IMPACT OF USING INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT) BY THE FARMERS OF SADAR UPAZILA UNDER GAZIPUR DISTRICT

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CERTIFICATE

This is to certify that the thesis entitled, **"IMPACT OF USING INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT) BY THE FARMERS OF SADAR UPAZILA UNDER GAZIPUR DISTRICT**" submitted to the Faculty of **AGRICULTURE**, Sher-e-Bangla Agricultural University, Dhaka in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN AGRICULTURAL EXTENSION AND INFORMATION SYSTEM**, embodies the result of a piece of bona fide research work conducted by **SYEDA TASNIM JANNAT, Registration No. 09-03305** 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 duly acknowledged.

Dated:

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Dedicated to

My

Beloved Parents

Krishibid Dr. Syed Md. Zainul Abedin

and

Khaleda Begum

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ABBREVIATIONS AND ACRONYMS

AICC: Agricultural Information and Communication Centre

AIS: Agriculture Information Service

BBS: Bangladesh Bureau of Statistics

BIID: Bangladesh Institute of ICT in Development

CGIAR: Consortium of International Agricultural Research Centers

CIA: Central Intelligence Agency

CTA: Technical Centre for Agricultural and Rural Cooperation

CV: Coefficient of Variation

DAE: Department of Agricultural Extension

DD: Difference-in-Difference

FAO: Food and Agriculture Organization

GIS: Geographic Information System

GPS: Global Positioning System

ICT: Information and Communication Technologies

NS: Non significant

PFI: Problem Faced Index

SAAO: Sub Assistant Agriculture Officer

SD: Standard Deviation

SPSS: Statistical Package for Social Sciences

TV: Television

UISC: Union Information and Service Centre

df: Degrees of freedom

r: Coefficient of correlation

Tk.: Taka

ABSTRACT

Information and Communication Technologies (ICT) has already been established as a potential tool for agricultural development not only in Bangladesh but also all over the world. This study was intended to describe the selected characteristics of the farmers, assess the impact of using ICT by them and examine the contribution of the selected characteristics of the farmers to the impact of using ICT as perceived by them. The impact was measured using Difference-in-Difference method of impact assessment considering study and control group to measure the impact minimizing spill-over effect. Data were collected from 96 study group respondents selected from the intervention area (proportionately from Khundia, Digdha and Shukhundi villages of Sadar upazila under Gazipur district) in purposive sampling method. Data were also collected from 32 control group respondents selected from the control village Baldha using purposive sampling method. The changes in yield of cereal crop (Boro rice), yield of vegetables, agricultural income and number of adopted new varieties of agricultural crops by the respondents were measured from 2012 to 2014 in case of both study and control groups. Although the Boro rice yield increase was higher in study group (6.58%) than control group (3.32%), the difference was insignificant as a hailstorm took place before the harvesting period of Boro rice. The increases in yield of vegetables, agricultural income and number of adopted new varieties of agricultural crops by the respondents were significantly higher in study group (vegetables yield: 5.15%, agricultural income: 13.15%, number of adopted new varieties: 182.58%) than the control group (vegetables yield: 4.24%, agricultural income: 10.63%, number of adopted new varieties: 78.63%). It was also observed that the respondents' age, level of education, effective farm size, use of ICT media in agriculture, farming experience, agricultural knowledge and problems faced in using ICT media in agriculture had significant contribution to the impact of using ICT by the farmers. It may be concluded that by ensuring market price and minimizing natural disaster affect, use of ICT media in agriculture may play a significant role in increasing the yield of Boro rice, yield of vegetables, agricultural income and number of adopted new varieties of agricultural crops by farmers. It may recommend that the Bangladesh government should take initiative for more practicing ICT media in agriculture, reconsider lack of ICT facilities and ensure more educational and training facilities for the farmers for a sustainable agricultural development.

Key words: impact assessment, ICT, multiple regression analysis, study group, control group, spill-over effect

CHAPTER I

INTRODUCTION

1.1 General Background

The economy of Bangladesh depends chiefly on agriculture. The contribution of agriculture sector to the GDP in 2014-15 fiscal year at current prices is 15.59% (BBSa, 2016). The challenge of feeding the increasing population from the shrinking land and water resources is a great task. Many agencies are working to support the farmers to produce food materials and related products. A number of approaches are taken to provide farmers required information to support their farming operation. The agricultural system of Bangladesh has a long history of coping with the challenges. The system has experienced remarkable development over time. Inclusion of Information and Communication Technologies (ICT) enhanced the capacity of the system to face the challenges. Agricultural technologies generated by agricultural research Institutes are now being disseminated to the farmers by the agricultural extension agencies. The use of ICT media for disseminating agricultural technologies has been proved to be useful for enhancement of production. ICT is an acronym that stands for Information and Communication Technologies, which can broadly be interpreted as technologies that facilitate communication, processing and transition of information by electronic means (CTA, 2003). According to another definition, Information and Communication Technologies (ICT) are the tools that help build human network, increase public awareness and provide access to information and knowledge for the use of people (Lieshout, 2011). Again, ICT is defined by FAO (1993) as technologies involved in collecting, processing, storing, retrieving, disseminating and implementing data and information using microelectronics, optics and telecommunications and computers. Under the umbrella of these definitions, any communication technologies like radio, community radio, television, audio-visuals, mobile phone, telephone, computer, internet, call centre, Geographic Information System (GIS), Global Positioning System (GPS) etc. denote ICT in a broad sense. In recent years, the usefulness of ICT has been a prominent feature in all spheres of life. Through ICTs the world has become like a global village. It is increasingly recognized that ICT is necessary for accessing required information and knowledge (Aker, 2011). ICT can be viewed as a catalyst that can bring sustainable development in the society. ICT is the backbone of any digital initiative. ICT covers the

vast area of information technology, communication technology and the telecommunication technology. ICT is also a combination of physical backbone and intellect. Computer systems, network machineries, software, wire and wireless connectivity systems, broadcast hardware and many other hardware and accessories are the physical backbone. The trained human behind the backbone are the intellect (Digital World, 2016).

Impact can be defined as positive and negative, primary and secondary long-term effects produced by a developmental intervention, directly or indirectly, intended or unintended (Garbarino and Holland, 2009). According to CGIAR, impact assessment is a type of evaluation that is intended to determine the consequences of an intervention, in terms of outcomes of interest (FAO, 2010).

Bangladesh is an agriculture based developing country. Improved technologies are the means for increasing yield and thereby agricultural production. Proper utilization of agricultural information and technologies is the way to increase agricultural production. The present population of Bangladesh is approximately 160 million (BBSb, 2016) and it is likely to reach 218 million by 2050 (Streatfield and Karar, 2008). Since the contribution of GDP in Bangladesh economy is prone to fluctuation, the utilization of ICT to overcome the existing challenges may bring sustainable solution. The contribution of agriculture to the GDP was 18.36 percent in 2009-10 FY and it fell to 16.33 percent in the 2013-14 FY (bdnews24.com, 2015). To feed the huge population in such fluctuating trend traditional technological interventions are not adequate. Utilization of all available technologies including ICT will be helpful to face the challenges of supplying agricultural produces to the increasing population when land resources are diminishing continuously. Keeping this view in consideration the government of Bangladesh already adopted the strategy of creating Digital Bangladesh within Vision 2021. This strategy of the government indicates that proper utilization of ICT is a must for advancing the country as a dignified nation. ICT has the potential to play very important role in agricultural development programs. The wide use of ICT may result spectacular development in the agricultural sector. Although ICT has an enormous effect and potential on the agricultural development little research has been conducted regarding the impact of ICT in agriculture particularly in Bangladesh. Hence, on the basis of the above considerations the research regarding this topic has been designed.

1.2 Statement of the Problem

Agriculture sector is a dynamic sector specially in Bangladesh. The rapidly emerging ICT sector in Bangladesh is playing significant role in the development of the whole country in many ways. Radical Agricultural development is also taking place due to use of ICT in agriculture. In this research, radio agricultural programs, TV agricultural Programs, mobile phone/smart phone/telephone, computer/laptop/tablet/ multimedia/ Internet, Krishi Call Centre/Farmers help Line and agricultural assistance services of mobile phone companies (Banglalink Krishi Jigyasha/ Banglalink Krishibazaar/ Grameenphone Krishi Tatthya Sheba/ Robi Haat-bazaar) were taken as ICT media for examining the impact of using ICT by the farmers. In the context of the above circumstances the researcher intended to find out the answers of the following research questions:

1. What were the characteristics of the farmers?
2. What was the impact of using Information and Communication Technologies (ICT) by the farmers?
3. What was the contribution of the selected characteristics of the farmers to the impact of using ICT by them?

1.3 Objectives

Considering the importance of Information and Communication Technologies (ICT) in agriculture, the following objectives were selected to study the impact of using ICT by the farmers of Sadar upazila under Gazipur district:

i. To describe some selected characteristics of the farmers such as:

- Age
- Level of education
- Purpose of farming
- Family size
- Effective Farm size
- Annual income
- Training exposure
- Use of ICT media in agriculture

- Service taking from agricultural service centre
- Farming experience
- Agricultural Knowledge
- Problems faced in using ICT media in agriculture

ii. To assess the impact of using Information and Communication Technologies (ICT) by the farmers of Sadar upazila under Gazipur district where the ICT Media are:

- Radio agricultural programmes
- TV agricultural Programmes
- Mobile phone/smart phone/telephone
- Computer/laptop/tablet/multimedia/Internet (with the help of media supplied in AICC)
- Krishi Call Centre/Farmers help Line
- Agricultural assistance services of mobile phone companies (Banglalink Krishi Jigyasha/ Banglalink Krishibazaar/ Grameenphone Krishi Tatthya Sheba/ Robi Haat-bazaar)

iii. To find out the contribution of the selected characteristics of the farmers to the impact of using ICT as perceived by the farmers of Sadar upazila under Gazipur district.

1.4 Justification of the Study

The Information and Communication Technologies (ICT) is becoming part and parcel of our life. Utilization of ICT materials in agriculture has already been started in Bangladesh. The apparent benefit of these technologies is also being felt. This study will reveal the impact of ICT among the farmers of Sadar upazila under Gazipur district which also influences the socio-economic development. ICT offers a variety of programs both for the social development and economic development (Kumar and Sankarakumar, 2012).

The findings of this research will be especially applicable in the selected area of Sadar Upazila under Gazipur district. However, the findings may also be applicable in other areas of Bangladesh where similar conditions like this area prevail. The farmers, extension personnel, researchers, planners and policy makers will be largely benefited by this research work. Thus, the findings of the study will be of remarkable significance in the field of agricultural sector of Bangladesh.

1.5 Assumptions

An assumption is the supposition that an apparent fact or principle is true in the light of the available evidence (Goode and Hatt, 1952). The researcher had taken the following assumptions into consideration during carrying out the study.

1. The respondents had enough capability to provide proper response to the questions furnished in the interview schedule.
2. Views and opinions provided by the respondents included in the sample were representative of the whole population of the study area.
3. The items, questions, and scale of measurement of the variables were reasonably authentic to represent the actual condition of the respondents.
4. The findings of the study would give a clear concept of the impact of ICT.
5. The data furnished by the respondents were free from bias.
6. The researcher was capable to adjust with the social and cultural environment of the study area. So, the respondents could provide their information correctly.

1.6 Limitations of the Study

It is necessary to impose certain limitations to make the research manageable and meaningful. Thus, during the entire research the most challenging limitations were:

1. The research was confined to the four villages of Sadar upazila under Gazipur district.
2. Data were collected from a small group of respondents taken as the sample of the study because of time and resource constraints.
3. The sample size was determined at eight percent (8%) level of precision of the population. It would be better if it could be determined at $\leq$ 5% level of precision of the population.
4. The research was carried out taking unequal number of respondents in study and control group.

5. The researcher collected data once for two different years (2012 and 2014) based on recall data in the present study.

6. Further research is essential for identifying other sources of bias although efforts were taken to minimize spill-over effects.

7. Only twelve socio-demographic characteristics of the farmers were selected as independent variables.

8. The researcher had to face many difficulties in conducting the research as assessment of impact is very complex especially in case of measuring the impact of ICT as it has very rapid changing nature.

1.7 Definition of Terms

Information and Communication Technologies (ICT): ICT stands for Information and Communication Technologies and is defined as technologies involved in collecting, processing, storing, retrieving, disseminating and implementing data and information using microelectronics, optics and telecommunications and computers.

Digital Bangladesh: Digital Bangladesh is a socio-economic transformation process enabled by Information and Communication Technologies (ICT). This is an integral part of the Vision 2021 of the Government of Bangladesh which promises a prosperous and equitable middle-income Bangladesh by its golden jubilee of independence. It has four priorities- a) developing human resources ready for the 21st century; b) connecting citizens in ways most meaningful to them; c) taking services to citizens' doorsteps; and d) making the private sector and market more productive and competitive through the use of digital technology.

Vision 2021: Vision 2021 is the Charter of Change which was promulgated by the ruling Government of Bangladesh Awami League as the political manifesto during the National Election of 2008 and later adopted as the development approach for Bangladesh. Vision 2021 promises a prosperous and equitable middle-income Bangladesh by its golden jubilee of independence.

Age: Age of a respondent referred to the span of life and it was measured by the number of years from his/her birth to the time of interviewing.

Level of education: Level of education referred to the formal education received up to a certain level in a formal educational institution (school, college or university).

Purpose of farming: Purpose of farming referred to the farming purpose of the respondents. It denoted whether the respondent performed subsistence or commercial farming.

Family size: Family size referred to the number of members of the respondent's family including himself/herself. The head of the household, his wife, children, parents and other permanent dependents who jointly lived and ate together during interview was considered as the family members.

Effective farm size: It referred to that land area from which farmers may gain through effective use of that target land. Such as homestead land including pond area, own land under own cultivation, land taken from others on sharecropping, land given to others on sharecropping, land taken on lease etc.

Annual income: Annual income referred to the total earnings of a respondent and his/her family members from agricultural and non-agricultural sources (business, services, daily labour etc.) during the previous year. In this research, one score was assigned for each thousand taka.

Training exposure: Training exposure referred to the time spent in receiving agricultural training by the respondents. It was measured in number of days of training received by the respondents.

Use of ICT media in agriculture: It referred to the frequency of using different ICT media in agriculture by the respondents.

Service taking from agricultural service centres: It referred to the frequency of receiving agricultural services by the respondents from different agricultural service centres.

Farming experience: Farming experience referred to the time period during which he/she is performing agricultural activities.

Agricultural knowledge: It referred to the extent of basic understanding of the agricultural subject matters like crops, livestock, fisheries, agro-forestry, insect and diseases of crops, fertilizer etc.

Problem: Problem was defined as any difficult situation which requires some action to minimize the gap between "what ought to be" and "what is".

Impact: Impact referred to a term which refers to sustained changes as a result of any intervention which have lasting effect.

Change: It referred to any improvement or deterioration of the respondents in different aspects of their livelihood.

AICC: AICC stands for Agricultural Information and Communication Centre. It referred to a registered farmers' association where agricultural services are provided to the farmers through ICT media and online services according to the demands of the farmers.

UISC/Union Digital Centre: UISC stands for Union Information and Service Centre. It referred to a place for providing digital support service where farmers and other person can get any digital service. In this centre people can get various types of information related to government, livelihood and private services. Local entrepreneurs run the centres and these centres are hosted by UPs and supported by central administration.

Krishi Call Centre: Krishi Call Centre is an initiative of Ministry of Agriculture (MoA) which is run with the direction of Agriculture Information Service (AIS) in Bangladesh where agricultural experts are engaged to provide immediate and effective solution of any problem concerned with livestock, fisheries and agricultural production asked by the farmers over phone.

Impact evaluation: Impact evaluation referred to an outcome based evaluation structured or designed to answer the question of whether the outcomes observed were the result of the intervention or the observed outcomes would have happened anyway. It measures the degree by which the change in the outcome is attributable to the intervention.

Treatment group or study group: Organisations (or individuals) who receive the treatment or intervention.

Control group: The Organisations (or individuals) who do not receive the treatment or intervention.

Spill-over effect: The transmission or contamination of information from intervention group to control group.

Double difference or difference-in-differences (DD) method: This method compares a treatment/ study and control group within a specific period of time.

CHAPTER II

REVIEW OF LITERATURE

The chapter deals with a review of the related literatures having relevance with the present study. The purpose of the chapter was to present a review of the relevant previous studies done in brief and to construct a framework that will be appropriate for having clear conception of the research. There is scarcity of studies pertaining to the systematic impact analysis of ICT on different agricultural aspects of the farmers. Besides, only some limited studies investigating the relationships of the characteristics of individuals with the impact of ICT came into observation of the researcher. Hence, relevant literatures directly depicting the present research was not readily available.

However, the researcher made utmost efforts to collect the necessary information through extensive search of the available literatures and formulated a conceptual framework at the end of this chapter. Only a few studies relevant with the present research has been presented in this chapter under the heads of general review of impact of ICT and relationship of selected characteristics of the farmers with the impact of ICT.

2.1 General Review on Impact of Using ICT

2.1.1 Impact of Using TV and Radio

It was revealed in a study that agricultural productivity was increased because of radio programmes in the Philippines (UNESCO, 1996). In another study, it was revealed by Dodds (1999) that more than 50% of the 21,000 farmers experienced increase in crop yields through extension and education by radio programmes in Zambia.

Shepherd (2000) reported that the vegetable farmers could fix their price according to the rate of vegetable price being broadcast by their local radios and at lower prices than that of the farmers who did not accept the broadcast in Indonesia. The broadcast prices were the starting point in negotiating with traders the following day. It was also observed from the study that price differences were also reduced across markets due to availability of information to different markets in Albania. Moreover, in another study Djankov *et al.* (2001) reported that independent radio broadcasting services were found to be positively and significantly correlated with a range of development outcomes which included

improved lives and better functioning markets. But the results are not always similar. Different finding was observed by Glendenning *et al.* (2010) who reported that despite farmers' greater use of TV and radio than KVKs and extension workers, the empirical impact of these services on farm household income was not known.

2.1.2 Impact of Using Mobile Phone/Telephone/Telecommunication

Bayes (2001) observed that there was a perceptible influence of mobile phone services on production, marketing, and other important economic decisions confronting rural households in Bangladesh. It was also observed in the study that farm output prices were increased and farm input prices were decreased through the mechanism of information diffusion with the help of mobile phones.

In another study, Kumar (2011) also revealed that the farmers were able to reduce their use of pesticides by 50 percent – lowering expenses and improving crop productivity by receiving information about when pests are likely to be prevalent via their cell phones from the agricultural department in Turkey. Five weather sites were established by the agricultural department to monitor the need for pest control and frost prevention by placing pest traps and observing temperature levels and the information was provided to the farmers through their cell phones. It was also observed that the tracking of temperatures enabled the farmers to prevent losses from frost by monitoring temperatures hourly and sending text messages to the farmers who were able to adopt crisis management measures.

Xiaolan and Akhter (2009) conducted a study to examine the impact of a mobile phone technology enhanced service delivery system on agricultural extension service delivery in India. They carried out the impact analysis on the basis of randomized survey data taking potential systematic selection bias through double difference techniques and reflexive comparisons in consideration. It was observed that there were indirect benefit of the ICT-enhanced service delivery system in the dimensions of greater awareness and knowledge in agriculture technology and information of the farmers. Farmers' attitudes towards trying new technologies in future was also improved. Again, in a study conducted by Mittal and Tripathi (2009) on the use and impact of mobile phones and mobile-enabled services on agricultural productivity it was found that some of the farmers who used mobile phones for at least some agricultural activities reported about significant

productivity gains. Some increase in convenience and cost savings were reported by almost all small farmers due to use of mobile phones to get information like input availability or market prices. Positive impacts were found in only 1 of the 6 focus groups involving IKSL subscribers. On the contrary, positive impacts from the use of service were noticed among all the focus groups involving RML subscribers in Maharashtra. A diverse set of benefits including yield and price improvements due to mobile phone usage was also observed among the farmers of Maharashtra. Moreover, it was reported by all interviewees that positive economic benefits were generated by the mobile phone. It was reported in the study that potential losses could be substantially prevented through prompt reaction to information about weather and crop disease. Improved yields through adoption of new seed varieties and cultivation practices were also reported. Seed and crop losses were prevented with the help of weather information. The benefits were quantified by a few farmers which were in the range of 5-25 per cent of earnings. It was also observed that the mobile phone enabled the farmers to describe plant diseases from the field to the experts and to coordinate better with the hired labour.

In another study, Martin and Abbott (2011) reported that nearly half of the respondents (49%) indicated impacts of use of mobile phone on effectiveness, or increased productivity in rural Uganda. Access to agricultural advice, as well as access to agricultural inputs, such as labor, seeds, plant cuttings, livestock, loans from VEDCO or NAADS; consultation with veterinarians; and increased access to market information resulted in increased production. Moreover, nearly 22% of respondents indicated the impact of mobile phones during agriculture emergencies. The overall health and productivity of the livestock and crops of the respondents was increased due to continual consultation with veterinarians and agricultural experts through mobile phones. Besides, about 53% respondents reported about their increase in income.

Forestier *et al.* (2002) showed that the farmers received better prices for their crops with the help of rural telephony which led to significant increase in their earnings. In a different study, ITU (1999) found that the farm income of the farmers was doubled as they were able to check prices regularly by telephones in rural Thailand and Columbia. Another study carried out by De Silva (2008) revealed that a project in Maharashtra, India named “Warana Unwired” where the small but relevant information was sent to the sugarcane farmers via text messages on mobile phones had created a significant change in the incomes of the sugarcane farmers in the area. Moreover, Soysa (2008) carried out

another study on traceability in the agriculture value chains. In this study it was observed that incomes of the gherkin farmers in Sri Lanka were improved because of using a simple mobile phone application to reduce waste through a simple feedback system. In this system, text messages were sent to the farmers on a daily basis giving details of amount of gherkins rejected and the reasons for rejection in order to take immediate action to rectify the issue. Before the use of mobile phones by the farmers the information search costs of this activity were prohibitively high which resulted in significant losses to the farmer. Again in another research it was revealed that farmers' income and access to finance were increased and they were more benefitted than the other players through supply chain efficiencies because of use of several m-ARD apps (Qiang *et al.*, 2012).

