and discontinuation and rejection of Pheromone trap, multinomial logistic regression analysis was used which is shown in the Table 4.16. To do this analysis there is a need to consider any category as a reference category. The study considered adoption and continue group as a reference category as this group is desired

status and the reasons or identifying responsible factors for other two groups such as adoption and discontinue and rejection is necessary. Therefore, factors influencing farmers adoption and discontinue and rejection is highlighted below (considering adoption and continue as a reference or base category).

4.3.1 Factors influencing rejection of pheromone trap

Table 4.16 Parameter estimation result for the rejection group

Independent variables	B	S. E.	Wald	Sig.	Exp. (B)
Age	-0.017	0.033	0.277	0.598	0.983
Education	-0.073	0.103	0.496	0.481	0.930
Land size	0.003	0.002	1.546	0.214	1.003
Family size	-0.211	0.253	0.698	0.403	0.809
Farm income	0.033	0.015	5.281	0.096	1.034
Off farm income	0.008	0.002	14.604	0.000**	1.992
vegetable cultivation area	0.13	0.025	0.281	0.596	0.913
Number of vegetables grown	0.243	0.407	0.536	0.550	1.275
Farm Experience	0.036	0.036	1.002	0.317	1.037
Time spends in vegetable cultivation	0.435	0.313	1.936	0.164	1.545
Contact with extension agent	-2.094	1.027	4.154	0.042*	0.823
Use of improved variety	-2.714	1.308	4.307	0.038*	0.883
Trust in dealers of agricultural inputs	-0.048	0.237	2.341	0.114	0.953

The -2 Log Likelihood ratio is 194.569 which is different from 0. The Chi-square value is 72.805 which is significant at 1% level of confidence. The Cox and Snell R^2 value is .447 and The Nagelkerke value is .506 indicates good explanation power by the independent variables on the dependent variable. All these parameters indicate the analysis fitted well. A discussion based on the results is highlighted below.

4.3.1.1 Contributing relationship between off-farm income and farmers' rejection of Pheromone trap

From the multinomial logistic regression, it was concluded that the contribution of off-farm income on the farmers' rejection of Pheromone trap was measured by the testing the following null hypothesis;

"There is no contribution of off-farm income to the farmers' rejection of Pheromone trap".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of the farm income was significant at 1% level (.000)

b. So, the null hypothesis could be rejected.

c. The direction between off-farm income and rejection of Pheromone trap was positive.

The b-value of off-farm income is (0.008). So, it can be stated that as farm income increased by one unit, farmers' rejection of Pheromone trap increased by 0.008 units.

Based on the above finding, it can be said that farmers had more off-farm income increased farmers' rejection of Pheromone trap. Farmers having more off-farm income indicate giving less importance on farming. Probably this tendency influences them less interested towards Pheromone trap. Therefore, the extension agent should give emphasizes more the farmers having higher off-farm income to increase the adoption of Pheromone trap.

4.3.1.2 Contributing relationship between use of improved variety and farmers' rejection of Pheromone trap

From the multinomial logistic regression, it was concluded that the contribution of improved variety to their rejection of Pheromone trap was measured by the testing the following null hypothesis;

"There is no contribution of use of improved variety on the farmers' rejection of Pheromone trap".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of the use of improved variety was significant at 5% level (0.038)
b. So, the null hypothesis could be rejected.
c. The direction between use of improved variety and rejection of Pheromone trap was negative.

The b-value of farmer's use of improved variety was (2.714). So, it can be stated that as farmers use of improved variety increased by one unit, farmers' rejection of Pheromone trap decreased by 2.714 units. Considering the effects of all other predictors are held constant.

Based on the above finding, it can be said that the farmers who used improved variety have lower chance to reject Pheromone trap. Alternatively, it can be said that use of local variety influence farmers less to adopt Pheromone trap. This might be due to the fact that usually the farmers who seek to collect and use of improve variety to cultivate vegetables are more enthusiastic and active towards their profession.

4.3.1.3 Contributing relationship between extension agent contact on the farmers' rejection of pheromone trap

From the multinomial logistic regression, it was concluded that the contribution of extension agent to the farmers' rejection of Pheromone trap was measured by the testing the following null hypothesis-

"There is no contribution of extension agent to the farmers' rejection of Pheromone trap".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of the extension agent was significant at 5% level (.042)
b. So, the null hypothesis could be rejected.
c. The direction between extension agent and rejection of Pheromone trap was negative.

The b-value of extension agent is (2.094). So, it can be stated that as contact with extension agent increased by one unit, farmers' rejection of Pheromone trap increased by 2.094 units.

