ADOPTION OF MODERN CULTIVATION TECHNOLOGIES OF WHEAT BY THE FARMERS OF A SELECTED AREA UNDER TARAGANJ UPAZILA IN RANGPUR DISTRICT

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CERTIFICATE

This is to certify that the thesis entitled,**" ADOPTION OF MODERN CULTIVATION TECHNOLOGIES OF WHEAT BY THE FARMERS OF A SELECTED AREA UNDER TARAGANJ UPAZILA IN RANGPUR DISTRICT"** submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka in partial fulfilment of the requirements for the degree of **Master of Science (MS) in Agricultural Extension**, embodies the result of a piece of bona-fide research work conducted by **SILVY AKHTER, Registration no. 19-10017** under my supervision and guidance. No part of this thesis has been submitted for any other degree or diploma.

I further certify that any help or source of information, received during the course of this study has been dully acknowledgement by him.

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Dedicated to

My

Beloved Parents & Husband

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The Author

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ACRONYMS AND ABBREVIATIONS

BBS	Bangladesh Bureau of Statistics
GDP	Gross Domestic Product
HYV	High Yielding Variety
FAO	Food and Agriculture Organization
MoA	Ministry of Agriculture
GoB	Government of Bangladesh
NAC	National AgriCAre
TSP	Triple Super Phosphate
MP	Meurate of Potash
RDRS	Rangpur Dinajpur Rural Service
IPM	Integrated Pest Management
UAO	Upazila Agriculture Officer
SAAO	Sub-Assistant Agriculture Officer
AEO	Agricultural Extension Officer
SPSS	Statistical Package for Social Sciences
DAE	Department of Agricultural Extension

ADOPTION OF MODERN CULTIVATUIN TECHNOLOGIES OF WHEAT BY THE FARMERS OF A SELECTED AREA UNDER TARAGANJ UPAZILA IN RANGPUR DISTRICT

SILVY AKHTER

ABSTRACT

The objectives of this study were describing some selected characteristics of the farmers; to determine the extent of adoption of modern wheat cultivation technologies by the farmers, to explore the contributions of the selected characteristics of the farmers on their extent of adoption of modern wheat cultivation technologies and to describe the extent of problems faced by the farmers in adopting wheat cultivation technologies. The study was conducted in Shamganj village under Sayar union at Taraganj Upazila of Rangpur district. Data were collected by using interview schedule from the randomly selected 100 respondents during 01 December to 07 December, 2021. Descriptive statistics, Multiple Regression were used for analysis. The highest proportion (60 percent) of the wheat growers fell under the medium adoption category, while 24 percent had high adoption and 16 percent had low adoption of wheat cultivation technologies. Thus, an overwhelming majority (84%) of the wheat farmers had medium to high adoption. Education, annual income, training experience, innovativeness and organizational participation of wheat farmers had positive significant contribution with their adoption of selected wheat cultivation technologies. Whereas; age, family size, farm size, extension media contact, agricultural knowledge for wheat cultivation, attitude towards wheat cultivation and agricultural knowledge had no significant contribution. The findings of the study indicated that farmers' adoption of wheat cultivation technologies had medium to the marks. It is concluded that adoption of modern wheat cultivation technologies can be increased through organizational participation, extension media contact and agricultural knowledge. On the other hand, Farmers faced various types of problem to adopt wheat cultivation technologies. Government and non-government institution should take necessary steps to overcome this situation.

Chapter 1

INTRODUCTION

1.1Background of the Study

Bangladesh is an agricultural country. The country's population is 137 million with high density of 928/sqkm (Bangladesh Economic Survey, 2005). About 79.9 percent of its population lives in rural areas and 62 percent of the country's total labour force are engaged in agriculture (BBS, 2003). The total land area of Bangladesh is 14.84 million hectare of which 8.29 million hectare are cultivable land and total cropped area is 14.109 million hectare of which 8.022 million hectare are net cropped area (BBS, 2004). Actual food grain procurement under the Public Food Distribution System (PFDS) during FY2018-19 was 2.42 mmt, in which 2.38 mmt was rice and 0.04 mmt was wheat. According to the revised budget of the current fiscal year, the target of public food grain procurement has been set at 2.27 mmt, of which 2.07 mmt rice and 0.20 mmt wheat. Up to the 3rd quarter (July/19-March/20) of current fiscal year, 1.47 mmt of boro and aman rice already procured. Public procurement from boro 2020 season started from 26 April 2020 and will continue up to 31 August 2020 with a target of 0.8 mmt boro paddy and 1.15 mmt of boro rice (parboiled and atap rice) which is equivalent to 1.67 mmt. boro in terms of rice (Bangladesh food situation report,2020).Different natural calamities or disasters such as flood, drought, cyclone, tidal bore etc. affect the rice production. As a result rice production becomes uncertain. In this situation the cultivation of wheat can be given priority for solution of food crisis.

Wheat is one of the most important cereal crops and main staple food crops in the world. About two-thirds of the world's population use wheat as staple food (Mujumder, 1991). Dubin and Grinkel (1991) reported that in the recent years the largest area of wheat cultivation in the warmer climates exists in the South- East Asia including Bangladesh, India and Nepal. Bangladesh is a rice growing country but its climatic conditions are suitable for wheat production. Wheat is the second important cereal crop next to rice in our country and has achieved a remarkable progress in increasing wheat production and productivity over the last 30 years. In 1970 wheat cultivation area was only 1 million hectare. In 1985 the area increased at 0.7 million

hectare and total production were 1.2 million metric ton. In 1999 wheat cultivation area of our country was 0.85 million hectare and the production were about 1.9 million metric ton (Razzaque, 2000).

In Bangladesh wheat is the second important cereal crop next to rice and has achieved a remarkable progress in increasing wheat cultivation and productivity over the last 30 years and the average yield of wheat is only 2.2 ton/hectare (BBS, 2001) and it can be increased up to 6.41 ton/hectare (RARS, 1993). So, there is an ample opportunity to increase production of wheat per unit area through adoption of modern HYV wheat and also through improved cultivation technologies. Food production in Bangladesh is not increasing by keeping space with the increase of population growth. Total land area under food production has been decreasing year after year to accommodate the ever-increasing population. On the other hand, yield of rice, the major food crop of this country has been declining for the last two decades due to decreasing of soil fertility and crop production (Roy, 1996) and as a result the country has been suffering from food shortage. So, in this situation efforts should be taken to increase the food production by cultivating promising crop like wheat other than rice.

The areas under wheat crop were estimated at 30.47, 31.47 and 30.42 mhectares in 2013- 2014, 2014-2015 and 2015-2016 respectively. The following table shows the area & yield rates of wheat crop during 2013-14 to 2017-18.

Table 1.1 Estimated area and yield of wheat crop

Year	Area (hectare)	Production (Metric ton)	Yield(q/ha)
2013-14	30.47	95.85	31.45
2014-15	31.47	86.53	27.50
2015-16	30.42	92.29	30.34
2016-17	30.79	98.51	32.00
2017-18	29.58	99.70	33.71

Source: BBS, 2018

Average yield rate of wheat has been found 98.70 metric ton per hectare this year compared to 99.70 metric tons last year. The yield rate has increased by 1.19 percent this year over last year.

Total production of wheat crop has been estimated at 3.40 million metric tons in 2015-16 as against 3.60 million metric tons in the previous year which is 6.25 percent higher. Increase in areas and yield rate contributed to higher production in 2018-19.

Table 1.2 Production of wheat in different years

Year	Production (M. tons)	% change over previous year
2015-2016	34000	+6.25
2016-017	36000	+5.88
2017-2018	37000	+2.75
2018-2019	40000	+8.11

Source: MDIC 35

1.2 Statement of the Problem

The success of any technology depends on its dissemination among the potential users, which ultimately is measured by its level of adoption. It is assumed that notable improvements can take place in Bangladesh agriculture, if the available technologies are accepted and adopted by the farmers. Very little is known about the adoption of modern wheat production technologies by the farmers in the country. For wider adoption of modern wheat cultivation technologies, it is necessary to have a clear understanding of the present status of adoption of wheat cultivation technologies by the farmers. It is also necessary to have an understanding of the facts that contributed to adoption of wheat cultivation technologies. An understanding of the relationship of farmer's "adoption behavior with the selected characteristics as well as the problems faced by the respondents will be helpful to the planners and extension workers.

In view of the foregoing discussion, the researcher undertook a study entitled "Adoption of Cultivation Technologies of wheat by the farmers of Rangpur district in Bangladesh." The main purpose of the study was to have an understanding on the adoption of modern agricultural technologies by the farmers and about some selected factors contributing in the adoption of wheat cultivation technologies. For conducting the research in a planned and appropriate way, the researcher put forwarded the following questions:

1. What are the characteristics of wheat growers?

2. What extent the modern wheat cultivation technologies have been adopted by the farmers?

3. What are the farmers selected characteristics having contributions with the adoption of modern wheat cultivation technologies by the farmers?

4. What are the problems faced by the farmers in adopting wheat cultivation technologies?

1.3 Specific Objectives of the Study

The following objectives were formulated to give clear direction to the study:

i. To describe some selected characteristics of the wheat cultivators.

ii. To estimate the contribution between each of the selected characteristics of the farmers and their use of technologies of wheat cultivation.

iii. To determine and describe the extent of adoption of wheat cultivation technologies by the farmers.

iv. To describe the extent of problems faced by the farmers in adopting wheat cultivation technologies.

1.4 Justification of the Study

By improving wheat cultivation practices by the farmer's cultivation technologies of wheat may be increased. It is to be disseminated about the concept and benefits of the wheat cultivation technologies to the farmers in a convincing and attractive manner, so that farmer's response quickly to adopt wheat cultivation technologies. Taragang upazila under Rangpur district was considered as the most suitable location to study the phenomenon of adoption of wheat cultivation technologies by the wheat growers. Limitation of cultivable land and lack of knowledge and skill about wheat production are the major problem for the farmers. So, to ensure adequate food supply, it is necessary to give thrust to increase food production using modern wheat cultivation technologies. Agricultural intensification, to minimize food shortage and maximize self-sufficiency in food production is possible only when adoption of wheat

production technologies and their application skills create positive impact on the behavior of ultimate users. Several research institutes have developed quite a good number of modern agricultural technologies but the farmers have so far adopted a few of them. Technical, biological, environmental and socio-economic barriers are the main hindrances of technology transfer and adoption of wheat cultivation technologies. It is obviously true that farmers are the key elements of adoption of modern wheat cultivation technologies. At present, there is a lack of adequate understanding as to how the characteristics of the farmers influence their adoption of modern wheat cultivation technologies. These facts indicate the need for an investigation to ascertain the contributions of the characteristics of the farmers with their adoption of modern wheat cultivation technologies. Findings of this study, therefore, would be helpful to the planners and extension personnel in planning and execution of programs for enhancing the rice production yield.

1.5 Scope of the study

The main focus of the study was to determine the adoption of modern wheat cultivation technologies. The findings of the study would be specifically applicable to Rangpur district. However, the findings would also have implications for other areas of the country having relevance to the environmental and socio-cultural context of the study area. The investigator believes that the findings of the study would reveal the phenomenon related to diffusion of innovation. These would be of special interest to the policy makers and planners in formulating and redesigning the extension programs especially for wheat cultivation technologies. The findings are expected to be helpful to the field workers of different nation building departments and organizations to develop appropriate extension strategies for increasing the wheat production that will be supportive to meet the huge national demand.

1.6 Assumptions of the Study

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

1) The respondent included in the sample was capable of providing proper answer to the question in the interview schedule.

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

3) Views and opinions furnished by farmers included in the sample were representative views and opinions of the whole population of the study.

4) The finding of the study will have general application to other parts of the country with similar, socio-economic, cultural and agro-ecological conditions of the study area.

5) The respondents were more or less conscious about the use of wheat cultivation technologies.

1.7 Limitations of the Study

Considering the time, money and other necessary resources available to make the study manageable and meaningful, it was necessary to consider the following limitations:

1. The study was confined mainly to farmers' adoption of modern cultivation technologies of wheat.

2. The study was confined in Samganj village at Sawyer union of Taragang upazila under Rangpur district.

3. The characteristics of wheat growers were many and varied but only eleven characteristics were selected for investigation in this study.

4. Population of the study includes only the heads of the farm families.

5. Facts and figures were collected by the investigator applied to the present situation in the selected area.

6. For information about the study, the researcher was dependent on the data furnished by the selected respondent during data collection.

1.8 Definition of Key Terms

A concept is an abstract of observed thing; events or phenomenon or in other words, it is a short hand representation of variety of facts (Wilkinson and Bhandarkar, 1977). A researcher needs to know the meaning and contents of every term that he used. 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 are interpreted as follows:

Adoption: It is the implementation of a decision to continue the use of an innovation. According to Rogers (1995), "Adoption is a decision to make full use of an innovation as the best course of action available." When an individual takes up a new idea as the best course of action and practices it the phenomenon is known as adoption (Ray, 1991). In this study, adoption was defined as the phenomenon of taking up a new idea (wheat cultivation technologies) and put it into practices by the wheat growers of the study area.