Mittal *et al.* (2010) found that income impact of 5–25 percent of income was observed among the farmers in India due to the SMS service Reuters Market Light (RML) which provided personalized information to subscribed farmers on daily spot market prices, localized weather forecasts, and agroadvisories tailored for one crop and the stage in the crop cycle. In another research, Parker and Weber (2011) reported that the efficiency of mandis was improved and farmers were empowered to sell crops more profitably due to the SMS service Reuters Market Light (RML) in India. Again, in another study which was conducted to find out whether there was any difference in prices received by the farmers in Maharashtra who had used RML and those who had not using randomized control trials, no significant differences were found in price received between the treatment and control groups but it was also revealed that farmers were influenced by RML to change their crops to improve profitability by 14-20 percent (Fafchamps and Minten, 2011).

Kirui *et al.* (2013) conducted a study on the impact of mobile phone-based money transfer, especially in agriculture to examine the impact of MMT services on household agricultural input use, agricultural commercialization and farm incomes among farm households in Kenya. It was observed in the study that mobile phone-based money transfer services significantly increased level of annual household input use by $42, household agricultural commercialization by 37% and household annual income by $224. Another research carried out by Aloyce (2005) revealed that the farmers who used pre-paid credit system through mobile phone were able to change their life better by minimizing distance. It was also observed in another study that farmers got access to valuable market data through the use of mobile phones and messaging technology

(Campbell, 2005). Significant correlations were found between telecommunications and indicators of socio-economic development in another study conducted by (Souter *et al.*, 2005) in three countries (India, Tanzania and Mozambique).

Bayes *et al.* (1999) reported that in case of Village Pay Phones in Bangladesh livestock mortality rates were reduced due to the farmers' better access to extension officers through the use of mobile phones. Again, in another study it was revealed that the rural women were provided with mobile information to support goat rearing as part of a microfinance loan in Tamil Nadu which had more positive result (Balasubramanian *et al.*, 2010). In a different study, Karamagi and Nalumansi (2009) revealed that the dairy farmers could connect to FoodNet, a service that supplies up-to-date price information for agricultural commodities, as well as contact details for interested buyers via SMS through mobile phones and thus became able to sell their milk without spoilage in the Bugerere District in central Uganda.

It was revealed from a study that price dispersion and wastage was dramatically decreased due to introduction of mobile phones to Kerala fishermen by facilitating the spread of information which led to more efficient market through risk and uncertainty reduction (Jensen, 2007; Abraham, 2007). In another study, Mangstl (2008) also reported that information regarding weather forecasts, where to get the best catch, local market information was communicated through mobile phone among the fishermen in Tanzania. It was also revealed that mobile phones were also used by them to coordinate pick-up of catches.

Aker (2008) reported that significant reductions in grain-price dispersion net of transport costs across markets was observed because of use of mobile phones among the grain sellers in Niger. However, there are different results also. Alenea *et al.* (2008) carried out a study on the maize market in Kenya and observed that access to communication assets had positive but insignificant effects on market participation. It was found in the study that access to a mobile phone is less useful in accessing market information and in facilitating transactions if there is no viable market information service.

2.1.3 Impact of Using Internet

UNDP (2001) carried out a study and found that farmers' incomes were dramatically increased by receiving information about crop status, weather, global market prices and

training through an internet network among the farmer organizations in Chile. Again, in another study it was found that regional market price fluctuations were reduced and average yields were increased due to information providing on market prices and cropping techniques through the Internet kiosks established by the public sector in India (Goyal, 2010a). In a different study, it was reported by ICTA (2009) that dairy farmers were helped to achieve self-sufficiency in milk production by introducing web and mobile technologies in Sri Lanka. It was found out by the government that the milk production was low due to low pregnancy rates of the milking cows. The low pregnancy rates remained because timely artificial insemination and breeding services were not available due to the lack of communication between farmers and public sector service providers. These gaps were bridged through the attempt of ICTA by introducing mobile phone-based SMS messages and touch-button computers installed at the milk collection centres where farmers used to gather every morning to sell their milk. In this system a number of "just-in-time" services were provided along with access to artificial insemination agents so that pregnancy could be induced and thus increase milk production. But the results are not always positive. Smith *et al.* (2004) conducted a research to explore the adoption, usage patterns, and perceived benefits of computers and the Internet among the Great Plains farmers. The study revealed that about half of those farmers who used the Internet for farm-related business had reported zero economic benefits from it.

2.1.4 Impact of Using Call Centre/Telecentre

AIS (2013) reported that the farmers are provided with the instant solutions to their problems related to agriculture, fisheries and livestock by the specialists in the relevant fields in Krishi Call Centre over phone in Bangladesh. Again, it was reported by Banglar Krishi (2015) that the farmers are benefited by the instant solutions to their different problems regarding diseases and insects of crop, cultivation practices, fertilizer management, different agricultural aspects, livestock and fisheries from the experts and field level specialists over phone from Krishi Call Centre operated by Agriculture Information Service (AIS) under the Ministry of Agriculture (MoA).

In a different study conducted by McGuire (2015) it was reported that the farmers are benefited by e-krishok created by BIID in Bangladesh where the services based agriculture information are transferred to the farmers over mobile phones through the

government infrastructures which are already in existence. Farmers are also benefited by the agricultural information provided by Miaki, a private entity in Bangladesh.

Ashraf *et al*. (2015) conducted a research to find out the impact of ICT on indigenous peoples' quality of life at Ruma village of Bandarban district in Bangladesh. They found that positive contribution was made by ICTs as perceived by the participants of Grameen phone Community Information Centres (GPCIC), a shared ICT access facility where participants can access a wide range of ICT services, e.g. Internet, voice communication, video conferencing, and locally relevant and customized information services on topics such as agriculture, education, health, legal, environment and politics. It was mentioned by the participants that enhancement of about a wide range of issues pertaining to their quality of lives took place through the programs set by the GPCIC. In another study, it was reported by Katalyst (2012) that the farmers were able to access the timely and accurate information and become more knowledgeable about opportunities to improve agricultural practices, production, and farm investment decisions with the help of Grameenphone Community Information Centre (CIC) and the helpline services in Bangladesh. It was observed that the vast majority (90%) of the beneficiaries were benefitted by preventing near-certain losses through the access to information which assisted them to counter and remedy the identified pest, disease, and animal health concerns. It was also revealed that farmers achieved benefits ranging from BDT 1,000 (approximately USD 12) to upwards of BDT 20,000 (USD 240). Again, Dey *et al.* (2008) conducted a research in two telecentres: one of them was Palli Tathya Kendra at Joyag, Noakhali initiated by D-Net and another one was Grameen Phone Community Information Centre (CIC) located at Shaturia Upazila, Manikganj in Bangladesh. It was observed in the study that the farmers' information needs could be made through the use of mobile phones and telecentres by them. Use of mobile phone by some of the farmers enabled them to get cheaper fertilizers.

Ramasubbian *et al.* (2015) found in their study that Uttar Pradesh (3005915), Madhya Pradesh (1353410), Maharashtra (1351699), Rajasthan (1339232), West Bengal (1037440) were in the first five places benefited by the Kishan Call Centre (KCC) among 32 states on the basis of call received by the KCC related to agricultural information in India. On the contrary, Andhra Pradesh (4042), Goa, Diu & Daman (3840), Nagaland (2160), Lakshadweep (1212) and Dadra & Nagar Haveli (593) were the states in the least five places those who were making use of KCC service. Again, in a different study it was

observed that Lifeline (a mobile- and Internet-based ICT project in agriculture which provides answers to farmer queries based on their demand) had impact on their productivity estimated to be around 20 percent as perceived by the farmers in India (Glendenning and Ficarelli, 2012).

Arfan *et al.* (2013) conducted another study to investigate the comparative effectiveness of Punjab Agriculture Helpline (PAH) and other information sources for meeting information needs of farming community. It was observed that all respondents (100%) were getting information regarding agricultural technology from Punjab Agriculture Helpline. Electronic media especially Punjab Agriculture Helpline had significant importance in providing agricultural information to the farmers. It was also reported that Punjab Agriculture Helpline was an efficient way of getting information as perceived by the farmers.

In a different study, Fawole (2006) reported that agriculture helpline was very beneficial for farmers but if the solution is not implemented accordingly the information needs of the farmers would not be fulfilled.

2.1.5 Impact of E-Choupal Project

The e-Choupal initiative which provides farmers with an alternative marketing channel, information on local district weather, agricultural best practices, feedback on quality of crops, and input sales with accompanying field-specific testing such as soil tests had a supposedly positive effect on the incomes of participating farmers, as the system had made the supply chain efficient by excluding intermediaries from it and reducing transaction costs. The magnitude of the income change and the factors that influenced that change was not identified in the study (Bowonder *et al.*, 2007; Karnani 2007). Ludden (2005) reported that the farmers of Madhdhya Pradesh became rich through E-Choupal project by gaining control over the Soya procurement chain through a process where the middlemen were avoided so that buyers could directly buy Soya from the farmers in India. However, Goyal (2010b) derived from an experiment that the average price in the mandis (government-regulated wholesale agricultural markets) in a district was increased by 13 percent because of presence of e-Choupal in Madhya Pradesh, India. Moreover, (Goyal 2010b) also found that the net profits of the farmers were increased by 33 percent and soybean cultivation was increased by an average of 19 percent in the districts with e-

Choupal kiosks. It was also observed that a more efficient market channel than the mandi system was opened because of the e-Choupal initiative. Goyal (2010b) concluded that the impact on individual farm income and poverty was not derived from the study which would require further empirical studies, which could also examine the social impacts. Again, it was observed by (Ali and Kumar, 2011) that there was impact of better availability of information and knowledge on agriculture decision-making processes among the users of e-Choupal than the non-users. Better decision-making aptitudes on various agricultural practices across the agricultural supply chain were observed among the users of e-Choupal than the non-users. The e-Choupal initiative is not practiced in Bangladesh.

2.1.6 Impact of Using ICT Media

Islam and Gro¨nlund (2010) found that the need for market information of the farmers of Natore district in Bangladesh was fulfilled by the contents of Pallinet (an agricultural market information service) and they were in general satisfied with the service. It was observed in the research that the farmers were empowered as the Pallinet service enabled them to know the conditions in the surrounding markets more confidently than before. It was also revealed from the research that they were benefited through realizing higher income, either by relocating to other markets or by gaining improved bargaining power over the middlemen. In this regard, it was obtained from the research findings that produce were relocated to other markets at least once after receiving price information from Pallinet by 34 percent of the users. It was reported by more than half of the farmers that their profit margin were improved to some extent with the help of Pallinet. Besides, it was considered by 36 percent respondents that they were helped by the service in increasing their profits from selling their produce by around 10 to 20 percent. It was also observed that the prevailing power of the middlemen over the farmers was disrupt to some extent. Again, another study was carried out by Ogutu *et al.* (2014) to evaluate the impact of an ICT-based market information services (MIS) project on farm input use and productivity in Kenya using Propensity Score Matching (PSM) technique. In this study intervention and control groups were taken for comparison and spillover effect was minimized. It was revealed from the study that there was a positive and significant impact of the intervention on the use of seeds, fertilizers, land, and labor productivity. It was also found in the study that there was a negative and significant impact on the use of hired,

family, and total labor per acre. In another research, it was observed that the intensity of adoption of improved maize seed by the farmers was improved through their access to ICT-based MIS (Kiiza *et al.*, 2011).

Again, in another research it was revealed that the farmers of Kapasia and Ekhlaspur in Bangladesh could become sure about the important issues for semi-organic cultivation and apply that knowledge into their cultivation watching the video contents in the Income Generation Project for Farmers using ICT (Ozaki *et al.*, 2013).

However, Dhaka and Chayal (2010) conducted research in Bundi district of Rajasthan, India to analyze experience of farmers using ICT services for agricultural information. It was revealed in the study that direct access to information was considered as important benefit and it was given the highest priority by the farmers. It was perceived by the farmers that the ICT services were able to disseminate knowledge intensive information like market intelligence, weather forecast, early warning and management of disease and pests, production practices, post harvest management etc. It was reported by the farmers in the research that their quality of decision making was improved through obtaining alternative solutions to a set of problematic situations with the help of ICT. It was also found in the study that the market information including daily updates on the prices of agricultural commodities in the local markets of the surrounding district was perceived as the most relevant ICT services by the farmers. The farmers were able to sell their commodities at those markets where their agricultural products would command the best prices.

Again, it was found that ICT could provide more extensive, equitable, relevant, participative and cost effective education and empowerment for smallholder self-development. It was also revealed from the study that some ICT pilot programmes were successful and replicable in the other states of the country but any one of those programmes could not become successful in Jammu & Kashmir (J&K) state (Jamwal and Padha, 2009).

It was found in a study conducted by Munyua *et al.* (2009) that the use and application of modern ICTs could contribute in the development of small-scale agriculture in Africa. Some emerging ICTs such as Geographic Information Systems (GIS) and decision support systems, mobile mapping and hand-held personal computers (personal digital assistants/PDAs), precision agriculture and mobile (cellular) phone applications,

community radio stations, radio frequency identification tags, World Space satellite radio and access to the Internet and web-based applications facilitated the farmers to concentrate on high-value agricultural (HVA) products, to focus on improvement in productivity, to consider the options for commercial agriculture, to pay increased attention to new markets and marketing strategies, and to increase agricultural production through biotechnology. It was also revealed from the study that the cellular phone facilitated the farmers and entrepreneurs to access the market links. The study further revealed that farmers were provided with extension information through a telephony information service, the National Farmers Information Service (NAFIS) in English and Kiswahili using audio format in Kenya. Besides, farmers and traders had access to information on commodities being sold, their prices and the identity of their buyers and extension messages through other cellular phone applications providing market information and electronic trading platforms such as Tradenet.biz. Mobile phone also facilitated the farmers to pay farm workers and purchase farm inputs as an electronic money transfer channel. It was reported in Kenya that market information was offered to the farmers using voice mail through Interactive Voice Response (IVR) by Kenya Agricultural Commodity Exchange (KACE). It was also observed that farmers could subscribe to real-time information on agricultural and fish prices through their cell phones in Senegal.

Again, Lio and Liu (2006) revealed in a study that there was a significant positive impact of ICT on agricultural productivity. It was also observed that information and communication infrastructure influenced the adoption of modern industrial inputs in agricultural production in that study.

However, Meera *et al.* (2004) carried out a research to examine the performance of three ICT projects in India. It was observed in the research that under Warana project the farmers of the region were getting the information on the tonnage of sugarcane, payment details, etc. sent from the sugar administration building within a day which they required to get as soon as possible.

It was revealed from another study that the greater efficiency in the arbitrage of prices and less concentration of market power within segments of the value chain was the main effect of ICT use in rural and agricultural markets. It led to greater supply of produce

from producers to growing markets, reduced dependence on transportation for market transactions, and lower price variability (Jensen, 2010).

It was observed in a study that farmers gained additional benfit of Rs 3,820/- by reducing fertilizer and pesticide inputs, and getting extra yield being able to receive advice on planting, monitoring and harvesting crops and on pesticide and fertilizer usage based on digital photos taken by the farmers themselves through the project e-Sagu of the International Institute of Information Technology (IIIT) in Hyderabad, India (IIIT, 2009).

It was reported by Gandhi *et al.* (2009) that an assessment was conducted to compare the adoption rates between villages that used the Digital Green system (a nonprofit organization that disseminates agricultural practices using video as a medium) with rates in villages that used a Training and Visit extension approach. It was observed that at least one new agricultural practice was adopted by 85 percent of the farmers, whereas in the control villages it was adopted by only 11 percent of the farmers.

Hayami and Ruttan (1970), Antle (1983) revealed that a substantial proportion of the variation was observed in aggregate agricultural output across countries which was the result of inter-country differences in the gross domestic production of transportation and communication industries which pointed out that agricultural productivity was increased noticeably due to investments in communication facilities.

It was observed by Mwakaje (2010) that the ICT user farmers obtained higher prices than the farmers who did not use ICT for accessing market information in Rungwe District, Mbeya Region, Southwest Tanzania.

It was revealed from a study conducted in Pakistan that the position of the farmers' was strengthened during bargain with the traders by receiving widely available information on prevailing market prices for seed cotton through the use of ICT (Lohano *et al.*, 1998).

Nielsen and Heffernan (2006) examined the relationship between new and existing knowledge regarding animal health and production among 85 poor farmers in 13 communities in Bolivian Altiplano, who utilised the El Promotor, a multi-media, interactive programme. They observed that there was uptake of knowledge due to utilization of the ICT programme.

It was revealed in a study that the farmers were able to improve their production, linkages to profitable markets, and reduce poverty by accessing agricultural knowledge and

information through ICTs (such as, telecenters, cell phones and radio) in Tanzania (Lwoga and Ngulube, 2008).

2.2 Relationship of Selected Characteristics of the Farmers with the Impact of Using ICT by Them

2.2.1 Age and Impact of Using ICT

Reza (2007) reported that there was no significant relationship between the age of the farmers and their perceived impact of ICT use. However, Shin and Evans (1991) reported in another study that positive significant relationship was observed between age and impact of use of communication technologies. In another study, Kafura (2015) reported that there was negative significant relationship between the age of the farmers and the level of use of different ICT tools for agricultural purposes by them. Again, in another research conducted by Ahmed (2012) it was observed that there was no significant relationship between age of the farmers and ICT utilization in agriculture by them. It was also reported by Ali (2011) that age of the farmers had no significant relationship with the adoption of mass media based information for decision-making in vegetable cultivation. However, another study was conducted by Ogutu *et al.* (2014) who reported that there was significant positive correlation between the age of the farmers and their participation in ICT based market information service projects for accessing to agricultural market information. Again, in another research it was reported that age was related with the utilization of ICT in Kasulu, Magu, and Sengerema in Tanzania (Nielinger, 2003). However, Meera *et al.* (2004) reported that there was negative correlation between the age of the farmers and the frequent use of the internet services by them leading to the impact of ICT among them in all three ICT projects. But it was also observed in their study that the intranet services were quiet frequently used by the younger farmers. Nevertheless, there was no association between age of the farmers and the frequent use of ICT services by them in iKisan project. Again, Okello *et al.* (2012) noticed that the age of the farmers was a significant factor inversely influencing the use of ICT tools by them. It was observed in the study that the use of ICT tools for agricultural transactions was greater among the younger farmers. However, in another research conducted by Anastasios *et al.* (2010) it was revealed that age of the farmers had no contribution to the adoption of ICT by the farmers. Again, it was revealed in another study that there was no significant influence of the age of the farmers on the use

of different communication media in adoption of improved farm practices (Ahmed, 1977). However, Pandian (2002) observed that there was direct positive effect of the age of the farmers on the impact of Video Education on knowledge retention.

Ndag *et al.* (2008) reported that the younger farmers had more exposure to ICT usage and courses than the older farmers. Again, in another study it was observed that at least two types of ICT media were used by most of the respondents aged between 21 to 60 than the respondents of other ages (Mwakaje, 2010).

2.2.2 Level of Education and Impact of Using ICT

Reza (2007) reported that there was a positive significant relationship between the level of education of the farmers and the impact of use of ICT as perceived by them. In another study, it was observed by Kafura (2015) that there was positive significant relationship between the level of education of the farmers and the level of use of different ICT tools for agricultural purpose by them. However, in another research Ogutu *et al.* (2014) reported that no significant relationship was observed between the education of the farmers and their participation in ICT based market information service projects for accessing to agricultural market information. It was also reported by Ahmed (2012) that there was no significant relationship between education of the farmers and ICT utilization in agriculture by them. It was also revealed in another study that any significant difference was not observed in the use of ICT for market access across different education levels of the farmers (Mwakaje, 2010). Again, it was also observed by Ali (2011) that education of the farmers had no significant relationship with the adoption of mass media based information for decision-making in vegetable cultivation. However, in another research it was revealed that there was positive association between the education of the farmers and frequent use of information services by them and thus the impact of ICT among them in the Gyandoot and Warana ICT projects. It was observed in the study that the intranet services were quiet frequently used by more educated farmers. Nonetheless, education was not associated with the frequency of using ICT services in iKisan project (Meera *et al.*, 2004). However, it was reported by Okello *et al.* (2012) that the level of literacy of the farmers was a factor positively influencing the use of the ICT tools and mobile phone for agricultural transaction purposes by them. Again, in another research it was also revealed that educational level of the farmers positively influences the use of ICTs to access agricultural information by them (Das,

2014). In a different study conducted by Anastasios *et al.* (2010) it was revealed that education of the farmers was an influential factor predicting the adoption of ICT by the farmers. However, in a different study, Lio and Liu (2006) reported that certain socioeconomic characteristics such as higher levels of education and skills are prerequisites for the effective driving of agricultural productivity by new ICT. Moreover, it was observed in a study that education levels of the farmers had significant role in impacting decision-making aptitudes of the farmers on various agricultural practices across the agricultural supply chain due to use of e-Choupal (Ali and Kumar, 2011). Again, it was noticed that ICTs are more likely to be adopted and better-informed decisions on agricultural practices are more likely to be taken by the educated farmers (Agwu *et al.*, 2008; Taragola and Van Lierde, 2010). In a different study, Ndag *et al.* (2008) observed that the higher educational achievement of the farmers had contribution to their greater exposure to ICT usage and courses. Again, in another research it was revealed that there was direct positive effect of the education of the farmers on the impact of video education on knowledge retention (Pandian, 2002). However, Ahmed (1977) reported that there was no effect of education of the farmers on their use of communication media in adoption of recommended variety of jute and recommended fertilizer dose. Again, it was reported by Huque (1982) that there was no significant relationship between education of the farmers and their perceived effectiveness of television programmes.

2.2.3 Purpose of Farming and Impact of Using ICT

Okello *et al.* (2012) revealed that the farmers in Kirinyaga district in Kenya who produced market-oriented export vegetables had a higher likelihood of using ICT tools for agricultural transaction. In a different study it was observed that the farmers producing large quantities of crops used ICT to access market information and therefore they were able to sell a lot more and receive relatively better prices which had a positive impact on poverty alleviation (Mwakaje, 2010). However, De Silva and Ratnadiwakara (2008) carried out a case study of smallholder vegetable farmers in rural Sri Lanka to find out the specific role of information and communication technologies (ICT) in reducing transaction costs in agriculture by enabling timely and affordable communication. The researchers revealed from the study that the subsistence farmers hardly used any ICT for obtaining information and demonstrated that if farmers had used the phone at various

points in the agricultural value chain their information search costs could have been reduced significantly enabling greater farmer participation in commercial farming.