Based on the above finding, it can be said that if the farmers have more contact with extension agent, then the probability of rejection of Pheromone will be decreased. So, the role of extension agent is very important to decrease the rejecter of Pheromone trap. Extension agent increase farmer's knowledge about various aspect which helps farmers move towards adopting environment friendly technologies like Pheromone trap.

4.3.2 Factors influencing Adoption and discontinue of pheromone trap

The results of factors influencing adoption and discontinue behaviour of Pheromone trap is shown in the following Table.

Table 4.17 Parameter estimation results for the discontinuance group

Independent variables	B	S. E.	Wald	Sig.	Exp. (B)
Age	-0.21	0.033	0.429	0.513	0.979
Education	-0.058	0.107	0.290	0.590	0.044
Land size	.001	.002	.126	.723	1.001
Family size	-0.167	0.255	0.430	0.512	0.846
Farm income	-0.004	0.002	4.405	0.036*	0.996
Off farm income	0.031	0.015	5.182	0.123	0.096
Area under vegetable cultivation	0.012	0.024	0.247	0.619	1.012
Number of vegetables grown	0.546	0.414	1.739	0.187	1.726
Farm Experience	0.000	0.037	0.000	0.993	1.000
Time spends in vegetable cultivation	0.422	0.314	1.806	0.179	1.525
Contact with Extension agent	-2.177	1.016	4.588	0.032*	0.913
Use of improved variety	0.810	1.209	0.449	0.503	2.248
Trust in dealers of agricultural inputs	0.400	0.239	2.808	0.044*	2.671

4.3.2.1 Contributing relationship between farm income on the farmers' adoption and discontinue of Pheromone trap

The contribution of farm income on the farmers' adoption and discontinue of Pheromone trap was measured by the testing the following null hypothesis;

"There is no contribution of farm income on the farmers' adoption and discontinue of Pheromone trap".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of the off-farm income was at 5% significance level (.036)
b. So, the null hypothesis could be rejected.

c. The direction between farm income and off farm income on the farmers' adoption and discontinue of Pheromone trap was negative.

The b-value of level off farm income is (0.004). So, it can be stated that as farm income increased by one unit, farmers adoption and discontinue of Pheromone trap decreased by 0.004 units.

Based on the above finding, it can be said from the direction of coefficient value that farmers' income from agriculture source increased then farmers' adoption and discontinue of Pheromone trap will be decreased. Farmers in the study areas cultivated vegetables beside other crops. If they got more income from various crops then they might be felt unnecessary to use environment friendly technology like Pheromone trap.

So, the extension agent should give emphasize more the farmers having higher farm income to disseminate Pheromone trap.

4.3.2.2 Contributing relationship between trust in dealers of agricultural inputs on the farmers' adoption and discontinue of Pheromone trap

The contribution of trust in dealers of agricultural inputs to farmers adoption and discontinue of Pheromone trap was measured by the testing the following null hypothesis; "There is no contribution of trust in dealers of agricultural inputs to the farmers' adoption and discontinue of Pheromone trap".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of the trust in dealers of agricultural inputs was at 5% significance level (.044)
b. So, the null hypothesis could be rejected.
c. The direction between trust in dealers of agricultural inputs and adoption and discontinue of Pheromone trap was positive.

The b-value of level trust in dealers of agricultural inputs is (-.400). So, it can be stated that as trust in dealers of agricultural inputs increased by one unit, farmers' adoption and discontinue of Pheromone trap increased by -0.400 units.

Based on the above finding, it can be said that farmers' trust in dealers of agricultural inputs especially pesticides increase the probability of discontinue of Pheromone trap. Usually, the pesticide dealer feels good to suggest more use of pesticide to control pest. Therefore, the farmers who rely on the pesticide dealer's prescription or suggestion havea tendency to discontinue the Pheromone trap.

4.3.2.3 Contributing relationship between extension agent on the farmers' adoption and discontinue of Pheromone trap

The contribution of extension agent to farmers adoption and discontinue of Pheromone trap was measured by the testing the following null hypothesis;

"There is no contribution of extension agent to the farmers' adoption and discontinue of Pheromone trap".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

- The contribution of the extension agent was at 5% significance level (.032)
- So, the null hypothesis could be rejected.
- The direction between extension agent and adoption and discontinue of Pheromone trap was negative.

The b-value of level extension agent is (-2.177). So, it can be stated that as extension agent increased by one unit, farmers' adoption and discontinue of Pheromone trap decreased by -2.177 units.

Based on the above finding, it can be said that farmers' extension agent contact decreased the farmers' adoption and discontinue behavior of Pheromone trap. Extension agent plays an important role to reduce problems in adoption and discontinue of Pheromone trap many ways. They enhance knowledge of the farmers through various approaches like training, field day, farmers field school and so on.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1. Summary

5.1.1 Selected characteristics of the farmers

Age: The highest proportion 52 percent of the vegetable growers fell in the "old aged" category, while 24.4 percent of them fell in the "young aged" category and 23.6 percent in the "middle aged" category.