Age: It means the age of a farmer that will refers to the period of time from his birth to the time of investigation.

Agricultural knowledge: It is the extent of basic understanding of the farmers in different aspects of agricultural subject matters i.e. crops, livestock, fisheries, agro forestry, soil, seed, fertilizer, insects and diseases of crops, high yielding variety etc. It includes the basic understanding of the use of different agricultural inputs and practices.

Annual income: It means the total earning by the respondents himself and the members of his family from agriculture and other sources during last year. It is expressed in taka.

Assumption: An assumption is “The supposition that an apparent fact or principle is true in the light of the available evidence” (Goode and Halt, 1952).

Attitude towards wheat cultivation: The term attitude towards wheat cultivation of an individual was used to refer to his feelings, belief and action tendencies towards the various aspects of wheat cultivation i.e. knowledge + beliefs + action = attitude

Training exposure: It referred to the total number of days that a respondent received training in his entire life from different organization under different training programmmes.

Education: Education is referred to the describe change of human behavior, i. e. change in knowledge, skill and attitude of an individual through reading, writing and other related activities. It is measured in terms of year of schooling.

Extension media contact: It is referred to the respondents becoming accessible to the influence of different information media through different extension teaching methods.

Family size: The family size is measured by the total number of members in the family of a respondent. The families members are include the respondent, spouse, sons, daughters and other dependents. A unit score is assigned for each member of the family.

Farm size: The term related to the land owned by a farmer on which he carried his farming and family business, the area being estimated in terms of full benefit to the farmer. A farmer was considered to have full benefit from cultivated area either owned by himself or obtained or, lease from others and half benefit from the area which was either cultivated by borga or given to others for cultivation on borga basis.

Farmers /growers: The persons who were involved in farming activities are called farmers. They participated in different farm and community level activities like crops, livestock, fisheries, other farming activities etc.

Hypothesis: Defined by Goode and Halt (1952), a proposition this can be put to "a test to determine its validity". It may be true or false, it may seem contrary to or in accord with common sense. However, it leads to an empirical test.

Innovation: An innovation is an idea or practice perceived as new by an individual. It is the newness of the idea to the individual that determines his reaction to it.

Innovativeness: According to Rogers (1995) Innovativeness is the degree to which an individual is relatively earlier in adopting agricultural innovations, new ideas, practices and things than the other members of a social system. This was

comprehended by the quickness of accepting innovations by an individual in relation to others and was measured on the basis of time dimension.

Null hypothesis: The hypothesis which we pick for statistical test is null hypothesis (H0). In this study the null hypothesis is stated that there is no relationship between the concerned variables.

Organizational participation: Organizational participation of the respondent is measured in two dimension status of his participation and duration of participation in different organizations during the time of interviewing.

Problem: Problem referred to a difficult about which something to be done. Problem faced by the farmers in this study was defined as the extent of difficulties faced by growers in the way of adoption of wheat production technologies.

Research methodology: Research methodology is the description, explanation and justification of various methods of conducting research. It may be understood as a science of studying how research is done scientifically. In it we study the various steps that are generally adopted by a researcher in studying the research problem along with the logic behind them.

Respondents: People who have answered questions by an interviewer for a social survey. They are the people from whom a social research worker usually gets most data required for his research.

Statistical test: A body of rules which help to take decision regarding acception or rejection of the hypothesis is defined as test. In this study if a null hypothesis is rejected it is assumed that there is a relationship between the variables.

Variable: A general indication in statistical research of characteristic that occurs in a number of individuals, objects, groups etc. and that can take on various values, for example the age of an individual.

Chapter 2

REVIEW OF LITERATURE

To find out the adoption of wheat cultivation technologies and its contribution with selected characteristics of the farmers were the main task of the study. This Chapter contains synthesis of selected literature those were related to the present study. The researcher made an elaborate search of available literature for this purpose. There was no literature directly related to the present study. Therefore, the present researcher searched relevant studies conducted by different scientist and authors on the adoption of innovations. The finding of such studies related to the extent of adoption of innovation by the farmers and other partial studies have been reviewed and partially discussed in this Chapter.

This Chapter is divided into four sections; the first section deals with general context of adoption of innovation, the second section with past research findings relating to adoption of innovations, the third section with past research findings relating to the relationships of farmers adoption of innovations with their selected characteristics and the fourth section with the conceptual framework of the study.

2.1 General context of adoption of innovation

Hossain (1987) stated, if technology is to be made adaptable with the joint efforts of scientists, technologists, extension personnel and farmers, participation of concerned peer groups, client groups and their associates are essential. The characteristics of the effective technologies that they are technically sound, they can be disseminated effectively, they economically viable and also socially acceptable.

Karim (1973) conducted a study on the adoption of fertilizers by transplanting aman growers in former Keyotkhali union of Mymensingh district. He studied the adoption of three fertilizers namely urea, Triple super phosphate (TSP) and muriate of potash (MP). He found that four percent of the respondent growers had high adoption of fertilizers while nine percent had medium adoption and 41 percent low adoption. Remaining forty six percent (46 percent) of the respondent growers did not use any of the three fertilizers.

Rahman (1974) studied the adoption of IR-20 variety of paddy by the farmers in Bhabakhali union of Mymensingh district. He found that 29 percent of the growers had medium adoption on of IR-20 while 31 percent of the growers did not adopt the innovation.

Mohammad (1974) studied the extent of adoption of insect control measures by the farmers in Khamar union of Rajshahi district. He found that among the respondent farmers, 25 percent did not adopt insect control measures, 28 percent had high level of adoption, 32 percent had medium level of adoption and 25 percent had low level of adoption.

Sobhan (1975) studied the extent of adoption of ten winter vegetables namely, tomato, radish, lettuce, potato etc. in Boilor union of Mymensingh district. Overall adoption scores indicated that 27 percent of the farmers did not adopt winter vegetables cultivation while 48 percent had low adoption and 25 percent high adoption.

Ahmed (1977) studied the extent of adoption of three specific practices of jute cultivation in Noapara union of Faridpur district. He observed that among the respondent farmers 98 percent adopted the recommended varieties of jute, 72 percent adopted plant protection measures and 49 percent adopted recommended dose of fertilizer.

Razzaque (1977) studied on the extent of adoption of HYV rice in three villages of Bangladesh Agricultural University Extension Project area. He observed that among the respondent growers, 6.6 percent of the farmers had high adoption of HYV rice, 33.3 percent had medium adoption and 40 percent had low adoption.

Hossain (2006) found that majority (49 percent) of the HYV rice farmer had medium adoption, 25 percent had low adoption and 26 percent high adoption of selected HYV rice.

Home et al.(1999) conducted a study on awareness and adoption of IPM by Australian potato growers. The study revealed that the adoption was highest amongst crisping potato growers. The sources of information on IPM appeared to influence the level of adoption.

2.2 Past Research Findings Relating to Extent of Adoption of Innovations

Podder and Kashem (2000) concluded that about half (47 percent) of the growers had medium adoption compare to 14 percent low adoption and 39 percent high adoption of Mehersagar banana.

Razzaque (2000) studied on the extent of adoption of HYV rice in three villages of Bangladesh Agricultural University Extension Project area. He observed that among the respondent growers, 6.6 percent of the farmers had high adoption of HYV rice, 33.3 percent had medium adoption and 40 percent low adoption.

Squire (2000) studied on factors influencing traditional farmers to adopt improved food crop production technologies in BO district of Southern Sierra Leone. He found that agricultural technology communication media (other farmers (54 percent)): characteristics of the arable crops (good to excellent eating quality of the improved crop varieties (53 percent)); artificial fertilizers (55 percent); mechanical technology (65 percent); draught animal technology (59 percent); pest and disease control technologies (increase in crop yield (61 percent)); and row planting technologies (easy to weed (53 percent)).

Haider *et al.* (2001) studied the adoption level of improved Package of practices for T. Aman rice cultivation in Gouripur upazila of Mymensingh district. He found that the adoption level of farmers categories were 5 percent non adoption, 62 percent low adoption, 24.5 percent medium adopter and 8.5 percent high adopter. Vast majority (95 percent) of the farmers adopted MV programme of T. Aman rice.

Rahman (2001) conducted an investigation on knowledge, attitude and adoption of Aalok6201 hybrid rice by the fanners of Sadar upazila in Mymensingh district. The study revealed that the majority (75 percent) of the farmers had medium adoption while 18 percent and 7 percent had high and low adoption in Aalok-6201 hybrid rice cultivation respectively.

Akanda (1995) studied the adoption of recommended dose of fertilizer and found that 36.26 percent respondents used recommended dose of urea, 6.93 percent used recommended dose of TSP, 11.88 percent MP and only 2 percent respondent used gypsum in their potato cultivation.

Islam (2002) conducted a study on adoption of modem agricultural technologies by the farmers of Sandwip. The study revealed that 69 percent of the farmers had medium adoption while 13 percent had low adoption and 18 percent had high adoption of modem agricultural technologies.

Hasan (2003) found that majority (60 percent) at the farmers had medium adoption while 33 percent had low adoption and 7 percent had high adoption of recommended potato cultivation practices.

Hossain (2004) found that majority (77 percent) of the Boro rice farmer had medium adoption, 5 percent had low adoption and 18 percent high adoption of modern Boro rice cultivation practices

Rahman (2003) revealed that about half (47 percent) of the growers had medium adoption 44 percent had low and I percent had high adoption of year round homestead fruit cultivation practices.

Salam (2003) found that an overwhelming majority (94 percent) of the respondents were found having high constraints in adopting environmentally friendly farming practices while 6 percent had medium constraints. No farmer was found having low constraint.

Rahman (2003) found that ninety seven percent of the pineapple growers adopted 2-4 intercrops viz, Zinger, turmeric, sweet ground and aroid in pineapple cultivation.

Haque (2003) found that the majority (47 percent) of the growers had medium adoption of modem maize cultivation technologies while 28 percent had high adoption and 25 percent low adoption.

Zegeye *et al.* (2002) studied the determinants of adoption of improved maize technologies in major maize growing region of Ethiopia. He found that the rate of adoption of improved maize varieties and chemical fertilizer, factors affecting the adoption of improved maize varieties and the determinant factors affecting adoption of chemical fertilizers are alsohighlighted.

Haider *et al.* (2001) observed that almost one-third (37 percent) of the farmers fell in low adopter category compared to 32.5 percent falling in optimum adopter 23.5 percent above optimum adopter and only 7 percent had non-adopter on Nitrogenous

fertilizer. In respect of extent of phosphoric fertilizer two thirds (68 percent) of the farmers had non adopter category compared to 23 percent having above optimum adopter, 5 percent optimum adopter and only 4 percent had below optimum adopter of phosphoric (P) fertilizer. In respect of extent of potassic fertilizer three quarters categories compared to 10 percent falling bellow optimum adopter, 8 percent optimum adopter and only 3 percent above optimum adopter of potassic (K) fertilizer.

Rahman (2003) found that ninety seven percent of the pineapple growers adopted 2-4 intercrops viz, Zinger, turmeric, sweet ground and aroid in pineapple cultivation.

Haque (2003) found that the majority (47 percent) of the growers had medium adoption of modern maize cultivation technologies while 28 percent had high adoption and 25 percent low adoption.

Islam (2005) conducted a study on adoption of pashu pusti in cattle rearing at farmer's level. The study revealed that 71 per cent of the farmers had medium adoption while 18 per cent had high adoption and 11 per cent had low adoption of pashu pusti in cattle rearing at farmer's level.

.Muttaleb *et al.* (1998) found that over all adoption of plant protection practices was medium. Among the plant protection practices high adoption were observed in fungicides, insecticide and soil treatment and low adoption were found that treatment and low adoption were found in suburbanization of cut tuber hand picking of cutworm and rouging of diseased plant.

Mostafa (1999) studied the adoption of recommended mango cultivate practices by the mango growers of Nawabganj Sadar thana. He found that at half (49 percent) of the mango growers had "low adoption" 31 percent "very low" adoption and 20 percent had "medium" adoption of fertilizers.

Kariuka (1990) studied the economic impact of the adoption of hybrid maize in Swaziland. The study revealed the sensitivity of hybrid maize adoption to different farming systems and the limited usefulness of a partial analysis in evaluating the impact of innovations.

Juliana *et al.* (1991) undertook a study on adoption of integrated pest management practices in five villages of Vasusdevanallar block in Tirunelvi district, Tamilnddu,

India. They found that about 50 percent of marginal farmers, 47.50 percent of small farmers and 52.50 percent of big farmers had medium adoption and 42.50 percent of big farmers, 22.50 percent of small farmers and 5 percent of the marginal farmers had high level of adoption. In both adoptions level of big farmers' participation was higher in comparison to other categories of farmers.