2.2.4 Family Size and Impact of Using ICT

Kafura (2015) observed that there was no significant relationship between the family size of the farmers and the level of use of different ICT tools for agricultural purpose by them. Again, also in another research it was revealed that no significant relationship was observed between the household size of the farmers and their participation in ICT based market information service projects for accessing to agricultural market information (Ogutu *et al.*, 2014). In a different study conducted by Ahmed (2012) it was observed that family size of the farmers had no significant relationship with ICT utilization in agriculture by them. However, there was different result also. Okello *et al.* (2012) found in a study that the household size of the farmers was a factor negatively influencing the use of the mobile phone for agricultural transaction purposes by them.

2.2.5 Farm Size and Impact of Using ICT

Reza (2007) noticed that farm size of the farmers had a positive significant relationship with their perceived impact of ICT use. However, it was revealed by Pandian (2002) that there was direct negative effect of the farm size of the farmers on the impact of video education on knowledge retention. However, it was revealed by Kafura (2015) that the farm size of the farmers had no significant relationship with the level of use of different ICT tools for agricultural purpose by them. In a different study it was revealed also that farm size of the farmers had no significant relationship with utilization of ICT in agriculture by them (Ahmed, 2012). Again, Meera *et al.* (2004) also observed that there was no association between the landholding of the farmers and the frequency of using ICT services by them which depicted that irrespective of the landholding size, all farmers were using the ICT services. It was also interpreted in the study that the land holding size of the farmers did not influence the frequency of using ICT services by them and thereby the impact of ICT use. In another research conducted by Huque (1982) it was revealed that no significant relationship was observed between the farm size and the effectiveness of television programmes perceived by them. However, in another study it was observed by Ali (2011) that there was strong negative relationship between the farm size of the farmers and the adoption of mass media based information for decision-making in

vegetable cultivation. But, there were some different findings also. In different studies it was revealed that there was a strong positive relationship between farm size and adoption of farm technologies and ICT based information system (Alvarez and Nuthall, 2006; Caswell *et al.*, 2001).

It was reported by Das (2014) that farm size of the farmers positively influences the use of ICTs to access agricultural information by them. Again, in another research it was revealed that the farming experience of the farmers was a factor affecting the use of ICT tools by them (Okello *et al.*, 2012). In another research, Ali and Kumar (2011) reported that landholding size of the farmers had significant role in impacting decision-making aptitudes of the farmers on various agricultural practices across the agricultural supply chain due to use of e-Choupal. Again, in a different study it was observed by Kumar (2004) that farm size of the farmers influenced access to e-Choupals in Madhya Pradesh and thus greater impact of ICT among them.

In a study it was observed that the larger farmers achieved greater benefits in dealing with input availability and disease control through the use of ICT than the smaller farmers (Mittal and Tripathi, 2009).

2.2.6 Annual Income and Impact of Using ICT

Reza (2007) noticed that annual income of the farmers had a positive significant relationship with their perceived impact of ICT use. Again, in another research it was observed by Pandian (2002) that there was positive significant effect of the annual income of the farmers on the impact of video education on the knowledge retention by the farmers. However, Kafura (2015) revealed that there was positive significant relationship between the annual income of the farmers and the level of use of different ICT tools for agricultural purposes by them. Again, in a different study it was observed that there was no significant relationship between the annual income of the farmers and utilization of ICT in agriculture by them (Ahmed, 2012). Again, in another research Huque (1982) noticed that no significant relationship was observed between the annual income of the farmers and the effectiveness of the television programmes as perceived by them. It was observed by Ali (2011) that income levels of the farmers are more likely to affect the adoption of mass media based information for decision-making in vegetable cultivation. In a different study, it was observed that income levels of the farmers had significant role

in impacting decision-making aptitudes of the farmers on various agricultural practices across the agricultural supply chain due to use of e-Choupal (Ali and Kumar, 2011). In another research it was also revealed by Anastasios *et al.* (2010) that the annual income was the most influential factor predicting the adoption of ICT by the farmers. However, Mwakaje (2010) reported that significant difference was observed between ICT use and the level of income of the respondents. It was noticed that more than one type of ICT were used by the farmers with high incomes and thereby remaining in better position for accessing market information than the farmers with less income using only one type of ICT.

Again, in a study conducted by Lio and Liu (2006) it was revealed that farmers in richer countries began to utilize new ICT (especially the Internet) much more effectively to get enhanced agricultural productivity.

2.2.7 Training Exposure and Impact of Using ICT

Kafura (2015) observed that there was no significant relationship between the training exposure of the farmers and the level of use of different ICT tools for agricultural purposes by them. Again, it was reported by Das (2014) that formal training of a member of household engaged in agriculture positively influences the use of ICTs to access agricultural information by them. It was revealed in different studies that farmers' exposure to the ICT usage and courses had contribution to the use of ICT by them (Meera *et al.*, 2004; Ndag *et al.*, 2008). It was observed in a study that E-Dairy provided training on computer and Internet use to the dairy farmers which had enabled the farmers to request veterinary and extension services related to different issues about dairy through SMS or on touchscreen computers and thus obtain greater income from dairy (Qiang *et al.*, 2012).

2.2.8 Use of ICT Media in Agriculture and Impact of Using ICT

The literatures pertaining to use of ICT media in agriculture related to impact of ICT were very much limited. The researcher only found two literatures regarding this issue. It is yet to get any more findings related to use of ICT media in agriculture and impact of ICT.

Reza (2007) observed that there was positive significant relationship between the use of ICT materials by the farmers and their perceived impact of ICT use. In a different study,

it was revealed that there was significant positive correlation between the use of ICT device (mobile phone) by the farmers and their participation in ICT based market information service projects for accessing to agricultural market information (Ogutu *et al.*, 2014).

2.2.9 Service Taking from Agricultural Service Centre and Impact of Using ICT

The literatures regarding service taking from agricultural service centres related to impact of ICT were very much limited. The researcher only found three literatures regarding this issue. It is yet to get any more findings related to service taking from agricultural service centres and impact of ICT.

Okello et al. (2014) found that use of ICT-based MIS by the farmers to get the market information services was positively influenced by the farmer's belonging to a farmer organization. In another study, Ahmed (2012) observed that the extent of visit to ICT centres for agricultural purposes by the farmers had significant positive relationship with the ICT utilization in agriculture by them. In a different study, it was revealed that the farmers receiving agricultural information regularly from TV, radio, newspapers, other farmers, government agricultural extension services, traders, input dealers, seed companies and relatives were found to have highly variable perceived quality and relevance of the information received from the sources and lacked access to consistent, reliable information for many of their needs and often were dependent on a combination of traditional knowledge, experience and guesswork to make decisions while it was observed that they received better quality of information regarding agriculture because of mobile phone access than other sources (Mittal *et al.*, 2010).

2.2.10 Farming Experience and Impact of Using ICT

Reza (2007) revealed that no significant relationship was observed between farming experience of the farmers and the impact of use of ICT perceived by them. In a different study, it was observed that there was positive significant relationship between farming experience and impact of communication technology use (Shin and Evans, 1991). Again, it was noted by Kafura (2015) that there was negative significant relationship between the farming experience of the farmers and the level of use of different ICT tools in agriculture by them. In another research it was revealed that no significant relationship was observed between the farming experience of the farmers and their participation in

ICT based market information service projects for accessing to agricultural market information (Ogutu *et al.*, 2014). However, in a study carried out by Pandian (2002) it was reported that there was direct positive effect of the farm size on the impact of video education on the knowledge retention by the farmers.

2.2.11 Agricultural Knowledge and Impact of Using ICT

Reza (2007) found that there was positive significant relationship between agricultural knowledge of the farmers and the impact of use of ICT as perceived by them. In another study, it was observed that agricultural knowledge of the farmers had no significant relationship with the utilization of ICT in agriculture by them (Ahmed, 2012). In a different study it was revealed by Qiang et al. (2012) that farmers' access to knowledge and information had contribution to the expansion of their capacity through the use of ICT media. However, in another study it was observed that knowledge of the farmers had a significant positive relationship with the use of communication sources by them in improving cultural practices (Karim, 2005).

2.2.12 Problems Faced in Using ICT Media in Agriculture and Impact of Using ICT

Lwoga (2010) reported that the better dissemination of agricultural knowledge in the local communities through community radio and thereby the improvement of agricultural activities of the farmers was constrained by language restriction. In another study, Chilimo (2008) revealed that a number of problems in using ICT media like telecenters and rural radio in dissemination of information and knowledge for sustainable agricultural practices in Tanzania constrained the farmers from meeting their information needs which specially included high cost of ICTs, illiteracy, distance to the telecentre, language barrier, lack of electricity, frequent power cuts, sustainability issues and lack of awareness of most of the telecenter managers about the farmers' information needs. Again, it was observed in a different study that the spread of ICT technology among the farmers were hindered by a number of factors namely cost, availability, knowledge and reliability. Another problem namely lack of electric power in many rural areas was a dictating factor regarding the spreading of ICT among the farmers (Mwakaje, 2010). However, it was revealed by Hassan *et al.* (2009) that the five main problems in their study less affected the entrepreneurs who were more exposed to ICT usage and courses. Again, United Republic of Tanzania (2005) reported that there were many factors namely

high cost of ICT services in rural locations compared to urban locations, low literacy rates, low incomes and limited number of service providers, inappropriate legal and regulatory framework for the expanding market, inadequate telecom infrastructure and ICT expertise which had contribution to the low use of Internet. Moreover, it was noticed by Mwakaje (1999) that there were limitations of using radio sets for market information dissemination in Tanzania. The price information was disseminated only once a day and for a very short period of time which was hard for the farmers to time it regularly. It was also observed in the study that another problem which was lack of dry batteries and other maintenance aspects of the radios affected the regular use of radio sets by the farmers for receiving price announcement.

2.3 Research Gap of the Study

There are lots of researches on ICT in agriculture but very few researches had been done to solely assess the impact of ICT in agriculture. Moreover, among the limited studies on impact assessment of ICT in agriculture only a few researchers followed systematic method of impact analysis to assess the impact of ICT in agriculture. This was one of the research gaps of the study. Hence, the researcher carried out the present study to assess the impact of ICT among the farmers of Sadar upazila under Gazipur district following Difference in Difference (DID) method of impact assessment.

Moreover, very few researchers carried out impact assessment of ICT in agriculture taking study and control groups to compare between the groups. This was another research gap of the study. So, the researcher accomplished the present research taking both the study and control groups.

As far as searched, very few researches were conducted to find out the impact of ICT in agriculture minimizing spill-over effect. This was also a research gap of the study. According to the research gap, the researcher conducted the present work minimizing spill-over effect.

Furthermore, no research was undertaken previously following the methodology which was adopted by the researcher. This was also a significant research gap. The methodology of the present work was very unique in this regard. So, the researcher executed the research programme following the methodology as mentioned.

Additionally, no research was carried out taking the indicators of impact of ICT in agriculture into consideration which were adopted by the researcher in the present study. This is another research gap of the present work. Hence, the researcher administered the current research programme using those indicators to assess the impact of ICT.

Lastly, very few researches were conducted to assess the impact of ICT in agriculture taking the variables which were used in the present study. This is also a research gap of the present study. Therefore, the researcher carried out the present work using the variables as mentioned.

2.4 Conceptual Framework of the Study

The relationship between the experimental variables and the main focus of the study can be clearly depicted with the help of conceptual framework of the study. In this study, the researcher made an attempt to assess the impact of ICT among the farmers of Sadar Upazila under Gazipur district as the main focus of the study. It was conceptualized in the research that the impact of ICT among the farmers may be influenced and affected by the interacting forces of many socio-economic, personal and other types of characteristics of the farmers. Hence, the experimental variables of the study were some selected characteristics of the farmers as mentioned earlier. To make the process conspicuously interpretable a conceptual framework has been presented in a schematic diagram (Fig 2.1).

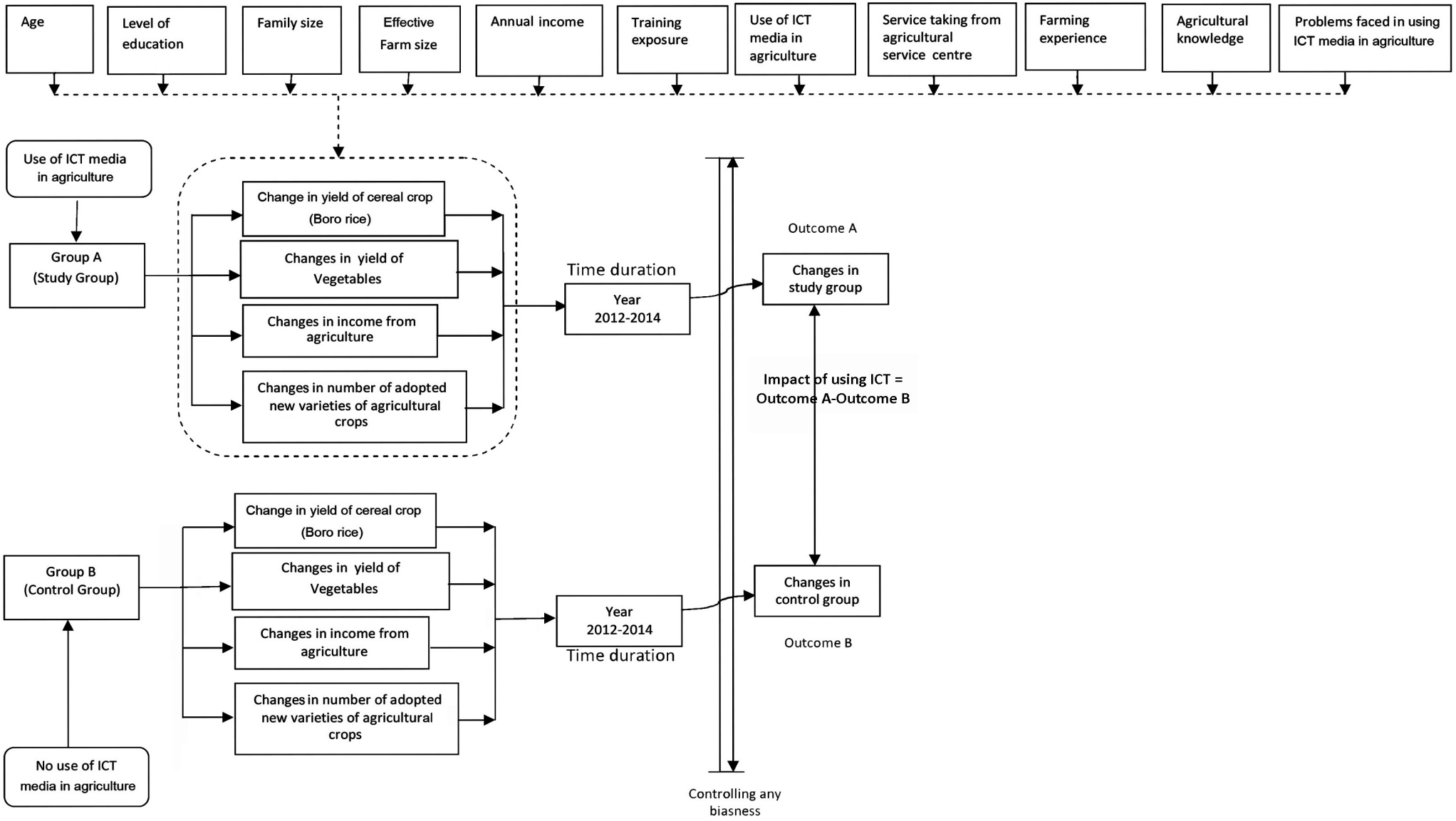

Figure 2.1. The Conceptual Framework of the Study

CHAPTER III

METHODOLOGY

The method and procedure followed in the study are presented in this chapter. The primary method which was followed in the present work was field survey with the help of structured interview schedule. The researcher was very much careful during consideration of the methodology as it was the prerequisite for carrying through a research systematically. The validity and reliability of the data and the appropriateness of the research findings depend solely on the methodology. The methodology of the present research is discussed in this chapter in the following sections.

3.1 Research Design

The main objective of the study was to determine the impact of using ICT by the farmers of Sadar upazila under Gazipur district. The selected six ICT media were radio agricultural programmes, TV agricultural programmes, mobile phone/smart phone/telephone, computer/laptop/tablet/multimedia/Internet (with the help of media supplied in AICC), Krishi Call Centre/Farmers help Line and agricultural assistance services of mobile phone companies (Banglalink Krishi Jigyasha/ Banglalink Krishibazaar/ Grameenphone Krishi Tatthya Sheba/ Robi Haat-bazaar). Firstly, the selected characteristics of the farmers were determined. Secondly, the impact was measured in quantitative method (Garbarino and Holland, 2009). In quantitative method, change in yield of cereal crop (Boro rice), changes in income of vegetables, changes in income from agriculture and changes in number of adopted new varieties of agricultural crops of the study and control group respondents from 2012 to 2014 were considered to measure the impact of using ICT. Here, the difference-in-differences method was used as impact assessment methodology (Gertler *et al.*, 2011). In the Double difference or difference-in-differences (DD) method comparison was made between study and control group within a specific period of time. The difference between 2012 and 2014 was measured both in case of study and control groups. Then, the study group was compared with the control group on the basis of the difference between 2012 and 2014. Thirdly, multiple regression analysis was conducted in order to identify the contribution of the selected characteristics of the respondents to the impact of using ICT as perceived by the

farmers of Sadar upazila under Gazipur district. Fourthly, correlation was conducted to explore the relationship between some specific indicators of dependent variable.

3.2 Locale of the Study

Sadar upazila under Gazipur district was purposively selected for the study. Baria union was purposively selected among 14 unions of Sadar upazila. Three villages namely Khundia, Digdha and Shukhundi were purposively selected from Baria union as intervention area for the research. This area was taken as intervention area as a more ICT exposed area due to presence of Agricultural Information and Communication Centre (AICC) in the area. One village namely Baldha from the same union was selected as control village as a less ICT exposed area. Both the intervention and control areas are very near to Gazipur Sadar upazila and Gazipur is near to Dhaka city. There are 1 high school, 1 primary school and 1 kindergarten in the Shukhundi village, 1 primary school in the Digdha village and 1 madrasha in the Khundia village and 1 market combinedly for the three villages in the intervention area. There are 1 kindergarten and 1 market in the control area Baldha village. Because of these educational institutions the literacy rate of the both intervention and control areas is quite high.

3.3 Population and Sampling Procedure

Total number of farmers of the selected three villages Shukhundi, Digdha and Khundia were 48, 71, and 144 respectively which constituted the population of the study group. A list of the sampling population of study group from the selected three villages was prepared with the cooperation of SAAO. Sample size was determined using Yamane (1967) formula. The formula was:

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

Where, n = sample size;

N = population size = 263;

e = the level of precision = 8%;

z = the value of the standard normal variable given the chosen confidence level = 1.96 with a Confidence Level = 95% and;

p = the proportion or degree of variability = 50%

So, sample size, n = 96.

From the list of 263 test population 96 (37% of the test population) study group respondents (ICT media users) were selected proportionately. The study group respondents (ICT media users) were selected in purposive sampling procedure. Thus, the sample size for Shukhundi, Digdha and Khundia were 17, 26 and 53 respectively making the total sample size of the study group 96. In the study villages, the farmers had been using at least one of the six selected ICT media in agriculture for two years or more were included in the study group. To reduce spill-over effect i.e. to avoid the problem of information flow from ICT media user farmers to non-ICT media user farmers, study group and control group were selected from separate villages. Three villages Shukhundi, Digdha and Khundia were selected for study group and one village namely Baldha was selected for control group. The study and control group villages were kept separate with a remarkable distance of about 3-5 km (Mazumder and Lu, 2015; Hulme, 2000). Thirty two (32) control group respondents (non-ICT media users) were selected in 1:3 ratio of the study group respondents following two-way stratified random sampling where education and annual income were the strata (Mazumder and Lu, 2015; Haque, 2002). Three categories were assigned for education: group 1 (denoted E1) respondents were illiterate or could sign only, group 2 (Denoted E2) respondents had primary education and group 3 (Denoted E3) respondents had secondary or higher education. Similarly, three categories were also assigned to annual income: group 1 (Denoted A1) was low-income group (income up to BDT 60000 per year), group 2 (Denoted A2) was medium-income group (income BDT 60001 to BDT 100000 per year) and group 3 (Denoted A3) was high-income group (income BDT 100001 and above per year) (Mazumder and Lu, 2015). The two-way stratified random data is shown in Table 3.2. Thus, the total sample size was 128. In control village the non-ICT user farmers were selected in purposive sampling procedure for control sample. The farmers using none of the selected six ICT media in agriculture were included in the control sample. Nine percent (9%) of the population was selected randomly and proportionately to include in the reserve list. The distribution of population, sample and reserve list is shown in the Table 3.1.