Education: The majority (43.1 percent) of the vegetable growers were primary level of education compared to 18.7 percent of them having illiterate. About 30.9 percent of the farmers were secondary of level education, while 7.3 percent of the farmers were above secondary level of education.

Land size: More than half (75.6 percent) of the farmers possessed small lands compared to above 19.5 percent of them having medium lands and 4.9 percent large lands.

Family size: The majority of the 59.4 percent of the vegetable growers had "medium family" of 5 to 8 members compared to more different than 39 percent of them having "small family" of up to 4 members. The proportion of "large family" was only 1.6 percent.

Farm income: The highest proportion (47.2 percent) of the respondent had medium annual income, while (27.6 percent) had low income and (25.2 percent) had high income.

Off farm income: The highest proportion (43.9 percent) of the respondent had small off farm income, while (18.7 percent) had no of farm income, (24.4 percent) had medium off farm income and 13 percent of the farmers had large off farm income.

Vegetable cultivation area: More than half (58.5 percent) of the farmers possessed medium vegetable land compared to 38.2 percent of them having small vegetable land and 3.3 percent large vegetable land.

Number of vegetables grown: The highest proportion (79.5%) of the respondents had moderate vegetable grown type as compared to (17.1%) and (3.4%) having less and high vegetable grown respectively.

Farm Experience: The majority (51.2%) of the farmers had moderate experience as compared to (23.6%) and (25.2%) having low and high experience respectively.

Time spends in vegetable cultivation: The majority (73.1 percent) of the respondents had moderate time spend against 10.6 percent of the respondents had less time spend and 16.3 percent had high time spend in vegetable cultivation.

Contact with extension agent: The highest proportion (74.8%) of the respondents had extensioncontact and (25.2%) having no extension contact.

Use of improved variety: The majority (89.4%) of the farmers had yes as compared to 10.6% having no. Most of the farmers used improved verity for vegetable cultivation.

Trust in dealers of agricultural inputs: The majority (69.1%) of the farmers had neutral as compared to (28.5%) and (2.4%) having disagree and agree respectively.

5.1.2 Adoption, non-adoption and rejection of Pheromone trap

Vegetable farmers 3 characteristics such as adoption and continue, adoption and discontinuation and rejection of Pheromone trap was the dependent variable of the study. The score of the respondents ranged from 0 to 2 with an average of 0.84 and standard deviation 0.83. The highest proportion (40.6 percent) of the respondent rejected Pheromone trap, while 30.1 percent had adoption and continue Pheromone trap and 29.3 percent had adoption and discontinue of Pheromone trap.

5.1.3 Multinomial logistic regression showing contributory factors on the adoption and discontinue behavior

In order to estimate the contribution of independent variables on the adoption and continue, adoption and discontinuation and rejection of Pheromone trap, multinomial logistic regression analysis was used. There is a significant contribution of respondents' off-farm income, extension agent, use of improved variety and the rest ten characteristics namely, age, education, land size, family size, off farm income, vegetable cultivation

area, number of vegetables grown, farm experience, time spends in vegetable cultivation, and trust in dealers of agricultural inputs had no significant contribution with their rejection of Pheromone trap. Again, there is a significant contribution of respondent's farm income, extension agent and trust in dealers of agricultural inputs and the rest ten characteristics namely, age, education, land size, family size, off farm income, vegetable cultivation area, number of vegetables grown, farm experience, time spends in vegetable cultivation and use of improved variety had no significant contribution with their adoption and discontinue of Pheromone trap.

5.2 Conclusions

1. The highest proportion (40.6 percent) of the respondent rejected Pheromone trap, while 30.1 percent had adoption and continue Pheromone trap and 29.3 percent had adoption and discontinue of Pheromone trap. So, still there have scope to take initiative for increasing the adoption and continue of Pheromone trap.

2. The results indicate that off-farm income of farmers had a positive and significant contribution with their rejection of Pheromone trap. Therefore, it can be concluded that more the off-farm income, have a tendency to rejection of Pheromone trap.

3. The results indicate that one-third (74.8 percent) of the respondents had extension contact. It shown significant contribution for both discontinue and rejection behaviour towards Pheromone trap. The results might be a good scenario to taking adoption and continue pheromone trap practice. However, still a portion of the farmers don't get contact of the extension agent that should be taken into consideration. At the same time how the extension agent can reach to all farmers should be find out.

4. Use of improved variety played a significant role on the farmers rejection of Pheromone trap. Use of improved variety lower the chances to reject Pheromone trap.Therefore, initiative to increase the adopter of improve variety may increase the use of Pheromone trap.