Kashem and Hossain (1992) conducted a research study on adoption behaviour of sugarcane growers of Zilbangla Sugar Mill, Dewanganj, Jamalpur, Bangladesh. They found among the growers, that 89 percent had high level of adoption of recommended practices of sugarcane.

Nikhade *et al.* (1993) observed in their study on adoption of improved practices of soyabean cultivation that percent adopted improved varieties. More than 82 percent had complete adoption of package practices like time showing, spacing and intercultural operations. Partial adoption was observed in majority of the soyabean growers (74.6 percent) with regard to recommended seed rate.

Nikhade *et al.* (1995) found that the adoption gap about the use of recommended technology of cotton among cotton growers was found to be about 30 percent which was quite high.

Siddaramaiha *et al*. (1995) studied adoption of improved Sericultural practices among big and small farmers. They indicate that there were cent percent adoption in following the recommended system of planting by both big and small farmers. Other practices adoption by a large percentage of farmers was: optimum time of planting (95%), adoption of recommended irrigation schedule (93.75%), recommended spacing (91.25%) and the use of improve variety of mulberry crop (87.50%). Nearly half of the respondents used the recommended quantity of farmyard manure and plant protection chemicals in mulberry cultivation.

2.3 Past research findings relating to the relationships of farmers' adoption of innovations with their selected characteristics

This selection presents a review of previous studies relating the association of the selected characteristics of the farmers and their adoption of innovations.Eleven characteristics of the contract growers were selected as independent variables of this study. The researcher made outmost efforts to search out studies dealing with

relationships of each of the selected characteristics with the adoption of wheat cultivation.

2.3.1 Age and adoption of innovation

Pathak *et al.* (1992) observed that there was positive and significant relationship between the age of the marginal farmers and their adoption of jute technologies. Similar finding was observed by Okoro et al (1992) and Hossain etal. (1992).

Sarkar (1997) observed that there was no significant relationship between age of the farmers and their adoption of improved potato cultivation practices. Similar findings were observed by Karim and Mahaboob (1986) and Kher (1992) in their respective studies.

Aurangozeb (2002) observed that there was significant negative relationship between age and use of integrated homestead farming technologies. The interpretation is that with increased age level of the respondents there was a conesponding decrease of the adoption of homestead farming technologies.

Haque (2003) conducted a study on farmer's adoption of modern maize cultivation technologies and he reported that age of the respondents had negatively significant relationship with their extent of farmer's adoption of modem maize cultivation technologies.

2.3.2 Education and adoption of innovation

Hussen (2001) conducted a study on farmer's knowledge and adoption of modem sugarcane cultivation practices. He found that education of the growers had a positive significant relationship with their adoption of modem sugarcane cultivation practices.

Islam (2002) conducted a study on adoption of modem agricultural technologies by the farmers of Sandwip. He found that education of the farmers had a positive significant relationship with their adoption of modem agricultural technologies.

Rahman (2001) conducted a study on knowledge, attitude and adoption of the farmers regarding Aalok 6201 hybrid rice in Sadar upazila of Mymensingh district. He found that age of the fanners had no significant relationship with their adoption regarding Aalok 6201 hybrid rice.

Aurangozeb (2002) observed that there was positive relationship between education and adoption of integrated homestead farming technologies. The educated women were more interested in adoption of integrated homestead farming technologies than the illiterate women.

Okoro and Obibuaka (1992) studied adoption of recommended practices among small holders in IMO state, Nigeria. The findings of the study indicated a positive relationship between education of the respondents and their adoption of recommended management practices.

Hossain (2003) concluded that education of the farmers had a significant and positive relationship with their adoption and modem Boro rice cultivation practices.

2.3.3 Family size and adoption of innovation

Chowdhury (1997) observed that there was a positively significant relationship between family size and adoption of selected BIN A technologies. Similar results were found by Islam (1993), Bashar (1993), Khan (1993), Pal (1995) and Sarkar (1997) in their respective studies.

Haque (2003) conducted a study on farmer's adoption of modem maize cultivation technologies. He observed that family size of the respondents had negatively insignificant relationship with their extent of fanner's adoption of modem maize cultivation technologies.

Rahman (2001) researched on knowledge, attitude and adoption of the fanners regarding Aalok-6201 hybrid rice in sadarupazila of Mymensingh district. He observed that family size of the fanners had no significant relationship with their adoption of Aalok-6201 hybrid rice.

2.3.4 Farm size and adoption of innovation

Chowdhury (1997) conducted a research on adoption of selected BINA technologies by the farmers. He indicated that farm size of the farmers had a strongly positive significant relationship with their adoption of selected BINA technologies. Rahman (1986), Okoro et al. (1992), Khan (1993). Hoque (1993) and Sarkar(1997) observed similar results in their respectivestudies.

Hussen (2001) found that the farm size had positive significant relation with their adoption of modern sugarcane cultivation practices.

Islam (2002) conducted a study on adoption of modern agricultural technologies by the farmers of Sandwip. He found that farm size of the farmers had a positive significant relationship with their adoption of modern agricultural technologies.

Aurangozeb (2002) observed that there was no relationship between homestead area and adoption of integrated homestead farming technologies.

Sardar (2002) found that the farm size of the farmers had significant positive relationship with their adoption of IPM practices.

Haque (2003) conducted a study on farmer's adoption of modern maize cultivation technologies. He observed that farm size of the respondents had insignificant relationship with their extent of farmer's adoption of modern maize cultivation technologies.

However, researchers' can‟t come to a unified decision on farmers‟ farm size and adoption of modern wheat production technology relationship, which requires further research.

2.3.5 Annual income and adoption of innovation

Hussen (2001) conducted a study on farmer's knowledge and adoption of modem sugarcane cultivation practices. He found that annual income of the growers had a positive significant relationship with their adoption of modem sugarcane cultivation practices.

Rahman (2001) conducted a study on knowledge, attitude and adoption of the farmers regarding Aslok 6201 hybrid rice in Sadar upazila of Mymensingh district. He found that annual income of the farmers had a significant and positive relationship with their adoption of Aalok 6201 hybrid rice.

Aurangozeb (2002) in his study found a positive significant relationship between annual income and adoption of integrated homestead fanning technologies.

Islam (2002) conducted a study on adoption of modem agricultural technologies by the farmers of Sandwip. He found that annual income of the farmers had a positive significant relationship with their adoption of modem agricultural technologies.

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 significant relationship with their adoption of IPM practices.

Haque (2003) conducted a study on farmer's adoption of modem maize cultivation technologies. He observed that annual income of the respondents had insignificant relationship with their extent of farmer's adoption of modem maize cultivation technologies.

Tolawar and Hirevenkaragouder (1989) studied on factors of adoption of poultry management practices. They revealed that the farmers having high income tend to own bigger size of poultry unit and possess more knowledge of improved practices leading to higher level of adoption.

2.3.6 Organizational participation and adoption of innovation

Ali (1984) found that organizational participation of contact farmers had significant positive contribution to their agricultural knowledge.

Cowdhury (1997) conducted a research study on the adoption of selected BINA technologies by the farmers. He found that there was significant positive relationship between the farmers' organizational participation and their adoption of selected BINA technologies

Balasubbramanian and Kaul (1984) studied adoption of improved practices by fish trawler owners in Kerala. The study indicated no relationship between organizational participation and adoption of improved practices.

. Halim (1985), Bashar (1993) and Pal (1995) observed the similar findings Haque (1984) conducted a study in Jessore district on the adoption of improved practices in sugarcane cultivation. He reported that organizational participation of the growers significantly influenced their adoption of the improved practices.

Mostafa (1999) conducted a study on adoption of recommended mango cultivation practices by the mango growers of Nawabganj Sadar Thana. He found that organizational participation of mango growers had a significant positive relationship with their adoption of recommended mango cultivation practices.

Hossain (2000) found insignificant relationship between organizational participation of the framers and their knowledge on Binadhan-6.

Hossain (2006) revealed that organizational participation of the farmers had no significant relationship with their adoption of HYV rice.

2.3.7 Extension media contact and adoption of innovation

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.

Haque (2003) concluded that extension contact of the farmers had significant positive relationship with their adoption of modern maize cultivation technologies

.Hussen (2001) conducted a study on farmers' knowledge and adoption of modern sugarcane cultivation practices. He found that extension contact of the growers had significant relationship with their adoption of modern sugarcane cultivation practices.

Rahman (2001) found that extension contact of the farmers had a significant and positive relationship with their adoption regarding Aalok 6201 hybrid rice.

Haque (2005) conducted a study to determine the relationship of farmers' characteristics with their adoption of modem rice varieties in Sadar thana of Mymensing district. He reported that extension contact of the rice growers had significant and positive relation with the adoption of modem rice varieties.

Islam (2002) conducted a study on adoption of modem agricultural technologies by the farmers of Sandwip. He found that extension contact of the farmers had no significant relationship with their adoption of modem agricultural technologies

2.3.8 Training received and adoption of innovation

Verma *et al.* (1989) found there was significant change in attitude of rural women from before training to after training in improved home making tasks. They said that due to gain in knowledge the attitude became more favorable.

Hossain (1981) showed that proper training could raise the knowledge and skill level of participants significantly.

Haque (2003) found that training received of the respondent had positive significant relationship with their practices in farmers' adoption of modern maize cultivation technologies.

Islam (2002) conducted a study on farmers' knowledge and adoption of ecological agricultural practices under the supervision of proshika. He found that agricultural training exposure of the farmers had no significant relationship with their adoption of ecological agricultural practices.

2.3.9 Knowledge and adoption of innovation

Sardar (2002) studied adoption of IPM practices by the farmers under PETRRA Project of BDRS. He found that agricultural knowledge had positive significant relationship with their adoption of 1PM practices.

Ahmed (2006) found that the knowledge on wheat cultivation of the farmers had significant positive relationship with their adoption of selected wheat varieties.

Mahmud (2006) found that the knowledge on wheat cultivation of the farmers had significant positive correlation with their adoption of modern wheat cultivation technologies.

Koch (1985) conducted a study in the north-west organic free, state South Africa concerning perception of agriculture innovativeness, aspiration, knowledge and innovation adoption. He observed that there was a strong positive relationship between perception, knowledge and practice adoption. This finding is very much in agreement with that of Rogers and Shoemaker (1971).

Reddy *et al.* (1987) found significant association between knowledge and use of improved package of practices in paddy production by participant and non participant farmers.

2.3.10 Innovativeness and adoption of innovation

Rogers (1983) reviewed 2,376 past research studies and postulated 31 generalization of innovativeness. This include among others are personal characteristics and socio-economic characteristics of the farmers. He stated that innovative farmers had more years of education, larger farm size, higher income, more cosmopoliteness, higher organization participation, lower degree of fatalism and higher knowledge in farming. However, age did not yield a consistent relationship with innovation proneness.

Kashem and Halim (1991) repotted that innovativeness of the farmers had significant positive correlation with their adoption of modern rice technology use of communication media in live stock production.

Jamal (1996) found no relationship between innovativeness of dropout rural youth with their preference in selected agricultural and non-agricultural entrepreneurship. Similar findings were obtained by Rahman (1995) and Rahu (1989). Hossain (1999) found a positive significant relationship between innovativeness of the farmers and their adoption of fertilizer and observed no relationship with adoption of pesticides.

Aurangozeb (2002) observed that there was significant relationship between innovativeness and adoption of integrated homestead farming technologies.

Rahman (2003) revealed that the highest proportion (63 percent) at the farmers had low innovativeness as compared to 22 percent medium innovativeness and 15 percent very low innovativeness.

Rahman (2005) found that the innovativeness of the farmers had no significant relationship with their adoption of modem rice varieties.

2.3.11 Attitude towards wheat cultivation and adoption of innovations

Hossain (1981) conducted a study on relationships of selected characteristics of the Jute growers with their adoption of improved practices of Jute cultivation. He found that there is no relationship between attitude towards intensive jute cultivations

scheme of the Jute growers and their adoption of improved practices of jute cultivation.

Hasan (1996) conducted a study on adoption of some selected agricultural technologies among the farmers as perceived by the frontline GO and NGO workers. He found that there was strong positive relationship between attitude towards development and perceived adoption of selected technologies.

Podder (1999) conducted a study on the adoption of Mehersagar Banana by the farmers of Gazaria union under Sakhipur Thana of Tangail district. He found that there was no relationship between attitude towards technology of the growers and their adoption of modem agricultural technologies.

Islam (2002) revealed that the attitude towards technology of the farmers had a significant positive relationship with their adoption of modem agricultural technologies.

2.3.12 Research gap of the study

Very few researches on adoption selected modern wheat production technologies by the farmers have so been conducted. Some researchers have found positive significant relationship between the selected characteristics and adoption of wheat production technologies. Some other found no significant relationship and very few have found negative significant relationship. No research work has so far been carried out to explore the relationship between each of the attitude of the farmers with their adoption of modern production technologies of wheat. So, the researcher carried out the present study to explore the relationship between each of selected characteristics of farmers with adoption of wheat production technologies.

2.3.13 Problem confronted by the farmers in different agricultural aspects

Rahman (1995) in his study identified problems faced by farmers' in cotton cultivation. Non-availability of quality seed in time, unfavorable and high cost of fertilizer and insecticides, lack of operating capital, not getting fair weight and reasonable price according to grade, affects of cattle in cotton field, lack of technical knowledge, lack of storage facility, stealing from field at maturity stage, and late

buying of raw cotton by Cotton Development Board were identified as major problems of cotton farmers in Mymensingh district.

Salam (2003) in his study identified constraints in adopting environmentally friendly farming practices. Top six identified constraints according to their rank order were: i) low production due to limited use of fertilizer (ii) lack of organic matter in soil, (iii) lack of Govt. support for environmentally friendly farming practices, (iv) lack of capital and natural resources for integrated farming practices, (v) lack of knowledge on integrated farm management and (vi) unavailability of pest resistant varieties of crops.

2.4 The Conceptual Framework of the Study

In scientific research, selection and measurement of variables constitute on important task. The hypothesis of a research while constructed properly contains at least two important elements i.e "A dependent variable" and "an independent variable". A dependent variable is that factors which appears, disappears or varies as the researcher introduces, removes or varies the independent variables (Townsend, 1953). An independent variable is that factor which is manipulated by the researcher in his attempt to ascertain its relationship to an observed phenomenon. In view of prime findings of review literature, the researcher constructed a conceptual frame work of the study which is self explanatory and is presented in Figure 2.1

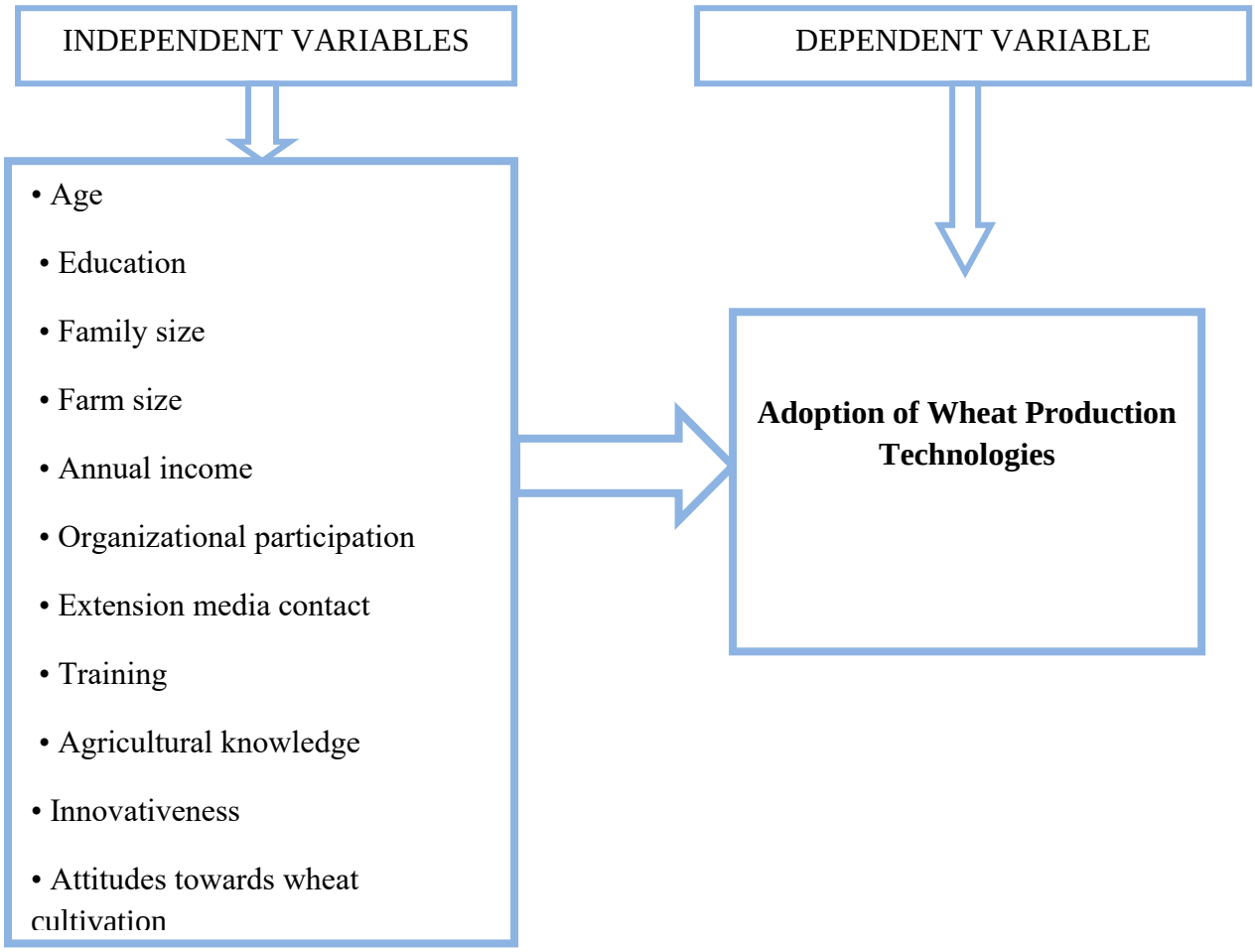

Figure 2.1The conceptual framework of the study

Chapter 3

METHODOLOGY

The methodology used in conducting any research is critically important and deserves careful consideration. It enables the researcher to collect valid and reliable information in terms of hypothesis or research instrument and to analyze the information properly to arrive at valid results. The methodology used in the present study has been described in this Chapter.

3.1 Locale of the Study

The study was confined to Taraganj upazila of Rangpur district- a former sub divisional town of Rangpur division. This upazila with an area of 128.66 sq km consists of 05 unions. It has a total population 142512; male 71.89 percent, female 70.61 percent; average literacy 43.80 percent. Main occupations are agriculture 23 percent, agricultural laborer 38 percent, wage laborer 4.04 percent, industries 4.91 percent, commerce 50 percent, transport 4.48 percent, construction 1.85 percent, service 46 percent, others 30 percent. Land use statistics include total cultivable land 11547 hectares, fallow land 1314 hectares; single crop 298 hectares , double crop 5050 hectares and triple crop 58022 hectares. Cultivable land under irrigation is 10430hectares. Land control among the peasants estimated as 25 percent are landless, 18 percent small, 12 percent medium and 2 percent rich. Main crops are potato, paddy, maize, mustard seed, wheat, bananas and vegetables. NGO activities are done mainly ASA, BRAC, POPI, PROSHIKA, NAC, RADARDP and TMSS (Upazila Agricultural Office, 2018).

Sayar union of Taraganj upazila contains various agricultural activities. Considering the wheat cultivation practices by the inhabitants, Shamganj village of Sawyer union was purposively selected as the study location of the present study. For clarity of understanding, maps of Rangpur district and Taraganj upazila have been presented in Figure 3.1 and 3.2.

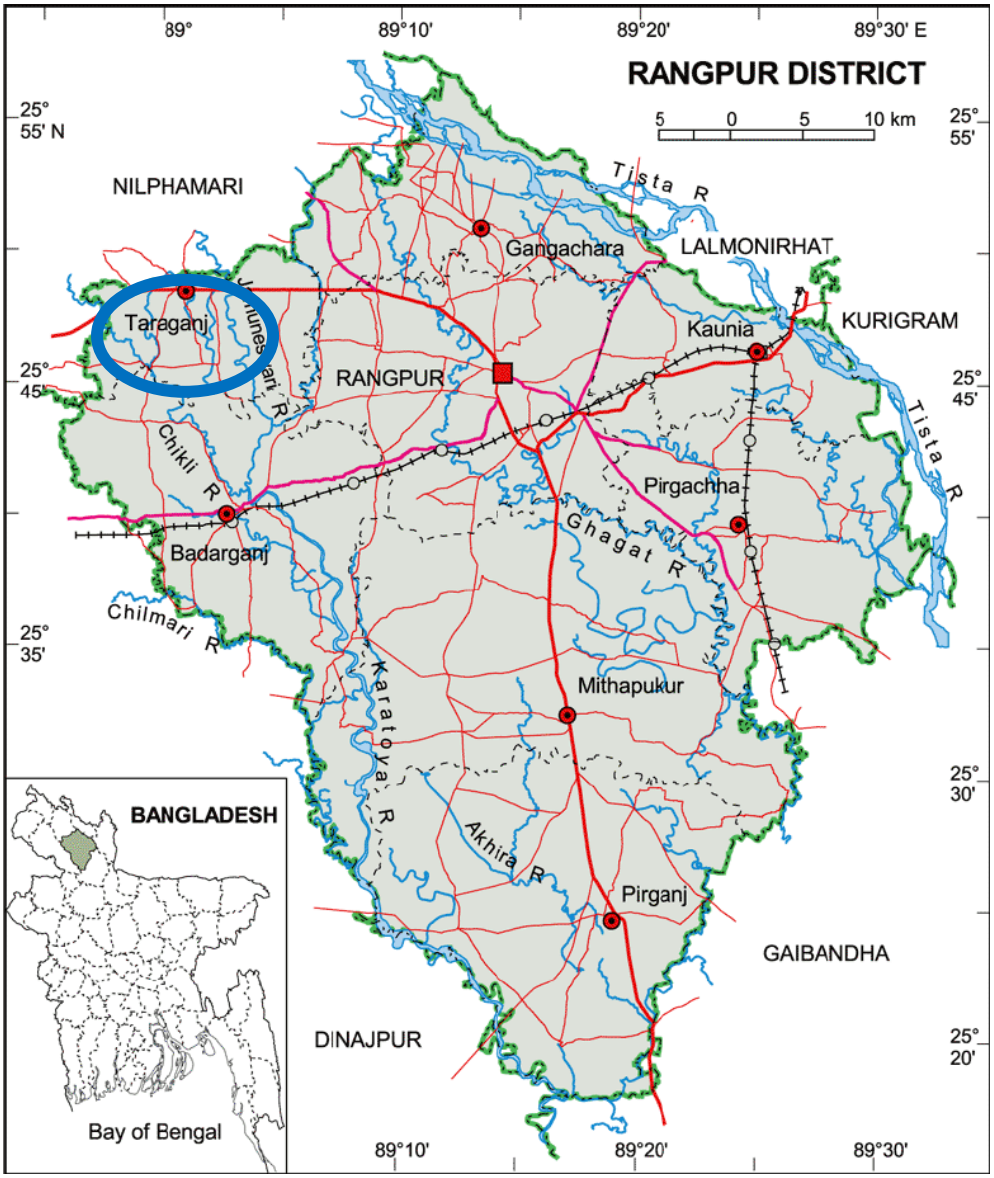

Figure 3.1 A map of Rangpur district showing Taraganj Upazila

Figure 3.2 A map of Taraganj upazila showing Sayar union.

3.2 Design of the Study

The design of the study was a descriptive survey research. It was designed to describe the contribution between selected characteristics of the farmers and their extent of adoption of wheat cultivation technologies. Efforts were also made to assess the problems of the farmers in adopting the wheat cultivation.

3.3 Population and Sampling Design

Simple random sampling method was used to select the respondents. However, out of five unions' one union- Sayar was selected randomly. From this union Shamganj village was purposively selected because farmers of this village have been cultivating wheat in large scale. Then a list of farmers of this village was made by the help of the Sub-Assistant Agriculture Officer of that block. The number of wheat grower families of this village was 502. Only heads of these 502 families constituted the population. Twenty percent of the farmers were selected from this village by using random sampling method. As a result 100 farmers constituted the sample size.

In addition to that, 2 percent of the population was selected randomly. Thus, the additional sample, so drawn stood 10 growers, which were included in the reserve list. In case, the individuals included in the original sample were not available or not found suitable at the time of data collection, the growers of the reserve list were used for the purpose.

3.4 Instruments for Data Collection

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 of 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 farmers of the study area.

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. Appropriate scales were developed to operationalize some characteristics of the farmers. A copy of the interview schedule in English version is presented in the Appendix-I.

3.5 Collection of Data

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) 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. The entire process of collecting data took place during 01 December to 07 December 2021.

3.6 Data Processing and Analysis

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 was done on the basis of categorization developed by the researcher. Simple statistics like frequency, percentage, range, mean, standard deviation and rank order were used to perform the data analysis. Multiple regressions were used to determine the contribution between selected characteristics of the farmers and adoption of wheat cultivation technologies.

3.7 Selection of the Variables of the Study

The variable is a characteristic, which can assume varying or different values in successive individual cases. Before setting the variable of the study, the researcher himself visited the study area and talked to the farmers and he was able to observe the selected characteristics of the farmers (in the study area) which might have influence

on the adoption of wheat cultivation technology 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 (Townsend, 1953). The dependent variable is often called 'criterion or predicted variable' whereas independent variable is called 'treatment, experimental or antecedent variable'. In the scientific research, the selection and measurement of variable constitute a significant task. Following this conception, the researcher reviewed literature to widen this understanding about the natures and scopes of the variables relevant to this research.

3.7.1 Independent variables

The Research Advisory Committee and the researcher were selected eleven characteristics of the farmers as independent variables of the study. These were age, education, family size, farm size, annual income, organizational participation, extension media contact, training, and knowledge on agriculture, innovativeness and attitude towards wheat cultivation.

3.7.2 Dependent variable

A dependent variable is that factor which appears, disappears or varies as the experimenter introduces, removes or varies the independent variables. Adoption of wheat cultivation technologies was selected as dependent variable.

3.8.1 Measurement of independent variables

The selected characteristics of the wheat growers constituted the independent variables of the study. To keep the research within the manageable sphere, eleven independent variables were selected for the study. The procedures of measurement of the selected variables were as follows.

3.8.1.1 Age

The age of individual is one of the important factors pertaining to his personality make up (Smith and Zope, 1970) which can play an important role in his adoption behavior. The age of respondent growers was measured by counting the actual years from his birth to the time of interview on the basis of his statement. It was measured in terms of actual years. No fraction of year was considered. A score of one (1) was assigned for each years of age. Age was placed in item no. 1 of the interview schedule (Appendix-I).

3.8.1.2 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 has given five (5). Each respondent of can‟t read & write has given a score of zero (0). A person not knowing reading or writing but being able to sign only has 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.

3.8.1.3 Family size

Family size of a wheat grower referred to the total number of members in his family including the respondent himself, his wife, sons, daughters and other members fully or partially dependent on him. The total numbers of family members were considered as the family size score of a respondent. For example, if a respondent has 6 members in his family, then his family size score was 6. This variable has been presented in item no. 3 of Appendix-I.

3.8.1.4 Farm size

Farm size of the respondent was measured as the size of his farm (including wheat and others crops) on which he continued his farm practices during the period of study. Each respondent was asked to mention the homestead area, the land under his own cultivation, land given to others on borga (share cropping) system, land taken from others on borga system, land given to others on lease system, land taken from others

on lease system and others like fruit garden, pond etc. The area was estimated in terms of full benefit to the growers or his family. The following formula was used in measuring the farm size:

Farm size = $A_1 + B_2 + ½ C_3 + ½ D_4 + E_5 + F_6$

Where,

A_1 = Homestead area

B_2 = Own land under own cultivation

C_3 = Own land given to others on share cropping

D_4 = Land taken from others on share cropping

E_5 = Land taken to others on lease system

F_6 = Others (fruit garden. pond) etc.

The unit of measurement was in hectare.

3.8.1.5 Annual income

The income of a farmer is an important indicator of how much he can invest in his wheat cultivation and production technologies. Annual family income of a respondent was measured in taka on the basis of total yearly earnings from wheat cultivation and other sources in which the respondent as well as his family members were involved. The method of ascertaining income from farming involved different aspects. The aspects are: agriculture, poultry rearing, domestic animal, fish, job, business and others. In calculating the annual family income of the respondents, the total yield from all the sources making in the preceding year were converted into cash income according to the prevailing market price and added together to obtain total income of a respondent. Data obtained in response to item no. 5 of the interview schedule were used to determine the family income of the respondents.

3.8.1.6 Organizational participation

Social organizational participation of respondent was measured on the basis of the nature of their participation in 4 selected organizations. Organizational participation of the respondent was measured in two-dimension status of his participation and duration of participation in different organizations during the time of interviewing. Organizational participation score was determined by the following formula:

$OPS = OP_1x1 + OP_2 x2 + OP_3 x3$

Where,

OPS= Organizational participation score

OP_1 = Total duration (year) of participation as ordinary member

OP_2 = Total duration (year) of participation as executive committee member

OP_3 = Total duration (year) of participation as executive committee officer

Organizational participation score of the respondent was computed on the basis of his participation in different organizations as shown in item no. 6 on the interview schedule (Appendix-I). Scores were assigned for participation of a respondent in an organization in the following manner.

Nature of participation	Score assigned
No participation	0
Ordinary member	1
Executive committee member	2
President/Secretary	3

Organizational participation score of a respondent was determined by adding his scores for participation in all organizations. The social organizational participation score could possible range from 5 to 45 where „5 indicated low participation and „45 indicated very high social organizational participation.

3.8.1.7 Extension media contact

It was measured as one's extent of exposure with different information sources. It was assumed that the more contact an individual would have with different information sources, the more he becomes educated and knowledgeable. An extension contact score was computed for each respondent on his extent of contact with 12 selected media (item no. 7, Appendix-I). Each respondent was asked to mention the frequency of his contact with each of the 12 selected media. Here the score was assigned as 0 for no contact, 1 for rarely, 2 for occasionally and 3 for regularly of the contact respectively. Extension media contact score of the respondents could range from 0 to 36, where 0 indicating no extension media contact and 36 indicating very high extension media contact. Respondent's extension contact score was obtained by adding the weights for his responses to all the sources listed in the instrument.

3.8.1.8 Training

Agricultural training of the respondents was calculated by the number of days that a respondent had received agricultural training in his entire life. It was indicated by the total number of days of receiving agricultural training by a respondent under different training programs.

3.8.1.9 Agricultural knowledge

To measure the agricultural knowledge of a respondent 12 questions were constructed in the interview schedule. Each respondent was asked to answer all the 12 questions. Out of assigned scores against each question, the summation of obtained scores against 12 questions represented the agricultural knowledge of a respondent. Agricultural knowledge was measured by the total knowledge score about agriculture. The total assigned score was 24 (item no. 9. Appendix-I). But, the score of each question was not equal; it was determined according to the extent of difficulty. Full score was assigned for each correct answer and zero (0) for the wrong answer and 0.5 for partially correct answer. However, for correct responses to all questions, a respondent could get a total score of 24, while wrong responses to all questions he could get 0 (zero). 0 indicating no agricultural knowledge and 24 indicates very knowledge.

3.8.1.10 Innovativeness

Innovativeness of a wheat grower was measured by computing an "innovativeness score" on the basis of his adoption of 6 selected wheat production technologies. Innovativeness is the degree to which an individual adopts an innovation relatively earlier than other members in a social system (Rogers, 1995). Scores were assigned on the basis of time required by an individual to adopt each of the technology in the following manner (item no. 10, Appendix-I):

Period of Adoption	Assigned Score
Within one year	5
Within two years	4
Within three years	3
Within four years	2
Within five years or above	1
Not at all	0

The scores for all the 6 selected wheat production technology were added together to constitute the innovativeness score of a respondent. Innovativeness score of a respondent growers could range from 0 to 30, where, 0 indicating no innovativeness and 30 indicating very high innovativeness.

3.8.1.11 Attitude towards wheat cultivation

An attitude may be defined as predisposition to act towards an object in a certain manner. Attitude of a grower towards wheat cultivation was used to refer to his belief, feelings and action towards the various aspects of wheat cultivation. It was measured by constituting 10 statements. A statement was considered positive if it possessed an idea favorable towards the wheat cultivation. On the other hand, a statement was considered negative if it was unfavorable towards the wheat cultivation. The respondents were asked to express their opinion in the form of ‘strongly agree’ or ‘agree’ or ‘undecided’ or ‘disagree’ or ‘strongly disagree’. A score of 5 was given to ‘strongly agree’, 4 to ‘agree’, 3 to ‘undecided’, 2 to ‘disagree’ and 1 to ‘strongly

disagree', if the statement was positive. A reverse scoring method was followed in case of statements considered negative. This variable appears in the item number 11 (Appendix-I). Attitude score of a respondent was determined by summing the scores obtained by him for all the items in the scale. The index scores of respondents could range from 10 to 50 where 10 indicating unfavorable and 50 for favorable attitude towards wheat cultivation.

3.8.2 Measurement of dependent variable

Adoption of selected wheat cultivation technologies was the dependent variable of this study. It was measured on the basis of the extent of adoption of 7 selected wheat production technologies by the farmers for three year. Adoption of multiple technologies is measured by the proportion of summation of mean area coverage (l) out of mean potential area (L) by the number of practices for particular time period; it is expresses in percentage resulting mean (X) area coverage. The formula calculating the adoption stands as G. L. Ray (1998);

$$\text{Adoption scores} = \frac{\sum X}{No.of\ technologies} x100$$

Suppose a farmer is using 7 modern wheat cultivation technologies with its cluster of technologies for the subsequent years 2018, 2019 and 2020.

a) Use of modern varieties(BARI Gom-24,Akber,Gaurab etc)
b) Time of wheat seeding(last week of October to first week of November)
c) Use of seed treatment chemicals(Vitavax-200, Captan etc)
d) Use of recommended fertilizers(Nitrogen 25 kg, phosphorus 35 kg and potash 46kg per acre respectively)
e) Time of Irrigation(First irrigation should be given 25-30 days after sowing, second irrigation within 45-50 days after sowing, third within 70-75 days after sowing and forth stage within 90-95 days after sowing)
f) Use of poison bait to control rat(0.5% Zinc Phosphide, Brodifacoum pellets etc)
g) IPM to control insect pest and diseases (sowing pest resistant varieties, Introducing pest predators, using pheromone trap etc)

Calculation of the adoption of above mentioned technologies. In this case adoption can be measured in the following ways:

Area of production	Year of the adoption			∑ l/L	X adoption
	2018	2019	2020		
Allocated area for production (l)	3	3	4	2	0.66
Potential area (L)	5	5	5		
Proportion of area coverage (l/L)	0.6	0.6	0.8		

Total adoption score of a respondent was found by adding one's adoption scores on seven aspects of adoption and then dividing by number of aspects. The adoption was expressed in percentage. Hence the adoption of a wheat grower could range from 0 to 100 where, 0 indicate no adoption and 100 indicate highest adoption.

3.9 Measurement of Problems Faced by the Farmers

Farmers in the study area might have faced various types of problems in the way of adopting wheat cultivation. But the investigator gained an experience through personal contact regarding common problems faced by the respondents before collection of data. Besides, the researcher gained experience through consultation with experts, pre-testing experience and reviewing previous research findings. Finally, he prepared a list of eight possible problems in this regard. A scale was prepared to indicate the extent to which each of the eight problems was applicable in the case of a respondent. The responses were obtained through a 4-point scale: 'high', 'medium', low' and 'not at all' and weights were assigned to these responses as, 3, 2, 1 and 0 respectively (item no. 13, Appendix-I).

Extent of Problems	Scoring System
High	3
Medium	2
Low	1
Not at all	0

In order to determine the comparative importance of the eight problems, a problem facing index (PFI) was computed for each of the problems by summing up the weights assigned for responses of all the respondents against each problem. Problem facing index of any problem could range from 0 to 24, where, 0 indicated no problem and 24 indicated high problem. Extent of PFI was computed by using the following formula:

Extent of Problem Facing Index (PFI) = Phx3 +Pmx2 + Pl x1 +Pnx0

Where,

Ph = Number of respondent with 'high problem'

Pm = Number of respondent with 'medium problem'

PI = Number of respondent with 'low problem'

Pn = Number of respondent with 'not at all problem'

Problem facing index of any problem could range from 0 to 24, where, 0 indicated no problem and 24 indicated high problem.

3.10 Statement of Hypothesis

According to Kerlinger (1973), a hypothesis is a conjectural statement of the relation between two or more variables. Hypotheses are always in declarative sentence form and they relate either generally or specifically variables to sentence form and they relate either generally or specifically variables to variables. Hypothesis may be broadly divided into two categories, namely, research hypothesis and null hypothesis.

3.10.1 Research hypothesis

The following research hypothesis was put forward to know the relationships between each of the eleven selected characteristics of the farmers and their adoption of wheat cultivation technologies:

Hypothesis: "Each of the eleven selected characteristics of the farmers will have significant relationships with their adoption of wheat cultivation technologies."

3.10.2 Null hypothesis

A null hypothesis states that there is no relationship between the concerned variables. The following null hypothesis was undertaken for the present study:

H_0: There is no relationship between the 11 selected characteristics of farmers and their adoption of wheat cultivation technologies.

If a null hypothesis is rejected on the basis of a statistical tests, it is assumed, that there is a relationship between the concerned variables.

3.11 Statistical Treatment

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 23. Statistical measures as a number, range, mean, standard deviation were used in describing the variables whenever applicable. Regressions of coefficient test were used to determine the contribution and among the categories of farmers with regard to their adoption to modern wheat cultivation technologies based on selected characteristics. Throughout the study the 0.01 and 0.05 levels of probability was used as the basis of rejection or accepting a null hypothesis.

CHAPTER 4

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 of modern wheat cultivation technology by the farmers of Rangpur district in Bangladesh. In accordance with the objectives of the study, presentation of the findings has been made in four sections. The first section deals with the selected characteristics of the wheat farmers, the second section deals with the extent of adoption of wheat production by the farmers, the third section, contribution between the extent of adoption of wheat production of the farmers and their characteristics have been discussed. The fourth section deals with the problem confrontation by the farmers in wheat production.

4.1 Selected Characteristics of the Farmers

This section deals with the classification of the farmers according to their various characteristics. Behavior of an individual is largely determined by his characteristics. Eleven characteristics of the farmers were selected for this research. The characteristics include: age, education, family size, farm size, annual family income, organizational participation, extension media contact, training, agricultural knowledge, attitude towards wheat production and innovativeness. 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 4.1The salient features of the selected characteristics of the farmers (n = 100)

Selected characteristics	Measuring unit	Range		Mean	S.D
		possible	observed		
Age	Year	-	25-80	43.66	13.006
Education	Year of schooling	-	0.5-13	5.12	3.54
Family size	No. of member	-	2-10	5.31	1.63
Farm size	Hectare	-	.10-2.15	.76	.69
Annual income	000' taka	-	70-380	134.30	66.87
Organizational participation	Score	-	8-65	21.08	10.22
Extension media contact	Score	0-36	8-23	14.44	4.44
Training	No. of days	0-32	3-18	9.86	4.13
Agricultural knowledge	Score	0-24	10-20	13.9	1.88
Innovativeness	Score	0-30	7-30	14.81	4.92
Attitude towards wheat cultivation	Score	10-50	29-46	35.43	3.88

4.1.1 Age

Age of the growers was found to range from 25 to 80 years. The average age was 43.66 years with the standard deviation 13. On the basis of age, the farmers were classified into three categories as shown in Table 4.2.

Table 4.1 Distribution of the farmers according to their age

Category	Basis of categorization	Observed range(years)	Number of farmers	Percent	Mean	SD
Young age	≤ 35	25-80	34	34	43.66	13
Middle age	36-50		38	38		
Old age	> 50		28	28		
Total			**100**	**100**		

Data presented in Table 4.2 indicate that the highest proportion (38 percent) of the respondents was in medium aged category compared to 28 percent old age and 34 percent young aged category. However, data also revealed that 72 percent of the growers in the study area were middle to young aged. The middle aged growers are the most productive group in the adoption of wheat. The extension agents can make use of these views and opinions in designing their extension activities among young and middle aged growers.

4.1.2 Education

Education scores of growers ranged from 0.5-13. The average score was 5.12 with the standard deviation 3.54. Based on their score, the growers were classified into four categories as shown in Table 4.3.

Table 4.2 Distribution of the farmers according to their education

Category	Basis of categorization	Observed range	Number of farmers	Percent	Mean	Std
Can sign only	0.5	.5-13	25	25	5.12	3.54
Primary education	1-5		35	35		
Secondary education	6-10		31	31		
Above secondary education	>10		9	9		
Total			**100**	**100**		

Data presented in Table 4.3 indicate that a large proportion (35 percent) of the respondents fell under category of primary education compared to 25 percent can only sign, 31 percent secondary and only 9 percent above secondary education. The findings indicate that 66 percent of the respondents were educated that varied from primary to secondary levels. The literacy rate of the country is 65.5 percent (BBS, 2017). Thus the findings indicate that in the study area, the literacy seems to be greater than the national average.

4.1.3Family size

The family size of the growers ranged from 2 to 10. The average score was 5.31 with the standard deviation 1.63. On the basis of their family size, the growers were classified into three categories as shown in Table 4.4.

Table 4.3 Distribution of the farmers according to their family size

Category	Basis of Categorization (years)	Observed range (Score)	Farmers		Mean	SD
			Number	Percent		
Small family	≤ 3 (Mean-1SD)	2-10	8	8	5.31	1.63
Medium family	4-6 (Mean ± SD)		75	75		
Large family	> 6 (Mean+1SD)		17	17		
Total			100	100		

Data presented in Table 4.4 reveal that the highest proportion (75 percent) of the growers fell under the medium family category compared to 17 percent large family and 8 percent small family category, respectively. The data also indicate that the average family size (5.31 percent) of the respondents in the study area was lower than the national average of 4.9 (BBS, 2003). This may be due to the effect of proper adoption of family planning measures and knowledge about family planning among the respondents or the prevalence of joint family planning among area.

4.1.4 Farm size

The farm size of the growers in the study area ranged from 0.10 to 2.15 hectares (ha). The average farm size was .78 ha with the standard deviation .68. Based on their farm size, the growers were classified into three categories as shown in Table 4.5.

Table 4.4 Distribution of the respondents according to their farm size

Category	Basis of categorization (ha.)	Observed range (ha.)	Farmers		Mean	SD
			Number	Percent		
Small	(0.021-0.20)	0.10-2.15	30	30	0.78	0.68
Medium	(0.21-1.00)		44	44		
Large	(1.01-3.0)		26	26		
Total			100	100		

Data presented in the Table 4.5 show that the major portion of the respondents (44 percent) fell under medium farm category while 26 percent large farm and 30 percent were small farm. Data also revealed that majority (74 percent) of the growers of the study area small to medium farms. Thus, most of the growers were in possession of medium and small farms.

4.1.5 Annual Income

The farm size of the growers in the study area ranged from 70 to 380 thousand Taka. The mean being134.30 thousand Taka with the standard deviation is 66.86.Based on their income group scores, the farmers were classified into three categories: low income (up to 80), medium income (81-160) and high income (above 160).

Table 4.6 Distribution of the farmers according to their annual family income

Category	Basis of categorization ('000' Taka)	Observed range ('000' Taka)	Farmers		Mean	SD
			Number	Percent		
Low income	≤80	70-380	26	26	134.30	66.86
Medium income	81-160		46	46		
High income	> 160		28	28		
Total			100	100		

From the above Table 4.6, it was observed that the highest portion (46 percent) of the respondents were in medium income group, while 26 percent respondents were in low income group and only 28 percent were in high income group. 74 percent farmers in the study area were in medium to high income group. The average income of the farmers was of the study area much higher than national average income of the country. This might be due to the fact that the farmers of the study area were not engaged in only agriculture. They earned from other sources, such as service, business, day labor, remittance etc.

4.1.6 Organizational participation

The maximum organizational participation score of the respondents was 42 and the minimum was 8 against the possible range of 5 to 45. However, the average was 17.08 and the standard deviation 8.21. Based on their participation scores, the respondents were classified into three categories: low participation (up to 7), medium participation (8-41) and high participation (>41). The distribution of the respondents according to their organizational participation is shown in Table 4.7

Table 4.7 Distribution of the farmers according to their organizational participation

Category	Basis of categorization (no. of days)	Observed range (no. of days)	Farmers		Mean	SD
			Number	Percent		
Low participation	≤7 (Mean-1SD)	8-42	15	15	17.08	8.21
Medium participation	8-41 (Mean ± SD)		60	60		
High participation	> 41 (Mean+1SD)		25	25		
Total			100	100		

Data contained in table. 4.7 indicate that highest proportion (60 percent) of the growers had medium participation as compared to 15 percent lower participation and 25 percent high participation. Data also revealed that majority (85 percent) of the respondents of the study area had medium to high level of organizational participation.

4.1.7 Extension media contact

The computed extension contact scores of the respondents ranged from 8 to 23 with an average of 14.44 and standard deviation of 4.43 against the possible range of 0 to 36. On the basis of extension contact scores, the respondents were classified into three categories: low extension contact (up to 9), medium extension contact (10- 18) and high extension contact (>18). The distribution of the respondents according to their extension contact is shown in Table 4.8.

Table 4.8 Distribution of the farmers according to their extension media contact

Category	Basis of categorization (Score)	Observed range (Score)	Farmers		Mean	SD
			Number	Percent		
Low media contact	≤9 (Mean-1SD)	8-23	18	18	14.44	4.43
Medium media contact	10-18 (Mean ± SD)		60	60		
High media contact	> 18 (Mean+1SD)		22	22		
Total			100	100		

Data presented in Table 4.8 indicate that the highest proportion (60 percent) of the farmers had medium extension contact, while 18 percent had low extension contact and the proportion of respondents having high extension contact was 22 percent. The findings of the study indicate that most of the respondents had medium and high extension contact with various information sources for getting necessary agricultural information.

4.1.8 Training Experience

The training of the respondents varied from 3 to 18 with a mean of 9.86 and a standard deviation of 4.13. The respondents were classified into three categories based on their training experiences scores: low training (up to 5), medium training (6to13) and high training (above 13). The categories and the distribution of the farmers according to their training received in wheat cultivation technologies are shown in table 4.9.

Table 4.9 Distribution of the farmers according to their training experience

Category	Basis of categorization (Score)	Observed range (Score)	Farmers		Mean	SD
			Number	Percent		
Low training	≤5 (Mean-1SD)	3-18	19	19	9.86	4.13
Medium training	6-13 (Mean ± SD)		54	54		
High training	> 13 (Mean+1SD)		27	27		
Total			100	100		

Data presented in Table 4.9 indicate that the highest proportion (54 percent) of the respondents received medium training compared to about 19 percent of them having low training and 27 percent having high training experience.

4.1.9 Agricultural Knowledge

Knowledge on wheat production scores of the respondents ranged from 6-20 with an average of 10.9 and standard deviation of 1.88 against the possible range of 0 to 24. On the basis of wheat production knowledge scores, the respondents were classified into three categories, poor knowledge (6-7), good knowledge (7 to 13) and batter

knowledge (>13). The distribution of the respondents according to their knowledge on improved wheat production is shown in Table 4.10.

Table 4.10 Distribution of the farmers according to their Agricultural knowledge

Category	Basis of categorization (Score)	Observed range (Score)	Farmers		Mean	SD
			Number	Percent		
poor knowledge	6-7	6-20	12	12	10.9	1.88
Good knowledge	7-13		73	73		
Batter knowledge	> 13		15	15		
Total			100	100		

Data contained in Table 4.10 indicate that the majority (73 percent) of the respondents had good knowledge compared to 15 percent felt in batter knowledge and 12 percent possesses poor knowledge. It therefore revealed that majority of the wheat farmers (88 percent) in the study area were under good to batter knowledge categories.

4.1.10 Innovativeness

The possible range of innovativeness score was 0 to 30 while the observed range was 7 to 30. The average score of the respondents was 14.81 and standard deviation 4.92. Based on their innovativeness scores, the respondents were classified into three categories: less (up to 9), moderate (10-19) and high (above 19). Data contained in Table 4.11 indicate that highest proportion (65 percent) of the growers were moderate innovative as compared to 16 percent less and 19 percent high innovative.

Table 4.11 Distribution of the farmers according to their innovativeness

Category	Basis of categorization (Score)	Observed range (Score)	Farmers		Mean	SD
			Number	Percent		
Less innovative	≤9 (Mean-1SD)	7-30	16	16	14.81	4.92
Moderate innovative	10-19 (Mean ± SD)		65	65		
High innovative	> 19 (Mean+1SD)		19	19		
Total			100	100		

Data also revealed that majority (84 percent) of the respondent growers of the study area were innovative from moderate to high extent. This would help the extension planners to chalk out future extension program for transfer of technologies to the potential growers.

4.1.11 Attitude towards wheat cultivation

The scores of attitude towards wheat cultivation ranged from 15 to 46 against the possible scores 10 to 50 with an average of 26.4 and a standard deviation of 3.88. Based on the scores of attitude towards wheat cultivation the respondents were classified into three categories: unfavorable (up to 21), neutral (22-30) and favorable (above 30). Data presented in Table 4.12 show that the highest proportion (55 percent) of the farmers belonged to favorable attitude category as compared to 25 percent to neutral and 20 percent to unfavorable category of attitude towards wheat production.

Table 4.12 Distribution of the farmers according to their attitude

Category	**Basis of categorization** (Score)	**Observed range** (Score)	**Farmers**		**Mean**	**SD**
			Number	**Percent**		
Unfavorable attitude	≤21 (Mean-1SD)	15-46	20	20	26.4	3.88
Neutral attitude	22-30 (Mean ± SD)		25	25		
Favorable attitude	> 30 (Mean+1SD)		55	55		
Total			100	100		

This indicates that 80 percent of the respondent growers could possess favorable attitude towards wheat production. This might be for their access to quality seed of high yielding varieties of wheat, irrigation, fertilizer etc.

4.2 Adoption of Wheat Cultivation Technologies

Adoption of wheat production technologies score was found to range from 20 to 89. The average score was 48.26 with a standard deviation of 16.60. Based on the scores of adoption of wheat production technologies, the farmers were classified into three categories as low adoption (≤ 31), medium adoption (32-64) and 'high adoption (> 64). The distribution of the respondents according to their adoption of wheat cultivation has been presented in Table 4.13.

Category	**Basis of categorization** (Score)	**Observed range** (Score)	**Farmers**		**Mean**	**SD**
			Number	**Percent**		
Low adoption	≤31 (Mean-1SD)	20-89	16	16	48.26	16.60
Medium adoption	32-64 (Mean ± SD)		60	60		
High adoption	> 64 (Mean+1SD)		24	24		
Total			100	100		

Table 4.13 revealed that the highest proportion (60 percent) of the respondents had medium, while 16 percent had low adoption and the rest 24 percent had high adoption of wheat cultivation technologies. It also reveals that an overwhelming majority (84 percent) of the farmers had medium to high adoption of wheat cultivation technologies which might suggest the reasons of lower production at the study area. Farmers always want to ensure their food security first then the return from their cultivation. In that case rice is first choice as it is their staple food. Few years ago some high yielding varieties of rice became famous for their yield as well their return. But with the time passing the cost of production of rice is increasing which lead the famers of the study area switch to adopt wheat cultivation.

4.3 Contribution of the selected characteristics of the farmers to the Adoption of wheat Cultivation Technologies

In order to determine the contribution of selected characteristics of wheat growers to their extent of adoption of modern production technologies of wheat, regression analysis was carried out which is presented in Table 4.14

Table 4.14 Multiple Regression Co-efficient of the selected factors indicating contribution to adoption of wheat cultivation farmers.

Dependent Variable	Independent variables	β	*P*	R^2	Adj. R^2	F
Adoption of wheat production	Age	.098	.193	0.60	0.55	12.11
	Education	.163	.041*			
	Family size	-.014	.851			
	Farm size	.072	.388			
	Annual income	.188	.051*			
	Organizational participation	.153	.034*			
	Extension media Contact	.017	.845			
	Training experience	.243	.007**			
	Innovativeness	.264	.003**			
	Attitude	.001	.992			
	Agricultural knowledge	.097	.236			

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

Among the eleven hypothesized relationships, five (5) variables namely education, annual income, organizational participation, training experience, innovativeness for wheat production were found significantly contribution to the adoption of modern technologies of wheat production (Table 4.14) while rest of the variables showed no significant contribution. All the factors jointly contribute 60% of the variance of the adoption ($R^2 = 0.60$).Each predictor may explain some of the variance in respondents' adoption of wheat farmers simply by chance. The adjusted R^2 value (0.55) penalizes the addition of extraneous predictors in the model, but values of 0.55 still show that the variance in respondents' adoption of wheat cultivation technologies can be attributed to the predictor variables rather than by chance, and that both are suitable

models (Table 4.14). In summary, the models suggest that the respective authority should consider the respondents' level of education, annual income, organizational participation, training experience for wheat production and innovativeness on production technologies of wheat farmers.

4.3.1 Significant contribution between education of the farmers and their adoption of wheat cultivation technologies

The contribution of education in adoption of wheat farmers by testing the following null hypothesis; "there is no contribution of education in adoption of wheat farmers in Taraganj upazila".

The p-value of the concerned variables was found .041. 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 education was at 5% significance level. So, the null hypothesis could be rejected.

Based on the above finding, it can be summarized that a wheat farmers had more education increased the capabilities to adoption of wheat production in Taraganj Upazila. Education enhances the abilities of the wheat farmers at short time than others which enabled them to adoption of wheat cultivation. So, education has significantly contributed to the adoption of cultivation technologies of wheat farmers. It seemed that educated farmers had more knowledge, a greater ability to understand and respond to anticipated changes, were better able to forecast future scenarios and, overall, have greater access to information and opportunities than others, which might encourage adoption.

4.3.2 Significant contribution between annual income of the farmers and their adoption of wheat cultivation technologies

The contribution of annual income in adoption of wheat farmers by testing the following null hypothesis; there is no contribution of annual income in adoption of cultivation technologies of wheat farmers.

The p-value of the concerned variables was found .051. The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The Farmer's annual income had positive influence on farmers' adoption of wheat cultivation. Contribution of the annual income was at 5% significance level. So, the null hypothesis could be rejected.

Farmer's annual income had positive influence on farmers' adoption of production technologies wheat cultivation. Based on the above finding, it can be said that farmers had more family income may increased the adoption cultivation technologies of wheat Taraganj Upazila. So, annual income on practices cultivation technologies of wheat has high significantly contributed to the farmers' adoption of wheat.

4.3.3 Significant contribution between organizational participation of the farmers and their adoption of wheat cultivation technologies

The contribution of organizational participation in adoption of wheat production by the farmers by testing the following null hypothesis; "there is no contribution of organizational participation in adoption of wheat farmers Taraganj upazila".

The p-value of the concerned variables was found .034. 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 organizational participation was at 5% significance level. So, the null hypothesis could be rejected.

The b-value of level organizational participation is (0.153). So, it can be stated that as organizational participation increased by one unit, farmers' adoption of wheat production increased by 0.153 units. Considering the effects of all other predictors are held constant. Based on the above finding, it can be said that farmers' have more organizational participation increased the farmers' adoption of wheat cultivation technologies.

4.3.4 Significant contribution between training experience of the farmers and their adoption of wheat cultivation technologies

The contribution of training experience in adoption of wheat cultivation technologies by the farmers by testing the following null hypothesis; "there is no contribution of training experience in adoption of wheat growers in Taraganj upazila".

The p-value of the concerned variables was found .007. 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 organizational participation was at 1% significance level. So, the null hypothesis could be rejected.

Farmer's training experience for wheat cultivation had positive influence on farmers' adoption of cultivation technologies and it has the more contribution on their adoption. This implies that with the increase of training capacity of the farmers will increase their adoption of cultivation technologies of wheat.

4.3.5 Significant contribution between innovativeness of the farmers and their adoption of wheat cultivation technologies

The contribution of innovativeness in adoption of wheat cultivation technologies by the farmers by testing the following null hypothesis; "there is no contribution of innovativeness in adoption of wheat cultivation technologies by the wheat growers in Taraganj upazila".

The p-value of the concerned variables was found .003. 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 organizational participation was at 1% significance level. So, the null hypothesis could be rejected.

The contribution showed a positive trend. Considering the findings, it could be mentioned that innovativeness of the farmers had significant and positive contribution with their adoption of wheat cultivation technologies. Kashem and Halim (1991) also found the significant and positive contribution between these two variables. This implies that with the increase of farmers innovativeness will increase their adoption of cultivation technologies of wheat.

4.4 Problems Faced by the Farmers in Adopting of Wheat Cultivation Technologies

Problem scores of the respondents were determined by using 8 selected problems. Computed scores of the respondents ranged from 6 to 22 against the possible range of 0 to 24 with the average being 13.05 and the standard deviation was 2.91 (Table 4.5). Based on problem facing index (PFI), the farmers were classified into three categories: lower (up to 10), medium (11-15) and higher problem (above 15)

Table 4.5 Distribution of the farmers according to their PF1

Category	**Basis of categorization** (Score)	**Observed range** (Score)	**Farmers**		**Mean**	**SD**
			Number	**Percent**		
Low problem	≤10 (Mean-1SD)	6-22	17	17	13.05	2.91
Medium problem	11-15 (Mean ± SD)		62	62		
High problem	> 15 (Mean+1SD)		21	21		
Total			100	100		

Most (62 percent) of the farmers faced medium extent of problems regarding wheat cultivation technologies and the rest 21 percent faced high extent of problems. It could be worthy to mention that17 percent of the respondents faced low extent of problems. It indicates that the farmers are intermingled with diversified problems in adopting wheat cultivation technologies. In order to measure the problems regarding wheat cultivation, open and closed questionnaire were used. The purpose of this section was to have an understanding on the problems faced by the farmers in adopting wheat cultivation technologies. However, eight selected problems in this regard were investigated and they have been ranked in Table 4.6 according the descending order of problem facing index (PFI)

Table 4.6 Ranking of problems according to descending order

Sl. No.	Problems	PFI	Rank Order
1.	Shortage of sufficient machineries and tools for wheat cultivation	196	1st
2.	Scarcity of modern variety of seed, fertilizer and pesticides when they are needed	195	2nd

3.	High cost involvement for adoption of modern technologies	173	3rd
4.	Inadequate knowledge about wheat production	170	4th
5.	Lack of accurate price	152	5th
6.	Inadequate irrigation in dry season	149	6th
7.	Lack of credit facilities	146	7th
8.	Inadequate help from SAAOs	124	8th

Data contained in Table 4.6 indicate that “Shortage of sufficient machineries and tools for wheat cultivation” ranked first with PFI value of 196 The second most important problem of the wheat growers was " Scarcity of modern variety of seed, fertilizer and pesticides when they are needed" with the PFI of 195. The third important problem of the respondent was “High cost involvement for adoption of modern technologies” with the PFI of 173. The growers of the study area did not get governments help, SAAOs help and other related information regarding wheat cultivation. Inadequate irrigation in dry season is the important problem with the PFI of 150.Cultivation of wheat requires several light irrigation but in that time farmers do not have access to the required irrigation water. However, lack of accurate price, lack of credit facilities, high cost involvement for adoption of modern technologies and inadequate help from SAAO were also some important problems which are needed to pay attention.No program for the farmers cannot be successful unless these problems are not properly addressed and triggered to be eliminated or at least diminished.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter deals with the summary of findings, conclusions and recommendations of this study. Regression analysis was used to test the proposed hypotheses using SPSS v.23. In this chapter, the summary of this study is presented.

5.1 Summary of the Findings

The major findings of the study are summarized below:

5.1.1 Selected characteristics influencing the adoption of wheat cultivation technologies

Age

The middle aged wheat farmers comprised the highest proportion (38 percent) followed by old aged category (28 percent) and the proportion were made by the young aged category (34.0 percent).

Education

Farmers under primary education category constituted the highest proportion (35 percent) compared to 31 percent secondary level and 25 percent can only sign category. On the other hand the lowest (9 percent) belonged to above secondary level category.

Family Size

Greater the half (75%) of the respondent had medium family compare to 17% and 8% had large and medium family size.

Farm Size

The medium land holder constituted the highest proportion (44 percent) of the farmers followed by 30 percent with small land holder and remaining 26 percent with large land holder.

Annual family income:

It was observed that the highest portion (46 percent) of the respondents were in medium income group, while 28 percent respondents were in high income group and only 26 percent were in low income group.

Organizational Participation

From the data it was observed that majority (60%) of the respondent had medium participation compared to 25% high participation and 15% low organizational participation.

Extension Media Contact

The farmers having medium extension media contact category constituted the highest proportion (60 percent) followed by high media contact (22 percent) and low media contact category (18 percent).

Training in wheat cultivation technology

Findings revealed that majority 54% of the respondents has medium training received in wheat production technology compared to 27% high training and 19% had low training received in wheat cultivation technology.

Knowledge on wheat cultivation technology

The highest proportion (73 percent) of the respondents had medium knowledge on improved wheat production technology, while 12 percent and 15 percent of the respondents had low and high knowledge on modern wheat cultivation technology respectively.

Attitude towards wheat cultivation

The highest proportion (55 percent) of the farmers belonged to favorable attitude category as compared to 25 percent to neutral and 20 percent to unfavorable category of attitude towards wheat cultivation.

Innovativeness

Data contained in Table 4.11 indicate that highest proportion (65 percent) of the growers were moderately innovative as compared to 16 percent less and 19 percent

high innovative.

5.1.2 Adoption of wheat cultivation technologies

The highest proportion (60 percent) of the respondents had medium adoption of production technologies of wheat, while 16 percent had low adoption and the rest 24 percent had high adoption of wheat cultivation.

5.1.3 Contribution of the selected characteristics of the farmers to their adoption of wheat cultivation technologies

Education, annual income, organizational participation, training experience and innovativeness of wheat cultivation technology had significant positive contribution with the adoption of wheat cultivation technologies. Age, family size, farm size, extension media contact and agricultural knowledge had no contribution with the adoption of production technology of wheat cultivation.

5.2 Conclusions

Conclusions drawn on the basis of the findings of this study and their logical interpretation in the light of the other relevant factors are furnished below:

i. In the study area farmers have been adopting wheat cultivation technologies in various extents. There were 60% medium adopters, 16% low adopters and 24% high adopters. Therefore, it may be concluded that adoption of cultivation technology of wheat was moderate at the study area.

ii. Education of the farmers had significant positive contribution with their adoption of cultivation technologies of wheat. Majority (66%) of the farmers belonged to secondary to above secondary education category.

iii. Annual income of the farmers showed a significant positive contribution to their adoption of wheat cultivation technologies. However, considering that most of the farmers belonged under medium income group. Therefore, it may be concluded that motivation programs should be taken especially for the farmers who have low income to adopt wheat cultivation.

iv. Majority (85%) of the respondents' belonged medium to high level of organizational participation categories. It may be concluded that organizational

participation of the farmers should have significant positive contribution with their adoption of cultivation technologies of wheat.

v. A great majority (87 percent) of the farmers had medium to high training experience on modern wheat cultivation technology, while there had a positive significant contribution with training experience on wheat cultivation technology of the farmers and their adoption of wheat cultivation. Therefore, it may be concluded that, farmers had higher training experience on wheat production technology were adopted more wheat cultivation in the study area.

vi. Majority (84 percent) of the respondents' belonged moderate to high innovative of wheat farmers' categories. Therefore, it may be concluded that the innovativeness of wheat farmers who was highly innovative should help to adopt wheat cultivation technologies.

5.3 Recommendations

From discussion and findings of the study, it is clear that wheat cultivation is fast becoming an integral part of agriculture economy. It may be recommended that agricultural extension agencies especially the DAE and relevant NGOs should critically review their training programmed and make sound provisions so that the farmers understand the benefit of adoption of wheat cultivation technologies. The DAE and other nongovernmental organizations should strengthen their extension services to the growers and farmers to motivate them for adoption of wheat cultivation technologies. The farmers should be encouraged to take proper care of their wheat production.

5.3.1 Recommendations for policy implications

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

i. A majority (84 percent) of the farmers had medium to high adoption of cultivation technologies of wheat. All the sample farmers were more or less involved in wheat cultivation yet their extent of adoption of cultivation technologies was not satisfactory. Therefore, it may be recommended that necessary steps should be taken to increase the adoption of wheat production technology in the study area.

ii. Education of the farmers had significant positive contribution with their adoption of wheat cultivation. Therefore, it may be recommended that, adult education should be provided to the farmers so that they could increase their educational level which might be helpful to increase their adoption of wheat cultivation technologies.

iii. Annual income and organizational participation of the farmer had significant positive contribution with adoption of wheat cultivation technologies. The cultivation may be recommended that necessary steps should be taken by the concerned authority, so that the farmers especially those who have low family income and lower organizational participation could help in increasing their income and make conscious to participate different agricultural organization to adopt wheat cultivation technologies.

iv. Innovativeness and training on wheat cultivation had significant positive contribution with their adoption of wheat cultivation technologies. Therefore, it may be recommended that, there should be conducted more extension works for increasing innovativeness and training the farmers which will be supportive to adoption of wheat cultivation.

v. It is recommended that the extension workers should work with the farmers of young to middle-aged category to promote adoption of wheat cultivation technologies. • It may also be recommended that extension workers should work with the all category farmers so as to increase the adoption of wheat cultivation technologies on a high significant scale.

The DAE should take necessary steps to increase the opportunities for the growers to visit demonstration plots and establish farmers' organization in the rural areas in order to make them more knowledgeable and more positive attitude involvement.

The concerned authorities should take necessary steps to increase the extension media contact of the farmers. For this, the Sub-Assistant Agriculture Officers (SAAOs) should frequently visit the farmers and advice them on wheat cultivation technologies.

5.3.2 Recommendations for further studies

A small piece of study as has been conduced cannot provide all information for the proper understanding of the adoption of wheat cultivation technologies. Further

studies should be undertaken to cover more information in the relevant matters. So the following suggestions were put forward for further research:

- ✓ The present investigation explored the contribution of the eleven characteristics of the farmers with their adoption of wheat cultivation technologies. Further research may be conducted by taking with other dependent and independent variables to observe contribution with their adoption of wheat cultivation technologies.

- ✓ The present study was conducted in Shamganj village of Sayer union at Taraganj upazila of Rangpur district. So, similar studies may be undertaken in other parts of the country to verily the findings of the present study.

- ✓ The present study has been carried out among the male farmers only. So, a similar study may be conducted with the farm women to examine their views and opinions regarding the adoption of wheat cultivation technologies.

- ✓ The present study was concerned only with the extent of adoption of wheat cultivation technologies. It is therefore, suggested that further studies should include attributes of innovations, adopter categories and use of information sources in relation to adopter stages and adopter categories.

- ✓ The study was confined among the wheat farmers only. Further study needs to be conducted among the general farmers and determine the extent of adoption of wheat cultivation technologies.

- ✓ Research studies can be undertaken to identify the problems of the farmers in adopting improved cultivation technologies of wheat cultivation as well as to determine their abilities and opportunities to overcome these constraints .Research should also be undertaken on the effectiveness of agricultural extension services and other related organizations in helping farmers for adoption of modern technologies of wheat cultivation.

CHAPTER 6

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(APPENDIX-I)

ENGLISH VERSION OF THE INTERVIEW SCHEDULE

DEPARTMENT OF AGRICULTURAL EXTENSION AND INFORMATION SYSTEM SHER-E- BANGLA AGRICULTURAL UNIVERSITY SHER-E-BANGLA NAGAR, DHAKA-1207.

INTERVIEW SCHEDULE FOR A RESEARCH STUDY ENTITLED

ADOPOTION OF MODERN CULTIVATION TECHNOLOGIES OF WHEAT BY THE FARMERS OF A SELECTED AREA UNDER TARAGANG UPAZILLA IN RANGPUR DISTRICT

Name of the respondent: ..... SI. No.....

Fathers name: .....

Village: .....

Union:.....

Upazila:.....
District:.....

Please answer the following questions. Your information must be keep secret and only used for the research purpose.

1. Age

How old are you? ..... years

2. Education

Please mention your educational back ground

a) Can sign only…… (0.5)

b) Primary education ……. (up to 5)

c) Secondary education…… (6-10)

d) Above secondary education……. (Above-10)

3. Family Size

How many members are there in your family? .....persons

4. Farm Size

Please mention your farm size.

Sl. No	Types of land	Area of land	
		Local Area	Hectare
01	Homestead area(A_1)		
02	Own land under own cultivation(B_2)		
03	Land given to others on share cropping(C_3)		
04	Land taken from others on share cropping(D_4)		
05	Land taken from others on lease(E_5)		
06	Others (fruit garden, pond) etc(F_6)		
07	Total=$A_1+B_2+1/2C_3+1/2D_4+E_5+F_6$		

5. Annual Income

Please particulars about your annual income from the following sources

(A) Income from agricultural crops

SL NO.	Name of crops	Production (Kg or Maund)	Value Per Kg or Maund (Tk)	Total Value (Tk)
1	Wheat			
2	Paddy			
3	potato			
4	Maize			
5	jute			
6	Pulse crops			
7	Oil crops			
8	Spices			
9	vegetables			
10	Fruits			
11	Others			
	Sub-total			

(B) Income from Livestock, poultry and fisheries

Sl No.	Source of income	Total production (Kg or Maund)	Value per unit element (TK)	Total Value (TK)
1	Livestock			
2	poultry			
3	fisheries			
	Sub-total			

(C) Income from Non-agricultural sources

Sl No.	Sources of income	Total income (TK)
1	Service	
2	Business	
3	Day labor	
4	Other family members	
5	Others	
	Sub-total	

Total income = (A+ B+ C) =..... Taka

6. Organizational Participation

Please state your frequency of participation of the following organization Please tick mark in right space or allude the year.

SL No.	Name of organization	Duration of participation (year)			
		President/ Secretary (3)	Executive committee member (2)	Ordinary member (1)	No participation (0)
1	NGO co-operative				
2	Mosque committee				
3	Farmers co-operative				
4	Market somity				

Organizational Participation Formula:

$OPS = OP_1x1 + OP_2 x2 + OP_3 x3$

Where,

OPS= Organizational participation score

OP_1 = Total duration (year) of participation as ordinary member

OP_2 = Total duration (year) of participation as executive committee member

OP_3 = Total duration (year) of participation as executive committee officer

7. Extension Media Contact

Please mention the frequency of communication of the following persons and agriculture relate media

SL No.	Communication media	Extent of communication			
		Regularly(3)	Occasionally(2)	Rarely(1)	Not at all.(0)
Personal media contact					
1	Agril. Extension Officer	3-5times/year	2-3times /year	1-2times /year	0
2	Upazila Agriculture Officer	3-4 times /year	2-3times /year	1-2times /year	0
3	Local leader	3-4times/month	2-3times/month	1-2times/month	0
4	NGO workers	3 times/month	2 times/month	1 time/month	0
5	Seed/Fertilizer dealer	3-4times/month	2-3times/month	1-2times/month	0
Group Media contact					
6	Group discussion	5-6times/year	3-4times/year	1-2times/year	0
7	Field day	3 times/year	2 times/year	1 times/year	0
8	Participation in agril. Training course	3 times/year	2 times/year	1 times/year	0
Mass Media Contact					
9	F. M..Radio	4-5times/week	2-3times/week	1time/week	0
10	Agricultural TV program	4-5times/week	2-3times/week	1time/week	
11	Agricultural Poster	5-6times/year	3-4times/year	1-2times/year	0
12	Agricultural exhibition	2times/year	1times/year	1times/2years	0

8. Training Experience

Please tick mark in right box

Do you participate to agricultural training programmed? Yes No

If yes, furnish the following information:

SI. No.	Types of training course	Sponsoring Organization	Duration (Days)
1			
2			
3			
4			
5			
Total			

9. Agricultural Knowledge

Please answer the following question

SL No.	Questions	Score	
		Weighted	Obtained
1	Write down the name of two varieties of wheat	2	
2	How much seed required for wheat cultivation per bigha?	2	
3	Write the name of two diseases of wheat	2	
4	Write down the name of two pest of wheat	2	
5	State two methods of controlling rat in wheat field	2	
6	Write down two major functions of TSP on wheat cultivation.	2	
7	State two major Functions of MP on wheat cultivation.	2	
8	How much fertilizer required for wheat cultivation per bigha?	2	

9	Mention benefit of irrigation in wheat cultivation	2	
10	Write two major weed in wheat cultivation	2	
11	Write the name of three crops cultivated for green manure	2	
12	How much cow dung required for wheat cultivation per bigha?	2	
	Total	24	

10. Innovativeness

Please give your information about the use of following wheat production technologies

SL No.	Technology	Adoption within time of being informed					Don't use (0)
		1st(5)	2nd(4)	3rd(3)	4th(2)	5th(1)	
1	Cultivation of new variety						
2	Use of green manure						
3	Applying crop rotation						
4	Intercropping						
5	Use of disease free and healthy seeds						
6	Use of pesticides						

11. Attitude towards Wheat Cultivation

Please indicate your agreement with the following statement

SL No.	Statements	Extent of agreement/disagreement				
		Strongly agreed (5)	Agreed (4)	Undecided (3)	Disagreed (2)	Strongly disagreed (1)
1	Diseases infestation is less in wheat cultivation					
2	wheat cultivation is costly					
3	Insect infestation is very low in wheat cultivation					
4	Wheat cultivation is laborious.					
5	Wheat is a protein rich grain food					
6	Wheat cultivation is complex					
7	Less irrigation required for wheat production					
8	Wheat can be grown under less or zero tillage					
9	Wheat is the second staple food in Bangladesh.					
10	Wheat is the highly infested by the BLAST disease					

12. Adoption of wheat cultivation technology

Please give your information about the use of following wheat cultivation technologies

SL No.	Technologies	Potential area(L)	Allocated area(I)	Year of the adoption (Proportion of area coverage)		
				2018	2019	2020
1	Use of modern varieties (Ananda, Barkat, Akbar, Kanchon and Gourab)					
2	Time of wheat seeding (last week of October to first week of November)					
3	Use of seed treatment chemicals (Vitavax-200, Captan etc.)					
4	Use of recommended fertilizers					
5	Irrigation					
6	Use of poison bait to control rat					
7	IMP to control insect pest and diseases					

Respondent adoption can be measured in the following ways:

Name of technologies	Year of the adoption			**∑I/L**	X adoption
	2018	2019	2020		
Allocated area for cultivation(I)					
Potential area(L)					
Proportion of area coverage(I/L)					

$$\text{Adoption scores} = \frac{\sum X}{No.of\ technologies} x100$$

14. Problems of wheat cultivation

Please mention the extent of problems that you faced during use and application of wheat production technologies.

SL No.	Problems	Extent of Problem			
		High (3)	Medium (2)	Low (1)	Not at all (0)
1	Shortage of sufficient machineries and tools for wheat cultivation				
2	Inadequate knowledge about wheat production				
3	Inadequate irrigation in dry season				
4	Lack of accurate price				
5	High cost involvement for adoption of modern technologies				
6	Inadequate help from SAAOs				
7	Lack of credit facilities				
8	Scarcity of modern variety of seed, fertilizer and pesticides when they are needed				

Thanks for your kind cooperation.

Dated..... ……..

Signature of Interviewer