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

Villages	Population	Sample	Reserve list
	No. of respondents	No. of respondents	
Khundia	144	53	5
Digdha	71	26	2
Shukhundi	48	17	2
Total Intervention Area	263	96	9
Baldha (Control Village)	Unknown	32	3
Total	-	128	12

Table 3.2 Two-way stratified random data of study group and control group respondents based on their level of education and annual income as strata

Category	% of respondents	No. of respondents from study group	Number of respondents from control group
E1 x A1	3.13	3	1
E1 x A2	3.13	3	1
E1 x A3	22.92	22	7
E2 x A1	2.08	2	2
E2 x A2	2.08	2	1
E2 x A3	31.25	30	9
E3 x A1	2.08	2	1
E3 x A2	2.08	2	1
E3 x A3	31.25	30	9
Total	100	96	32

Source: Mazumder and Lu, 2015

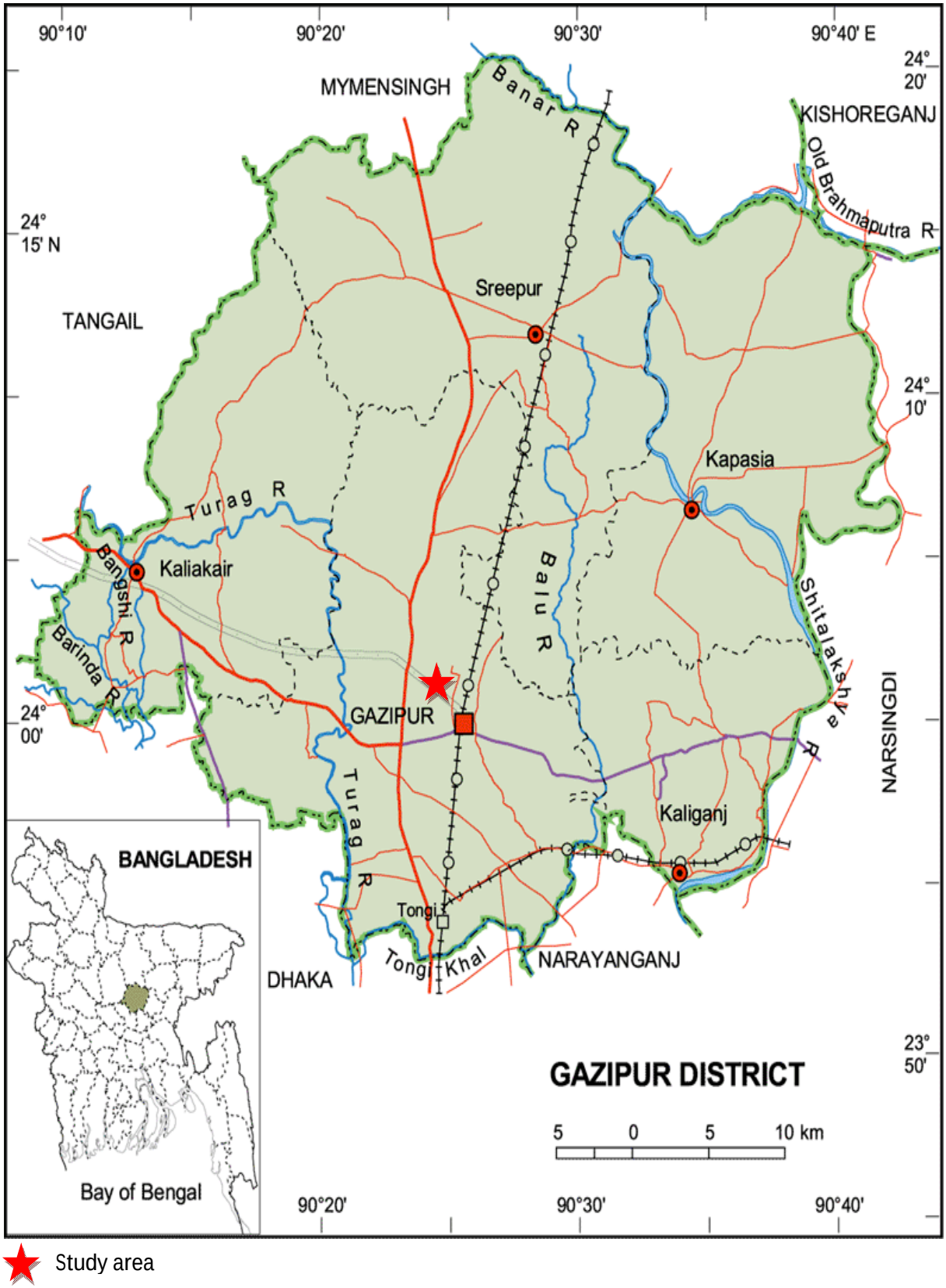

Figure 3.1. A map of Gazipur district showing Gazipur Sadar upazila

Figure 3.2. A map of Gazipur Sadar upazila showing study area

3.4 Data Collection Instrument

An interview schedule was prepared keeping objectives of the study in consideration. Direct questions and different scales were kept in the questionnaire to get the desired information. After preparation of data collection instrument pre-test was conducted on 10% of the sample i.e. 13 respondents (10 study group respondents and 3 control group respondents) from the population but excluded from the sample. Necessary correction and modification was made in the interview schedule based on pretest. After correction, the interview schedule was finalized for data collection.

3.5 Data Collection Procedure

Data were collected by the researcher herself through face-to-face interview of the selected farmers. The data were collected from October 17, 2015 to December 25, 2015. Data were collected once for two different years (2012 and 2014) based on recall data (Schröder and Börsch-Supan, 2008). Both study and control group data were collected using one data collection instrument where only the question no. XIII was considered for collecting data from control group.

3.6 Selection of Dependent and Independent Variables

In this study, the dependent variable was impact of Information and Communication Technologies (ICT) among the farmers of Sadar upazila under Gazipur district and the independent variables were age, level of education, purpose of farming, family size, effective farm size, annual income, training exposure, use of ICT media in agriculture, service taking from agricultural service centre, farming experience, agricultural knowledge and problems faced in using ICT media in agriculture.

3.7. Variables and Their Measurement

Procedure for measurement of independent and dependent variables are discussed in this section.

3.7.1 Measurement of Independent Variables

3.7.1.1 Age

The age of a respondent farmer was measured by counting the number of years from his/her birth to the time of interview based on his/her response. It was expressed in terms of years.

3.7.1.2 Level of Education

Level of education was measured on the basis of the respondent's ability to read or write or attending classes in the formal education system. It was expressed in terms of years of successful schooling. If the respondent could not read or write he/she was given a score of zero. If the respondent could sign his/her name only then he/she was given a score of 0.5. One score was given to a respondent for passing the final examination of each level in the formal education institution. For example, if the respondent farmer passed the final examination of class eight (VIII), his/her educational score was given 8.

3.7.1.3 Purpose of Farming

Purpose of farming was measured on the basis of the respondent's type of farming - commercial or subsistence. Commercial farming is a type of farming when a farm is set up for producing crops and farm animals for sale, with an intention of making a profit. Subsistence farming is a type of farming where the farm products are produced to provide for the basic needs of the farmer, with little surplus for marketing. If the respondent performed subsistence farming, it was coded as one (1) and if he/she performed commercial farming, it was coded as two (2).

3.7.1.4 Family Size

Family size of the respondent farmers was measured by counting the total number of family members of the respondent on the basis of his/her response. The head of the household, his wife, children, parents and other dependents who jointly lived and ate together during interview was considered as the family members. One score was given for each family member.

3.7.1.5 Effective Farm Size

Effective farm size of the respondent farmer was measured using the following formula. The effective farm size was expressed in decimal.

Effective farm size, $\mathbf{A=}\ A_{1+}\ A_{2+}\left[\frac{A_{3+}A_4}{2}\right]+A_5$

Where,

A_1 = Homestead land including pond area

A_2 = Own land under own cultivation

A_3 = Land taken from others on sharecropping

A_4 = Land given to others on sharecropping

A_5 = Land taken from others on lease

3.7.1.6 Annual Income

Annual income of the respondents was measured on the basis of total yearly income of the respondent himself/herself plus other family members. One score was assigned to each '1000' taka annual income of a respondent. The annual income was measured by using the following formula:

Total Annual Income = A+B+C

Where,

A = Annual income from agriculture

B = Annual income from livestock, poultry and fisheries

C = Annual income from service, business, labour and others

3.7.1.7 Training Exposure

Training exposure was measured by total number of days of agricultural training received by the respondent farmer in his/her life. One score was assigned for each day of training received by the respondent.

3.7.1.8 Use of ICT Media in Agriculture

The use of ICT media in agriculture was measured on the basis of the response of the ICT media user farmers against the extent of his/her use of selected six ICT media by putting

tick mark against any one of the five responses-'regularly', 'most often', 'occasionally', 'rarely', 'not at all'. The responses were scored as 4, 3, 2, 1 and 0 respectively. The use of ICT media in agriculture score of the respondent ranged from 0 to 24, where, 0 indicates no use and 24 indicates the highest use.

3.7.1.9 Service Taking from Agricultural Service Centre

Service taking from agricultural service centre was measured on the basis of nine (9) agricultural service centre using a 5-pont scale. The respondents were asked to check any one of the five responses-'regularly', 'most often', 'occasionally', 'rarely', 'not at all'. These responses were scored as 4, 3, 2, 1 and 0 respectively. The extent of taking services from agricultural service centre ranged from 0 to 36 where 0 indicates no service taking and 36 indicates the highest service taking.

3.7.1.10 Farming Experience

Farming experience of a respondent farmer was measured by counting the total years of the cultivation practices done by him/her at the time of interview on the basis of his/her response. It was measured in terms of actual years. No fractional year was not taken into consideration for measurement.

3.7.1.11 Agricultural Knowledge

A set of 11 questions was constructed in the interview schedule to measure agricultural knowledge of the respondents. A score of two (2) was assigned against each question. All the 11 questions were asked to each respondent. If the respondent could answer the question fully he was given the full marks (2) and if he/she could answer the question partially he/she was given the half marks (1). If he/she could not answer the question, he/she was given zero (0) mark. The agricultural knowledge score was measured by the summation of obtained scores against the 11 questions. The agricultural knowledge score could range from 0 to 22, where, 0 indicates very low agricultural knowledge and 22 indicates very high agricultural knowledge of the respondents.

3.7.1.12 Problems Faced in Using ICT Media in Agriculture

Problem faced in using ICT media in agriculture was measured by using a scale of 10 problems and asking the respondent to show their responses as 'not at all', 'low',

'medium', 'high' and 'very high' against each problem according to their extent of problem facing in using ICT media in agriculture. The weighted score of the five responses were assigned as 0, 1, 2, 3 and 4 respectively. The problems faced in using ICT media in agriculture score ranged from 0 to 40, where, 0 indicated no problem and 40 indicated the highest problems faced in using ICT media in agriculture.

3.7.1.13 Problem Faced Index in Using ICT Media in Agriculture

Ten problems were selected by the researcher through consultation with the experts. The respondents were asked to show their responses as 'not at all', 'low', 'medium', 'high' and 'very high' against each problem according to their extent of problem faced in using ICT media in agriculture. The weighted score of the five responses was assigned as 0, 1, 2, 3 and 4 respectively. The Problem Faced Index (PFI) of each of the 10 problems was measured using the following formula:

$PFI = 4\times f_v + 3\times f_h + 2\times f_m + 1\times f_l + 0\times f_n$

Where,

f_v = Number of respondents faced very high problem

f_h = Number of respondents faced high problem

f_m = Number of respondents faced medium problem

f_l = Number of respondents faced low problem

f_n = Number of respondents faced no problem at all

In order to make comparison among the problems, a rank order of problems was constructed in descending order of PFI.

PFI ranged from 0 to 384, where, 0 indicated no problem at all and 384 indicated very high problem faced.

3.7.2 Measurement of Dependent Variable

Impact of Using ICT by the Farmers of Sadar Upazila under Gazipur District

The dependent variable of this study is "Impact of using ICT by the farmers of Sadar upazila under Gazipur district". The dependent variable i.e. impact of using ICT by the

farmers of Sadar upazila under Gazipur district was measured in four dimensions: a) change in yield of cereal crop (Boro rice), b) changes in yield of vegetables, c) changes in income from agriculture and d) changes in number of adopted new varieties of agricultural crops. In each case, the impact was measured in difference-in-difference method. In this study, the difference between 2012 and 2014 was measured both for study and control group respondents. Finally, the study group was compared with the control group based on difference between 2012 and 2014 data record (Mazumder and Lu, 2015).

3.7.2.1 Change in Yield of Cereal Crop (Boro rice)

In case of cereal crops majority of the respondents practiced only Boro rice as their cereal crop. Therefore, the researcher considered only Boro rice as the study area's cereal crop. The change in yield/decimal of Boro rice of the respondents was measured in difference-in-difference method. The change value was computed considering the changes in yield/decimal of Boro rice from 2012 to 2014 and then comparing with control group.

3.7.2.2 Changes in Yield of Vegetables

The changes in yield/decimal of vegetables of the respondents were measured in difference-in-difference method. Some specific vegetables like cauliflower, cucumber, brinjal, bottle gourd, tomato, amaranth and sweet gourd were considered for measuring changes in yield/decimal of vegetables where the average yield/decimal of the seven vegetables was measured. The change value was computed considering the changes in yield/decimal of vegetables from 2012 to 2014 and then comparing with control group.

3.7.2.3 Changes in Income from Agriculture

The change value was measured by measuring the changes of total income obtained from cereal crops, vegetables, fruits and timbers, livestock and fishes from 2012 and 2014 and also comparing with the control group. The total production of the agricultural items and the total production cost was obtained from the response of the respondents and then total income was measured from the total production of the respective year. A score of one was assigned for each thousand taka change.

3.7.2.4 Changes in Number of Adopted New Varieties of Agricultural Crops

The change value was computed considering the changes in number of adopted new varieties of agricultural crops from 2012 to 2014 and also comparing with the control group. The new varieties of agricultural crops- rice, vegetables and fruits released within five years of the respective year were considered as new varieties of agricultural crops for adoption in the respective year.

3.8 Data Processing

The data were coded, compiled and tabulated according to the objectives of the study after the field survey. Standard units were given to all variables converting the local variables. All responses against the questions in the interview schedule were arranged in a master sheet for tabulation, categorization and organization of the data. Proper method of scoring was followed for converting the qualitative data into quantitative form.

3.9 Statistical Analysis

The computer software SPSS (Statistical Packages for Social Science) was used for the analysis of data. Various statistical measures like number and percentage distribution, range, mean, standard deviation, coefficient of variation (CV), rank order etc. were calculated for describing selected independent and dependent variables. Multiple regression analysis was conducted to examine the contribution of the selected characteristics of the respondents to the impact of using ICT as perceived by them. In case of multiple regression analysis, change in yield of cereal crop (Boro rice), changes in yield of vegetables, changes in income from agriculture and changes in number of adopted new varieties of agricultural crops by the respondents were considered as the sub-parameters of the dependent variable. The model used for the multiple regression analysis can be expressed using following formula:

$$Y_i = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + b_{10}x_{10} + b_{11}x_{11} + e, (i=1,2,3,4)$$

Where, $Y_{i=1}$ is the change in yield of cereal crop (Boro rice)

$Y_{i=2}$ is the changes in yield of vegetables

$Y_{i=3}$ is the changes in income from agriculture

$Y_{i=4}$ is the changes in number of adopted new varieties of agricultural crops

Of the independent variables, x_1 is the respondent's age, x_2 is level of education, x_3 is family size, x_4 is effective farm size, x_5 is annual income, x_6 is training exposure, x_7 is use of ICT media in agriculture, x_8 is service taking from agricultural service centres, x_9 is farming experience, x_{10} is agricultural knowledge and x_{11} is problems faced in using ICT media in agriculture. In the model, b_1, b_2, b_3, b_4, b_5, b_6, b_7, b_8, b_9, b_{10} and b_{11} are the regression coefficients of the corresponding independent variables and e is random error, which is normally and independently distributed with zero mean and constant variance. To explore the relationship between some specific indicators of dependent variable, co-efficient of correlation was computed. Pearson's Product Moment Correlation (r) was used to explore the relationship. Five percent (0.05) level of significance was used as the basis for rejecting any null hypothesis.

3.10 Compilation of Data

After collecting data from the respondents the collected data were complied, coded, tabulated and analyzed according to the objectives of the study. Numerical coded values were given to the responses. Besides, local units were converted into standard units.

3.11 Categorization of Data

The respondents were classified into different categories according to the distribution of data in order to describe the characteristics of the farmers and the impact of using ICT by the farmers of Sadar upazila under Gazipur district.

3.12 Statement of Hypothesis

Hypothesis can be broadly divided in two categories: Research hypothesis and Null hypothesis.

3.12.1 Research Hypothesis

"Each of 11 selected characteristics (age, level of education, family size, effective farm size, annual income, training exposure, use of ICT media in agriculture, service taking from agricultural service centre, farming experience, agricultural knowledge, problems

faced in using ICT media in agriculture) of the respondents has significant contribution to the impact of using ICT as perceived by the farmers."

3.12.2 Null Hypothesis

The above research hypothesis was converted into null hypothesis in order to test the conceptual model of the research. The major hypothesis which was formulated to test the conceptual model of the study is furnished below:

"There was no contribution of the eleven selected characteristics of the respondents to the impact of using ICT as perceived by the farmers."

The eleven selected characteristics of the respondents were age, level of education, family size, effective farm size, annual income, training exposure, use of ICT media in agriculture, service taking from agricultural service centre, farming experience, agricultural knowledge and problems faced in using ICT media in agriculture.

CHAPTER IV

RESULTS AND DISCUSSION

The findings of the research have been presented in this chapter in the following four sections: a) Selected characteristics of the respondents, b) The impact of using ICT by the farmers of Sadar Upazila under Gazipur District, c) Contribution of the selected characteristics of the respondents to the impact of using ICT as perceived by the farmers and d) Relationships among the changes in selected indicators of both study and control group respondents.

4.1 Selected Characteristics of the Respondents

The findings of the eleven selected characteristics of the respondents have been discussed in eleven subsections. A brief summary of the characteristic profile of the respondents like measuring unit, categories and distribution, mean, standard deviations have been presented as follows in Table 4.1.

Table 4.1. Salient features of the respondents

Sl. No	Characteristics	Measuring unit	Range		Mean	Standard deviation
			Possible	Observed		
01	Age	Year	Unknown	30 - 85	51.92	12.88
02	Level of education	Years of schooling	Unknown	0-16	4.84	3.91
03	Family size	Score	Unknown	2 - 11	5.14	1.82
04	Effective farm size	Decimal	Unknown	23.63 – 880.25	205.26	171.63
05	Annual income (‘000’ Taka)	‘000’ Taka	Unknown	28.18-988.32	350.07	228.78
06	Training exposure	Number of days	Unknown	0-35	10.56	12.54
07	Use of ICT media in agriculture	Score	0-24	2 - 24	9.55	3.94
08	Service taking from agricultural service centre	Score	0-36	0-25	9.24	5.08
09	Farming experience	Years	Unknown	2 - 75	31.96	15.18
10	Agricultural knowledge	Score	0-22	8-22	16.14	3.43
11	Problems faced in using ICT media in agriculture	Score	0-40	6-32	18.81	5.92

4.1.1 Age

Data furnished in the Table 4.2 show that the old aged respondent group was higher than young and middle aged group. It might be due to that the most of the young and middle aged people moved towards Dhaka city as the study area is very close to the capital and were away from performing agricultural activities. Reza (2007) found similar result in respect of ICT user farmers. However, different results were observed by Rashid (2014), Ozaki *et al.* (2013) and Meera *et al*. (2004) where middle aged respondent group was higher than the young and old aged respondent groups among the ICT user farmers. Ahmed (2012) also found different result for the similar issue, where young aged respondent group was higher than the middle and old aged respondent groups respectively.

Table 4.2. Distribution of the respondents according to their age

Categories	Respondents		Mean	SD	CV (%)
	Number	Percent			
Young (up to 35)	15	15.6	51.92	12.88	24.81
Middle aged (36-50)	34	35.4			
Old (>50)	47	49.0			
Total	96	100			

Source: Reza, 2007

4.1.2 Level of Education

Data presented in the Table 4.3 show that the highest number of respondents belonged to primary education level followed by secondary education level. The lowest number of respondents belonged to the above secondary education level followed by those who had no education and those who could sign only respectively. It was observed in the study that the national education level which is 61.5% on an average (CIA, 2016) is much below than the education level of the respondents of the study area which is 90.6%. It may be due to the fact that the study area is very near to the Gazipur Sadar Upazila which is also near to Dhaka city and there are 1 high school, 2 primary schools, 1 kindergarten and 1 madrasha in the study area. So, the literacy rate is very high in the study area. Similar finding was observed by Rashid (2014) in respect of ICT user farmers. Different results were observed by Reza (2007) where the highest number of respondents were educated up to secondary level of education and Meera *et al.* (2004) where the highest number of respondents was educated up to high school level followed by those who were educated

up to middle school, had primary education and illiterate respectively for the similar issue. Ahmed (2012) also found different finding where more than half of the respondents belonged to above secondary education group followed by secondary, primary and no education respectively among the ICT user farmers.

Table 4.3. Distribution of the respondents according to their level of education

Categories	Respondents		Mean	SD	CV (%)
	Number	Percent			
Illiterate (0)	9	9.4	4.84	3.91	80.77
Can sign only (.5)	18	18.8			
Primary education (1-5)	34	35.4			
Secondary education (6-10)	30	31.3			
Above secondary education (>10)	5	5.2			
Total	96	100			

Source: Rashid, 2014

4.1.3 Purpose of Farming

Data presented in the Table 4.4 reveal that the commercial farmer group was higher in number than the subsistence farmer group. It indicates that most of the respondents in the area performed agricultural activities for commercial purpose. Perhaps the reason was that the study area is near to Dhaka city and also the study area is very near to the Sadar Upazila. So, the demand of crops especially vegetables is very high in the area and the farmers are very much aware of that which led them to perform commercial farming to get the highest economic benefit in short time duration. Again, as the study area is near to the city and thereby the literacy rate is high in the study area the farmers performed commercial farming even taking land on share-cropping. The demand of fruits is also very high in the area. So, the farmers also performed commercial farming through fruit gardens.

Table 4.4. Distribution of the respondents according to their purpose of farming

Categories	Respondents		Mean	SD	CV (%)
	Number	Percent			
Commercial farming	82	85.42	1.19	0.39	32.77
Subsistence farming	14	14.58			
Total	96	100.00			

4.1.4 Family Size

Data furnished in the Table 4.5 show that the majority of the respondents (52.08%) had medium sized family, 41.67% of the respondents had small family and only 6.25% of them had large family. The findings indicate that most of the respondents had medium or small families. The national average of the family size is 4.4 (BBS, 2011) which is almost near to the finding of the present study which is 5.02. Both the statistics show that the families are becoming smaller gradually. It may be due to the fact that the large families are being converted into small nuclear families and the government also implementing different successful family planning initiatives to make the people aware of overpopulation and thereby motivating them to keep their families small. Similar finding was observed by Ahmed (2012) in respect of ICT user farmers in his study.

Table 4.5. Distribution of the respondents according to their family size

Categories	Respondents		Mean	SD	CV (%)
	Number	Percent			
Small (up to 4)	40	41.67	5.02	1.86	37.05
Medium (5-8)	50	52.08			
Large (>8)	6	6.25			
Total	96	100			

Source: Haque, 2002

4.1.5 Effective Farm Size

Data furnished in the Table 4.6 show that most of the respondents (66.7%) had small farm size followed by medium, marginal and large farm size respectively. There were no landless farmers among the respondents. In the national level also most of the farmers (84.27%) have small farm holdings (BBS, 2013) which is similar to the finding of the present study. It may be due to land fragmentation from generation to generation and conversion of agricultural land for other purposes. Similar finding was observed by Rashid (2014) where most of the farmers had small farm among the ICT user farmers. Considering small and medium farm size category Ahmed (2012) also found similar result in respect of ICT user farmers. Again, similar result was also found by Meera *et al.* (2004) in case of Gyandoot project and Warana Wired Village project where most of the farmers were small and marginal farmers among the ICT users but in case of iKisan project different results were observed where majority of the respondents using ICT were medium land owners. Reza (2007) observed different result for the similar issue where the highest number of respondents had medium farm.

Table 4.6. Distribution of the respondents according to their effective farm size

Categories	Respondents		Mean	SD	CV (%)
	Number	Percent			
Marginal (up to 49.43 Dec)	9	9.4	205.26	171.63	83.62
Small (49.44-247.16 Dec)	64	66.7			
Medium (247.17-741.48 Dec)	21	21.9			
Large (>741.48 Dec)	2	2.1			
Total	96	100			

Source: Islam, 2007

4.1.6 Annual Income

Data furnished in the Table 4.7 shows that the respondents having low and medium annual income were higher than the respondents having high annual income. The national average of the annual income is 137.748 thousand taka (BBS, 2010) which is much below the finding of the present study which is 350.0674 thousand taka. It may be due to the fact that the study area is an industrial area adjacent to Dhaka city. So, the price of land is high in the study area. Moreover, most of the farmers were commercial farmers in the area so their annual income was high. Again, many of the respondents in the study area were service holders and businessmen and also many of them had sons or relatives in abroad who sent foreign remittance. Perhaps because of these facts the annual income of the respondents in the study area was higher than the national average.

Table 4.7. Distribution of the respondents according to their annual income ('000' Taka)

Categories (mean ± 0.5sd)	Respondents		Mean	SD	CV (%)
	Number	Percent			
Low income (up to 235.68)	36	37.5	350.07	228.78	65.35
Medium income (235.69-464.46)	36	37.5			
High income (>464.46)	24	25.0			
Total	96	100			

Similar finding was observed by Ahmed (2012) in respect of ICT user farmers. Reza (2007) found different result for the similar issue where the highest number of respondents had medium annual income.

4.1.7 Training Exposure

Data presented in the Table 4.8 reveals that the respondents having low training exposure were higher than the respondents having high and medium training exposure respectively.

Here, the standard deviation (12.54) is higher than the mean (10.56) as majority of the respondents did not get any training while a small portion of the respondents received training for long duration. It might be due to less frequent provision of agricultural training to the farmers from different agricultural organizations. Perhaps another reason was that a few influential farmers in the study area who kept good communication with different organizations got training frequently, but majority of the farmers did not get similar support due to non-influential communication.

Table 4.8. Distribution of the respondents according to their training exposure

Categories (mean ± 0.5sd)	Respondents		Mean	SD	CV (%)
	Number	Percent			
Low level of training (up to 4 days)	50	52.1	10.56	12.54	118.75
Medium level of training (5-17 days)	18	18.8			
High level of training (>17 days)	28	29.2			
Total	96	100			

4.1.8 Use of ICT Media in Agriculture

Data furnished in the Table 4.9 shows that the respondents having medium level of use of ICT media in agriculture were higher than the respondents having low and high level of use of ICT media in agriculture respectively. It indicates that most of the respondents had quite frequent access to ICT media for agricultural activities. But as ICT is a new concept in Bangladesh till now the use of more developed ICT media like Internet, laptop, tablet, smart phone is not common phenomena at all among the farmers of the country.

Table 4.9. Distribution of the respondents according to their use of ICT media in agriculture

Categories (mean ± 0.5sd)	Respondents		Mean	SD	CV (%)
	Number	Percent			
Low level of use (up to 8)	39	40.6	9.55	3.94	41.26
Medium level of use (9-12)	43	44.8			
High level of use (>12)	14	14.6			
Total	96	100			

The farmers use the mobile phones only for information transmission by making and receiving calls only. They do not know the multifarious use of the mobile phones or smart phones. Perhaps because of the facts majority of the respondents had medium and low levels of use of ICT media in the study area. Similar result was observed by Kafura (2015)

in respect of ICT user farmers. Rashid (2014) and Reza (2007) found different results for the similar issue where the highest proportion of the respondents had low use of ICT media.

4.1.9 Service Taking from Agricultural Service Centre

Data furnished in the Table 4.10 shows that the respondents having low level of service taking from agricultural service centre were higher than the respondents having medium and high levels of service taking from agricultural service centre respectively. It might be due to the fact that different agricultural service centre especially those providing digital agricultural services have not gained much popularity till now. Perhaps another reason was that the farmers were not eager to take the agricultural services from agricultural service centre.

Table 4.10. Distribution of the respondents according to their service taking from agricultural service centre

Categories (mean ± 0.5sd)	Respondents		Mean	SD	CV (%)
	Number	Percent			
Low service (up to 7)	35	36.5	9.24	5.08	54.98
Medium service (8-12)	33	34.4			
High service (>12)	28	29.2			
Total	96	100			

4.1.10 Farming Experience

Data furnished in the Table 4.11 shows that the respondents having medium farming experience were higher than the respondents having high and low farming experience respectively. As the study area was near to Dhaka city most of the people of the study area were businessmen or were engaged in different professions other than agriculture. Perhaps the above reasons may be attributed for the medium farming experience of the most of the respondents. Reza (2007) observed similar result in respect of ICT user farmers.

Table 4.11. Distribution of the respondents according to their farming experience

Categories	Respondents		Mean	SD	CV (%)
	Number	Percent			
Low experience (1-16)	17	17.7	31.96	15.18	47.50
Medium experience (17-44)	58	60.4			
High experience (>44)	21	21.9			
Total	96	100			

Source: Reza, 2007

4.1.11 Agricultural Knowledge

Data furnished in the Table 4.12 show that the respondents having medium agricultural knowledge were higher than the respondents having low and high agricultural knowledge respectively. Perhaps most of the respondents had medium agricultural knowledge because of using ICT media in agriculture. Considering medium agricultural knowledge Ahmed (2012) found similar finding in respect of ICT user farmers. Different result was observed by Reza (2007) for the similar issue where the highest proportion of the respondents had high agricultural knowledge.

Table 4.12. Distribution of the respondents according to their agricultural knowledge

Categories (mean ± 0.5sd)	Respondents		Mean	SD	CV (%)
	Number	Percent			
Low knowledge (up to 14)	28	29.2	16.14	3.43	21.26
Medium knowledge (15-18)	45	46.9			
High knowledge (>18)	23	24.0			
Total	96	100			

4.1.12 Problems Faced in Using ICT Media in Agriculture

Data furnished in the Table 4.13 show that the respondents facing minimum level of problems in using ICT media in agriculture were higher than the respondents facing high and medium level of problems in using ICT media in agriculture respectively. The finding indicates that there were almost equal proportions of respondents facing minimum, high and medium levels of problems in using ICT media in agriculture respectively. But the highest percentage (38.5%) of the respondents faced minimum level of problems in using ICT media in agriculture. It might be due to the fact that there were enough infrastructural and technological facilities for use of ICT media in the study area.

Table 4.13. Distribution of the respondents according to their problems faced in using ICT media in agriculture

Categories (mean ± 0.5sd)	Respondents		Mean	SD	CV (%)
	Number	Percent			
Minimum level of problem (up to 16)	37	38.5	18.81	5.92	31.47
Medium level of problem (17-22)	29	30.2			
High level of problem (>22)	30	31.3			
Total	96	100			

However, other respondents faced high and medium levels of problems in using ICT media in agriculture because of probable lack of proper awareness, motivation and

training about the use of ICT media in agriculture.

4.1.13 Problem Faced Index in Using ICT Media in Agriculture

The observed problem faced index in using ICT media in agriculture ranged from 1-373 against the possible range of 0 to 384. The formula for determining PFI has been shown in chapter 3.

Table 4.14. Rank order of 10 selected problems faced by the respondents in using ICT media in agriculture

Problems	Extent of Problem faced					PFI	Rank Order
	Not at all (0)	Low (1)	Medium (2)	High (3)	Very High (4)		
Low speed internet facilities	0	0	3	5	88	373	1
High cost of computer, radio, television, mobile phone, internet and agricultural services of the non-government mobile phone companies.	6	5	16	14	55	299	2
Lack of formal training regarding use of ICT media	5	10	18	19	44	279	3
The ICT media are difficult to use	4	12	20	14	46	278	4
Lack of enough time to spend on ICT media	28	3	19	18	28	207	5
Lack of necessary electricity facilities for using ICT media	41	10	9	6	30	166	6
Illiteracy	71	0	0	1	24	99	7
Inadequate agricultural programmes of the radio and television.	57	7	17	4	11	97	8
Lack of awareness about the benefit of using ICT in agriculture	93	0	2	1	0	7	9
Lack of adequate digital service centers for providing ICT facilities	95	1	0	0	0	1	10

PFI = Problem Faced Index

The selected ten problems faced by the respondents which were arranged in rank order according to their descending order of problem faced index (PFI) are shown in Table 4.14.

On the basis of PFI, it was observed that 'Low speed internet facilities' ranked first followed by 'High cost of computer, radio, television, mobile phone, internet and agricultural services of the non-government mobile phone companies', 'Lack of formal training regarding use of ICT media, 'The ICT media are difficult to use', 'Lack of enough time to spend on ICT media', 'Lack of necessary electricity facilities for using ICT media', 'Illiteracy', 'Inadequate agricultural programmes of the radio and television', 'Lack of awareness about the benefit of using ICT media in agriculture' and Lack of adequate digital service centers for providing ICT facilities respectively.

4.2 Impact of Using ICT by the Farmers of Sadar Upazila under Gazipur District

It was revealed from the finding of the study that the use of ICT media by the farmers for agricultural purpose had some significant role in their agricultural development. In order to measure the impact of using ICT, the agricultural development of the respondents of study group was compared with the control group. Significant development of the respondents of the study group was observed which might be attributed to the use of ICT media.

The agricultural development was measured by the changes in yield of cereal crop (Boro rice), yield of vegetables, agricultural income and number of adopted new varieties of agricultural crops by the respondents from 2012 to 2014.

The details of the findings have been discussed in the following sections.

4.2.1 Change in Yield of Cereal Crop (Boro rice)

Table 4.15 shows that the average change in yield of the respondents who experienced positive change in yield of Boro rice was slightly higher than those of the control group but the difference was insignificant. Again, the average change in yield of the respondents experiencing negative change in yield of Boro rice was slightly higher than those of the control group and the difference was insignificant. It might have happened due to the natural disaster (hailstorm) which took place before the harvesting period of Boro rice in 2014 fiscal year.

Table 4.15. Distribution of study group and control group respondents according to their change in yield of cereal crop (Boro rice) (Kg/Dec)

Types of Changes	Study Group			Control Group			t-value
	Number of respondents	Mean	SD	Number of respondents	Mean	SD	
Positive Change	53	9.11	4.36	17	9.00	1.78	0.101^{NS}
Negative Change	39	-9.23	8.35	14	-9.49	2.46	0.115^{NS}
No change	4	-	-	1	-	-	-
Total	96	1.28	9.43	32	0.63	10.86	0.303^{NS}

NS = Non significant

Table 4.16 shows that the average yield of Boro rice was higher in 2014 than the year of 2012, but the change was non-significant in both cases (study group and control group). A hailstorm took place in 2014 fiscal year before the harvesting period of Boro rice that might have influence for non-remarkable changes where the change of yield was higher in study group than the control group respondents.

Table 4.16. Yield difference in cereal crop (Boro rice) within study group and control group in the year of 2012 and 2014 (Kg/Dec)

	Category of Yield (mean± 0.5sd)	2012		Category of Yield (mean ± 0.5sd)	2014		%Change	t-value (df = 95)
		Number (%)	Mean		Number (%)	Mean		
Study Group	Low yield (up to 16.02)	22 (23.2)	19.46	Low yield (up to 15.78)	27 (28.1)	20.74	6.58	1.154^{NS}
	Medium yield (16.03-22.90)	43 (45.3)		Medium yield (15.79-25.70)	28 (29.2)			
	High yield (>22.90)	30 (31.6)		High yield (>25.70)	41 (42.7)			
	SD	6.88		SD	9.92			
	CV (%)	35.36		CV (%)	47.81			
	Category of Yield (mean± 0.5sd)	2012		Category of Yield (mean± 0.5sd)	2014		%Change	t-value (df = 31)
		Number (%)	Mean		Number (%)	Mean		
Control Group	Low yield (up to 16.53)	9 (28.1)	19.00	Low yield (up to 15.11)	11 (34.4)	19.63	3.32	0.377^{NS}
	Medium yield (16.54-21.47)	8 (25.0)		Medium yield (15.12-24.15)	7 (21.9)			
	High yield (>21.47)	15 (46.9)		High yield (> 24.15)	14 (43.8)			
	SD	4.94		SD	9.04			
	CV (%)	26.02		CV (%)	46.04			

NS= Non significant

Therefore, it may be concluded that, ICT media might had a significant yield difference in the study group which was absent due to affect by natural disaster. A similar finding concluded by Alia *et al.* (2013) and he observed that the indirect effect of rural radio rice programs through adoption of modern varieties on rice farmers' yield was significantly positive.

4.2.2 Changes in Yield of Vegetables

Table 4.17 shows that the average change in yield of the respondents who experienced positive change in yield of vegetables was much higher than those of the control group and the difference between the study and control group was significant at 1% level of probability.

Table 4.17. Distribution of study group and control group respondents according to their changes in yield of vegetables (Kg/Dec)

Types of Changes	Study Group			Control Group			t-value
	Number of respondents	Mean	SD	Number of respondents	Mean	SD	
Positive Change	93	4.67	1.63	30	3.85	0.74	2.646**
No change	3	-	-	2	-	-	-
Total	96	4.52	1.80	32	3.61	1.19	2.669**

** Significant at .01 level

Table 4.18 shows that the average yield of vegetables in 2014 was higher than the year of 2012 and the changes were significant at 1% level of probability in both cases (study group and control group). The increases in vegetables yield were higher in study group than the control group respondents. It can be concluded that use of ICT media by the respondents in study group had a potential influence. Ozaki *et al.* (2013) observed that yield amount of the vegetables was increased smoothly at Kapasia and Ekhlaspur in Bangladesh due to participation of the farmers in the Income Generation Project for Farmers using ICT except the yield amount of 2012 Kharif-1 at Kapasia which was damaged due to huge rain which supports the finding revealed from the present study.

Table 4.18. Yield difference in vegetables within study group and control group in the year of 2012 and 2014 (Kg/Dec)

	Category of Yield (mean ±0.5sd)	2012		Category of Yield (mean± 0.5sd)	2014		%Changes	t-value (df = 95)
		Number (%)	Mean		Number (%)	Mean		
Study Group	Low yield (79.79)	3 (3.1)	87.79	Low yield (up to 83.88)	3 (3.1)	92.31	5.15	24.639**
	Medium yield (79.80-85)	93 (96.9)		Medium yield (83.89-100.73)	93 (96.9)			
	High yield (>85)	0 (0)		High yield (>100.73)	0 (0)			
	SD	15.98		SD	16.85			
	CV(%)	18.21		CV(%)	18.25			
	Category of Yield (mean± 0.5sd)	2012		Category of Yield (mean± 0.5sd)	2014		%Changes	t-value (df = 31)
		Number (%)	Mean		Number (%)	Mean		
Control Group	Low yield (up to 73.95)	2 (6.3)	85.21	Low yield (up to 77.29)	2 (6.3)	88.82	4.24	17.212**
	Medium yield (73.96-96.46)	30 (93.8)		Medium yield (77.30-100.54)	30 (93.8)			
	High yield (>96.46)	0 (0)		High yield (>100.54)	0 (0)			
	SD	22.51		SD	23.44			
	CV(%)	26.42		CV(%)	26.39			

** Significant at .01 level

4.2.3 Changes in Income from Agriculture

Table 4.19 shows that the average income from agriculture of the respondents in 2014 was higher than the year of 2012 and the changes were significant at 1% level of significance in both cases (study group and control group). The table also reveals that the increases in agricultural income were higher in study group than the control group respondents which might be due to the use of ICT media by the study group respondents. However, the increase in agricultural income might be even much higher than the present finding revealed from the study if there were reasonable market price of rice and no natural disaster resulting in heavy loss in Boro rice production.

Table 4.19. Difference in income from agriculture within study group and control group in the year of 2012 and 2014 ('000' taka)

	Category (mean± 0.5 sd)	2012		Category (mean± 0.5 sd)	2014		%Changes	t-value (df = 95)
		Number (%)	Mean		Number (%)	Mean		
Study Group	Low (up to 138.72)	31 (32.3)	238.75	Low (up to 167.55)	35 (36.5)	270.15	13.15	25.787**
	Medium (138.73-338.78)	44 (45.8)		Medium (167.56-372.75)	41 (42.7)			
	High (>338.78)	21 (21.9)		High (>372.75)	20 (20.8)			
	SD	200.06		SD	205.20			
	CV(%)	83.79		CV(%)	75.96			
	Category (mean± 0.5 sd)	2012		Category (mean± 0.5 sd)	2014		%Changes	t-value (df = 31)
		Number (%)	Mean		Number (%)	Mean		
Control Group	Low (up to 150.00)	11 (34.4)	238.72	Low (up to 176.22)	11 (34.4)	264.10	10.63	18.653**
	Medium (150.01-327.44)	13 (40.6)		Medium (176.23-351.97)	13 (40.6)			
	High (>327.44)	8 (25.0)		High (>351.98)	8 (25.0)			
	SD	177.43		SD	175.76			
	CV(%)	74.33		CV(%)	66.55			

** Significant at .01 level

It was observed by Okello (2010) that much higher margin (i.e. 86%) was earned by the farmers after joining the ICT-based market information service project DrumNet project. That means they received higher incomes from the sale of their crops due to participation in DrumNet project. Moreover, it was also found that much higher and stable price was earned by the farmers after joining the DrumNet project than before. In another research, it was noted by Raj *et al.* (2011) that a mobile phone service providing information on the correct use of nutrients in the Nagapattinam district of India led to 15% higher income of the intervention farmers than the control group through reduction of cost due to the application of appropriate (i.e. lower) amounts of seeds and nutrients. The above mentioned literatures strongly support the finding of the present study.

4.2.4 Changes in Number of Adopted New Varieties of Agricultural Crops

Table 4.20 shows that the average change of the respondents who experienced positive change in number of adopted new varieties of agricultural crops was much higher than those of the control group and the difference between the study and control group was significant at 1% level of probability.

Table 4.20. Distribution of study group and control group respondents according to their changes in number of adopted new varieties of agricultural crops

Types of Changes	Study Group			Control Group			t-value
	Number of respondents	Mean	SD	Number of respondents	Mean	SD	
Positive Change	86	2.69	.87	28	1.18	.39	8.851**
No change	10	-	-	4	-	-	-
Total	96	2.41	1.17	32	1.03	.54	6.434**

** Significant at .01 level

Table 4.21 shows that the average number of adopted new varieties of agricultural crops by the respondents in 2014 was higher than the year of 2012 and the changes were significant at 1% level of probability in both cases (study group and control group). The increases in number of adopted new varieties were higher in study group than the control group respondents. It can be concluded that use of ICT media by the study group respondents might have influenced the remarkable changes of study group respondents. A similar finding concluded by Alia *et al.* (2013) and he observed that the adoption of modern varieties of rice was significantly higher by the farmers who had listened radio programmes of rice before 2008 than those who had not. Again, in another research it was revealed that the farmers in rural Nigeria were able to get a new variety of maize through interactions with scientists made possible by the internet (Adekunle and Alluri, 2006). The above literatures vividly corroborate the finding of the present study.

Table 4.21. Difference in number of adopted new varieties of agricultural crops within study group and control group in the year of 2012 and 2014

	Category (mean±0.5 sd)	2012		Category (mean± 0.5 sd)	2014		%Changes	t-value (df = 95)
		Number (%)	Mean		Number (%)	Mean		
Study Group	Low (up to 1)	48 (50)	1.32	Low (up to 3)	39 (40.6)	3.73	182.58	20.220**
	Medium (2-3)	48 (50)		Medium (4-5)	46 (47.9)			
	High (>3)	0 (0)		High (>5)	11 (11.5)			
	SD	1.02		SD	1.71			
	CV(%)	77.35		CV(%)	45.76			
	Category (mean±0.5 sd)	2012		Category (mean± 0.5 sd)	2014		%Changes	t-value (df = 31)
		Number (%)	Mean		Number (%)	Mean		
Control Group	Low (up to 1)	13 (40.6)	1.31	Low (up to 2)	14 (43.8)	2.34	78.63	10.846**
	Medium (2-3)	19 (59.4)		Medium (3-4)	18 (56.3)			
	High (>3)	0 (0)		High (>4)	0 (0)			
	SD	.90		SD	1.15			
	CV(%)	68.40		CV(%)	49.27			

** Significant at .01 level

4.2.5 Summary of Impact of Using ICT

Table 4.22 shows that there were significant positive differences in each of the component of the total changes within the study and control groups except in case of yield of cereal crop (Boro rice) as a natural disaster (hailstorm) took place before the harvesting period of Boro rice during the 2014 fiscal year which might have an influence on the non-remarkable change within study and control groups based on change in yield of cereal crop (Boro rice). The differences within the study and control groups in case of other three components were highly significant at 1% level of probability. The differences might be even much higher than the present condition if there were reasonable market price of rice and no natural disaster occurring excessive loss in Boro rice production.

Table 4.22. Component based total changes within study group and control group

Sl No.	Components	Study Group	Control Group	%Changes	t-value (df = 126)
1	Difference in yield of cereal crop (Boro rice)	1.28	0.63	103.17	0.303^{NS}
2	Differences in yield of vegetables	4.52	3.61	25.21	2.669**
3	Differences in income from agriculture	31.40	25.38	23.72	2.673**
4	Differences in number of adopted new varieties of agricultural crops	2.41	1.03	133.98	6.434**

** Significant at .01 level
NS= Non Significant

4.3 Contribution of Selected Characteristics of the Respondents to the Impact of Using ICT as Perceived by the Farmers

Table 4.23 tests the hypothesis that there is no significant relationship between some factors and the impact of using ICT as perceived by the farmers. In order to assess the factors contributing to the level of contribution in improving the agricultural conditions of the respondents, multiple regression analysis was conducted.

4.3.1 Contribution of Selected Characteristics of the Respondents to the Change in Yield of Cereal Crop (Boro Rice)

Table 4.23 shows that there is a significant contribution of respondents age, level of education, use of ICT media in agriculture, agricultural knowledge and problems faced in using ICT media in agriculture to changing the yield of cereal crop (Boro rice) of the respondents. Of these, age was the most important contributing factor (significant at the 1% level of significance) and the respondents level of education, use of ICT media in agriculture, agricultural knowledge and problems faced in using ICT media in agriculture were the second most important contributing factors (significant at the 5% level of significance). Few independent variables such as age, use of ICT media in agriculture and agricultural knowledge are related to increase knowledge regarding Boro rice production and adoption of improved practices in the cultivation of Boro rice might have an influence on the change in yield of Boro rice.

Table 4.23. Multiple regression coefficients of contributing factors related to impact of using ICT by the farmers by changing their yield of cereal crop (Boro rice), yield of vegetables, income from agriculture and number of adopted new varieties of agricultural crops

Dependent variable	Independent variables	B	p	R^2	Adjusted R^2	F	p
Change in yield of cereal crop (Boro rice)	Age (years)	0.423	0.003**	0.398	0.319	5.053	0.000**
	Level of education (years of schooling)	-0.230	0.035*				
	Family size	-0.063	0.508				
	Effective farm size (decimal)	0.006	0.950				
	Annual income ('000' Taka)	-0.098	0.432				
	Training exposure (days)	-0.080	0.433				
	Use of ICT media in agriculture (score)	0.311	0.031*				
	Service taking from agricultural service centre (score)	0.166	0.288				
	Farming experience (years)	-0.224	0.113				
	Agricultural knowledge (score)	0.221	0.032*				
	Problems faced in using ICT media in agriculture (score)	-0.254	0.028*				
Changes in yield of vegetables	Age (years)	0.281	0.020*	0.560	0.502	9.714	0.000**
	Level of education (years of schooling)	0.183	0.049*				
	Family size	-0.029	0.718				
	Effective farm size (decimal)	0.105	0.241				
	Annual income ('000' Taka)	0.020	0.853				
	Training exposure (days)	0.019	0.822				
	Use of ICT media in agriculture (score)	0.330	0.008**				
	Service taking from agricultural service centre (score)	0.060	0.652				
	Farming experience (years)	0.186	0.125				
	Agricultural knowledge (score)	0.177	0.044*				
	Problems faced in using ICT media in agriculture (score)	0.000	0.998				

Dependent variable	Independent variables	B	p	R^2	Adjusted R^2	F	p
Changes in income from agriculture	Age (years)	-0.003	0.980	0.531	0.469	8.629	0.000**
	Level of education (years of schooling)	-0.012	0.900				
	Family size	0.014	0.871				
	Effective farm size (decimal)	0.384	.000**				
	Annual income ('000' Taka)	-0.005	0.964				
	Training exposure (days)	-0.087	0.332				
	Use of ICT media in agriculture (score)	0.408	0.002**				
	Service taking from agricultural service centre (score)	-0.060	0.664				
	Farming experience (years)	0.269	0.032*				
	Agricultural Knowledge (score)	0.179	0.049*				
	Problems faced in using ICT media in agriculture (score)	-0.012	0.906				
Changes in number of adopted new varieties of agricultural crops	Age (years)	-0.222	0.042*	0.638	0.591	13.47	0.000**
	Level of education (years of schooling)	0.064	0.446				
	Family size	0.063	0.392				
	Effective farm size (Decimal)	0.210	0.011*				
	Annual income ('000' Taka)	-0.006	0.948				
	Training exposure (days)	0.066	0.406				
	Use of ICT media in agriculture (score)	0.777	0.000**				
	Service taking from agricultural service centre (score)	-0.182	0.133				
	Farming experience (years)	0.237	0.032*				
	Agricultural knowledge (score)	-0.045	0.570				
	Problems faced in using ICT media in agriculture (score)	-0.120	0.176				

* Significant at 0.05 level
** Significant at 0.01 level

Level of education had a negative impact on the change in yield of Boro rice of the respondents which indicates that the more educated the respondents the less they were

inclined to the cultivation of Boro rice as cultivation of Boro rice is a losing concern because of high investment in production and no profit or even sometimes loss from Boro rice cultivation. Problem faced in using ICT media in agriculture also had a negative impact on the change in yield of Boro rice of the respondents which indicates that the respondents who faced the problems in using ICT media for agricultural activities might not feel free to utilize the ICT media to a great extent and thus they were reserved from adoption of improved practices in the cultivation of Boro rice.

4.3.2 Contribution of Selected Characteristics of the Respondents to the Changes in Yield of Vegetables

Table 4.2 shows that except the problems faced in using ICT media in agriculture all the previously mentioned predictor variables also had significant contributions to the changes in yield of vegetables of the respondents, but the level of significance of the contributions differed from one model to another. In this model, the most important contributing factor was the use of ICT media in agriculture which profoundly influenced the changes in yield of vegetables of the respondents. The second most important contributing factors were the age, level of education and agricultural knowledge of the respondents. The predictor variables such as age, level of education, use of ICT media in agriculture and agricultural knowledge might have influenced the respondents' greater knowledge regarding vegetable cultivation and adoption of improved practices in vegetable cultivation.

4.3.3 Contribution of Selected Characteristics of the Respondents to the Changes in Income from Agriculture

Table 4.23 also reveals that the effective farm size, use of ICT media in agriculture, farming experience and agricultural knowledge of the respondents significantly contributed to the changes in the respondents' income from agriculture. Of the predictor variables, farm size and use of ICT media in agriculture were the most important contributing factors and had a great influence on the changes in agricultural income of the respondents. The farming experience and agricultural knowledge of the respondents were the second most important contributing factors. The effective farm size of the respondents is concerned with the economic strength of the respondents which might have influenced the changes in agricultural income of the respondents. Use of ICT media in agriculture, farming experience and agricultural knowledge might have influenced greater knowledge and experience in agriculture of the respondents and thus greater agricultural income.

4.3.4 Contribution of Selected Characteristics of the Respondents to the Changes in Number of Adopted New Varieties of Agricultural Crops

Table 4.23 also indicates that age, effective farm size, use of ICT media in agriculture and farming experience of the respondents had significantly contributed to the changes in number of adopted new varieties of agricultural crops by the respondents. In this model, effective farm size and use of ICT media in agriculture were the most important contributing factors and greatly influenced the changes in number of adopted new varieties of agriculture crops by the respondents. Respondents' age and farming experience were the second most important contributing factors. Respondents' effective farm size is associated with the economic power of the respondents and hence, might have influenced the changes in number of adopted new varieties by the respondents. Other predictor variables such as use of ICT media in agriculture and farming experience of the respondents might have increased the knowledge and experience of the respondents and thus influenced them to become innovative and adopt new varieties. Age had a negative contribution to the changes in number of adopted new varieties of agricultural crops by the respondents which implies that the younger the respondents were the more they were innovative and were more likely to adopt new varieties of agricultural crops.

About 39.8% (R^2=.398) of the variation in the change in yield of cereal crop (Boro rice) of the respondents can be attributed to their age, level of education, family size, effective farm size, annual income, training exposure, use of ICT media in agriculture, service taking from agricultural service centre, farming experience, agricultural knowledge, and problems faced in using ICT media in agriculture. The F value indicates that the model is significant (p=0.000). About 56% of the variation of the changes in yield of vegetables of the respondents was accounted for by the joint predictive power of age, level of education, family size, effective farm size, annual income, training exposure, use of ICT media in agriculture, service taking from agricultural service centre, farming experience, agricultural knowledge, and problems faced in use of ICT media in agriculture (R^2=0.56). The F value is significant (p=0.000). About 53.1% (R^2=.531) of the variance of the changes in agricultural income was attributed to the age, level of education, family size, effective farm size, annual income, training exposure, use of ICT media in agriculture, service taking from agricultural service centre, farming experience, agricultural knowledge and problems faced in using ICT media in agriculture of the respondents. The F value shows that the model is significant (p=0.000). About 63.8% of the variation of the

respondents' changes in number of adopted new varieties of agricultural crops was attributed to their age, level of education, family size, effective farm size, annual income, training exposure, use of ICT media in agriculture, service taking from agricultural service centre, farming experience, agricultural knowledge, and problems faced in using ICT media in agriculture (R^2=.638) with a significant F value (p=0.000). Each predictor variable may contribute some of the variations in the agricultural condition of the respondents simply by chance.

Adjusted R-square value penalizes the addition of extraneous predictors in the model, and the values of 0.319, 0.502, 0.469 and 0.591 still shows that the variance in the yield of cereal crop (Boro rice), yield of vegetables, income from agriculture and number of adopted new varieties of the respondents can be attributed to the predictor variables rather than by chance, and all the four models are suitable models.

In summary, the modeling proposes that the government should consider the farmers' age, level of education, effective farm size, use of ICT media in agriculture, farming experience, agricultural knowledge, and problems faced in using ICT media in agriculture during providing ICT services in agriculture for the farmers. To develop the agriculture through the use of ICT the government should reconsider the problems faced by the farmers in using ICT media for agricultural purposes and find and implement the solutions to these problems. The government should also reconsider the pattern of Boro rice cultivation where the farmers have to invest more but do not get profit and even loss in Boro rice production. The research institutes should develop the replacement of Boro rice so that the farmers can cultivate rice without much irrigation which contributes a great part of investment in Boro rice production. The government should also fix profitable price of rice for the farmers so that they can get profit from rice production and thus continue the cultivation of rice in the country. The government should provide educational facilities to the farmers of villages so that they can get more agricultural knowledge for the development of agriculture. The government should make more arrangements for the use of ICT in agriculture so that the farmers can spontaneously avail of the digital facilities without any hindrances and increase their knowledge and improved practices in agriculture. The government should arrange more agricultural training through different agricultural organizations like Department of Agricultural Extension (DAE) and research institutes on different agricultural aspects so that all farmers equally

get the facilities and apply their knowledge in agricultural development. Proper steps should also be taken by the government to convert the fallow land into land under cultivation for increasing agricultural land.

4.4 Relationships among the Changes in Selected Indicators of both Study and Control Group Respondents

4.4.1 Relationship between Change in Yield of Cereal Crop (Boro Rice) and Changes in Yield of Vegetables of Study Group Respondents

To determine the relationship between the change in yield of cereal crop (Boro rice) and changes in yield of vegetables of study group respondents the following null hypothesis was tested:

"There is no relationship between the change in yield of cereal crop (Boro rice) and changes in yield of vegetables of the study group respondents".

The computed correlation coefficient (r) between the two indicators of dependent variable in study group gives direction to the following observations:

Firstly, the relationship showed a positive trend and secondly, the value of r (0.450) was significant at 1 percent level of probability with 95 *d.f.*

Based on the above observations, the null hypothesis was rejected and hence the researcher drew conclusion that the change in yield of cereal crop (Boro rice) had significant relationship with the changes in yield of vegetables of the respondents in the study group. This means that the more the changes in yield of Boro rice of the respondents in study group the more was the changes in yield of their vegetables.

4.4.2 Relationship between Change in Yield of Cereal Crop (Boro Rice) and Changes in Income from Agriculture of Study Group Respondents

To determine the relationship between the change in yield of cereal crop (Boro rice) and changes in agricultural income of the respondents in the study group the following null hypothesis was tested:

Table 4.24. Coefficient of correlation of the changes in selected indicators of both study and control group respondents

Within study group	Change in yield of cereal crop (Boro rice)	Changes in yield of vegetables	Changes in income from agriculture ('000 taka)	Changes in number of adopted new varieties of agricultural crops
Change in yield of cereal crop (Boro rice)	-			
Changes in yield of vegetables	0.450** (p= 0.000)	-		
Changes in income from agriculture ('000 taka)	0.314** (p= 0.002)	0.603** (p= 0.000)	-	
Changes in number of adopted new varieties of agricultural crops	0.420** (p= 0.000)	0.579** (p= 0.000)	0.580** (p= 0.000)	-
Within control group	Change in yield of cereal crop (Boro rice)	Changes in yield of vegetables	Changes in income from agriculture	Changes in number of adopted new varieties of agricultural crops
Change in yield of cereal crop (Boro rice)	-			
Changes in yield of vegetables	-0.208^{NS} (p= 0.252)	-		
Changes in income from agriculture ('000 taka)	-0.079^{NS} (p= 0.667)	0.324^{NS} (p= 0.070)	-	
Changes in number of adopted new varieties of agricultural crops	-0.032^{NS} (p= 0.863)	-0.219^{NS} (p= 0.229)	-0.245^{NS} (p= 0.177)	-

** Significant at 0.01 level
NS= Non significant

"There is no relationship between the changes in yield of cereal crop (Boro rice) and changes in agricultural income of the respondents in the study group".

The computed correlation coefficient (r) between the two components of dependent variable gives direction to the following observations:

Firstly, the relationship showed a positive trend and secondly, the value of r (0.314) was significant at 1 percent level of probability with 95 *d.f.*

On the basis of the above observations, the null hypothesis was rejected and hence the researcher drew conclusion that the change in yield of cereal crop (Boro rice) had significant relationship with the changes in income from agriculture of the respondents in study group. This implies that the more the change in yield of Boro rice of the respondents in the study group the more was the changes in their income from agriculture.

4.4.3 Relationship between Change in Yield of Cereal Crop (Boro Rice) and Changes in Number of Adopted New Varieties of Agricultural Crops by the Respondents in Study Group

To find out the relationship between the change in yield of cereal crop (Boro rice) and the changes in number of adopted new varieties by the respondents in the study group the following null hypothesis was tested:

"There is no relationship between the change in yield of cereal crop (Boro rice) and changes in number of adopted new varieties by the respondents in the study group".

The computed correlation coefficient (r) between the two components of dependent variable leads to the following observations:

Firstly, the relationship showed a positive trend and secondly, the value of r (0.420) was significant at 1 percent level of probability with 95 *d.f.*

On the basis of the above observations, the null hypothesis was rejected and hence the researcher drew conclusion that the change in yield of cereal crop (Boro rice) had significant relationship with the changes in number of adopted new varieties of agricultural crops by the respondents in the study group. This implies that the more the changes in yield of Boro rice of the respondents in the study group the more was the changes in the number of adopted new varieties by them.

4.4.4 Relationship between Changes in Yield of Vegetables and Changes in Income from Agriculture of Study Group Respondents

To find out the relationship between the changes in yield of vegetables and the changes in agricultural income of the respondents in the study group the following null hypothesis was tested:

"There is no relationship between the changes in yield of vegetables and changes in agricultural income of the respondents in the study group".

The computed correlation coefficient (r) between the two components of dependent variable gives direction to the following observations:

Firstly, the relationship showed a positive trend and secondly, the value of r (0.603) was significant at 1 percent level of probability with 95 *d.f.*

Based on the above observations, the null hypothesis was rejected and hence the researcher drew conclusion that the changes in yield of vegetables had significant relationship with the changes in income from agriculture of the respondents in study group. This indicates that the more the changes in yield of vegetables of the respondents in study group the more was the changes in their income from agriculture.

4.4.5 Relationship between Changes in Yield of Vegetables and Changes in Number of Adopted New Varieties of Agricultural Crops by the Respondents in Study Group

To find out the relationship between the changes in yield of vegetables and the changes in number of adopted new varieties of agricultural crops by the respondents in the study group the following null hypothesis was tested:

"There is no relationship between the changes in yield of vegetables and changes in number of adopted new varieties of agricultural crops by the respondents in the study group".

The computed correlation coefficient (r) between the two components of dependent variable gives direction to the following observations:

Firstly, the relationship showed a positive trend and secondly, the value of r (0.579) was significant at 1 percent level of probability with 95 *d.f.*

Based on the above observations, the null hypothesis was rejected and hence the researcher drew conclusion that the changes in yield of vegetables had significant

relationship with the changes in number of adopted new varieties of agricultural crops by the respondents in the study group. This indicates that the more the changes in yield of vegetables of the respondents in the study group the more was the changes in the number of adopted new varieties by them.

4.4.6 Relationship between Changes in the Respondents' Income from Agriculture and Changes in Number of Adopted New Varieties of Agricultural Crops by the Respondents in Study Group

To find out the relationship between the changes in the respondents' agricultural income and the changes in number of adopted new varieties of agricultural crops by the respondents in the study group the following null hypothesis was tested:

"There is no relationship between the changes in the respondents' income from agriculture and changes in number of adopted new varieties of agricultural crops by the respondents in the study group".

The computed correlation coefficient (r) between the two components of dependent variable gives direction to the following observations:

Firstly, the relationship showed a positive trend and secondly, the value of r (0.580) was significant at 1 percent level of probability with 95 *d.f.*

Based on the above observations, the null hypothesis was rejected and hence the researcher drew conclusion that the changes in the respondents' agricultural income had significant relationship with the changes in number of adopted new varieties of agricultural crops by the respondents in the study group. This indicates that the more the changes in agricultural income of the respondents in the study group the more was the changes in the number of adopted new varieties by them.

4.4.7 Relationship between Change in Yield of Cereal Crop (Boro Rice) and Changes in Yield of Vegetables of Control Group Respondents

To determine the relationship between the change in yield of cereal crop (Boro rice) and changes in yield of vegetables of the control group respondents the following null hypothesis was tested:

"There is no relationship between the change in yield of cereal crop (Boro rice) and changes in yield of vegetables of the control group respondents".

The computed correlation coefficient (r) between the two indicators of dependent variable gives direction to the following observations:

Firstly, the relationship showed a negative trend and secondly, the value of r (-0.208) was not significant at 5 percent level of probability with 31 *d.f.*

Based on the above observations, the null hypothesis was accepted and hence the researcher drew conclusion that the change in yield of cereal crop (Boro rice) had a negative insignificant relationship with the changes in yield of vegetables of the respondents in the control group.

4.4.8 Relationship between Change in Yield of Cereal Crop (Boro Rice) and Changes in Income from Agriculture of Control Group Respondents

To determine the relationship between the change in yield of cereal crop (Boro rice) and changes in agricultural income of the respondents in the control group the following null hypothesis was tested:

"There is no relationship between the change in yield of cereal crop (Boro rice) and changes in agricultural income of the respondents in the control group".

The computed correlation coefficient (r) between the two components of dependent variable gives direction to the following observations:

Firstly, the relationship showed a negative trend and secondly, the value of r (-0.079) was insignificant at 5 percent level of probability with 31 *d.f.*

On the basis of the above observations, the null hypothesis was accepted and hence the researcher drew conclusion that the change in yield of cereal crop (Boro rice) had no significant relationship with the changes in income from agriculture of the respondents in control group and the trend of relationship between these changes was negative.

4.4.9 Relationship between Change in Yield of Cereal Crop (Boro Rice) and Changes in Number of Adopted New Varieties of Agricultural Crops by the Respondents in Control Group

To find out the relationship between the change in yield of cereal crop (Boro rice) and the changes in number of adopted new varieties of agricultural crops by the respondents in the control group the following null hypothesis was tested:

"There is no relationship between the change in yield of cereal crop (Boro rice) and changes in number of adopted new varieties of agricultural crops by the respondents in the control group".

The computed correlation coefficient (r) between the two components of dependent variable leads to the following observations:

Firstly, the relationship showed a negative trend and secondly, the value of r (-0.032) was not significant even at 5 percent level of probability with 31 *d.f.*

On the basis of the above observations, the null hypothesis was accepted and hence the researcher drew conclusion that the change in yield of cereal crop (Boro rice) had no significant relationship with the changes in number of adopted new varieties of agricultural crops by the respondents in the control group and the trend of relationship between these changes was negative.

4.4.10 Relationship between Changes in Yield of Vegetables and Changes in Income from Agriculture of the Control Group Respondents

To find out the relationship between the changes in yield of vegetables and the changes in agricultural income of the respondents in the control group the following null hypothesis was tested:

"There is no relationship between the changes in yield of vegetables and changes in agricultural income of the respondents in the control group".

The computed correlation coefficient (r) between the two components of dependent variable gives direction to the following observations:

Firstly, the relationship showed a positive trend and secondly, the value of r (0.324) was not significant even at 5 percent level of probability with 31 *d.f.*

Based on the above observations, the null hypothesis was accepted and hence the researcher drew conclusion that the changes in yield of vegetables had a positive but insignificant relationship with the changes in income from agriculture of the respondents in control group. This implies that with the changes in yield of vegetables of the respondents in control group the changes in their agricultural income were not significantly increased.

4.4.11 Relationship between Changes in Yield of Vegetables and Changes in Number of Adopted New Varieties of Agricultural Crops by the Respondents in Control Group

To find out the relationship between the changes in yield of vegetables and the changes in number of adopted new varieties of agricultural crops by the respondents in the control group the following null hypothesis was tested:

"There is no relationship between the changes in yield of vegetables and changes in number of adopted new varieties of agricultural crops by the respondents in the control group".

The computed correlation coefficient (r) between the two components of dependent variable gives direction to the following observations:

Firstly, the relationship showed a negative trend and secondly, the value of r (-0.219) was not significant even at 5 percent level of probability with 31 *d.f.*

Based on the above observations, the null hypothesis was accepted and hence the researcher drew conclusion that the changes in yield of vegetables had no significant relationship with the changes in number of adopted new varieties of agricultural crops by the respondents in the control group and the trend of relationship was negative.

4.4.12 Relationship between Changes in the Respondents' Income from Agriculture and Changes in Number of Adopted New Varieties of Agricultural Crops by the Respondents in Control Group

To find out the relationship between the changes in the respondents' agricultural income and the changes in number of adopted new varieties of agricultural crops by the respondents in the control group the following null hypothesis was tested:

"There is no relationship between the changes in the respondents' income from agriculture and changes in number of adopted new varieties of agricultural crops by the respondents in the control group".

The computed correlation coefficient (r) between the two components of dependent variable gives direction to the following observations:
Firstly, the relationship showed a negative trend and secondly, the value of r (-0.245) was not significant even at 5 percent level of probability with 31 *d.f.*

Based on the above observations, the null hypothesis was accepted and hence the researcher drew conclusion that the changes in the respondents' agricultural income had no significant relationship with the changes in number of adopted new varieties of agricultural crops by the respondents in the control group and the relationship had a negative trend.

CHAPTER V

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of Findings

5.1.1 Individual Characteristics of the Respondents

Age: The old aged respondent group was higher (49.0%) than the young (15.6%) and middle aged group (35.4%).

Level of education: The highest proportion (35.4%) of the respondents was in primary education level followed by secondary education level (31.3%). The lowest proportion (5.2%) of the respondents belonged to the above secondary education level followed by those who could sign only (18.8%) and those who had no education (9.4%) respectively.

Purpose of farming: The majority (85.42%) of the respondents was commercial farmers and a small portion (14.58%) of the respondents was subsistence farmers.

Family size: The majority (52.08%) of the respondents had medium sized family compared to the respondents having small (41.67%) and large (6.25%) family respectively.

Effective farm size: Most of the respondents (66.7%) had small effective farm size followed by medium (21.9%), marginal (9.4%) and large (2.1%) effective farm size respectively.

Annual income: The respondents having low (37.5%) and medium annual income (37.5%) were higher than the respondents having high annual income (25.0%).

Training exposure: The majority (52.1%) of the respondents had low training exposure while 29.2 percent of the respondents had high training exposure and 18.8 percent of the respondents had medium training exposure respectively.

Use of ICT media in agriculture: The majority (44.8%) of the respondents had medium level of use of ICT media in agriculture while 40.6% of the respondents had low level of use of ICT media in agriculture and 14.6% of the respondents had high level of use of ICT media in agriculture respectively.

Service taking from agricultural service centre: The majority (36.5%) of the respondents had low level of service taking from agricultural service centre while 34.4% of the respondents had medium and 29.2% of the respondents had high level of service taking from agricultural service centre respectively.

Farming experience: The majority of the respondents (60.4%) had medium farming experience while 21.9% of the respondents had high farming experience and 17.7% of the respondents had low farming experience respectively.

Agricultural knowledge: The majority (46.9%) of the respondents had medium agricultural knowledge while 29.2% of the respondents had low and 24.0% of the respondents had high agricultural knowledge respectively.

Problems faced in using ICT media in agriculture: The highest percentage of the respondents (38.5%) faced minimum level of problems in using ICT media in agriculture while 31.3% of the respondents faced high level of problems and 30.2% of the respondents faced medium level of problems in using ICT media in agriculture respectively.

Problem Faced Index in using ICT media in agriculture: On the basis of PFI, it was observed that 'Low speed internet facilities' ranked first followed by 'High cost of the computer, radio, television, mobile phone, internet and agricultural services of the non-government mobile phone companies', 'Lack of formal training regarding use of ICT media, 'The ICT media are difficult to use', 'Lack of enough time to spend on ICT media', 'Lack of necessary electricity facilities for using ICT media', 'Illiteracy', 'Inadequate agricultural programmes of the radio and television', 'Lack of awareness about the benefit of using ICT in agriculture' and 'Lack of adequate digital service centers for providing ICT facilities' respectively.

5.1.2 Impact of Using ICT by the Farmers of Sadar Upazila under Gazipur District

Change in yield of cereal crop (Boro rice): The average yield of Boro rice was higher in 2014 than the year of 2012, but the change was insignificant in case of both study and control groups. A hailstorm took place in 2014 fiscal year before the harvesting period of Boro rice that might have influence for non-remarkable changes where the change of yield was higher in study group than the control group respondents.

Changes in yield of vegetables: The average yield of vegetables in 2014 was significantly higher than the year of 2012 in case of both study and control groups. The increases in yield were higher in study group than the control group respondents and it might have happened because of the use of ICT media by the study group respondents.

Changes in income from agriculture: The average income from agriculture of the respondents in 2014 was significantly higher than the year of 2012 in case of both study and control groups. The increases in agricultural income were higher in study group than the control group respondents which might be due to the use of ICT media by the study group respondents.

Changes in number of adopted new varieties of agricultural crops: The average number of adopted new varieties of agricultural crops by the respondents in 2014 was significantly higher than the year of 2012 in case of both study and control groups. The increases in number of adopted new varieties of agricultural crops were higher in study group than the control group respondents which might have resulted due to the use of ICT by the study group respondents.

Summary of impact of using ICT: There were significant positive differences in each of the component of the total changes within the study and control groups except in case of yield of cereal crop (Boro rice) as a natural disaster (hailstorm) took place before the harvesting period of Boro rice during the 2014 fiscal year which might have an influence on the non-remarkable change within study and control groups based on change in yield of cereal crop (Boro rice). The differences might be even much higher than the present condition if there were reasonable market price of rice and no natural disaster occurring excessive loss in Boro rice production.

5.1.3 Contribution of the Selected Characteristics of the Respondents to the Impact of Using ICT as Perceived by the Farmers

1. There were significant contribution of the respondents' age, level of education, use of ICT media in agriculture, agricultural knowledge and problems faced in using ICT media in agriculture to changing the yield of Boro rice of the respondents.

2. There were significant contribution of the age, level of education, use of ICT media in agriculture and agricultural knowledge of the respondents to changing the yield of vegetables of the respondents.
3. The effective farm size, use of ICT media in agriculture, farming experience and agricultural knowledge of the respondents significantly contributed to the changes in the respondents' income from agriculture.
4. The age, effective farm size, use of ICT media in agriculture and farming experience of the respondents had significant contribution to the changes in number of adopted new varieties of agricultural crops by the respondents.

About 39.8% (R^2=0.398), 56% (R^2=0.56), 53.1% (R^2=0.531) and 63.8% (R^2=0.638) of the variation in the change in yield of cereal crop (Boro rice), changes in yield of vegetables, changes in agricultural income and changes in number of adopted new varieties of agricultural crops by the respondents respectively were attributed to the age, level of education, family size, effective farm size, annual income, training exposure, use of ICT media in agriculture, service taking from agricultural service centre, farming experience, agricultural knowledge and problems faced in using ICT media in agriculture of the respondents.

5.1.4 Relationships among the Changes in Selected Indicators of both Study and Control Group Respondents

1. There was a highly significant positive relationship between the change in yield of cereal crop (Boro rice) and the changes in yield of vegetables of the respondents in the study group.
2. There was a highly significant positive relationship between the change in yield of cereal crop (Boro rice) and the changes in their income from agriculture of the respondents in the study group.
3. There was a highly significant positive relationship between the change in yield of cereal crop (Boro rice) and changes in number of adopted new varieties of agricultural crops by the respondents in the study group.
4. There was a highly significant positive relationship between the changes in yield of vegetables and the changes in agricultural income of the respondents in the study group.

5. There was a highly significant positive relationship between the changes in yield of vegetables and the changes in number of adopted new varieties of agricultural crops by the respondents in the study group.
6. There was a highly significant positive relationship between the changes in the respondents' agricultural income and the changes in number of adopted new varieties of agricultural crops by the respondents in the study group.
7. Change in yield of cereal crop (Boro rice) had a negative and insignificant relationship with the changes in yield of vegetables of the respondents in the control group.
8. Change in yield of cereal crop (Boro rice) had no significant relationship with the changes in income from agriculture of the respondents in control group and the trend of relationship between the changes was negative.
9. The change in yield of cereal crop (Boro rice) had negative insignificant relationship with the changes in number of adopted new varieties of agricultural crops by the respondents in the control group.
10. The changes in yield of vegetables had a positive but insignificant relationship with the changes in income from agriculture of the respondents in control group.
11. The changes in yield of vegetables had negative and insignificant relationship with the changes in number of adopted new varieties of agricultural crops by the respondents in the control group.
12. The changes in the respondents' agricultural income had negative and insignificant relationship with the changes in number of adopted new varieties of agricultural crops by the respondents in the control group.

5.2 Conclusions

The findings of the study enabled the researcher to formulate the following conclusions:

- ICT media had significant impact on yield of vegetables, agricultural income and number of adopted new varieties of agricultural crops by the respondents.
- The farmers faced some problems in using ICT media in agriculture, although the use of ICT media had a great influence on agriculture.
- The increases in Boro rice yield, vegetables yield, agricultural income and number of adopted new varieties of agricultural crops by the respondents were likely to be

influenced by the study group respondents' age, level of education, effective farm size, use of ICT media in agriculture, farming experience, agricultural knowledge and problems faced in using ICT media in agriculture.

5.3.1 Recommendations for Policy Implications

On the basis of the findings and conclusion of the research some recommendations have been formulated. These are the followings:

- The study revealed that the use of ICT media by the respondents enabled them to achieve agricultural development. To sustain agricultural development through the use of ICT media the government should make more arrangements for the use of ICT media in agriculture so that the farmers can spontaneously avail of the digital facilities without any difficulties and increase their knowledge and improved practices in agriculture.

- The findings of the study revealed that the changes in selected indicators of dependent variable were attributed to the farmers' age, level of education, effective farm size, use of ICT media in agriculture, farming experience, agricultural knowledge and problems faced in using ICT media in agriculture. It may be recommended that the government should consider the farmers' age, level of education, effective farm size, use of ICT media in agriculture, farming experience, agricultural knowledge and problems faced in using ICT media in agriculture during providing ICT services in agriculture for the farmers.

- The findings of the study showed that there were several problem faced by the farmers in using ICT media in agriculture and the problems had affected the impact of using ICT in agriculture. The government should reconsider the problems faced by the farmers in using ICT media in agriculture and address appropriate solutions to these problems for the sake of agricultural development.

- The findings of the study revealed that the increases in agricultural income were significantly higher than the control group which might have been resulted due to the use of ICT media by the study group respondents but the increases in agricultural income might be even much higher than the finding of the study if there were reasonable market price of rice and no natural disaster resulting

in heavy loss in Boro rice production. It may be recommended that the concerned authority should reconsider the pattern of Boro rice cultivation with minimum costing. The research institutes should develop more rice varieties that need minimum level of irrigation. The government should also ensure market price. It can also be recommended that the research institutes may return to develop strong rice varieties that can fight with any natural disaster like hailstorm, rain, flood etc.

- The research findings indicate that the level of education of the farmers had significant contribution to the impact of using ICT. Hence, it may be recommended that the government should provide educational facilities to the farmers so that they can get more agricultural knowledge for agricultural development.

- The research findings indicate that the agricultural knowledge of the farmers had significant contribution to the impact of using ICT as perceived by them. Therefore, it may be recommended that the government should arrange more agricultural training emphasizing on theoretical and practical aspects through different agricultural organizations like Department of Agricultural Extension (DAE) and research institutes on different agricultural aspects so that all farmers may get adequate facilities and apply their knowledge in agricultural development.

- The research findings indicate that the effective farm size of the farmers had significant contribution to the impact of using ICT. Therefore, it may be recommended that proper steps should be taken by the government to convert the fallow land into land under cultivation for increasing agricultural land.

5.3.2 Recommendations for Further Research

- The present research was undertaken in the Sadar upazila of Gazipur district. The findings of the study are essential to be tested in the other areas of the country.

- The present research was undertaken to measure the impact of using ICT where six ICT media were considered as the ICT media in this study. Further research should be conducted to assess the impact of using specific ICT media separately.

- The present study was carried out to measure the impact of using ICT using four indicators. Further research undertaking should be carried out to measure the impact of using ICT with different indicators of impact.

- The researcher collected data once for two different years (2012 and 2014) based on recall data in the present study. Further research should be carried out through baseline and follow-up survey procedure.

- The present research was carried out considering unequal number of respondents in study group and control group. Further research should be conducted taking similar number of respondents in study group and control group.

- The sample size was determined at 8% level of precision of the population. Further research should be carried out with the sample size determined at $\leq$ 5% level of precision of the population.

- Contribution of only eleven selected characteristics of the respondents to the impact of using ICT was examined. It may be recommended for further research to examine the contribution of other socio-economic characteristics of the farmers to the impact of using ICT as perceived by them.

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Appendix A

Bangla Version of Interview Schedule

KwL.m¤cmviY I Bbdi‡gkb wm‡÷g wefvM

‡k‡i evsjv KwL.wekwe`¨vjq

‡k‡i evsjv bMi, XvKv- 1207|

MvRxcÿ †Rjvi m`i Dc‡Rjvi KlK‡`i g‡a¨ Z_¨ I †hvMv‡hvM chy³ e¨envi‡i cfve kxlK M‡elYvi mvÿvrKvi Abyôvb t

µwgK bs t .....

DËi `vZvi bvg t .....

Mvg t ..... BDwbqb t .....

_vbv t ..... †Rjv t .....

I. *Avcbvi eqm KZ?* ..... eQi|

II. *Avcwb ‡Kvb †kYx chš †jLvcov K‡i‡Qb?*

* †jLvcov Rwb bv .....

* ïa bvg `¯LZ Ki‡Z cwi.....

* Awg ..... †kYx chš c‡owQ|

III. *Avcwb wK D‡Ï‡k¨ KwLlKvR K‡ib?*

□ 1. ewYwR¨K D‡Ï‡k¨

□ 2. Lvlqv-civi D‡Ï‡k¨

IV. *cwiev‡ii m`m¨ msL¨v t*

Avcbvi cwiev‡ii m`m¨ msL¨v KZ? ..... Rb|

V. *KvhKix Lvgv‡ii AvqZb t*

µwgK bs	***Rwgi cKvi***	***kZvsk***
1	cKimn emZ ewo‡Z Rwgi cwigvY (A_1)	
2	wbR PvI KZ Rwg (A_2)	
3	eMv †`lqv Rwg (A_3)	
4	eMv †blqv Rwg (A_4)	
5	eÜK †blqv Rwg (A_5)	
	‡gvU { **A**= $A_{1+}\ A_{2+}\left[\frac{A_{3+}A_4}{2}\right]_+ A_5\}$	

VI. *Avcbvi MZ eQ‡ii Av‡qi wewfbœ `ßi t*

i. Rwgi dmj t avb n‡Z Awq .....UvKv|
cvU n‡Z Awq .....UvKv|
mwilv n‡Z Awq .....UvKv|
mewR n‡Z Awq .....UvKv|
dj e¶ n‡Z Awq .....UvKv|
KvV RvZxq e¶ n‡Z Awq .....UvKv|
evk n‡Z Awq .....UvKv|
Ab¨vb¨ dmj n‡Z Awq.....UvKv|

ii. Mevw` cïcwL I grm¨ t

Mevw` cï n‡Z Avq .....UvKv|
nvm- giMx n‡Z Avq .....UvKv|
gvQ n‡Z Avq .....UvKv|

iii. AKwl LvZ t

e¨emv n‡Z Avq .....UvKv|
PvKix n‡Z Avq .....UvKv|
gRix n‡Z Avq.....UvKv|
Ab¨vb¨ Drm n‡Z Avq .....UvKv|

‡gvU Avq= i + ii + iii=..... UvKv|

VII. *Avcwb wK KwLlwelqK †Kvb cwkÿY wb‡q‡Qb?*

bv..... n¨vu.....

hw` n¨vuq, Zvn‡j `qv K‡i wb‡Pi Z_¨¸‡jv w`b|

µwgK bs	*cwkÿY ev welq e¯i bvg*	*cwkÿ‡Yi mgqKvj (w`b)*
1		
2		
3		
4		
5		

VIII. *KwLlKv‡R Z_¨ I ‡hvMv‡hvM chy³ gva¨gmgn¨e¨env‡ii gvÎv*

gva¨‡gi bvg	*e¨env‡ii gvÎv*				
	wbqwgZ (4)	*cvqB (3)*	*gv‡S gv‡S (2)*	*LyeB Kg (1)*	*‡gv‡UB bv (0)*
1. ‡iwWI i Kwl welqK Abôvb	cwZ w`‡b 1 evi ev Zvi D‡aŸ (4)	cwZ mßv‡n 1-6 evi (3)	cwZ gv‡m 1-3 evi (2)	cwZ eQ‡i 1-11 evi (1)	e¨envi Kwi bv (0)
2. ‡Uwjwfk‡bi Kwl welqK Abôvb	cwZ w`‡b 1 evi ev Zvi D‡aŸ (4)	cwZ mßv‡n 1-6 evi (3)	cwZ gv‡m 1-3 evi (2)	cwZ eQ‡i 1-11 evi (1)	e¨envi Kwi bv (0)
3. ‡gvevBj †dvb/ ¯§vU‡dvb/†Uwj‡dvb	cwZ w`‡b 1 evi ev Zvi D‡aŸ (4)	cwZ mßv‡n 1-6 evi (3)	cwZ gv‡m 1-3 evi (2)	cwZ eQ‡i 1-11 evi (1)	e¨envi Kwi bv (0)
4. Kw¤úDUvi/j¨vcUc /U¨ve‡jU/gwëwgWqv/B›Uvi‡bU (Kwl Z_¨ I †hvMv‡hvM †K‡›` mieivnKZ gva¨‡gi mvnv‡h¨)	cwZ mßv‡n 1 evi ev Zvi D‡aŸ (4)	cwZ gv‡m 1-3 evi (3)	cwZ eQ‡i 6-11 evi (2)	cwZ eQ‡i 1-5 evi (1)	e¨envi Kwi bv (0)
5. Kwl Kj †m›Uvi/dvgvm ‡ní jvBb	cwZ mßv‡n 1 evi ev Zvi D‡aŸ (4)	cwZ gv‡m 1-3 evi (3)	cwZ eQ‡i 6-11 evi (2)	cwZ eQ‡i 1-5 evi (1)	e¨envi Kwi bv (0)
6. †gvevBj †dvb †Kv¤úvbxi Kwl mnvqZv †mevmgn (evsjvwjsK Kwl wRÁvmv/evsjvwjsK KwlevRvi/ MvgxY‡dvb Kwl Z_¨ †mev/ iwe nvU-evRvi)	cwZ mßv‡n 1 evi ev Zvi D‡aŸ (4)	cwZ gv‡m 1-3 evi (3)	cwZ eQ‡i 6-11 evi (2)	cwZ eQ‡i 1-5 evi (1)	e¨envi Kwi bv (0)

IX. *Kwl.tmev tK›` mgn-t_‡K Kwl.tmev tbqvi aiY*

¯vbxq Kwl.tmev tK›` / Drtmi bvg	‡mev tbqvi aiY				
	wbqwgZ (4)	cvqB (3)	gv‡S gv‡S (2)	LyeB Kg (1)	‡gv‡UB bv (0)
1. Kwl Z_¨ I †hvMv‡hvM †K›` (AICC)	cwZ mßv‡n 1 evi ev Zvi D‡aŸ (4)	cwZ gv‡m 2-3 evi (3)	cwZ gv‡m 1 evi (2)	cwZ eQ‡i 1-11 evi (1)	GKevi I bv (0)
2. BDwbqb Z_¨ I †mev †K›` (UISC)/BDwbqb wWRUvj †m›Uvi	cwZ mßv‡n 1 evi ev Zvi D‡aŸ (4)	cwZ gv‡m 2-3 evi (3)	cwZ gv‡m 1 evi (2)	cwZ eQ‡i 1-11 evi (1)	GKevi I bv (0)
3. GbwRI Kvhvjq	cwZ mßv‡n 1 evi ev Zvi D‡aŸ (4)	cwZ gv‡m 2-3 evi (3)	cwZ gv‡m 1 evi (2)	cwZ eQ‡i 1-11 evi (1)	GKevi I bv (0)
4. Kwl Z_¨ mwfm (AIS)	cwZ mßv‡n 1 evi ev Zvi D‡aŸ (4)	cwZ gv‡m 2-3 evi (3)	cwZ gv‡m 1 evi (2)	cwZ eQ‡i 1-11 evi (1)	GKevi I bv (0)
5. Dc‡Rjv Kwl Awdm	cwZ mßv‡n 1 evi ev Zvi D‡aŸ (4)	cwZ gv‡m 1-3 evi (3)	cwZ eQ‡i 2-11 evi (2)	cwZ eQ‡i 1 evi (1)	GKevi I bv (0)
6. Dc‡Riv cwYm¤ú` Awdm	cwZ mßv‡n 1 evi ev Zvi D‡aŸ (4)	cwZ gv‡m 1-3 evi (3)	cwZ eQ‡i 2-11 evi (2)	cwZ eQ‡i 1 evi (1)	GKevi I bv (0)
7. Dc‡Rjv grm¨ Awdm	cwZ mßv‡n 1 evi ev Zvi D‡aŸ (4)	cwZ gv‡m 1-3 evi (3)	cwZ eQ‡i 2-11 evi (2)	cwZ eQ‡i 1 evi (1)	GKevi I bv (0)
8.Kwl M‡elYv †K›` mgn	cwZ mßv‡n 1 evi ev Zvi D‡aŸ (4)	cwZ gv‡m 1-3 evi (3)	cwZ eQ‡i 2-11 evi (2)	cwZ eQ‡i 1 evi (1)	GKevi I bv (0)
9.Ab¨vb¨ Kwl welqK ms¯v mgn	cwZ mßv‡n 1 evi ev Zvi D‡aŸ (4)	cwZ gv‡m 1-3 evi (3)	cwZ eQ‡i 2-11 evi (2)	cwZ eQ‡i 1 evi (1)	GKevi I bv (0)

X. *Kwl.Kv‡R AwfÁZv*

Kwl Kv‡R Avcbvi AwfÁZv KZ eQ‡ii ? ..... eQi|

XI. *Kwl.msµvš Ávb*

`qv K‡i wb‡Pi ckM‡jvi DËi w`b|

µwgK bs	ck	b¤i	
		‡gvU b¤i	cvß b¤i
1	`BwU D"P djbkxj †ev‡iv av‡bi Rv‡Zi bvg ejb|	2	
2	`BwU ivmvqwbK mv‡ii bvg ejb|	2	
3	dm‡ji `BwU ¶wZKi †cvKvi bvg ejb|	2	
4	dm‡ji `BwU DcKvix †cvKvi bvg ejb|	2	
5	av‡bi `BwU †iv‡Mi bvg ejb|	2	
6	`BwU KxUbvk‡Ki bvg ejb|	2	
7	`BwU d‡ji Rv‡Zi bvg ejb|	2	

8	‡Uwjwfk‡b m¤úPwiZ nq Ggb `wU Kwl welqK Abôv‡bi bvg ejb|	2	
9	B`i `g‡bi `BwU c×wZi bvg ejb|	2	
10	giMxi `wU †iv‡Mi bvg ejb|	2	
11	Mi‡i `wU †iv‡Mi bvg ejb|	2	

XII. *Kwl‡ÿ‡Î Z_¨ I †hvMv‡hvM chy³ gva¨gmgn-e¨envi‡ii mgm¨vmgn-t*

KwlKv‡R Z_¨ I †hvMv‡hvM chw³ gva¨gmgn e¨envi Ki‡Z wM‡q Avcwb †Kvb †Kvb mgm¨vi m¤§Lxb n‡q‡Qb †m m¤ú‡K Avcbvi gZvgZ w`b|

µwgK bs	*mgm¨v*	*mgm¨vi aiY*				
		‡gv‡UBbv (0)	*Kg (1)*	*gvSvgwS (2)*	*‡ewk* (3)	*Lye †ewk (4)*
1	Z_¨ I †hvMv‡hvM chw³ gva¨g mg‡ni e¨envi welqK Avbôv wbK ckÿ‡Yi Afve					
2	KwlKv‡R Z_¨ I †hvMv‡hvM chw³ gva¨gmgn e¨envi Kivi mweavb m¤ú‡K AÁZv|					
3	†Uwjwfkb Ges †iwWIi Kwl welqK Abôvb h‡_ó bq|					
4	‡iwWI, †Uwjwfkb, †gvevBj †dvb, Kw¤úDUvi, B›Uvi‡bU Ges ‡emiKvix †gvevBj †dvb †Kv¤úvbx¸‡jvi Kwl welqK †mev AZ¨š e¨qeûj|					
5	Z_¨ I †hvMv‡hvM chw³ msµvš †mev cvIqvi Rb¨ chvß wWwRUvj †mev‡K‡›`i Afve|					
6	Z_¨ I †hvMv‡hvM chw³ gva¨gmgn e¨envi Kiv KwVb|					
7	Z_¨ I †hvMv‡hvM chw³ gva¨gmg‡n e¨q Kivi gZ chvß mg‡qi Afve|					
8	Z_¨ I †hvMv‡hvM chw³ gva¨gmgn e¨env‡ii Rb¨ c‡qvRbxq we`¨‡Zi Afve|					
9	Kg MwZ m¤úb B›Uvi‡bU|					
10	wbiÿiZv						

XIII. *Z_¨ I †hvMv‡hvM chy³ e¨env‡ii cfve t*

K) Lv`¨k‡m¨i dj‡b cwieZb t

Drcw`Z cY¨	*2012*		*2014*	
	PvIKZ.Rwgi cwigvY (kZvsk)	*djb (‡KwR)*	*PvIKZ.Rwgi cwigvY (kZvsk)*	*djb (‡KwR)*
‡ev‡iv avb				

L) mewRi dj‡b cwieZb t

Drcw`Z cY¨	*2012*		*2014*	
	PvIKZ.Rwgi cwigvY (kZvsk)	*djb (‡KwR)*	*PvIKZ.Rwgi cwigvY (kZvsk)*	*djb (‡KwR)*
djKwc				
kmv				
†e¸b				
jvD				
U‡g‡Uv				
WvUv				
wgwó Kgov				

M) Av‡qi cwieZb t

i. Lv`¨km¨ t		
Drcw`Z cY¨	**2012**	**2014**
	Drcw`Z c‡Y¨i gj¨ (UvKv)	**Drcw`Z c‡Y¨i gj¨ (UvKv)**
‡ev‡iv avb		
Avgb avb		

ii. mewR t		
Drcw`Z cY¨	**2012**	**2014**
	Drcw`Z c‡Y¨i gj¨ (UvKv)	**Drcw`Z c‡Y¨i gj¨ (UvKv)**
djKwc		
kmv		
†e¸b		
jvD		
U‡g‡Uv		
WvUv		
wgwó Kgov		
Ab¨vb¨		

iii. dj I KvV RvZxq ey¨ t		
Drcw`Z cY¨	**2012**	**2014**
	Drcw`Z c‡Y¨i gj¨ (UvKv)	**Drcw`Z c‡Y¨i gj¨ (UvKv)**
dj		
KvV		
evk		

iv. Mew`cï I nwm gyjvM t				
Mew`cï	**2012**		**2014**	
	msL¨v	**gj¨ (UvKv)**	**msL¨v**	**gj¨ (UvKv)**
Mi‡				
QvMj				
nvm				
giwM				
KeZi				
`a				
wWg				
Ab¨vb¨				

v. grm¨ t	
2012	**2014**
Drcw`Z gv‡Qi gj¨ (UvKv)	**Drcw`Z gv‡Qi gj¨ (UvKv)**
Kwl Avq= i+ii+iii+iv+v =	Kwl Avq= i+ii+iii+iv+v =

Drcv`b LiP t

i. Lv`¨km¨ t		
Drcw`Z cY¨	**2012**	**2014**
	Drcv`b LiP (UvKv)	**Drcv`b LiP (UvKv)**
‡ev‡iv avb		
Avgb avb		

ii. *meŵR t*		
Drcŵ`Z cY¨	***2012***	***2014***
	Drcv`b LiP (UvKv)	***Drcv`b LiP (UvKv)***
djKŵc		
kmv		
†e¸b		
jvD		
U‡g‡Uv		
WvUv		
ŵgŵó Kgov		
Ab¨vb¨		

iii. *dj I KvV RvZxq e¸ÿ t*		
Drcŵ`Z cY¨	***2012***	***2014***
	Drcv`b LiP (UvKv)	***Drcv`b LiP (UvKv)***
dj		
KvV		
evk		

iv. *Meŵ`cï I nvm gÿyM t*		
Meŵ`cï	***2012***	***2014***
	Drcv`b LiP (UvKv)	***Drcv`b LiP (UvKv)***
Mi‡		
QvMj		
nvm		
giŵM		
KeZi		

v. *grm¨ t*	
2012	***2014***
Drcv`b LiP (UvKv)	***Drcv`b LiP (UvKv)***
KwI‡Z †gvU LiP= i+ii+iii+iv+v =	KwI‡Z †gvU LiP= i+ii+iii+iv+v =
KwI n‡Z bxU Avq=	KwI n‡Z bxU Avq=

N) dm‡j i bZb RvZ Mn‡Yi ai‡Y cwieZb t

cY¨	***2012***	***2014***
	MnYKZ bZb Rv‡Zi msL¨v	***MnYKZ bZb Rv‡Zi msL¨v***
avb		
meŵR		
dj		

Avcbvi gj¨evb mgq I Z_¨ †`qvi Rb¨ Avcbv‡K A‡kI ab¨ev`|

_____

mv¶vrKvi MnYKvixi ¯v¶i I ZwiL

Appendix B

English Version of Interview Schedule

Department of Agricultural Extension and Information System

Sher-e-Bangla Agricultural University

Sher-e-Bangla Nagar, Dhaka-1207

Interview Schedule of Impact of ICT among the Farmers of Sadar Upazila under Gazipur District:

Sl. No. .....

Name of the Respondent .....

Village ..... Union .....

Upazila/Thana ..... District….....

I. Age ..... years

II. Level of Education :

* Cannot read or write .....

* Can sign name only .....

* Studied up to class….....

III. Purpose of Farming :

□ 1. Commercial farming

□ 2. Subsistence farming

IV. Family size…….number

V. Effective Farm Size :

Sl. No.	Type of land	Area (Decimal)
1	Homestead land including pond area (A_1)	
2	Own land under own cultivation (A_2)	
3	Land taken from others on sharecropping (A_3)	
4	Land given to others on sharecropping (A_4)	
5	Land taken from others on lease (A_5)	
	Total land **{A=** $A_{1+}\ A_{2+}\left[\frac{A_{3+}A_4}{2}\right]_{+}A_5$}	

VI. Annual income :

Please mention your income earned in the last year.

i. Crop:

Income from paddy .....taka
Income from jute .....taka
Income from mustard .....taka
Income from vegetables.....taka
Income from fruit trees .....taka
Income from timber trees.....taka
Income from bamboo .....taka
Income from other crops.....taka

ii. Livestock and Fish:

Income from cattle.....taka
Income from poultry.....taka
Income from fish.....taka

iii. Non-agricultural activities:

Income from business.....taka
Income from service .....taka
Income from other sources .....taka

Total income= I + II + III=.....taka

VII. Training Experience :

Did you receive any agricultural training**?**

No..... Yes.....

If yes, please provide the following information

Sl. No.	**Name of Training or Subject**	**Duration of Training (Days)**
1		
2		
3		
4		
5		

VIII. Use of ICT Media in Agriculture :

Name of ICT Media	Extent of Use				
	Use regularly (4)	**Use most often (3)**	**Use occasionally (2)**	**Use rarely (1)**	**Do not use at all (0)**
1. Radio agricultural programmes	1 time in a day or above (4)	1-6 times in a week (3)	1-3 times in a month (2)	1-11 times in a year (1)	Do not use at all (0)
2. TV agricultural programmes	1 time in a day or above (4)	1-6 times in a week (3)	1-3 times in a month (2)	1-11 times in a year (1)	Do not use at all (0)
3. Mobile phone/ smart phone/ telephone	1 time in a day or above (4)	1-6 times in a week (3)	1-3 times in a month (2)	1-11 times in a year (1)	Do not use at all (0)
4.Computer/laptop/tablet/ multimedia/Internet (With the help of supplied media in AICC)	1 time in a week or above (4)	1-3 times in a month (3)	6-11 times in a year (2)	1-5 times in a year (1)	Do not use at all (0)
5. Krishi Call Center/ Farmers Help Line	1 time in a week or above (4)	1-3 times in a month (3)	6-11 times in a year (2)	1-5 times in a year (1)	Do not use at all (0)
6. Agricultural assistance services of mobile phone companies (Banglalink Krishi Jigyasha/ Banglalink Krishibazaar/ Grameenphone Krishi Taththya Sheba /Robi Haat-Bazaar)	1 time in a week or above (4)	1-3 times in a month (3)	6-11 times in a year (2)	1-5 times in a year (1)	Do not use at all (0)

IX. Service Taking from Agricultural Service Centre :

Name of Local Agricultural Service Centers/Sources	Extent of taking agricultural services				
	Regularly (4)	**Most often (3)**	**Sometimes (2)**	**Rarely (1)**	**Not at all (0)**
1. Agriculture Information and Service Centre (AICC)	1 time in a week or above (4)	2-3 times in a month (3)	1 time in a month (2)	1-11 times in a year (1)	Do not use at all (0)
2. Union Information and Service Centre (UISC)/Union Digital Centre	1 time in a week or above (4)	2-3 times in a month (3)	1 time in a month (2)	1-11 times in a year (1)	Do not use at all (0)
3. NGO Office	1 time in a week or above (4)	2-3 times in a month (3)	1 time in a month (2)	1-11 times in a year (1)	Do not use at all (0)
4. Agricultural Information Service (AIS)	1 time in a week or above (4)	2-3 times in a month (3)	1 time in a month (2)	1-11 times in a year (1)	Do not use at all (0)
5. Upazila Agricultural Office (UAO)	1 time in a week or above (4)	1-3 times in a month (3)	2-11 times in a year (2)	1time in a year (1)	Do not use at all (0)
6. Upazila Livestock Office	1 time in a week or above (4)	1-3 times in a month (3)	2-11 times in a year (2)	1time in a year (1)	Do not use at all (0)
7. Upazila Fisheries Office	1 time in a week or above (4)	1-3 times in a month (3)	2-11 times in a year (2)	1time in a year (1)	Do not use at all (0)
8. Agricultural research centres	1 time in a week or above (4)	1-3 times in a month (3)	2-11 times in a year (2)	1time in a year (1)	Do not use at all (0)
9. Other agriculture related organizations	1 time in a week or above (4)	1-3 times in a month (3)	2-11 times in a year (2)	1time in a year (1)	Do not use at all (0)

X. Farming Experience :

How long experience do you have in farming?..... years

XI. Agricultural Knowledge :

Please answer the following questions.

Sl. No.	Question	Mark	
		Total marks	**Obtained marks**
1	Mention the name of two high yielding varieties (HYV) of Boro rice	2	
2	Mention the name of two chemical fertilizers	2	
3	Mention the name of two harmful insects of crops	2	
4	Mention the name of two beneficial insects of crops	2	
5	Mention the name of two timber crops	2	
6	Mention the name of two insecticides	2	
7	Mention the name of two varieties of fruit	2	
8	Mention the name of two agricultural programmes broadcasted on TV	2	
9	Mention the name of two practices suitable for rodent killing/management	2	
10	Mention the name of two diseases of poultry	2	
11	Mention the name of two diseases of cattle	2	

XII. Problems Faced in Using ICT Media in Agriculture :

Please indicate the extent of problems you face in using ICT media in agriculture

Sl. No.	Problems	Extent of Problem				
		Not at all (0)	Low (1)	Medium (2)	High (3)	Very high (4)
1	Lack of formal training regarding use of ICT media					
2	Lack of awareness regarding the benefit of using ICT media in agriculture.					
3	Inadequate agricultural programmes of the radio and television.					
4	High cost of computer, radio, television, mobile phone, internet and agricultural services of the non-government mobile phone companies.					
5	Lack of adequate digital service centres for providing ICT facilities.					
6	The ICT media are difficult to use.					
7	Lack of enough time to spend on ICT media.					
8	Lack of necessary electricity facilities for using ICT media.					
9	Low speed internet facilities.					
10	Illiteracy					

XIII. Impact of Using ICT :

a) Change in Yield of Cereal Crop :

Item	2012		2014	
	Cultivated Area (Decimal)	Yield (Kg)	Cultivated Area (Decimal)	Yield (Kg)
Boro rice				

b) Changes in Yield of Vegetables :

Item	2012		2014	
	Cultivated Area (Decimal)	Yield (Kg)	Cultivated Area (Decimal)	Yield (Kg)
Cauliflower				
Cucumber				
Brinjal				
Bottle gourd				
Tomato				
Amaranth				
Sweet gourd				

c) Changes in Income from Agriculture :

i. Cereal Crops

Item	2012	2014
	Value of Produced Product (Taka)	Value of Produced Product (Taka)
Boro rice		
Aman rice		

ii. Vegetables

Item	2012	2014
	Value of Produced Product (Taka)	Value of Produced Product (Taka)
Cauliflower		
Cucumber		
Brinjal		
Bottle gourd		
Tomato		
Amaranth		
Sweet gourd		
Others		

iii. Fruits and Timbers

Item	2012	2014
	Value of Produced Product (Taka)	Value of Produced Product (Taka)
Fruit		
Timber		
Bamboo		

iv. Livestock

Item	2012		2014	
	Number	Total Market Value (Taka)	Number	Total Market Value (Taka)
Cow				
Goat				
Duck				
Hen				
Pigeon				
Milk				
Egg				
Others				

v. Fisheries

2012	2014
Total Market Value of Produced Fishes (Taka)	**Total Market Value of Produced Fishes (Taka)**
Total Income from Agriculture =i+ii+iii+iv+v =	**Total Income from Agriculture** = i+ii+iii+iv+v =

Production Cost :

i. Cereal Crops

Item	2012	2014
	Production Cost (Taka)	Production Cost (Taka)
Boro rice		
Aman rice		

ii. Vegetables

Item	2012	2014
	Production Cost (Taka)	Production Cost (Taka)
Cauliflower		
Cucumber		
Brinjal		
Bottle gourd		
Tomato		
Amaranth		
Sweet gourd		
Others		

iii. Fruit and Timbers

Item	2012	2014
	Production Cost (Taka)	Production Cost (Taka)
Fruit		
Timber		

Bamboo		
iv. Livestock		
Item	**2012**	**2014**
	Production Cost (Taka)	**Production Cost (Taka)**
Cow		
Goat		
Duck		
Hen		
Pigeon		

v. Fisheries	
2012	**2014**
Production Cost (Taka)	**Production Cost (Taka)**
Total Production Cost in Agriculture = i+ii+iii+iv+v **=**	**Total Production Cost in Agriculture** = i+ii+iii+iv+v **=**
Net Income from Agriculture =	**Net Income from Agriculture =**

d) Changes in Number of Adopted New Varieties of Agricultural Crops :

Item	**2012**	**2014**
	Number of adopted new varieties of agricultural crops	**Number of adopted new varieties of agricultural crops**
Rice		
Vegetables		
Fruits		

Signature of interviewer and Date

APPENDIX-C

T-distribution Table with Critical Values

t distribution critical values

	Upper-tail probability *p*											
df	.25	.20	.15	.10	.05	.025	.02	.01	.005	.0025	.001	.0005
1	1.000	1.376	1.963	3.078	6.314	12.71	15.89	31.82	63.66	127.3	318.3	636.6
2	0.816	1.061	1.386	1.886	2.920	4.303	4.849	6.965	9.925	14.09	22.33	31.60
3	0.765	0.978	1.250	1.638	2.353	3.182	3.482	4.541	5.841	7.453	10.21	12.92
4	0.741	0.941	1.190	1.533	2.132	2.776	2.999	3.747	4.604	5.598	7.173	8.610
5	0.727	0.920	1.156	1.476	2.015	2.571	2.757	3.365	4.032	4.773	5.893	6.869
6	0.718	0.906	1.134	1.440	1.943	2.447	2.612	3.143	3.707	4.317	5.208	5.959
7	0.711	0.896	1.119	1.415	1.895	2.365	2.517	2.998	3.499	4.029	4.785	5.408
8	0.706	0.889	1.108	1.397	1.860	2.306	2.449	2.896	3.355	3.833	4.501	5.041
9	0.703	0.883	1.100	1.383	1.833	2.262	2.398	2.821	3.250	3.690	4.297	4.781
10	0.700	0.879	1.093	1.372	1.812	2.228	2.359	2.764	3.169	3.581	4.144	4.587
11	0.697	0.876	1.088	1.363	1.796	2.201	2.328	2.718	3.106	3.497	4.025	4.437
12	0.695	0.873	1.083	1.356	1.782	2.179	2.303	2.681	3.055	3.428	3.930	4.318
13	0.694	0.870	1.079	1.350	1.771	2.160	2.282	2.650	3.012	3.372	3.852	4.221
14	0.692	0.868	1.076	1.345	1.761	2.145	2.264	2.624	2.977	3.326	3.787	4.140
15	0.691	0.866	1.074	1.341	1.753	2.131	2.249	2.602	2.947	3.286	3.733	4.073
16	0.690	0.865	1.071	1.337	1.746	2.120	2.235	2.583	2.921	3.252	3.686	4.015
17	0.689	0.863	1.069	1.333	1.740	2.110	2.224	2.567	2.898	3.222	3.646	3.965
18	0.688	0.862	1.067	1.330	1.734	2.101	2.214	2.552	2.878	3.197	3.611	3.922
19	0.688	0.861	1.066	1.328	1.729	2.093	2.205	2.539	2.861	3.174	3.579	3.883
20	0.687	0.860	1.064	1.325	1.725	2.086	2.197	2.528	2.845	3.153	3.552	3.850
21	0.686	0.859	1.063	1.323	1.721	2.080	2.189	2.518	2.831	3.135	3.527	3.819
22	0.686	0.858	1.061	1.321	1.717	2.074	2.183	2.508	2.819	3.119	3.505	3.792
23	0.685	0.858	1.060	1.319	1.714	2.069	2.177	2.500	2.807	3.104	3.485	3.768
24	0.685	0.857	1.059	1.318	1.711	2.064	2.172	2.492	2.797	3.091	3.467	3.745
25	0.684	0.856	1.058	1.316	1.708	2.060	2.167	2.485	2.787	3.078	3.450	3.725
26	0.684	0.856	1.058	1.315	1.706	2.056	2.162	2.479	2.779	3.067	3.435	3.707
27	0.684	0.855	1.057	1.314	1.703	2.052	2.158	2.473	2.771	3.057	3.421	3.690
28	0.683	0.855	1.056	1.313	1.701	2.048	2.154	2.467	2.763	3.047	3.408	3.674
29	0.683	0.854	1.055	1.311	1.699	2.045	2.150	2.462	2.756	3.038	3.396	3.659
30	0.683	0.854	1.055	1.310	1.697	2.042	2.147	2.457	2.750	3.030	3.385	3.646
40	0.681	0.851	1.050	1.303	1.684	2.021	2.123	2.423	2.704	2.971	3.307	3.551
50	0.679	0.849	1.047	1.299	1.676	2.009	2.109	2.403	2.678	2.937	3.261	3.496
60	0.679	0.848	1.045	1.296	1.671	2.000	2.099	2.390	2.660	2.915	3.232	3.460
80	0.678	0.846	1.043	1.292	1.664	1.990	2.088	2.374	2.639	2.887	3.195	3.416
100	0.677	0.845	1.042	1.290	1.660	1.984	2.081	2.364	2.626	2.871	3.174	3.390
1000	0.675	0.842	1.037	1.282	1.646	1.962	2.056	2.330	2.581	2.813	3.098	3.300
z^*	0.674	0.841	1.036	1.282	1.645	1.960	2.054	2.326	2.576	2.807	3.091	3.291
	50%	60%	70%	80%	90%	95%	96%	98%	99%	99.5%	99.8%	99.9%
	Confidence level *C*											

Source: Web 1