5. From the analysis it can be concluded that higher the farm income higher the adoption and discontinue of Pheromone trap. If farmers get high income from crop production,

then they are reluctant to use environment friendly approach like Pheromone trap. Therefore, initiative to understand them to realize the importance of non-chemical ways to control pest in vegetables is necessary.

6. The majority (81.5%) of the respondents had agreed to neutral opinion regarding trust in pesticide dealer. The factor is also significant in farmers decision regarding adoption and discontinue behavior of Pheromone trap. Those who have trust in pesticide dealers' suggestion for pest control have a probability to discontinue of Pheromone trap.

5.3 Recommendations

5.3.1 Recommendations for policy implications

1. Majority of the farmers of the study area were found rejection of Pheromone trap. So, DAE should take initiative to influence farmers to increase the adoption and continue of Pheromone trap.

2. The improved seed production and distribution authority should increase their effort so that more and more farmers can use improve seed in vegetable cultivation.

3. The extension agent contact found significant in both discontinue and rejection of Pheromone trap. Therefore, it is recommended that the government should take initiative to increase the number of SAAO to cover all farmers in a particular block.

4. The vegetable farmers with higher off-farm and on-farm income had a lower tendency to use Pheromone trap. Therefore, the extension agent should contact more with these types of vegetable farmers.

5. Trust in pesticide dealers played an important role in using environment friendly technologies. Very often they misguide the farmers or give emphasize on the chemical control. Therefore, the extension agent should have communication with thedealers or fill the gap.

5.3.2 Recommendations for the future study

The following recommendations are made for the future study:

1. The present study conducted in Shibgonj upazila under Bogura district. The findings of the study need to be varied by undertaking similar research in other zones of the country.

2. The study investigated the contributions of the 13 selected characteristics of the farmers with their adoption, discontinuation and rejection of Pheromone trap. But farmer's adoption, discontinuation and rejection of Pheromone trap might be affected by other various personal, social, psychological, cultural and situational factors of the farmers. It is, therefore, recommended that further study should be conducted involving other characteristics in this regard.

3. The study focused on the adoption, post-adoption and rejection of Pheromone trap by the farmers in vegetable cultivation. Similar study should conduct based on other IPM technique.

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Appendix -A

English version of the Interview Schedule

Department of Agricultural Extension & Information System

Sher-e-Bangla Agricultural University, Dhaka–1207

Interview Schedule for data collection for the Research on

DETERMINANTS OF ADOPTION, DISCONTINUATIONAND REJECTION OF PHEROMONE TRAP: A CASE ON VEGETABLE GROWERS OF BOGURA DISTRICT

Name:..... Village_____

Upazila ..... District

(Please answer the following questions. Your answer will be used for research purpose only)

1 Age:

How old are you?

Ans:.....yrs.

2 Education level

Please mention your educational level.

a) I can't read and write

b) I can sign only

c) I read up to class……

d) I have passed……class

3. Family size

How many members are there in your household including you?

Ans: .....

4. Land size

How much land do you have for cultivation?

Ans:.....hectare

5. Farm income

Please mention your income from farm on the following items-

Item	Production	Value (BDT)
Agriculture		
Livestock		
Poultry		
Fisheries		
Other sources		
Total		

6. Off-farm income

Please mention your annual off-farm income.

Sources of income	Amount (BDT)
Service	
Day labour	
Business	
Others	
Total	

7. Area under vegetable cultivation

How much land you used for vegetable cultivation in the last year?

Ans:.....decimal

8. Number of vegetables grown

How many types of vegetables did you cultivate last year?

Ans: .....

9. Farm experience

How long you are engaged in vegetable cultivation?

Ans:_____yrs.

10. Time spent in vegetable cultivation

How many hours you spent for vegetable farming?
Ans:.....hrs./day

11 Contact with extension agent

Did you contact with local extension agent for managing pest in vegetables?

a) Yes b) No

12. Use of improved variety

For cultivating vegetables, do you use improved variety?

a) Yes b) No

13. Trust in dealers of agricultural inputs

Please mention your agreement on trust in dealers of agricultural inputs

Item	Degree of agreement				
	SA	A	NC	DA	SDA
a) Agricultural input dealers (AID) prescribe pesticides only when needed					
b) AID encourage non-chemical methods for control pest					
c) AID knows the recommended dose of pesticides					
d) AID motivate farmers to apply recommended dose of pesticides					

*SA = Strongly Agree, A = Agree, NC = No comment, DA = Disagree, SDA = Strongly Disagree

14. Adoption status

Please mention your adoption status regarding use of Pheromone trap from the followings-

a) Adoption and continue

b) Adoption and discontinue

c) Rejection

Thank you for your co-operation. Signature: