Enhancing the Role of ICT in Disseminating Agricultural Information to Farmers in Bangladesh

DOCTOR OF PHILOSOPHY

SUSMITA DAS

Department of Information Science and Library Management
University of Dhaka, Bangladesh

February 2016

DEDICATED

to

The Farmers of Bangladesh

whose hardship in farm and sufferings in life has stirred me to better understand their farming towards higher productivity and income that may make a difference in their livelihood.

Enhancing the Role of ICT in Disseminating Agricultural Information to Farmers in Bangladesh

Enhancing the Role of ICT in Disseminating Agricultural Information to Farmers in Bangladesh

BY

SUSMITA DAS

SUPERVISOR
DR. M. NASIRUDDIN MUNSHI

CO-SUPERVISOR
DR. WAIS KABIR

A THESIS ON THE TOPIC MENTIONED ABOVE SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR AWARD OF THE DOCTOR OF PHILOSOPHY OF THE UNIVERSITY OF DHAKA

DEPARTMENT OF INFORMATION SCIENCE AND LIBRARY MANAGEMENT
UNIVERSITY OF DHAKA, BANGLADESH
February 2016

Department of Information Science & Library Management
UNIVERSITY OF DHAKA

তথ্যবিজ্ঞান ও গ্রন্থাগার ব্যবস্থাপনা বিভাগ
ঢাকা বিশ্ববিদ্যালয়

CERTIFICATE

This is to certify that the thesis entitled "**Enhancing the Role of ICT in Disseminating Agricultural Information to Farmers in Bangladesh"** submitted by Susmita Das for the Degree of Doctor of Philosophy is an original research done by her under our direct guidance and supervision and that this thesis has not been submitted either in part or in full by the candidate for any Degree, Diploma, Associateship, Fellowship or other similar title.

It is also certified that this thesis represents an independent work on the part of the candidate.

Dr. M. Nasiruddin Munshi
Professor
Department of Information Science and Library Management
University of Dhaka

DR. WAIS KABIR
Executive Chairman (Former)
Bangladesh Agricultural Research Council (BARC)
Farmgate, Dhaka

Declaration

I hereby declare that this thesis entitled "**Enhancing the Role of ICT in Disseminating Agricultural Information to Farmers in Bangladesh"** is my original work resulting from the investigation for the Degree of Doctor of Philosophy, Department of Information Science and Library Management, University of Dhaka. The entire research was carried out by me under the guidance and supervision of Dr. M. Nasiruddin Munshi, Professor, Department of Information Science and Library Management, University of Dhaka and Dr. Wais Kabir, former Executive Chairman of Bangladesh Agricultural Research Council.

I further declare that this thesis has not been previously submitted in partial or in full for any Degree or Diploma to any University or Institution.

Dhaka
February, 2016

Susmita Das

ABSTRACT

Agriculture in Bangladesh is blessed with favorable agro-climatic conditions to grow a number of crops, fisheries and animals. Information Communication Technology (ICT) has proved to be significant to enhance agricultural production. Realizing its potential, Bangladesh has currently started using ICT for its agricultural development programs. However, the role of ICT in the field of agricultural information dissemination is yet to be fully realized to receive the potential benefit. Considering the fact, the study has been undertaken with a view to increasing agricultural knowledge delivery by enhancing the ICT use and minimizing the information gap between farmers' needs and new technologies. The study reviewed the present status of the ICT initiatives in agriculture and the access of ICT among the end users and utilization of agricultural information to the farmers of Bangladesh through ICT tools. The main objective of the study was to explore the magnitude of contribution of ICT in the agricultural production system. The study also focuses on the role of ICT in creating difference on farmer's agricultural production system and overall income. It also explores the impact of ICT on overall agricultural development.

The research questions concentrate on what extent the role of ICT is contributing in disseminating agricultural information services to farmers, what factors need to be considered for enhacing the role of ICTs in agricultural information delivery systems, how the advancement of Information and Communication Technologies can be effeciently applied to help farmers increase their production and how the results of this study can be upscaled in wider area.

The whole study presented in this thesis is divided into eight chapters; each chapter incorporates the specific issues of the study area. *Chapter one* outlines the background of the general context of the research and identifies the various constituents of the problems related to ICT based information dissemination services in agriculture. *Chapter two* offers the literature review of a number of empirical studies carried out on ICT based initiatives in agriculture all over the country and around the world. The literature review reveals different levels of ICT based initiatives and a strong relation to the production and income in general and development in agriculture in particular has been visualized. *Chapter two* focuses on present status of agricultural information service delivery systems in Bangladesh with some successful agricultural initiatives worldwide. *Chapter four* discusses the research design and

methodology applied in this study. The chapter highlights how the different types of data were collected, analyzed, and presented. A mixed methods (MM) approach was used for data collection and analyses. *The Chapter five* presented on the summary and findings of fifteen focus group discussions. The results on different variables like farmers' production, and income are discussed in *the Chapter six* with reference to the research questions designed and presented in the study. Description of crops, different technologies are shown in the sub sections following fisheries and livestock. Gender involvement in agricultural operation, the details of the respondents the way they lead their life, the tools they use in their farming, the production they produce and the income they receive associated with crops, fisheries and livestock farming, have been attempted to analyze in the chapter. The economic and the demographic feature of the farmers of the two groups are shown here. A farmer friendly ICT based model has been proposed in *the Chapter seven.* Recommendation and conclusion of the research results are described in *the Chapter eight*.

This thesis contributes to the field of agricultural information dissemination system of Bangladesh. The study has significantly elicted the strong relationship between the use of ICT through successful initiatives as well as the production and income of the farmers. The proposed model is expected to help farmers adopt technology in an efficient way to get the easy access through agricultural information service delivery which could influence their production in a positive way.The study offers professionals and policymakers involved in agricultural development insights into application and best use of ICT. Most importantly, it highlights the contribution of information and knowledge of the farmers in Bangleadesh, the very important segment of the population who are stakeholders at the centre of food production and well being of the population of the country.

Acknowledgements

First of all, my sincere and humble gratitude goes to the Almighty God to enable me to make my dream a reality.

I would bestow sincere and respectful gratitude to my supervisor, Dr. M. Nasiruddin Munshi, Professor, Department of Information Science and Library Management, University of Dhaka for his intelligent guidance, invaluable suggestion and support throughout this enormous task. His scholastic direction, constructive criticism and constant encouragement have shaped the whole work. I am greatly indebted to my supervisor for his insightful and selfless care and advice that I was badly in need to complete the study.

I am grateful to my co-supervisor, Dr. Wais Kabir, a renowned scientist, the former Executive Chairman of Bangladesh Agricultural Research Council (BARC) and a known personality in agricultural research management, for his continuous inspiration, scholarly help, superb guidance, and relentless persuasion to complete the task. His knowledge, encouragement, and support are always invaluable resources to me.

I extend my gratitude to Professor Dr. Muhammad Mezbah-ul-Islam, Chairman, Department of Information Science and Library Management, University of Dhaka, for his encouragement and support. Also I express my sincere gratitude to Professor Dr. S. M. Mannan, Professor Dr. S. M. Zabed Ahmed, Professor Dr. Salma Chowdhury, Dr. Kazi Mostak Gausul Huq and other teachers of the department for their sincere cooperation, support and help during the research work. I want to thank the officers and staff of the Department for their effective assistance.

I am also grateful to Dr. Abul Kalam Azad, Executive Chairman, BARC, for his kind co-operation, guidance and support. His inspiration made me produce the output and complete the research work.

I would like to express my gratitude and appreciation to CSISA-BD (USAID Project) for providing support through scholarship program for the development of human resources in agricultural science. This indeed helped me to undertake the study successfully. I also express my sincere appreciation to Dr. Tim Russel (Chief of Party CSISA-BD), Dr. Paul Fox (IRRI representative in Bangladesh), Dr. T. P. Tiwari (CIMMYT), Dr. Craig Meisner (Country Director- World Fish Center, South-Asia, BD) for their inspiration and guidance.

I would also like to give heartfelt thanks to Dr. Paresh Chandra Golder, Member Director of BARC for his inspiration & co-operation. I solely thank Dr. Mohammad Nurul Alam, crop specialist (SAC), Mr. Aminuzzamaan, Director Training & Manpower, Mr. Rafique Mostafa

Kamal, Director, AIC, BARC and all of my colleagues at BARC for their constructive advice and co-operation. I thank all the staff of BARC too for their assistance.

Also thank to Dr. Kathleen Colverson (Associate Director, University of Florida, USA), Andrea Bohn (Associate Director, MEAS & INGENEAS Project, University of Illinois, USA) and Dr. Sridhar Goutom (Senior Scientist, ICAR) for their support, inspiration and valuable advice in conducting the research work.

I wish to express my special thanks to Md. Nazrul Islam (Ex-Director of AIS), all AIS personnel including Mr. Abul Kalam & Mr. Pijus Kanti Sarker (DD, DAE), and professionals of NARS institutes for providing adequate data and information during the period of my field study. I thank Professor Noor Md. Rahmatullah (Department of Agricultural Statistics, SAU) for his guidance in data analysis.

I take the opportunities to acknowledge the contribution of Extension professionals, officers of DAE, Sub-assistant Agricultural Officers who helped me much in data collection through their warm hospitality and sharing experience.

I am truly indebted to my husband, Mr. Paritosh Mondal for his knowledge, encouragement, resourceful support and true guidance. He was benignly accompanied on the field visit despite his busy workload and his toilsome work framed the text and accomplished structuring the thesis.

I also owe to my parents in law, loving sisters, and beloved son, Prodipto for having patience to be with me in completing the research work. It is my father, Mr. Prosanto Kumar Das and my mother, Doly Das who gave me prudence, constant inspiration, and unstinted support that led to complete the great task. I also thank brother, Mr. Tarok Mondal and Mr. Ashutosh Mondal for proofread and making the benchmarking of the get-up of the thesis.

I am greatly indebted to the authors whose works I have cited in this research work. I cannot but give thanks to all of my friends working in different institutions, who have given support during my research. I appreciate many others whom I have come across during the long and windy journey of this research work.

Finally, farmers who voluntarily assisted me in the field study and shared their opinion deserve special thanks.

Susmita Das

TABLE OF CONTENTS

Chapter Three: The Status of Agricultural Information Services...43

List of Tables

List of Figures

Abbreviations and Acronyms

AAS	Agro-Advisory Service
ADB	Asian Development Bank
AEC	Agricultural Extension Component
AEC	Agricultural Extension Capacity
AEZ	Agro Ecological Zone
AGORA	Access to Global Online Research in Agriculture
AGRICOLA	Agricultural Online Access
AGRIINDEX	Agricultural Index
AGRIS	International Information Systems for the Agricultural Sciences and Technologies
AIC	Agricultural Information Center
AICC	Agriculture Information Communication Centre
AIS	Agricultural Information Service
ALA	American Library Association
AMIS	Agricultural Market Information Service
ARFIS	Agricultural Research Financial Information System
ARI	Agricultural Research Information
ARIS	Agricultural Research and Information System
ARISNET	Agricultural Research Information System Network
ARLIS	Agricultural Research Library Information System
ARMIS	Agricultural Research and Management System
ARPIS	Agricultural Research Personnel Information System
ASEAN	Association of South East Asian Nation
AVRDC	Asian Vegetable Research Development Center
BADC	Bangladesh Agricultural Development Cooperation
BAI	Bangladesh Agricultural Institute
BARC	Bangladesh Agricultural Research Council
BARI	Bangladesh Agricultural Research Institute
BASIS	Bangladesh Association of Software & Information Services
BAURES	Bangladesh Agricultural University Research System
BB	Bangladesh Betar (Radio)
BBS	Bangladesh Bureau of Statistics
BER	Bangladesh Economic Review
BFRI	Bangladesh Fisheries Research Institute
BFRI	Bangladesh Forest Research Institute
BIID	Bangladesh Institute of ICT in Development
BINA	Bangladesh Institute of Nuclear Agriculture
BJRI	Bangladesh Jute Research Institute
BLRI	Bangladesh Livestock Research Institute
BNNRC	Bangladesh NGOs Network for Radio and Communication
BPH-8	Brown Plant Hopper
BRAC	Bangladesh Rural Advancement Committee
BRKB	Bangladesh Rice Knowledge Bank
BRRI	Bangladesh Rice Research Institute

BSFIC	Bangladesh Sugar and Food Industries Corporation
BSRI	Bangladesh Sugarcrop Research Institute
BTRC	Bangladesh Telecommunications Regulatory Commission
BTRI	Bangladesh Tea Research Institute
BTTB	Bangladesh Telegraph and Telephone Board
BTV	Bangladesh Television
CABI	Commonwealth Agricultural Bureau International
CARIS	Current Agricultural Research Information System
CAS	Current Awareness Service
CASTT	Coastal Association for Social Transformation Trust
CBO	Community Based Organizations
CCC	Classified Catalogue Code
CD	Compact Disc
CDMA	Code Division Multiple Access
CD-ROM	Compact Disc Read Only Memory
CEAL	Community Extension Agent for Livestock
CEDA	Child Development Education Alliance
CFP	Central Focal Point
CGIAR	Consultative Group on International Agricultural Research
CIC	Community Information Centre
CIDA	Canadian International Development Agency
CR	Community Radio
CRS	Community Radio Station
CSISA	Cereal Systems Initiative for South Asia
CIMMYT	International Maize and Wheat Improvement Center
DAATJ	Digital Archive on Agricultural Theses and Journals
DAE	Department of Agricultural Extension
DAM	Department of Agricultural Marketing
DAM	Dhaka Ahasania Mission
DANIDA	Danish International Development Agency
DEN	Digital Equality Network
D.Net	Development Research Network
DoF	Department of Fisheries
DFRS	Desktop Fertilizer Recommendation Software
DFRS	Department of Forest Research and Survey
DLS	Department of Livestock Services
EDGE	Enhanced Data GSM Environment
FADO	Farm Adaptive Dynamic Optimization
FAO	Food and Agricultural Organization
FAS	Farm Advisory Service
FEWSNet	Famine Early Warning System Network (USAID)
FFS	Farmer's Field School
FGD	Focal Group Dissemination
FIAC	Farmers Information Advice and Center
FM	Frequency Modulation
FRILDC	Fisheries Research Institute Library and Documentation Centre

FSA	Future Solutions for Business
FSR	Farming System Research
FSRD	Farming System Research Development
GB	Governing Board
GDP	Gross Domestic Product
GIS	Geographical Information System
GNI	Gross National Income
GP	Grameenphone
GPCIC	Grameenphone Community Information Centre
GPRS	General Packet Radio Services
GSMC	Global System for Mobile Communication
HEQEP	Higher Education Quality Enhancement Project
HIES	Household Income and Expenditure Survey
HYV	High Yielding Variety
IAEA	International Atomic Energy Agency
ICAR	Indian Council of Agricultural Research
ICARDA	International Center for Agricultural Research in the Dry Area
ICM	Integrated Crop Management
ICT	Information Communication Technology
ICT4D	Information and Communication Technologies for Development
IGA	Income Generating Activities
INGENEAS	Integrating Gender and Nutrition within Agricultural Extension Services
IPCC	Inter Governmental Panel on Climate Change.
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
ISD	Information System Development
ISP	Internet Service Provider
IT	Information Technology
KCC	Kisan Call Centre
KR	Krishi Radio
LAN	Local Area Network
LEAF	Local Extension Agent for Fisheries
MEAS	Modernizing Extension Advisory Services
MFI	Microfinance Institution
MIS	Management Information System
MLP	Market Linkage Program
MoU	Memorandum of Understanding
M. Phil.	Master of Philosophy
M. S	Master of Science
MV	Modern Variety
NAIS	National Agricultural Information System
NARS	National Agricultural Research System
NATP	National Agricultural Technology Project
NGO	Non-Government Organization
NICTP	National Information and Communication Technology Policy

NMS	National Media Survey
O&M	Operations and Maintenance
OPAC	Online Public Access Catalogue
P C	Personal Computer
Ph. D.	Doctor of Philosophy
PK	Pallitathya Kendra
PRSP	Poverty Reduction Strategy Paper
PSTN	Public Switched Telephone Network
RAS	Readers Advisory Services
RDA	Rural Development Academy
RKC	Rural Knowledge Centre
SAARC	South Asian Association Regional Cooperation
SME	Small and Medium Scale Enterprises
SAC	SAARC Agriculture Centre
SADC	Southern African Development Community
SCA	Seed Certificate Agency
SDI	Selective Dissemination of Information
SEBA	Society for Economic and Basic Advancement
SMS	Short Message Service
SOLARIS	Soil and Land Resource Information System
SPSS	Statistical Package for Social Sciences
SRDI	Soil Resource Development Institute
TEEAL	The Essential Electronic Agricultural Library
TPS	True Potato Seed
UDC	Universal Decimal Classification
UGC	University Grants Commission
UISC	Union Information and Service Center
UNDP	United Nations Development Programs
USSD	Unstructured Supplementary Service Data
VKC	Village Knowledge Centres
VOIP	Voice Over Internet Protocol
VRC	Vocational Rehabilitation Centers
VSAT	Very Small Aperture Terminal
WAN	Wide Area Network
WB	World Bank
WWW	World Wide Web
YCMC	Youth Community Multimedia Centre
YPSA	Youth Power in Social Action

Chapter One

Introduction

1.1 Introduction

Agriculture in Bangladesh is greatly blessed by favourable agroclimatic conditions where wide ranges of crops and other agricultural commodities are grown successfully. Information and Communication Technologies have proved to be a significant indicator to enhance agricultural production through introduction of farm technologies. Currently Bangladesh has accelerated its efforts in using ICT for its agricultural development programs. However, the role of ICT in the field of agricultural information dissemination is yet to be fully realized to receive the maximum benefit. Realizing the fact, the study has been undertaken on how ICT influences the production system, how the role of ICT can be enhanced in the total production system and what measures can be taken to disseminate the agricultural information to the farmers. The study takes account of the adaptation that ICT should greatly contribute to the access and utilization of agricultural information as well as technologies. Bangladesh is slowly but steadily coping up with ICT tools particularly in the areas of farmers' information delivery in the backdrop of a number of challenges including inadequate infrastructure facilities, lack of awareness, lack of ICT literacy etc.

Agriculture is a dynamic sector in Bangladesh which needs regular adaptation of new farm technologies in order to meet the growing demands of diversified food items and other related production inputs. About 80 percent of the total population is based on the rural areas and 70 percent is directly or indirectly dependent on agriculture as a source of livelihood in a wide range of agricultural activities. The agricultural sector contributes to around 15.96% (FY 2014-2015) (BBS, 2015) of the country's Gross Domestic Product (GDP) and generates employment for 47 percent of the total labor force (BBS, 2013). Increasing agricultural production for growing people is a major challenge for present agriculture. The production system is smallholder dominated with average farm size of 0.6 hectare (BBS, 2009). These small holding farmers need to intensify and diversify farming through acquiring adequate knowledge and information. Proper dissemination of information for agricultural and rural communities is a crucial task. Dissemination of relevant information to the farming communities can facilitate the effective adoption of agricultural inputs, decision making on markets and adoption of scientific methods (Kiplang'at,1999). Efficient farming is often constructed due to limited scope to access the knowledge and information in appropriate and

timely manner. So reducing the gaps that exist in productivity between the research stations and farmers' fields in agricultural information service delivery is very important to fight against poverty and hunger. The gap in yield is sometimes called as knowledge gap between researchers and farmers.

Table 1.1: Yield gap of major crops 2008-2010 (t ha^{-1})

Crop	Potential yield at research	Demonstration	Farmers' practices	Yield gap
Aus rice	9.00	4.85	3.50	1.35
Aman rice	9.00	7.05	4.00	3.05
Boro rice	9.00	7.85	4.80	3.05
Wheat	4.00	3.00	2.12	0.88
Mustard	1.50	1.00	0.73	0.27
Lentil	1.65	1.40	0.75	0.65
Mung	1.17	0.75	0.68	0.07
Black gram	1.50	1.30	0.76	0.54
Grass pea	1.63	1.00	0.84	0.16
Sugarcane	54.00	48.60	38.47	10.13

Sources: *Kashem et al.(2008-10)*

This study is designed to find the impact of agricultural information dissemination through ICT. Information is the time winning resource for the development to all the professionals, scientists and farmers as well. Similarly, Diso (1994) holds, "As a matter of policy, information must be seen as a basic resource for development if durable structures are to be provided for effective access and utilization, which entails information capturing, coordination, processing and dissemination." This dissemination becomes more important when arable land is decreasing due to urbanization and industrial use. On the other hand, the agriculture sector faces major challenges in enhancing production like pests and diseases or climatic hazards like submergence, salinity, drought, heat, cold, soil toxicity etc. The major focus of the production system is increasing production with less land, less water, fewer chemicals and less labour in the context of global climate change. Climate change, coincident with increasing demand for food, fiber and other essential commodities has the potentials to irreversibly damage the natural resources on which agriculture depends with significant consequence of food insecurity.

The farmers of Bangladesh are in need of the site specific modern information on production and protection technologies of different agricultural commodities, agro-climatological advisory services and market information and so on. The farmers utilize multiple sources to obtain their desired information. But the availability of timely information to the rural community which is inadequate, has created problems not only in production process but also in marketing of their products. These problems related to production, processing and marketing could have been solved to a greater extent when farmers receive information in right time from a reliable source at community level.

1.2 Background of the Study

Agriculture is the art and science of cultivating the soil, growing crops and raising livestock. It includes not only foodstuff but also raw material of medicine, furniture, agri-business industries, machinery, dairy, poultry and fisheries industries. It provides people all over the world with food, meat, fish, sugar, spices, fruits and manufacturing material. Agriculture provides most of the world's food and fabrics. Cotton, wool, tobacco, edible as well as non-edible oil and leather are all agricultural products. Agriculture also provides wood for construction, and paper products (http://education.nationalgeographic.com/encyclopedia/agriculture/).

The term 'agro' has stemmed from the Greek word 'agros' meaning field, which has led to its current usage meaning anything that falls under the 'agricultural' category. Agro-products mean raw and finished goods under the classifications of plants, animals and other life forms. These are the life force, the very source of survival for the human kind. It is not only source of food but a major chunk of the world population is also dependent on agriculture as their source of survival. An approximate 36% of the world's workers are engaged in agriculture with Bangladseh's 70% of the population being directly and indirectly employed in this sector.

From very ancient times agriculture has been the main source of the livelihood of the vast majority of the population of the territories that constituted the Bengal province as in 1911, and in the two parts into which this province was subsequently divided independent Bangladesh and West Bengal under the Indian Union (Islam & Jamal,2012). The landmass of the country is mostly of delta formations. People over the centuries have been cultivating, preserving, and using more than 1364 plant species coming from both endemic and exotic origins, for about 85 diverse uses. There are about 175 species of medicinal herbs. Ethnic groups, distributed in different areas, have been involved, over centuries, in collecting and preserving the highly rich biodiversity to meet their needs.

The total land area of Bangladesh is about 14.3 million hectare of which about 59.8% is available for cultivation(Islam,2003). About 8.0 million net land is available for cultivation with cropping intensity of 191% (meaning one unit area of land used for different crops). There are 1,51,83,183 farm holdings in Bangladesh whereas 51% of the cultivable land is mono cropped, 36% double cropped and 13% tripled cropped. Depending on the flooding depth, the land is categorized as highland (20%), medium highland (39%), medium lowland (15%), lowland (8%) and very lowland (2%). The average size of a holding is about 0.5 hectare. In form, each holding consists of a few pieces of land which generally range from 0.1-0.2 hectare (BBS, 1996). Based on physical environment relevant to land use, the land is divided into 30 agro-ecological zones and 88 sub-regions (Hossain,Chowdhury & Chowdhury,2012).

Agricultural land is declining for fragmentation, industrial occupation, human settlement and river erosion. It is fragmented into small pieces because of the huge number of farm holdings. Human population in Bangladesh is increasing very first. For this reason, agricultural land is declining at an alarming rate. During the decade of 80's, only 15% land in rural areas was being used as dwelling houses and non-agricultural /off farm activities, but now, it has been increased to 30%. During 1983-1984 the total cultivated area was 2 crore 2 lakh and 38 thousand acres. In 1996, it has been decreased to 1 crore, 74 lakh and 49 thousand acres. The agricultural land declined by 0.26% per year between 1976 and 2010, including an acceleration to 0.45% per year between 2000 and 2010 (Hassan et al.,2013). The major crops cultivated in the country are rice, wheat, maize, sugarcane, potato, jute, pulses, oilseeds, spices and vegetables. Cereals and potato production fulfils the country's requirement. Rice has now surplus. Other crop productions are deficient in the country. To meet the demand, a huge amount of foreign currency is spent for importing sugar, pulses, oilseeds and spices every year. The deficiency of some crops can be minimized through increase of production in a suitable land with a minimum cultivation cost. For that, it is important to identify and delineate suitable area for growing particular crop in order to harvest maximum potential yield.

Agriculture was considered to be the backbone of the Bangladesh economy at the time of its independence since about half of its gross domestic product (GDP) would come from this sector. Over the years the contribution of the agriculture sector to GDP has declined due to the structural change of the economy. With the dominance of the service sector followed by the industrial sector, agriculture is now positioned in the third rank with a contribution of about 20 percent in the GDP.

Despite a relatively lower contribution in the national income, the importance of the sector is still very critical from the point of its role to employment generation and poverty reduction.

Following independence in 1971, agricultural production in Bangladesh increased at around the rate of 2% per year. The growth rate accelerated during the 1990s and early 2000s to around 4% per year. The Sixth Five Year Plan sought to build on the success of such rapid agricultural growth, and a remarkable 5.1% growth was achieved in 2010-11. However, this momentum could not be sustained subsequently and the growth rate fell sharply in 2011-12 to 2.7% and weakened further to only 2.2% in 2012-13. The drop in performance was largely due to slower growth of the crop sub-sector.

Table 1.2: Contribution of Agriculture Sector to GDP (in percentage) (Constant Price According to Financial Year)

Sector and Sub-sector	2001 -02	2002 -03	2003 -04	2004 -05	2005 -06	2006 -07	2007 -08	2008 -09	2009 -10	2010 -11	2011 -12	2012 -13	2013 -14	2014 -15*
Crop	13.75	13.43	13.23	12.51	11.10	11.08	10.88	10.63	10.79	10.50	10.01	9.49	9.28	8.83
Fisheries	5.40	5.25	5.11	5.00	3.67	3.75	3.79	3.78	3.73	3.73	3.68	3.68	3.69	3.69
Livestock	2.96	2.93	2.91	2.95	2.38	2.27	2.19	2.13	2.06	1.98	1.90	1.84	1.78	1.73
Forestry	1.88	1.86	1.83	1.82	1.86	1.83	1.82	1.82	1.81	1.79	1.78	1.76	1.74	1.72
Total	**23.99**	**23.47**	**23.08**	**22.28**	**15.33**	**15.17**	**14.89**	**14.58**	**14.65**	**14.27**	**13.70**	**13.09**	**12.81**	**12.27**

Note: From FY 2001-02 to FY 2004-05 Base year is1995-96, and from FY 2005-06 to FY 2044-15 Base year is 2005-06; * FY2014-15 data is provisional
Source: BBS, 2015 (Provisional data)

Bangladesh is endowed with a climate favorable for the cultivation of a wide variety of both tropical and temperate crops. Though nearly 100 different kinds of crops are presently grown in Bangladesh, rice is the principal one which grows in all the three crop growing seasons of the year and covers about 77 percent of the total cropped area of about 13.7 million hectare. High yielding varieties cover about 75 percent of the total rice area. For example, Bangladesh Rice Research Institute (BRRI) maintains about 8,000 rice land races in the gene bank collected from different parts of the country. Other important crops are wheat, jute, potato, oilseeds, pulses, tobacco, cotton, sugarcane, fruits, and vegetables. Crops in Bangladesh are grown both under rain fed and irrigated conditions. Irrigated agriculture is usually associated with improved technologies like HYV's, high fertilizer doses, and improved management practices. Consequently, the productivity of irrigated agriculture is high, and more or less stable with an assured water supply.

However, rainfed agriculture is dominant, since nearly 60 percent of the net sown area is dependent upon rain as a source of water for crop production. Traditional practices, local varieties, and low levels of inputs and management are associated with rain fed agriculture. Productivity in general is

low, and year to year fluctuation in production is large. Both moisture deficiency and excesses of rain contribute to instability in agricultural production. Biodiversity in Bangladesh is very rich including aquatic animals. Similarly, for other crops and fisheries Bangladesh maintains heritage of wide ranges of diversity.

Table 1.3: Food grains production

(In lakh MT) Food grains	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15 (Target)
Aus	15.12	22.93	21.00	21.33	23.33	23.32	21.58	23.26	23.28
Aman	108.41	110.02	122.25	127.91	127.98	127.98	128.97	130.23	131.90
Boro	159.90	186.77	182.87	185.25	186.17	187.59	187.78	190.07	189.77
Total Rice	283.43	319.76	326.12	334.03	335.41	338.90	338.33	343.56	388.95
Wheat	7.25	9.56	9.58	9.69	9.72	9.95	12.55	13.02	13.33
Maize	8.99	23.69	11.37	8.87	15.52	19.54	21.78	25.16	25.21
Total	**299.672**	**352.93**	**347.07**	**358.12**	**360.65**	**368.65**	**372.66**	**381.74**	**383.49**

Source: Bangladesh Economic Reveiew 2015

A spatial and temporal arrangement of crops within a cropping year is largely determined by physical, biological, and socio-economic factors. There are three cropping seasons - Rabi, Kharif-I or Pre-Kharif, and Kharif-II. Crops of different characteristics grow on different seasons.

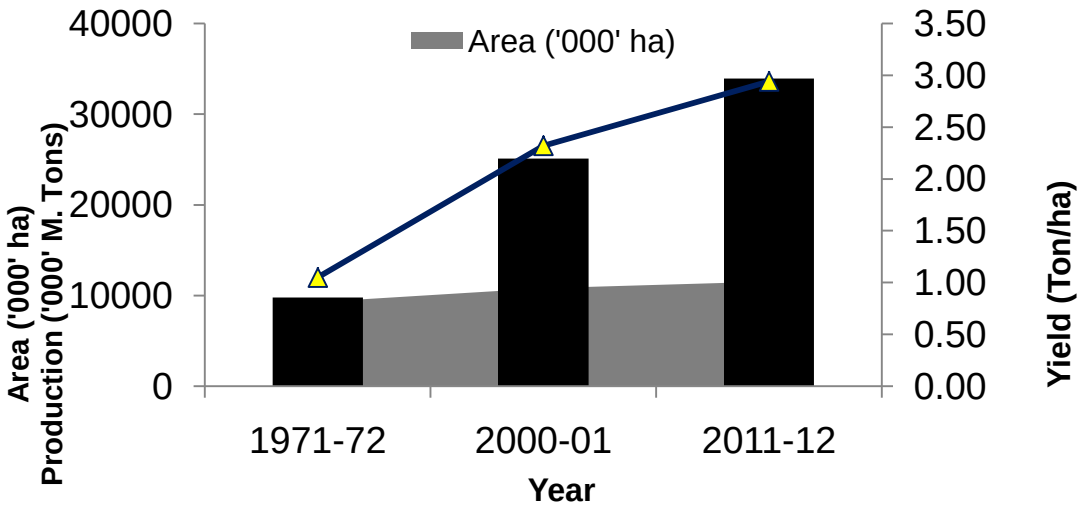

Figure 1.1: Trend of production and yield of total rice (Source: BBS, 2013)

The mechanism to reach agricultural products, inputs and services to target groups include producers, consumers and intermediaries. A huge number of people are engaged in the marketing of agricultural products like rice, jute, vegetables, fruits, cattle, milk, poultry, eggs and fish. The history of agricultural marketing is as old as agriculture. Exchange of commodities had been prevalent in

Bengal's agrarian society but the reinforcement of cash economy during British rule made agricultural marketing easier and eliminated many of the problems of conversion.

Application of input, skills, tools and machines for agricultural purposes is a universal phenomenon. Agricultural technologies affect and are affected by the society that uses them, and the importance of technological development can only be evaluated after consideration of a variety of social and technical factors. Agricultural operations in Bangladesh are more of the traditional rural type and are profoundly affected by local conditions of weather, soils, water, pests and diseases, and by land tenure systems. Most agricultural lands are fragmented and the farmers do not generally use as such modern implements. The indigenous technology practised by the farmers of this subcontinent for centuries, in some form, are still in use in rural agriculture.

Agriculture is facing new and severe challenges in its own right. With rising food prices that have pushed over 40 million people into poverty since 2010, more effective interventions are essential in agriculture (World Bank, 2008). The growing global population, expected to hit 9 billion by 2050, has heightened the demand for food and placed pressure on already-fragile resources. Feeding that population will require a 70 percent increase in food production (FAO, 2009).

Information and communication have always mattered in agriculture. Ever since people have grown crops, raised livestock, and caught fish, they have sought information from one another. Farmers always have been puzzled with the most effective planting strategy on steep slopes and where they can buy the improved seed or feed this year or how they can acquire a land title or who is paying the highest price at the market or even how they can participate in the government's credit program. Producers rarely find it easy to obtain answers to such questions, even if similar ones arise season after season. Farmers in a village may have planted the 'same' crop for centuries, but over time, weather patterns and soil conditions change and epidemics of pests and diseases come and go. Updated information allows the farmers to cope with and even benefit from these changes. Providing such knowledge can be challenging, however, because the highly localized nature of agriculture means that information must be tailored specifically to distinct conditions.

The 21st century is well-known as the information society era characterized by the acquisition, development, storage, use and sharing of information and knowledge (Kavulya, 2007). An information society can be defined as a society in which the use of ICT plays an important role in

how people live. In the information society, people's lives interface with ICT in different ways, in the way they work, relax and sustain themselves (Bannister & Remenyi, 2003).

Bangladesh has stepped into the new era of Digital World with a spectacular vision for making Digital Bangladesh. This vision would be saddled by E-Agriculture involving multidisciplinary initiatives of Agricultural Informatics, Agricultural Development and Entrepreneurship towards building a hunger-free, efficient and resourceful Bangladesh. The National Agricultural Extension Policy is currently under revision in the new version where e-agriculture has been added as one of the nine principles of the policy. The policy includes improving the Public Private Partnerships in extension, improving the research-extension-farmer linkage.

There are many technologies developed by the research institutes remaining in the shelves and they need to be transferred to the end users. Unprecedented advances (Hoq, 2011) are seen in ICT initiatives in all fields including agriculture.Therefore, there is a need to realize the potential of ICT for all relevant users including farmers in order to achieve agricultural development process. In this connection, Islam (2006) investigated the activities of major traditional and technology based rural information and thus emphasized information professionals of the country to work together to develop a comprehensive rural information service infrastructure. In addition, a few studies have focused on the use of ICT to accelerate technology transfer in agriculture. Today, a new paradigm of agricultural development is fast emerging in developing countries like Bangladesh where ICT plays a key role in accelerating the availability of transferring technology in agriculture. The different ICT tools used by the agricultural scientists, extension professionals, policy makers and farmers should be studied to accelerate agricultural production system. But the conventional facilities are not enough for addressing all sorts of gaps. Studying how to accelerate existing ICT use with its enhancing role is needed.

Government has taken a number of steps like production of improved quality and high yielding varieties of seeds, development and expansion of the draught and saline tolerant varieties, short duration crops and varieties of crops adaptable to the weather and environment of a particular region, expansion of small irrigation facilities, reduction of water logging, (IPM) for pest control etc. Cultivation of short duration (highest 110 days) crops help reduce food scarcity in mongaprone (drought) areas and generate employment. Steps have also been taken to scale up subsidy on agricultural inputs, ensure fair price and supply of agricultural inputs. The Government has taken an initiative to introduce a Crop Insurance Scheme to provide the farmers of small and medium land

holding with crop price support in the event of crop failure due to natural disasters. In addition, an endowment Fund has been established to provide support to increase productivity through diversification of crops. Apart from this, the Government has distributed input assistance cards to 143.75 lakh farmer families of the country (Bangladesh Economic Review,2015).

Improvement of agricultural production, profitability and sustainability depends on the farmers to adopt change and their innovative use of technologies and availability of resources. Access, efficiency and affordability of agricultural information are the major barriers in the battle to uplift agricultural productivity among small scale farmers (Muriithi et al., 2009). In Bangladesh, agricultural information services that are being provided by Government, NGO, private organizations, agricultural research organizations and advisory centers, are increasingly involved in orienting services towards the specific needs of the rural service delivery. There are a number of attempts undertaken by the public and private organizations and many NGOs to accelerate the dissemination of appropriate technologies to the end users. A number of Government organizations like Agriculture Information Service (AIS), Department of Agriculture Extension (DAE), Department of Livestock Service (DLS), Department of Fisheries (DoF), Department of Marketing (DAM), AIS, National Agricultural Research System (NARS) and NGO, private sector, public and private TV channels, Bangladesh Betar (radio) and Community Radio are engaged in improving farmers livelihood by their programs. In this field, DAE and AIS under Ministry of Agriculture play a important role. DAE effectively started using ICT for delivering agricultural information services for the agriculture.

Now it is the time to investigate whether the role of ICT in agriculture is enhanced for the overall increase of production and standard livelihood of the farmers. This thesis is aimed at examining the role of 'Information & Communication Technology (ICT) in disseminating information on agricultural service delivery systems and technologies and its contribution to the access of information to the farmers in Bangladesh. The poor and illiterate farmers of developing countries like Bangladesh adopted old and traditional farming methods for the cultivation. But in the last decades farmers have improved the productivity through introduction of ICT in farming by proper intervention of public and private organizations. This made Bangladesh come out of chronic food deficit to self-sufficient country.

1.2.1 Information Communication Technology (ICT) in Agriculture

ICT is required to be defined first. The definition of ICT seems to be subjective. Different scholars have different opinions on what to include and what not to do in the definitions of ICT. This may be because information and communication technologies are expanding and advancing at accelerated rate day-by-day. As a result, what may be included in the definition today may not be the same as what will be included tomorrow. ICT is an umbrella term that includes any communication device or application, encompassing radio, television, cellular phones (mobile), computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them, such as videoconferencing and distance learning (http://searchsmb.Techtarget.com2006). Rao (2007) defines ICT as a range of technologies that integrate information technology devices like personal computers with communication technologies such as telephones and telecommunication networks. Both the range of the technologies and their convergence with conventional media are expanding all the time. For the purpose of this study, information and communication technologies are defined as a range of technologies that consist of hardware, software, networks and media that facilitate the collection, storage, processing, transmission, retrieval, presentation and communication of information (voice, data, text, images) using electronic means. This definition encompasses both the new ICT such as e-commerce, websites and computers and the traditional ICT such as radio and television, as well as the various services and applications associated with them.

The new Information Communication Technologies (ICT) are bringing about the facilities to the door steps of the farmers and sustain this revaluation by empowering the resources. Thus resource poor farmers are getting updated with knowledge and information about agricultural technologies, best practices , markets, sources of finance, weather, soil- moisture conditions and the environment (Singh, 2006).

The term 'ICT' has been developed since the 1980s, when it was popularized in the United Kingdom. ICT is different from information technology (IT) because it enchances the role of communications and the integration of telecommunication networks and computer networks (Malone et al., 2013). Information Communication Technologies (ICT) were properly recognized by the world leaders as a key element or development enabler in the World Summit on Information Society (WSIS) in Geneva and Tunis in 2003 and 2005 respectively (Tunis commitment, 2005). Bangladesh is not the exception of those countries which give ICT use in high priority in every sector including agriculture. The current government's 'Digital Bangladesh' by 2021 vision justifies this statement. The key objective

of the Digital Government is to leverage ICT in all spheres of government to ensure delivery of services to those who are the least served. Accounting for 15.96% of the GDP, agriculture and rural economy play a strategic role in accelerating economic growth and alleviating poverty in Bangladesh where 70% of the workforce is absorbed by agriculture. Naturally this sector gets the highest emphasis on the e-services strategy of 'Digital Bangladesh'. Speciffically 'e-Agriculture' is an emerging field where Information and Communication Technologies or ICT (Radio, TV, Cell Phone, PDAs, PCs) can help farmers boost productivity by giving them access to vital information, such as weather forecasts, crop advice and market pricing. This digitalization empowers the farmers by establishing linkages with policy makers and promote growth or agri-businesses and rural enterprises by connecting the country with the international market. To fulfill these objectives, the Ministry of Agriculture and UNDP developed e-Krishi vision 2021. E-Krishi focuses on leveraging easily accessible ICT including cell phones, radio, TV. etc. to enhance and develope agriculture. The e-Krishi vision 2021 is an output of a comprenshive effort of the Ministry of Agriculture, the Ministry of Fisheries and Livestock and the Agriculture Vision Team of the 'Acess to Information (a2i)' Programme of the Prime Minister's Office with technical assistance from UNDP.

The use of ICT in Bangladesh Agriculture has started since 2003.That year, Support to ICT taskforce program was launched by the Ministry of Agriculture. Perhaps it would be the first initiative to set up an Agricultural Information System. D.Net, an NGO developed an idea of 'Pallitathaya Help Centre' in 2005. While implementing, they found it most challenging to understand the problems related to agricultural information of rural people.

The government so far has taken various innovative steps towards e-Krishi such as the department of agriculture marketing website, AICC by AIS (MoA), AIS Website (www.ais.gov.bd) as an important website by MoA, the BRRI Rice Knowledge Bank, E-Fertilizer Recommendation Guide (online) and the Soil and Land Resource Information System (SOLARIS) by Soil Resource Devlopment Institute, Farmers Information and Advisory centre (FIAC) by NATP (MoA), E-Livestock by (DLS, MoFL), Mati o Manus (Soil & Man), Desh amr mati amr and Sonali Fasal initiated by BTV, Amar Desh, Krishi Samachar by Bangladesh Betar. Krishi Radio 98.8 in Borguna is conducted by AIS (MoA), Agricultural Call Center (16123) is an initiative by AIS (MoA). Previously it was toll free but now each call costs 0.25 TK. National E-Information hub is an important govt. e-portal. SMS for sugarcane farmers – Purji by A2i and BSFIC is a vital service for the rural farmers. Thirty GIS based crop zoning map is the first AEZ map in Bangladesh and it is undertaken by BARC.

Private sector and NGOs have also taken many initiatives such as Gonokendors at BRAC, D.NET–Pallitathaya Kendra, GP-Communication Information Centre, RDA (Bogra), Dam (gonokendro), Ghat-Rural ICT centre, YCMC (Youth Community Multimedia Centre), RTC of Practical Action, Amader Gram of BEFS, BNNRC, Farmer's query system in an important initiative commenced by mPower uses mobile technology, Bd FISH is a web based platform for sharing fisheries information. Mobile operating company Banglalink launched 'Banglalink Jigyasa 7676' Bangladesh Computer Council, Hridoye Mati o Manus by Channel I. 'InfoLady' is a rural woman entreprenuer trained and equipped with bicycle, netbook, and other accessories, by USAID-funded Cereal Systems Initiative for South Asia (CSISA), Batighar centre, E-Krishi by Bangladesh Institute of Information Development (BIID) and Coast Bangladesh etc. Ridoye Mati O Manush by Channel i, Green home, CIC by grameen phone, infolady, cell bazar, Miaki Call Center, Plant Doctor by Susilon.

Knowledge and rural innovations are now widely regarded as key drivers of economic growth and it is clear that Information and Communication Technologies (ICT) are deeply implicated in knowledge flow and innovation (Verlaeten, 2002). By recognizing the fact, AIS under MoA has recently established many ICT based initiatives like Agricultural Information and Communication Centre (AICC) in different rural areas which is the main research area in this study. The best farming practices of that particular area are emphasized and much information service is disseminated among the entire area. Market linkages are established for proper pricing and access to modern agricultural information has been made available at the doorstep of the farmers. All these services are delivered through a committee formed in Agriculture Information and Communication Centre (AICC).

In Bangladesh the usage of ICT enabled services in agriculture evoled during last 10 to12 years followed traditional trends, strarting from mass media, fixed telepony, mobile and finally through internet. The recent revolution in ICT industry, specially due to massive penetration of mobile phone and digital Bangladesh initiative contributed ICT use in agriculture significantly.

Developing a one-stop-shop approach with Farmers' Information and Advice Centres (FIAC) has been introduced as an innovative approach established in selected Union Parishads (grass root level). Some of 600 FIACs are equipped with ICT set up and these centers are the research area of the present study. The FIAC has been found to be effective while delivering important services and running under one project. Furthermore, the Prime Minister's Office is spearheading the Digital

Bangladesh concept. For example, Access to Information (A2i) links up each Union Information Center by internet to give better access to information services including agriculture. UISC which is governed under A2i project is one of the ICT centers undertaken in the study.

The e-Krishok has been initiated by BIID for the farmers' services in farming activities and facilitating market linkage opportunities. Different types of agricultural programs telecast through a number of TV channels and broadcast by different radio stations. Besides, there are nearly 15 community radios across the country side providing information services by different agricultural region wise programs to the farmers. The only one agricultural community radio located at Amtoli Upazila Complex in Borguna district is operated by AIS under MoA. The Agricultural Call Centre is jointly organized by AIS and Practical Action, Bangladesh providing better access to agricultural information to its huge clients across the country . AIS has also been improving agricultural information to farmers in various modes in both print and electronic media including a user friendly website (www.ais.gov.bd) in Bangla language.

Different National Agricultural Research Systems under MoA and MoLF have taken a number of mobile and web based initiatives mostly using ICT to transfer technologies to the farmers. Mobile based initiatives provide farmers with SMS services. Different dynamic web based approaches have been successful. These information service delivery systems are found effective among the ICT oriented farmers. On the other hand, the traditional farmers who are not blessed with information technology services remain backward in farming; and their production and income varies from that of the farmers of ICT service area. Thus the current study will draw a line of action in designing future approach of ICT based technological improvement among diversified groups of farmers in major agro-ecological regions of the country.

1.3 Hypothesis of the Study

A hypothesis is a proposed explanation for a phenomenon. It is a wild guess or educated prediction of an area that can be tested. A hypothesis is used in an experiment to define the relationship between two variables. The purpose of a hypothesis is to find the answer to a question. A formalized hypothesis will force researcher to think about what results we should look for in an experiment.

To formulate the hypothesis for the present study, the independent and dependent variables are required to be identified. The farmers of ICT and non-ICT based service areas are regarded an independent variables and their production and income are thought to be dependent variables.

Spcific nature of the relationship exists between these two types of variables. From the relationship, the study determines two hypotheses. Based on the objectives of the study, the following hypotheses were stated in the null form:

1.The use of ICT in agriculture does not enhance farmers' production & income

2.The use of ICT does not assist farmers to adopt new technologies

A hypothesis is not only testable but it must also be falsifiable. The relationship between the use of ICT in farming and the production and the income of the farmers need to be tested and it will be false if we say, there is no relationship between two things. Testing result- the differeces or the sameness will come out after the testing is done. Then hypothesis formulating or determining null hypothesis will be successful. So, testing the determined hypotheses is important in the study. The present research will adopt different types of t- test like co-efficient, regression, difference-in-difference (DiD) model and chi-square test to test the hypotheses in the later chapter.

1.4 Research Question & Objectives of the Study

The central research question of this study may be specified as the following:

How Information and Communication Technology tools are being used to enhance the delivery of timely agricultural information to the farmers of Bangladesh. Or how the role of ICT can be enhanced further for the proper dissemination of agricultural information to the farmers of Bangladesh for increasing agricultural productivity.

Additionally, the main question leads to four sub-questions:

1. What is the role of ICT in disseminating agricultural information services to farmers?
2. What factors need to be considered for enhancing the role of ICT in agricultural information delivery systems at present ?
3. How can Information and Communication Technologies help farmers increase their production?
4. How can the outcome of this study be implemented on a wider scale?

The research focuses the following objectives.

1. To analyze the existing information dissemination systems both of ICT and non-ICT based farmers

2. To assess the impact of ICT initiatives on agriculture including fisheries and livestock
3. To review the current agricultural information disseminating programs using ICT
4. To analyse the influence of the use of ICT in agricultural production
5. To design an appropriate ICT based model of agricultural information and knowledge delivery systems

1.5 Scope of the study

This thesis is framed within the research area of Information and Communication technology for disseminating agricultural information to the farmers all over Bangladesh that is concerned about how ICT can help poor farmers to get the appropriate information. It will ultimately play an appropriate role in increasing their production and can make a difference to the lives of the poor farmers.

1.6 Significance of the Study

The results of the study will be relevant to policy makers, researchers, students, academicians– especially those who will undertake study topics focusing ICT and agricultural information dissemination. From a policy perspective, the findings of the study could help ICT providers, policy makers, information provider, agriculture extension personnel, rural community leaders, administrators and the Bangladesh Government to develop better strategies in addressing challenges faced by the farmers of Bangladesh in applying ICT in the access and utilization of agricultural information by the farmers. A number of poor farmers still use traditional methods inherited from their descendants. These methods are sub-optimal as far as production efficiency is concerned and can result in low crop yields. This study may inspire and encourage farmers to acquire valuable information and eventually adapt their rural lifestyle. As a result, farmers' livelihoods may be improved and agriculture will become more sustainable. The farmers and other agriculture producers will be benefitted from the recommendations of this research aimed at improving their agriculture output. These issues on the significance needed examination to ascertain their impact on the success or otherwise of ICT application in accessing and utilizing agricultural information by the farmers of Bangladesh. The overall inspiration is that the farmers of Bangladesh should have better access and utilization of agricultural information in the help of ICT for modernizing and enhancing their production.

1.7 Organization of the Study

The present study is designed to look into an important aspect on the prevalent ICT initiatives in Bangladesh. That is, it investigates the use of ICT in agriculture and the production as well as the income of the farmers of two service areas. The thesis containing the study has been logically progressed and organized in eight (8) chapters.

Chapter One is a general introduction to the whole work. The statement of the problem and objectives of the study have been presented in this chapter. It specifies the research focus by articulating a set of research questions relating to the farmers of both service areas and their income and production. It also draws out the significance of the study from different perspectives. The chapter asserts the purpose of the study. Finally, it delimits the scope of the study and concludes with its utility.

Chapter Two is devoted to a detailed analysis of different ICT initiatives that address the farmers' information needs. This chapter reveiws different ICT tools used in agricultural information dissemination, the influence of print media, the impact of internet based initiatives and the practicality of agro-metrological initiatives and sheds light on important books, journals, periodicals and MPhil/PhD dissertations on agriculture in the respective field.

Chapter Three shows the status of existing information services in Bangladesh on the ICT tools and technologies that result into acceleration of income and production. It dicusses the agricultural information service delivery systems in Bangladesh. The main ICT centers like AICC, FIAC, UISC, CR/KR and many other small initiatives are brought into light of this chapter. It analyses different electronic media based services like different radio stations and programmes, different television channels and programs. The chapter put different print media-based initiatives, web-based services on dissusion. Telephone and mobile based services are also linked up with the chapter.

Chapter Four elaborates the techniques and methods that were adopted to sample the respondents of the traditional and the ICT service areas and collect and analyze the data of this study. The chapter looks to the selection of sample size and sampling techniques. It also discusses sampling strategies, data collection methods and procedures, unstructured interview and Focus Group Discussion and the ways how data will be analysed and presented.

Chapter Five deals with the summary and the findings of focus group discussions. Fifteen focus group discussions are held among the farmers, extension personnel and the researcher on certain agenda at fifteen places. The chapter also discusses the summary and major findings of these FGDs.

Chapter Six concentrates on the presentation and interpretation of the results of this study. This chapter contains a summary of the findings and the discussion of the data. It presents the personal profile of the respondents with their age, education, gender, farm holding, agricultural equipment, ICT tools. The chapter goes deep into economic feature of the respondents of the two service areas, the source of their income, the profit of the annual ncome and draws a comparative analysis of the income of the farmers of two types. It also shows corelation, regression, chi-square test and DiD model of the farmers' income and production. The chapter illustrates access to radio, television and computer, their programs and uses. The chapter compares the present income with the past one. Most used pest management technology, information sources of quality fingerling, vaccination of livestock and many other things. It includes agricultural works our woman are involved in, their training, the problems they are faced with and their decision on selection of crop types & other things. The impact of ICT in agricultural development along with the most needful technology to boost agriculture productivity, the technologies learnt from ICT based information centre and many other things are discussed in the chapter.

Chapter Seven includes a model plan on the agricultural information dissmenation services. It discusses designing an international standard model sothat it can be implemented in future.

Chapter Eight contains a summary of the findings and discussion of the conclusions that may be drawn together with recommendations for the improvement of agriculture in Bangladesh, on the one hand and for subsequent research, on the other. The thesis concludes in chapter eight with discussion of the agricultural implications of the study, an acknowledgement of its limitations, and finally a number of suggestions for future research directions.

1.8 Conclusion

This study is expected to contribute a lot of the improvement in agriculture of Bangladesh. Besides, the agriculture scientists, researchers and policy makers will be benefited from different perspectives of the thesis. It will expand a helping hand for them to make proper guidelines for future generations. Moreover, the study will help the researchers widen her horizon of knowledge making more confident and competent. Thus it is reseacherser's expectation to serve the nation through quality service. And finally, it will help the nation in the time to come. In first chapter, the general context and the research problem of this study have been explained. Then, the organization of the dissertation is outlined and the research questions are articulated.

Finally, the significance and the rationale for the study are presented, and the background of ICT initiatives in agriculture has also been detailed in the present study. The next chapter clarifies basic concepts and explores theoretical and methodological advances pertaining to the uses of ICT initiatives in farming factors and their influence on farmers' production and income. An extensive discussion of studies in other research areas that influence and shape the present study is also included in the next chapters.

Chapter Two

Literature Review

2.1 Introduction

The purpose of literature review is to enhance the role of ICT for disseminating agricultural information to the farmers of Bangladesh. The previous related studies conducted in different parts of the world have been reviewed in this chapter. These are examined with a view to providing a focus for this study and for the answers to the research questions. This chapter presents the literature review and places the relevance of the previous research to this study. The contributions of the present study to the exiting body of literature are also discussed in this chapter.

In recent years, there has been an increasing interest amongst scholars, agriculturists, and extension personnel alike in the role of ICT in agriculture. Therefore, literature in this field is expanding day by day. Besides lots of books, dissertations, journals, articles and information from online sources are available on the issue. All these have been studied with a view to gaining insight into the complex dimensions of the use of ICT and the influences on their production and income. Many studies on the use of ICT based services in the country as well as other parts of the world have also been reviewed for this purpose. Moreover, the studies that are very much relevant to the present study are presented in this chapter.

The chapter is divided into different sections providing a review of literature relevant to the present research area. It focuses on the literature dealing with the role of Information Communication Technology (ICT) in agricultural information dissemination. For systematic approach, the literature was reviewed under the sequence of themes deliberately chosen to reflect the objective of the study. So it addresses the farmers' information needs. The chapter points out different ICT tools (radio, television and mobile) used in Agricultural Information Dissemination, media initiatives like television, radio and Community Radio Station (CRS), documentary film, print media etc. It also reveals literature on internet based initiatives and agro-metrological initiatives. Besides, some literature dealing with various dimensions and manifestations of ICT and agriculture were also studied and placed in the chapter.

2.2 Use of ICT for the Farmers' Information Needs

Information is a systematic body of knowledge organized in such a way that conveys or tends to convey message(s). The process of transferring this information from the originator in right time may be provided in response to the specific requirement of the intended users namely, policy makers, scientists, educationists, extensionists, farmers etc. This may also be provided in anticipation of a group or community of users. Mannan & Ahmed (1994) observed that there is an urgent need of establishing a network of libraries, documentation and information centers dealing with rural development research.

The source of information is important to the users. Information sources originate from traditional institutions such as tea stall, the market and other places where people gather and exchange information (Ahmed, Munshi & Uddin, 1996). The major developments in the field of Information and Communication Technology (ICT) have transformed the world more than any other technological invention since the 200 years of industrial revolution (Salam and Arman, 2013). The term 'Information and Communication Technology' (ICT) includes any communication technology, any communication device or system encompassing radio, television, mobile phones, computer, networking hardware and software, satellite communication system, as well as the various types of applications associated with them. The innovations in electronics, speech processing, vedio, telecommunications, computing, software and wireless communication have brought on a flood of new experiences to mankind from ICT for development.

Islam and Islam (2008) explained how the community needs information to make the best use of resources available to them and get direct or indirect help in solving their day to day problems. They also advocated to make a sound coordination with CIC and rural libraries and suggested some effective measures for the improvement of community information services in Bangladesh. The development of a society largely depends on the access to information- a power and a national resource which is a common property resulting in an increased usage of information.

The use of ICT has become increasingly integrated to address the farmers' information need in all over the world. In Bangladesh, farmers are slowly but steadlily being habituated to adopting new technologies and farming methods that are the blessing of ICT world. In the 21st century agriculture is one of the diversed industries which are increasing rural income as well as long term stability of its natural resources. This can create different activities which will affect farmers, stakeholder, customers and government industries. Information and Communication Technologies have

transferred most important information about agriculture in developing countries. These developing countries now are connected with developed nations and getting the latest information and technologies regarding weather, natural resources and other related information (Rao,2007). The term 'Information and Communication Technologies' could be used for multitude of stand including telephone, television, video, voice information systems, and fax (Warren, 2002).

Information is a time winning item. The attitude towards information varies from man to man. The attitude of the information user in Bangladesh has been quite passive. There is low demand for current information and the majority of the academic community are not frequent users of information (Mannan & Bose, 1998). Information and Communication Technologies are integrated with different devices such as computer, internet, mobile phones, television and radio. ICTs have a key role in agri-food sectors to provide a fast information and knowledge about agriculture through all over the world. Their effective distribution of ICT can increase agricultural attractiveness by production, transaction costs, raising production, efficiencies and farmers' incomes, providing more information and value to stakeholders (Rao, 2007).

Information and Communication Technologies have played very effective role in the agriculture development and in the decision making of farmers' communities in different countries (Cash, 2001; Galloway & Mochrie, 2005; Opara, 2008; Taragola & Van Lierde, 2010). ICT are real source of information and knowledge for people including farmers and reduced the distance among different communities of the world (Herselman, 2003). ICT have brought significant changes in agriculture development and transfer information and knowledge through various technologies among farmers (Birkhaeuser, Evenson, & Feder, 1991).

The use of ICT in agriculture for rural development is very important. There is need of such technologies in rural areas for increasing the production of agriculture especially in African countries. It has provided average access to agricultural information where farmers are getting many problems in connectivity of communication technologies (Meera, Jhamtani, & Rao, 2004). Chapman and Slaymaker (2002) investigate that those farmers who have used the information and communication technologies in agriculture have increased their production by information and knowledge. Similarly those who have used the e-services, e-commerce applications, also have increased their income.

Dey, Prendergast & Newman (2008) agree to the use and appropriation of ICT by rural Bangladeshi farmers. They examine farmers' information needs and how and to what extent those needs can be addressed through the use of different ICT tools and applications and their appropriation in the settings of rural Bangladesh.

Kiplang'at (1999) postulated that dissemination of relevant information to the farming communities can facilitate the effective adoption of agricultural inputs, decision making on markets and adoption of scientific methods. However, lack of dissemination of information across the agricultural supply chain is a major concern in the developing world. Information and communication technologies have potential to disseminate the agricultural systematic information among smallholder farmers. Similarly the mobile phones, television, internet and radio have the facility to transfer related and timely information that helps to make decisions to use resources in the most productive and profitable way (Ekbia & Evans, 2009; Ommani & Chizari, 2008).

Das & Kabir (2014) asserted that farmers once suffered from lack of access of information on modern knowledge due to scarce communication are now getting smart in enhancing productivity. For example, AICC farmers in Bangladesh are benefitted by new agricultural technologies from obtaining trainings like basic computer, internet usage, IPM, fertilizer usage pattern, soil health, and market price.

2.3 Use of Different ICT Tools in Agricultural Information Dissemination

This section examines how different ICT tools like telephone, mobile phone, television and radio, networking, internet, agro metrological services are used in agricultural information dissemination in an effective way. The services run with the help of ICT tools like mobile phone, telephone, radio, TV are studied here for further knowledge of the role of ICT in agriculture. Besides, the services rendered from ICT tools like television, radio and community radio station (CRS), documentary film, print media are studied in the section to review related literature.

2.3.1 Telecommunication Initiatives

Mobile phones confer distinct advantages as a communication link in isolated circumstances. Mobile users can determine when and where they can communicate and access information. The telephone system is not only a fundamental communication infrastructure but also a basic facility which supports the use of other technologies. In some African areas, the telephone was the only ICT tool used by most farmers (Bertolini, 2004 cited in Munyua, Adera & Jensen, 2008). Its advantages

included adaptability and the capability of transferring both voice and data at gradually decreasing cost (Mangstl, 2008). The role of different telecommunication tools in the field of agricultural information dissemination like mobile, telephone and call centre are very important all over the world. These communication devices present several advantages such as portability, wide range of coverage and instantaneous two-way communications.

In Bangladesh, mobile phone network reaches 97% of the population. There are 97.18 million active phone lines (Source: www.btrc.gov.bd). In rural areas, the vast majority of phones are basic models with pre-paid scratch cards used to pay for airtime. The main feature used is voice calls. Mobile providers and banks are now rolling out 'Mobile Money' that is expected to make a big difference in money flows from urban to rural and thus impact agricultural production as well. In rural areas, the vast Win Incorporate is a private company in Bangladesh that offers ICT enabled mobile-based content services to Grameen Phone and Banglalink. Initially, they supported the lunching of these services. In Bangladesh, there are some initiatives also taken by some private mobile companies such as 7676.

Hasan (2015) asserted that mobile phone is one of the most popular electronic media among the natives of Bangladesh for news and information. Mobile phones have significantly been able to reduce communication gap and information costs for the rural poor in the country. This not only provides new opportunities for rural farmers to obtain access to information on agricultural technologies, but also to use ICT (Information and Communication Technologies) in agricultural extension systems. Since 2007, there has been a proliferation of mobile phone based applications and services in the agricultural sector, providing information on market prices, weather, transport and agricultural techniques via voice, short message service (SMS) and internet.

Mittal & Mehar (2012) pointed out that rapid growth of mobile telephony and the introduction of mobile-enabled information services provide ways to improve information dissemination to the knowledge intensive agriculture sector and helps to overcome information asymmetry existing among the group of farmers. The paper explores further on this topic and provides evidence to show how mobile phones and mobile-enabled agricultural services have impacted the farmers. As mobile penetration continues to increase among farming communities and information services and to adapt and proliferate, the scope exists for a much greater rural productivity impact in the future.

Saravanan and Bhattacharjee (2014) analyzed that the Rubber Board in India provides the update of both national and international rates of natural rubber through SMS throughout the country.

Through this service the rubber farmers and dealers in India (especially those in the state of Kerala in South India) are tracking the prices of the commodity in real time by SMS. The rubber growers are helped by this SMS service by the Rubber Board that provide updates on the global as well as domestic market rates to the farmers, which is also displayed in the Rubber Board's web portal (www.rubberboard.org.in).

In another study, it is claimed that the Bangladesh Sugar & Food Industries Corporation (BSFI) under MoI uses the SMS format to transact purchase orders of sugarcane to growers. The Department of Agricultural Marketing under the Ministry of Agriculture disseminates price and commodity information through its Web site. Banglalink, a mobile network operator, runs a call centre for agricultural market-based information. The use of mobile phones in poverty reduction and rural development has ignited much interest over the past decade. Mobiles have become the most ubiquitous telecommunication technology in developing countries where subscription rates have soared from 250 million in 2000 to 4 billion a decade later (ITU, 2010) . By 2010, subscribers from developing countries accounted for around three quarters of the 5.4 million global subscriptions, up from a third in 2000 (ibid).

Additionally, mobile communication technologies have become gradually more important in many parts of the world, especially in improving the delivery of information about agriculture (Munyua, Adera & Jensen, 2008). They conducted a study on Ghanaian 12 fishermen who were using mobile phones to communicate with the purpose of providing each other with information about where to fish, weather conditions and market prices. The advice communicated about best place to sell their catch was also utilized by Kerala fishermen in India (Abraham, 2007 cited in Mittal & Tripathi, 2009; Jensen, 2007 cited in Mittal & Tripathi, 2009).

The rapid growth of mobile using was made possible through falling handset prices and calling rates, the introduction of pre-paid mobile phones packages and the expansion of networks into rural areas. While users in Africa initially included mainly male, educated, young, wealthy and urban populations, the share of poor, elderly and rural individuals has also been increasing (Aker & Mbiti 2010).

Mittal, Gandhi, & Tripathi (2010) studied the IFFCO Kissan Sanchal Ltd., Reuters Market Light and Fisher Farmers Mobile Access initiatives and observed that farmers are more comfortable with voice mode than text mode because of the problem of illiteracy/ language barriers. The case study on the mobile initiatives on the crop sectors, in particular, on small farmers points out that mobiles are

being used in ways which contribute to productivity enhancement (ibid). However, another study on EID parry by Bowonder & Yadav (2005) emphasized on developing ICT platform for enhancing agricultural productivity. The study underlines that the farmers are able to access wide range of information regarding climatic condition, knowledge about the fertilizers, seeds and the cropping patterns from the information kiosk (Veeraraghavan, Yasodhar, & Toyama, 2007). In his study on Warana Wired initiatives found that an application to send images/videos through mobile phones may also be developed where farmers can also send images/videos as and when required.

Mobile communication technologies have become gradually more important in many parts of the world, especially improving the delivery of information about agriculture (Munyua, Adera & Jensen, 2008). These communication devices present several advantages such as portability, wide range of coverage and instantaneous two-way communications. Real time agricultural information and fish prices were also provided through mobile phones in Senegal.

Mittal, Gandhi & Tripathi (2010) first time studied the impact of mobile phones on the crop sector in India with a focus on small farmers. They found that a number of mobile-enabled information services have an impact on agriculture in India. These services deliver a wide range of information to farmers and fishermen. The results are based on information collected through focus group discussions and interviews with farmers carried out in Uttar Pradesh, Rajasthan, Maharashtra and the National Capital Region of New Delhi and with fishermen in Pondicherry. The study does not cover all regions of India nor is it fully representative of rural India.

Fishermen reported benefit from mobile phones as a means of two-way communication as well as a means of access to the information service while at sea. This included dealing with emergencies and acting on weather information in time to return safely to shore. Mobile use allowed fishermen to avoid potential losses to boats and nets as well as risks to personal safety. Emergency and safety benefits were consistently described as the most important benefits from the fisher friend service. For instance, mobile phones were used to communicate among some Ghanaian fishermen with the purpose of providing each other with information about where to fish, weather conditions and market prices (Munyua, Adera & Jensen, 2008).

Farmers also reported about the benefits of mobile phones. Now they are able to make and receive calls while working on the farm. This included the ability to describe plant diseases from the field to

experts and to co-ordinate better with their hired labour. Traders and commission agents reported about improvements from their ability to deal with truck breakdowns and the ability to shift crops en route in response to changing market conditions (Mittal, Gandhi, & Tripathi, 2010). The advice communicated about best place to sell their catch was also utilized by Kerala fishermen in India (Abraham, 2007 cited in Mittal & Tripathi, 2009; Jensen, 2007 cited in Mittal & Tripathi, 2009).

Several case studies have examined the impact of mobile phone use by fishermen in India and Senegal. They found that the introduction of mobile phones decreased price dispersion and wastage by facilitating the spread of information. This made markets more efficient and brought benefits both to the consumers and to suppliers. Mobiles allow fishermen, particularly the more prosperous ones, to get timely price information and decide on the best place to land and sell their daily catch (Mittal, Gandhi, & Tripathi, 2010). Abraham (2007) in his study on Kerala fishermen found that the widespread use of mobile phones increased the efficiency of markets by decreasing risk and uncertainty, although it noted that realizing potential efficiencies depended on easy access to capital. Using mobile phones at sea, fishermen are able to respond quickly to market demand and prevent wastage from the catch– a common occurrence before the adoption of phones. Mobile phones help co-ordinate supply and demand, enabling traders and transporters to take advantage of the free flow of price information by catering to demand in undersupplied markets. A study on Senegalese fishermen yielded similar results (Rashid & Elder, 2009).

Mobile telephony could facilitate information access that could allow the delivery of tailored information, as and when needed by the farmer. For establishing these facilities, the farmer must know 'trust' and be able to connect with a range of information sources that can meet his information needs (Mittal, Gandhi, & Tripathi, 2010).

Other studies have found that mobile telephony is regarded as the most successful ICT tool used in attempts to develop the global agricultural sector (Mangstl, 2008). Mobile telephones have been used by farmers for a variety of purposes. For example, Jensen and Thysen (2003) reported that short message service (SMS) was used to acquire required information, such as weather information and suitable time to spray pesticides. Besides information delivery, the mobile phones can be applied to specific other purposes such as transferring money from one bank account to another for labour payments and input purchases in Kenya (Hafkin & Odame, 2002 cited in Munyua, Adera & Jensen, 2008). Moreover, market information in voice mail formats is delivered to Kenyan farmers (Munyua, Adera & Jensen, 2008).

A study in Niger found that the availability of mobile phones reduces price dispersion and fluctuation in grain markets. Cell phones have a greater impact on price dispersion for participants who are further away from their markets, and for those with worse roads (Aker, 2008). Other research studies have reported that farmers and agricultural experts are sending information as images via mobile phones with a built-in digital camera (Parikh, 2009). This approach saved time and money in addition to providing more support by a limited number of agricultural experts to a greater number of farmers over a larger area.

The reduction in price dispersion with increased cell phone use is also seen in the grain markets in the sub-Saharan African country, Niger. Cell phones have a greater impact on price dispersion where travel costs are high (Aker, 2008). Similarly, during a project implemented in Senegal, it was found that farmers in the field were able to check prices before they set off to markets and thus they could secure, on average, about 15 per cent higher profits. The adoption of mobile telephony by farmers and agricultural traders in Ghana has helped them reduce both their transportation and transaction costs. The members associated with trade networks, now equipped with new technology, are able to organize their activities more efficiently and with considerable cost savings (Overa, 2006).

Fong (2009) revealed his study that the Chinese government has invested US$1.13 billion in establishing a mobile infrastructure for about 26,000 villages in recent years through the state owned company, China Mobile, to enable farmers to keep track of weather conditions or forecasts and product prices. In July 2006, China Unicom launched an agricultural wireless information project for farmers in 26 provincial district. This programme helped farmers access useful information for efficient planning and production. The study of deSilva and Ratnadiwakara (2008) found that Gherkin farmers in Sri Lanka were able to improve their incomes through simple mobile phone applications that helped reduce waste through a feedback system. The study found that up to 40 percent of crop loss could be prevented with quick interventions facilitated by information received via SMS. Farmers also expressed their willingness to pay for such services if it would save their time and money.

Islam (2011) developed an agricultural market information service (AMIS) which could be one of the important tools for reducing such social inequality by integrating the farmers with their markets more efficiently. Following the failure of a web-based AMIS initiated by the Government of Bangladesh and considering the wide availability of cellular networks, a mobile phone based AMIS was implemented on a pilot basis in some remote villages in Bangladesh. This paper evaluates the

efficiency and effectiveness of this mobile service in terms of users, technology, process and facilitating conditions in a rural context. In general, this is an interpretive case study as well as an evaluation research that is based on two small-scale surveys and observations. Based on a literature review, a conceptual model is also applied for a systematic evaluation. Findings show that effectiveness of a rural e-service depends on the design and delivery of the service in accordance with the individual's information needs, adaptive technologies with easy accessibility within a given infrastructure, affordable services with a rational business model, adequate awareness, and efficient communication with the respective community.

de Janvry et al. (1991), Fafchamps & Vargas Hill (2005) expressed in their study that the mobile phone has reduced the gap among traders and farmers and same time farmers directly communicate with buyers and customers to find the good price of their product. Famers before going to market simply contact one of the best buyers who purchase production in good price. They also highlighted that in the rural areas of developing countries mobile phones spreading day-by-day and different organizations have launched many projects for the agriculture development and increase the production by using different technologies in agriculture. Mobile phones have created a new business opportunities for the poor farmers and have given the access to information about market, health and weather services in remote areas. The uses of mobile phones among farmers have played positive impact in their income and productivity because before travel communicate with buyers and sell their product at good price.

Muto & Yamano (2011) and Lee & Bellemare (2013) conducted two studies in Ghana and Uganda where mobile phones were introduced among farmers for communicating with traders and their representatives for selling their bananas in advance and negotiate with customers and get high price. The mobile phones technologies directly connected the farmers and buyers without any disturbances and they receive directly good price from brokers and customers. Famers have another advantage of mobile phones that they need not go to market but directly communicate and ask the price of their production. In this context, they save their money, time and energy. Mobile phones have reduced the gap between rural and urban areas. The mobile phones connected farmers and market customers. In Mali, farmers of Timbuktu were able to communicate with their family members who live in capital cities. Furthermore, in Ghana, farmers in Tamale send a text messages to learn about corn oil and tomatoes prices thousand kilometers away from their cities.

Another study was conducted in West and South African countries where mobile phones have provided good facilities and access of the farmers to getting the information about agriculture from their near market especially and they have no proper access of communication technologies in their areas. The study showed that mobile phones have given a positive impact on farmers' income (Aker & Mbiti, 2010 and Klonner & Nolen, 2008). Another study was conducted in Uganda about the effect of mobile phones on agriculture product and markets information where farmers ultimately get information about market effectiveness. In 2003 and 2005, the mobile phone coverage increased 10% among farmers' probability of market participation. It was observed that mobile phones are more useful for increasing the knowledge and product of the crop. This kind of technology has provided a good benefit to farmers who live in remote areas of the country. It was showed that mobile phones have provided a platform to farmers for sharing and getting the information about agriculture. Farmers nowadays using mobile phones for multipurpose, some are using for getting the price of product from market while others are directly communicating with customers for selling their goods in better price (Muto and Yamano, 2009). Furthermore, farmers are using SMS services for keeping them up to date about weather as well as use of pesticides in their farms (Murthy, 2009). The most important role of mobile phones in developing countries showed that farmers use the mobile phones for getting the information from different markets and weather information while other communicate with agriculture experts to obtain information about the use of pesticides in their farms. For instance, the Bangladeshi farmers directly contact with buyers and get the information about rice price and vegetables while some of them inquire about the price of coffee from international broker countries. Two decades before it was very difficult for farmers to take information about their production from market within minutes from their villages (Kefela, 2011). There is no doubt that the mobile phones technologies were used in different sectors of the society such as in health, education, rural development and in agriculture for the economic growth in developing countries. The impact of information and communication technologies empowers farmers' communities in rural areas and provided access to marketing information. Furthermore, farmers communicate with buyers in different markets of cities and sell their product where they find better price of their good services (Siraj, 2011).

Mobile communication technology and wireless sensor networking also were used in weather monitoring system that has provided lot of benefit to different communities in the shape of increasing the income and awareness. Similarly, these kinds of technologies should introduce in agriculture sector which can give new approaches to farmers for their agriculture development. Using communication technologies without any disturbance mobile phone users have provided

Wireless Multi- hop, for different feature to communicate with each other (Javaid et al., 2013 and Javaid et al., 2011).

Islam & Hoq (2010) asserted that the rural communities have different needs for information depending upon their functions, responsibilities, and duties. Different community information centres are meeting up these demands through the provision of information services. They highlighted community information centres established in the rural areas of Bangladesh and describe how these centres are playing a vital role for providing specific internet-based information services to the rural communities.

An evaluation study by Hanumankar (2011) asserted that there is considerable interest and acceptance among farmers for ICT based agricultural extension services. The study has shown that farmers in the age group of 29 to 48 years are the biggest user group of Kissan Call Centres (KCC) helpline.

2.3.2 Media Initiatives

Mass media are essential elements for transferring effective agricultural information and technologies that are crucial to enhance agricultural production. Information could be disseminated to a large scale of audience at a very fast rate by using different mass media. In the field of information dissemination, media are useful intermediate for farmers to make their appropriate technologies easy access and learn how to effectively utilize them in their farming systems and practices. Radio and television have one of the most important media for diffusing the technical, systematic and scientific information to the people.

A number of research interventions have focused on the role of media in the field of agricultural information dissemination that could help farmers to take appropriate decision for their farming. This type of findings made by Lwoga (2010) who found that mass media are important in providing information for enabling the rural community to make informed decision regarding their farming activities, especially in the rural areas of developing countries.

Muhammad (2005) opined that mass media could play an important role in disseminating information about education, health, and agriculture development in another study. Media inform the farmers about weather forecast as well as use of pesticide and indicate about flood situation and environmental changes in area. Hussain (2005) exposed that mass communication is one of the most

important methods in transferring agricultural technology through mass media like radio, television, documentary film and print media. He further added that there is need of using the new farm technologies to enhance the productivity of agriculture in Pakistan.

Qamar (2006) in his study revealed that in developing countries, latest mass media have made their place for backing up agricultural sector through extension activities. Nazari and Hassan (2011) in their study analyzed that mass media have the capacity to uplift the knowledge and having impact on behavior. Oakley & Garforth (1985) attempted to analyze that the cost of extension advice through mass media comes to be considerably low as compared to individual and group methods.

To a large extent, mass media serve as a variable instrument for information dissemination in agriculture. Among different mass media, television, one of the powerful important mass media, is considered to be an important ICT tool in modern times. Television is one of the most popular electronic media too all over the world for news and information. It also transfers modern agricultural technologies to the literate and illiterate farmers alike even in interior areas (ICCDIA). This medium works well for people who are not highly literate because they are attractive, easy to understand, especially with visual and animated material; in addition to needing only modest recording fluency (Hassan et al., 2008).

Many studies have been conducted on television as powerful medium. People are getting them as one of the powerful channels of the mass media, which transmits information very fast about agricultural technology among the farmers community. Farmers are getting their utmost information most simplest way. Similar observations are made by Irfan et al. (2006) who said that most important communication tools presented today are mass media through the use of this technology and agriculture related information can be transferred easily to the farmers. Other attempts were taken by Alam & Haque (2014) who attempt to analyze the contribution of various TV channels on the dissemination of agricultural information to the farmers for their agricultural enrichment. Findings indicate a positive curve towards the dependency and contribution of TV channels.

In Bangladesh, farm and home broadcast agricultural products were introduced through BTV (Bangladesh Television) in 1980 (http://en.wikipedia.org/wiki/Mati_O_Manush). Private channels have started telecasting agricultural programs in 2004. In 2004, a new programme at Channel i named Hridoye Mati O Manush ("Soil and Men in Heart") started based on the format of his earlier programme *Mati O Manush*.(Wikipedia) Channel i initiated much more in this regard including

special bulletins on agriculture to make farmers independent on the use of various technologies to boost agricultural development. At present there are almost 26 public and private channels that are engaged in producing stimulation for the farmers to hold farming to their mind's content along with other entertainment programmes.

Tortermvasana (2011) examined his study that the lack of accessibility to other communication technologies and finding has led to a combination of broadcasting and narrow-casting media which have been needed to deliver agricultural information in a number of research projects. Television is the most effective tool in communication for the support of development. Therefore, TV can provide an illiterate person with not only valuable instructional education in agricultural but also health, population control, sanitation and other aspect of his daily life (Rahman, 1999).

The development about agriculture in developing countries mostly depends on the use of information and communication technologies that can connect the different communities of people. The radio and television have played a very important role in enhancing the capacity of farmers by broadcasting different agricultural related programs. Murty and Albino (2012) explored in their comparative study that television disseminates scientific and agricultural knowledge among farmers and provides latest information with the discussion of agriculture experts. In the context of India and Ethiopia, television has played most vital role as a medium of diffusion information about agriculture. It showed that farmers could get easily information by watching the agriculture related programs on television.

Similar study has been done by Age et al. (2012) who exposed that television has created awareness and knowledge among farmers about the use of technologies in farming television produce. Such kind of programs creates interest among masses and mostly the masses depend on media for getting the information regarding education, health and agriculture. He further added that the perspective of agriculture development television producers and directors should make the objectives for the development of agriculture by producing the different programs for growth of agriculture.

Television has provided a lot of information to all stakeholders of the society. The fruitful results about agriculture development depend on the use and the mobilization of the community relies on television. The experts of agriculture extension believe that mass media can bring the positive changes and growth of agriculture in developing countries by using the communication technologies in their countries. Nazari and Hasbullah (2008) believe that television is one of the effective media of

communication for dissemination agriculture information among farmers quickly. In different countries such as India, Pakistan, Bangladesh, and Sri Lanka the farmers' education is low. Therefore, television is one of the best and favorite media of communication where farmers can watch and get the information about the use of different techniques and pesticides in short time.

The result of the study conducted by Nazaril and Hassan (2011) and Loges, (1994) in Iran indicated that 68% of the respondents believe that television produced agricultural programs that provided good benefit to farmers. Furthermore, it poited that the programs should produce in their regional languages that can provide good benefit to farmers. However, 87% of the respondents said that 6 to 8 pm is more suitable time for broadcasting the agriculture programs. In this time, most farmers are free to watch programs easily and around 20 minutes duration is enough for agriculture program on television. It also showed that in various related issues of agriculture such as bad weather situation, television is one of the most important sources of disseminating agriculture related information among farmers.

Another study conducted by Rolle & Satin (2002) stressed that the information about agriculture could be transferred by using the appropriate tool of information communication technologies such as television that is famous medium of communication tool among farmers to use and diffuse the information regarding agriculture. There are many ways to transfer the information about agriculture by newspapers, magazines, brochures as well as electronic media such as radio and television.

Goyal (2010) argued that different communities use the information and communication technologies in different ways such as farmers who prefer to watch the television and get the information about weather and markets regularly. However, farmers also use the other communication tools for information. It was showed that many developing countries have established different centres of communication technologies for providing the information about agriculture to the farmers. While in some countries, many governments have started information services centres for agriculture information. However, television is one of the good sources of agriculture information among farmers in developing countries.

Buren (2000) undertook a study to ascertain whether the electronic media have brought revolutionary changes in the life of different communities mostly farmers are getting more benefit from these technologies such as television. Television has given new choice to the farmers for

watching the different agriculture programs on different channels. Farmers choose the best way for keeping up to date each other about different information of agriculture. It was also showed that television is not only the sufficient source of agriculture information but there is need to provide other technologies for latest information to farmers. Television is playing an important role in sharing attitude, creating interests and presenting information.

Sher (2001) described that the significance of television for rural communities and development of agriculture cannot be denied. Television produces many agriculture programs for the rural communities in their local languages. TV producers invite agriculture experts to suggest on new techniques and methods of sowing, ploughing, harvesting and seeding the crop.

Khan (2002) explained that in Pakistan per hectare yield of almost all crops is far below than other countries. There is need to increase farmers' access to adopt ICT in the field of agriculture. Under such condition, farmers need sufficient information exposure to the latest technologies. Mahmood and Sheikh (2005) reported that mass media are playing very significant role in making awareness and knowledge about the latest agricultural technologies information among the farmers. Media is one of the best sources of spreading information about new technologies and innovation of agriculture among farmers that is faster than personnel contacts. Communication technology is playing very essential role in making awareness about different agricultural technologies among farmers.

In the countries where literacy level is very low especially in rural areas, the choice of mass media is very important. In this context, the television and radio can play a major role in transferring modern agricultural technology to the educated and uneducated farmers within a short time for farmer communities (Nazari & Hasbullah, 2008).

Buren (2000) asserted that mass media have increased in knowledge and information that similarly has provided good output in recent years. The main reason of the popularity of television among masses is that it is simply people who propose to choose the easiest way for getting information and learning. The simplest way can be found in television educational programs about health, education as well as agriculture development.

Nazari & Hassan (2011) focused their attention on mass media that offer powerful channels for communicating agricultural messages and related information that can enhance the capacity building of farmers. Broadcast media have the ability to disseminate information to large audiences efficiently; and television can be a particularly most famous channel among farmers. Hussain (2005) believed that radio and television are the most effective tools in communication for the support of development. Rahman (1999) explored his study that TV can provide an illiterate person valuable instruction and education in agriculture, health population control, sanitation and other aspect of this daily life.

Many studies have also been done on radio as the most popular medium for the mass people. Nazari & Hasbullah (2008) in their study explored that dissemination of information along with new concepts and farming techniques can bring noble opportunities to the farmers. They also observed that radio could be a useful medium to educate farmers if it appeals them with new programs having modern agricultural technologies. He more supplemented that the literacy of farmers is important to understand such programs and apply them appropriately.

The study by CEDA (2001) on the impact of agricultural programs transmitted by Radio Nepal mentions that such programs have helped the farmers improve the farming methods. The farmers have received the agricultural programs transmitted by Radio Nepal and Nepal Television for information and knowledge. It was found that the farmers have listened with enthusiasm the agricultural programs like Sukrabarko Budhi Aamai (The Old Mother on Friday), question answer on Friday, veterinary series on Tuesday, discussion on Thursday, and farming program on Sunday.

Sharma (2010) stated that agricultural programs transmitted by Radio Nepal have been very much useful in the context of Nepal. Such programs have left positive impacts in both small and large scale development. Another study of FAO (2005) has found that farm radio has contributed in terms of strengthening social unity, enhancing communicative ability, giving knowledge about locality, preserving environment and solving the problems that arise in the communities. The study has recommended that farm radio should be used extensively as a tool for rural development. The study was conducted in Bhawalpur, district of Punjab Pakistan; it revealed that radio was the more effective source of dissemination of agriculture information among famers about agro-forestry.

Furthermore, it was also indicated that most of the farmers were interested in agro-business news and farmers were obtaining the information various aspects of agriculture and improving their skill and knowledge. The study was conducted in Nigeria about dissemination agriculture information among farmers showed. It also showed that radio provided livestock as well as fisheries information to farmers and radio was the prominent medium of communication among farmers in Nigeria (Abbas et al., 2009, Bolorunduro et al*.,* 2004).

Okwu et al*.* (2007) stressed on the effectiveness of radio about agriculture programs. It revealed that majority of the farmers like to listen to agriculture programs. Furthermore, it showed that most of the farmers to listen programs about agronomic and plant production. However, some respondents like to listen to livestock information on radio.

Fossard (2005) and Saadi et al. (2008) asserted the similar observations that radio is multidimensional source of transferring the information in the rural areas of developing countries and the impact of radio showed a positive among different communities of people such as farmers. There is no doubt that modern information about agriculture can be diffused by using the television. The findings of the study showed that television was the best source of information about dissemination information about wheat, seed and soil.

Ani & Baba (2009) argued that the Information and Communication Technologies are main elements that disseminate effective technologies to grow agricultural production. By the use of these technologies access to farmers and learn how to effectively utilize these technologies in farming systems and practices. The use of radio among farmers in remote areas is still popular. Most of farmers depend on traditional media such as radio and newspaper. These media channels could transfer information among farmers in remote areas and can enhance the knowledge and skills for the development of agriculture.

Murty & Albino (2012) comprehensively observed that radio is one of the best media of communication that has played a very vital role in socio-economic cultural and agricultural information. They also described radio as a powerful communication tool in rural areas that provides agricultural and marketing information and the best sources of diffusing agricultural, technical and scientific information to the farmers.

They further showed that in developing countries there is problem of electricity in rural areas. Therefore, farmers and other communities mostly depend on radio to meet their needs of information regarding education, health, agricultural news and weather information. They think that the achievement of agricultural development programs in developing countries basically depends on the nature and level of the use of mass media channels in mobilization of people for development in general. They also highlighted that radio has brought changes in different sectors of society such as radio broadcast agriculture programmes and latest information for farmers. On the other hand, radio has provided new approaches and knowledge to millions of people in remote areas. Finally they concluded that the radio is very beneficial tool of communication especially for illiterate farmers to gather information of various kinds on agriculture and other features to keep up to dates their knowledge and services.

Sadaqath & Mariswamy (2007) state that the credibility regarding radio information is one of the most important elements of communication process and its success will grow proportionally if the receivers of the information perceive the sources to be trustworthy and competent. Weiss et al. (2000) studied on Food and Agriculture organization FAO that working in Mali to provide information among rural farmers about marketing, weather, environmental, diseases, water management and pest monitoring to increase the productivity of agriculture in their country. This kind of information was broadcast by radio in remote areas. Radio technology has played an important role in providing the information about agriculture, weather and use of pesticides among farmers.

Murty and Albino (2012) stressed the importance of radio as one of most important tools of communication technologies playing a vital role in the development of agriculture. Radio provides latest information and knowledge about market to farmers. Furthermore, by using the radio farmers get immediate response from agriculture experts about agriculture issues and problems. Similarly, the role of radio in socio, economic and cultural information spreading is also important in rural areas of developing countries. However, it showed that in different developing countries there is no access of electricity. Therefore, farmers and other communities mostly depend on radio to meet their needs of information regarding education, health, agricultural news and weather information.

Kalirajan & Shand (1984) explored their study in developing countries such as Pakistan, India and Bangladesh where education level is low and the choice of mass media is very vital particularly Electronic Media for farmers to keep them up to date about agriculture. Radio broadcast new approaches, ideas, research findings and scientific information for farmers which increased their

knowledge and skills and farmer adopt such techniques for the development and increase the productivity of their production. In the perspective of Pakistan, mass media produce many programs and publish articles, features and columns about agriculture information.

Bobblili (2006) (cited in Munyua, Adera & Jensen, 2008) described that a radio has been used to broadcast much useful agricultural content. For example, discussions related to agricultural problems and solutions have been broadcast in Zambia. This was found to be useful for the target audiences: the disadvantaged farmers Chapman et al. (2003) remarked about rural radio: Rural radio can be used to improve the sharing of agricultural information by remote rural farming communities. Participatory communication techniques can support agricultural extension efforts especially using local languages and rural radio to communicate directly with farmers and listener groups.

Radio has been used to broadcast in multiple languages in many areas; for example, in Nigeria English and several local languages, such as Hausa, Igbo and Yoruba, were used in broadcasting 14 radio programs along with three television programs (Ekoja, 2004). Using radio to report produce prices in local languages is another example of successful radio use in Bolivia (IICD, 2006).

Kweku (2006) (cited in Munyua, Adera & Jensen, 2008) ; Parikh, (2009) stressed that Community radio for broadcasting information has also been widely used in several programs, both on its own and along with other methods. Hassan et al. (2008); Munyua, Adera & Jensen, (2008) argued that with the popularity of radio broadcast, it is also reported that the radio is not only one of the top four widely used ICT tools but its importance also has increased in improving rural agriculture. Community radio can be successfully incorporated into agricultural extension service programs in Zimbabwe (Nyareza & Dick, 2012). Community radio for broadcasting information has also been widely used in several programs (Kweku, 2006).

Waters et al. (2011) assessed the impact of community radio in Indonesia and concluded that effective radio activities can make a significant change in a community's life. Chapman et al. (2003) found that rural radio is effective in improving the sharing of agricultural information by remote rural farming communities. Sterling et al. (2007) assert that Community Radio provides listeners with the voice with which to respond to programming and to create programming content. Indeed, Simli Radio (Ghana) has considerable impact on listeners in the communities.

Dhanraj (2010) analyzed the contribution of community radio (CR) movement for conscientization and development of deprived rural people in various parts of world in general and south Asia (India) in particular. He also indicates that the community radio movement has created grassroots-level participation and horizontal circulation of ideas among the deprived rural communities, which are necessary pre-conditions to democratization of communication and redistribution of power.

2.4 The Influence of Print Media

Mass media particularly electronic & print media are playing very important role in creating awareness about new agricultural technologies among farmers. Mass media are spreading agricultural technologies to the farmers at a faster rate than personal contacts. Khushk and Memon (2004) stated that production and distribution of printed material help farmers in the transfer of new information and technologies. Printing helps in preserving the technologies in the shape of books/booklets, magazines, newspapers and brochures. Among the media, newspaper possesses the capacity to do this better than most other media (Defleur & Dennis, 1981).

Abbas et al. (2003) stated that a central Punjab, majority of the farmers consulted pamphlets, magazines, and newspapers for getting the information regarding sugarcane production technologies. These were regarded as the most suitable forms of print media for adoption of sugarcane production technologies.

Singh (2001) stated that farm publications have proved to be effective means for dissemination of information, especially to introduce new technologies. Farm publications are also useful for disseminating information among literate farmers.

2.5 The Impact of Internet based Initiatives

Internet has transformed this world into a global village by reducing the distances of information exchange. Computer has become a robust tool of this era of technological advancement and internet facility boomed the scope of 'edutainment' (Williamson and Smoak, 2005).

Kelsey et al. (2002) indicated that the development in information technology like internet has enhanced the opportunities of access and training pertinent to critical issues. It also contributes towards information dissemination. E-mail facility and websites have increased the scope of media by expanding the sphere of access (Tawari, 2006). Kenny (2002) pointed out that despite possessing crucial importance, internet technology has been facing various obstacles like networking (infrastructure), language problem, and illiteracy. Khan (2010) also affirmed that lack of computer

literacy and lack of interest appeared as major hurdles in using the internet (ibid). There is also a need to exploit interactive role of internet (Leeuwis, 2004) and internet facility can pave the way for extension activities (Bamka, 2000; Kallioranta et al., 2006). Moreover, websites should be developed that can cover the appealing sides of a variety of people (High and Jacobson, 2005).

Gupta (2005) believed that telephone facility has increased the opportunity of getting access to the people living even in remote areas. It contributes towards developing farmers' linkages with other people including extension experts. Malhan and Rao (2007) uttered that help lines facilitate the mechanism for getting information/assistance regarding people's problems by using toll free numbers. A sophisticated form of communication also is on the scene in the form of mobile phone for the swift exchange of information among the farming community.

Tiwari (2008) explored the internet's popularity and its efficiency in communication and the reducing price of hardware have resulted in the implementation of internet connectivity in several projects such as the iKisan.com project, the TARA Haat project (ibid) and the e-Choupal project (Rao, 2007) in India. These projects have applied a variety of connectivity based technologies to the needs of each project. Telephone dial-up connections may be a simple answer for limited budget projects with low amounts of data transferred within telephone line-covered areas.

Locke et al. (2005) thought that connectivity through computer networks may be an appropriate way to provide information to farmers. For geographically remote locations, for example, each village centre could communicate with the outside world, nearby villages, other countries or other continents, via several types of communication tools, such as dial-up telephone connections, wireless networks or a satellite communication system called very small aperture terminal (VSAT). Internet use is regarded as record keeping for online selling or purchasing and searching for information

Most of the farmers in Australia have access and knowledge on how to use the internet (ABS, 2000). Malhan and Rao (2007) described in their study that a web portal (AGMARKNET) offers daily reports of the price of 300 products of 2000 varieties. Tiwari (2008) & Rao (2007) in their study stated that the Internet's popularity, its efficiency in communication and the reducing price of hardware have resulted in the implementation of Internet connectivity in several projects such as the iKisan.com project, the TARA Haat project (andthe e-Choupal project) in India.

As Talbot and Newman (1998) explained in the context of community groups learning to use the Internet in Northern Ireland, there are hurdles. People have to overcome before they can make

effective use of such tools, what they called the 'how-to' gap (or effective use). To learn how to use these tools and ruralinfobd.com, they need to learn not only a set of computer literacy skills, but also the potential benefits.

Information professionals have potential to serve the farmers with information services. Uddin (2002) depicted the present status of information services in the libraries of agricultural scientists and research organizations. His paper showed that agricultural scientists and researchers are the actual source for catering information needs of the farmers. It reflected the agricultural information systems in Bangladesh. The climate, land, population, economy, a historical overview of Bangladesh agriculture, agricultural education, research and extension system of Bangladesh and role of NGO's in agriculture are stated in the study. The researcher proposed a network of agricultural information system in Bangladesh. His suggestion for necessary development of agriculture in Bangladesh has come to use to great extent.

2.6 The Practicality of Agro Metrological Initiatives

Gommes et al. (2010) explained the best approach to agro meteorological services as FADO (Farm Adaptive Dynamic Optimization). That is a technologically sophisticated approach that basically constitutes a modernization of response farming. Based on African, Chinese, Indian and Indonesian (Stigter, 2010a) experience, FADO may now be considered a technically feasible approach, which, however, is rarely implemented in developing countries.

Stigter et al. (2010) in their study explored that agro meteorological service in the developed countries focuses on the provision of environmental data and information to national policy and decision makers. They do that in support of sustained food production, sustainable development, carbon sequestration in agro-ecosystems and land management practices that affect exchange processes of greenhouse gasses. Because developed countries may have or develop technology to initially adapt more readily to climate change and climate variability, technology transfer may play a certain role but local innovations, such as those in multiple cropping, remain most important for application under the very different conditions in developing countries.

Rao and Manikandan (2008); Kushwaha et al. (2008) in their studies in India showed that economic impact of an Agro-Advisory Service (AAS) based on weather forewarning is significant and benefited the AAS farmers to a large extent through weather-tuned farming. AAS farmers reaped more yield when compared to non-AAS farmers owing to technical guidance on all cultivation aspects, especially selection of varieties, timely application of fertilizer/pesticides, inputs saving in terms of water, manpower, electricity, and fuel through proper irrigation scheduling.

Das et al. (2010) found that a farmer may want to use forecasts for decisions at a number of scales; in order to manage farm decisions; to plan water resource management depending on how much rain is expected in the catchment or to use the expected national food supply forecast to decide on the investment in inputs. This illustrates that although users may operate primarily at one scale, their decision-making may depend on information from a variety of scales and so varying levels of forecast skill might be acceptable. Despite the scale of action and decision-making, it is paramount to accompany improved dissemination with improved explanations of forecast characteristics and limitations. Although seasonal forecasts are expected to be used more frequently in the future, the cost of taking precautions (based on the forecast) must be weighed against the savings that the precautions would bring if the unwanted climate event occurred. Users of seasonal forecasts could, for example, be more actively engaged in economic evaluation assessments (Richardson, 2000) to get an idea of the potential rewards and penalties accrued in unfavorable weather situations.

2.7 Conclusion

This chapter has constructed the theoretical and empirical basis for the study of farmers' use of ICT and their production and annual income through a critical review of the relevant literature. Different views, opinions and findings found in the previous works will be a guideline for the present study. All of them, of course, develop an insight for the present work too. However, the studies are found to have differed from each other in many ways. Hence, further research is needed to uncover the impact of the use of ICT on the farmers' production and income in both service areas. In addition, of course, the findings would contribute to enrich the relationship of production and income between the farmers of two service areas.

In Bangladesh, the research on ICT use in agriculture is still in its early stage of development. The small amount of research that is carried out in this context has broadly followed the foundation of ICT use and its potential on the sector. Many small research works on the use of ICT in agriculture are going focusing this problem. However, no research work has been done on this issue in a large scale. Hence, research in this field is essential and necessary. Therefore, the present research studies related to enhancing the role of ICT in agriculture have been reviewed in the chapter.

Chapter Three

The Status of Agricultural Information Services

3.1 Introduction

This chapter, based on the objectives of the study and the review of related literature in chapter two, highlights the present status of ICT based information and communication centres, electronic media based initiatives, print media based initiatives, web based services and telephone and mobile based services in Bangladesh. Some global successful initiatives are also studied in the chapter to look into the present trends of the devolvement of ICT in agriculture. The study on existing information delivery services in Bangladesh has been done in order to generate a standard model to be implemented in future. The ICT centers, electronic media initiatives, print media initiatives, web and mobile based services of both government and non-government have been brought under the coverage.

3.2 Present Status of Agricultural Information Service Delivery Systems in Bangladesh

The problems related to production, processing and marketing could be solved to a great extent when farmers receive information in right time from a reliable source at community level. The agricultural environment in Bangladesh in relation to availability of agricultural information sources is confined to agricultural libraries, research station and national and international agricultural database (Das, 2011). Access, efficiency, and affordability of agricultural information are the major barriers in the battle to uplift agricultural productivity among small scale farmers (Murithi et al*.,* 2009). ICT are real sources of information and knowledge for people including farmers to reduce the gap among different communities of the world (Herselman, 2003).

From the last decade, agriculture sector in Bangladesh has been decorated with acronyms and nomenclatures that are related to farms and farmers and that are of good signs of development in the sector. In Bangladesh, agricultural information services that are being provided by the Government, NGO, private organizations, agricultural research organizations and advisory centers are increasingly involved in orienting services towards the specific needs of the rural service delivery. A number of Government like Department of Agriculture Extension (DAE), Department of Livestock Service (DLS), Department of Fisheries (DoF), Agricultural Information Service (AIS) and National Agricultural Research System (NARS) and non-government organizations like Practical Action, D-Net, Catalyst, Bangladesh Institute of ICT Development (BIID) etc. have taken ICT initiatives. Department

of Marketing, public and private TV channels, Bangladesh Betar (radio) and Community Radio are engaged in providing ICT based services to improve farmers' livelihood by their programs. DAE, NARS, AIS, DAM, DoF, DLS of the Ministry of Agriculture, Ministry of Fisheries and Ministry of Livestock, and other concerned Ministries have been providing agricultural information to farmers in various modes both in print and electronic media. A2i (Access to Information) initiated by Prime Minister's Office has brought about a revolution in ICT based information dissemination among other citizen services. Other initiatives like Information Communication Centre (AICC), Union Information Service Center (UISC), Krishi Radio 98.8, Krishi Call Centre, radio, and television programs, video documentary including a user-friendly website (www.ais.gov.bd) in Bangla (language) are also rendering important agricultural services to the farmers. The National Agricultural Extension Policy is currently under the revision in the new version where e-agriculture has been added as one of the nine principles of the policy (National Agricultural Extension Policy, 2012).

Some NGOs and private farms are playing important role in developing the agriculture sector. BIID has established e-krishok, Batighar and Farm Book. Besides, 'm power' uses mobile technology to help farmers. Grameen phone, GP-Communication Information Center (GPCIC), Krishi Sheba, Krishi jigyasha of Banglalink (Mobile Operator), Gonokendra of BRAC**,** D.NET-Pallitathaya Kendra etc. are engaged in answering farming queries.

3.3 Information Communication Technology (ICT) Centres

Information and Communication Technology has become very important and a driving force in Bangladesh agricultural sector. From the last decade, agriculture literature has been enriched with different acronyms and nomenclatures that are related to farms and farmers and these are of good indicator of development paradigm.

There are some significant agricultural information services for the benefits of the farmers of Bangladesh. Of them rural centre based information sources are very useful to our farming community. Important ones are discussed below:

3.3.1 Union Information Service Center (UISC)

With the support of the United Nation's Development Programme (UNDP), Access to Information (A2i) being implemented by the Prime Minister's Office with technical support from UNDP and USAID is offering greater access to both commercial and citizen services through 4,501 information centers. The first step ahead to make the country digitalized was the establishment of Union

Information and Service Centres popularly known as UISC. The aim of project is facilitating the implementation of the Digital Bangladesh Vision. The project's slogan "Citizens need not go to services because services will come to them" is being realized across the country particularly for the underserved communities (www.bd.undp.org/content/bangladesh/.../access-to-information--ll-.html). A total of 3.91 million citizens are directly receiving information and services from UISCs every month (BBS, 2014).

3.3.2 IPM and ICM Clubs

The first innovative clubs are Intergrated Pest Management (IPM) and Integrated Crop Management (ICM) to the farmers as blessing. Integrated Pest Management (IPM) began in Bangladesh in 1981 with the introduction of the first phase of FAO's Inter-country Programme (ICP) on rice IPM. The early 1990s saw the expansion of IPM through the subsequent phase of the FAO Regional Rice IPM-ICP project during 1990–1996. During this phase, a new model for training was introduced, based on the approach of the Season-long Training of Trainers (SLTOT) and the Farmer Field School (FFS) model, first developed in Indonesia. The strategy of the rice IPM-ICP was to build up the capabilities of the Department of Agricultural Extension (DAE) to impart high-quality IPM training to rice farmers. Farmers trained under the ICP Programme showed substantial reductions in pesticide use, significantly increased yields, and increased decision-making capabilities, based on a greater awareness of the biological and ecological mechanisms underlying their agricultural systems (National Integrated Pest Management Policy, 2002).The IPM component of the Strengthening Plant Protection Services (SPPS) project was designed to introduce IPM in 120 upazilas, in close collaboration with the DAE_UNDP/FAO IPM Project (Settle et al., 2000).

In Bangladesh, the promotion of IPM program, is shared by both public and private sectors though public sector plays a more significant role than private one. Among public sectors, the Department of Agricultural Extension (DAE), the largest agro-based organization, is major responsible to implement the IPM activities. Besides, some Non-government Organizations (NGOs) are involved with the extent of IPM programs. With the collaboration of GOs and NGOs, different international agencies; Food and Agriculture Organization (FAO) and United Nations Development Program (UNDP), bilateral donor agencies; United States Agency for International Development (USAID) and Danish International Development Agency (DANIDA) and development banks; World Bank (WB) and Asian Development Bank (ADB), are implementing various projects to disseminate IPM throughout the country (Kabir and Rainis, 2013). The introduction of these clubs was the inception of the

movement that farmers as well as the agricultural scientists should have done together. This was the right start of the ICT based initiatives for the platform of the present CIS, AICC, FIAC etc.

3.3.3 Agriculture Information and Communication Center (AICC)

Agricultural Information Service under MoA established ICT and community based Agriculture Information and Communication Center (AICC) in different rural areas in Bangldesh. It is a rural innovation widely regarded as key driver of economic growth where information and communication technologies (ICT) are deeply implicated in knowledge flow and innovation (Verlaeten, 2002). Best practices of a particular area are emphasized and it is disseminated among that entire area. Market linkages are established for proper pricing.The idea of establishing AICC at rural areas has driven from the farmers' clubs like the Integrated Pest Management/Integrated Crop Management Clubs/FFS that was aimed at providing farmers with demand-led agricultural technologies and information at their door step. AICC aims to leverage these existing infrastructures of existing clubs to set up integrated information centers for farmers. This is also a venue for male and female, young and experienced farmers, fishermen and livestock owners to interact and learn together, thus ensuring social integration. Ten well-equipped ICT labs have been set up in 10 agricultural regions and nine labs at the AIS existing regional offices (Rajshahi, Rangpur, Sylhet, Chittagong, Rangamati, Khulna, Barishal, Comilla, Mymensingh) and one at Dhaka Headquarters. These ICT labs would be the 'ICT hub'.

Under the initiative, the government has primarily established 20 AICCs during 1990s in different agro ecological zones. In 2009, 95 AICCs, in 2014 150 AICCs & in 2015 254 AICCs have been set up. The objectives of AICC are to increase farmers' access to demand led and timely information on agriculture and agribusiness. Therefore, the target of AICC is to attain poverty alleviation, income generation, and thus livelihood development. Now 499 AICCs are now running in every upazila in Bangladesh.

3.3.3.1 Infrastructure

A single room is set with computer, printer, multimedia projector, sound system, digital camera, mobile phone and furniture. In some AICCs, two rooms in a individual house are arranged for ICT facilities and discussions. These rooms are usually donated by benevolent persons of particular area. Sometimes a farmer comes forward with a piece of land or a diapilated house as gift. The group of farmers through such contribution develop a fund to build a house for ICT based establishment. There are examples where the Union Parishad Chairman or a local land lord willingly donates a land or a house for the development of centre.

3.3.3.2 Management

The AICCs are established at the grass root level, and monitoring and technical support is maintainted by the personnel of AIS and DAE for smooth running. Moreover, in each Upazila, a committee is formed for monitoring, supervision and proper guidance to these AICCs activities and provides necessary suggestions. The committee sends their report on the AICC activities to Director, AIS in every two months. An executive committee is also formed in each AICC with the provision of president, secretary, treasurer, computer operator and other members. The number of general members varies from 30-200 or more. All members including the president and the secretary pay a fixed subscription to maintain the monthly expenditure and maintenance of ICT equipments. The subscription also varies from center to center. The President and the secretary keep in touch with AIS and extension personnel for providing service. The committee maintains a cooperative fund for operation and maintenance.

3.3.3.3 Services

AICC provides computer training, composing and printing of necessary documents on payment. It also organizes agricultural video documentary show, internet service like receiving public examination results, government circular, Skype call etc. The AICC provides answering queries from farmers through website source or directly communication of AIS personnel at HQ at Dhaka. It also provides expert opinion using phone calls. If necessary, AICC enables to arrange video conference through Skype. By showing multimedia drama by AICC creates awareness on specific agriculture production system. AICC also earns by renting ICT equipments.

3.3.3.4 Beneficiaries

Mainly local farmers and relevant club members are regarded as real beneficiaries of AICCs.

3.3.3.5 Future Initiative of AICC

Considering the success and experience of the ICT services, additional 254 AICCs have just been established in 254 upazilas under different district across the country with the financial support of National ICT Infra-network for bangladesh Govt.phase-2 (Infosarker) under Information and communication technology division (http://infosarker.bcc.net.bd). These newly established AICCs will also be monitored and supervised by AIS, MoA. Necessary ICT logistics would be provided amongst these AICCs. Besides, basic training for computer operation would also be provided. These centres will act as the information disseminating centre like ‘one stop service centre’ to that locality. It is expected that it will make a bridge between the urban and rural information gap, as well as help to materialize the vision of the government of ‘Digital Bangladesh’.

3.3.4 Community Information Center (CIC)

Community Information Center (CIC) or GPCIC is important initiative taken by Grameen phone (GP) aimed at providing internet access and other communications services to rural areas. In February 2006, 26 CICs were established as a pilot project (www.grameenphone.com/.../community-information-cen....). GPCIC helps the rural farmers, entrepreneurs, and general people to access relevant information. There are 509 GPCICs all over the country and GP plans to set up additional centers gradually. These CICs are used for a wide variety of business and personal services ranging from accessing health and agricultural information to using government services and video conferencing with relatives overseas. The services offered by CICs are helping the farmers and rural entrepreneurs to do farming and businesses more efficiently and effectively. They now get critical and important information on farming techniques, diseases management, right dosage of fertilizer, market prices etc. Besides, farmers and general people get services like digital photography, composing, scanning, e-mail, video-conferencing, public examination results etc.

3.3.5 Farmers Information and Advice Centre (FIAC)

Farmers Information and Advice Centre (FIAC) is a government enterprise developed by National Agriculture Technology Project (NATP) under Ministry of Agriculture and Ministry of Fisheries and Livestock. NATP funded by the World Bank (WB) is implementing the project activities since October 2008. For ensuring the right information for the farmers, NATP established a one-stop advisory service center at union level called Farmer's Information and Advice Center (FIAC) to provide support for preparation of extension micro plans and their implementation at union level and to provide service of the medium level farmers at grassroots level. The project is assisted with demonstration, exchange visits, location specific solution of farm problems on key technologies. So far, 732 FIACs have been established at newly built Union Parishad Complexes and made functional against the Project target of 1300. 100 out of 732 FIAC are provided with computers in the mid of the project. Out of 732 FIACs, 620 have been renovated and well furnished and the rest are yet to be renovated as these have been made operational recently. Presently FIACs are functioning as farmers' one-stop-service centre with the grassroot extension agents of DAE, DLS and DoF. It includes three Sub Assistant Agriculture Officers (SAAO) from DAE and other two local service providers, one from DLS called Community Extension Agent for Livestock (CEAL) and one from DoF called Local Extension Agent for Fisheries (LEAF). The FIAC is providing technical services to farmers in solving problems related to farming practices and agro-business. The rate of advice provided per month is ranged from 15 to 54 numbers depending on the time of cropping season (http://www.pcu-natp.gov.bd/pdf/20130805011412_EIAT.pdf). SAAOs, LEAF and CEAL are providing

services to the farmers and their production problems of crops, livestock and fisheries following scheduled duty roaster. Most of the FIACs are equipped with small equipment like seed moisture meter, water testing kit, vaccination kit, foot pumps and other agricultural equipment and learning tools like seed museum and pest museum and only 100 FIACs have their computers. Renovation of FIAC offices and training provided to SAAOs from the project fund enriched their capacity and encouraged the farmers to visit FIACs for new agricultural knowledge, information and technologies. There are fifteen Common Interest Groups (CIGs) in one region. Ten groups are selected for crops, 3 for livestock and 2 for fisheries. As many as 20012 CIGs have been formed (30% CIG farmers are woman) 1,280 CEALs and 1335 LEAFs have been selected as initiatives under this project (http://www.lcgbangladesh.org/Agriculture/presentations%5C2014%5CNATP%20brief_LCG-AFSRD_02Mar2014.pdf). CIGs are being trained regularly to inform other farmers on different technologies.

One hundred one traning centres have recently been established at upazila for providing training for the farmers. Lack of newly built Union Parishad Complex is the main hindrance of establishing desired number of FIACs. All FIACs are to be digitalized by 2021 in next phase of NATP. In that case, smart phones will be provided with all SAAOs on pilot basis. Besides, there will be facilities of desktop based vedio conferencing and voice recording system message for the agriculture officers at all district and upazila levels (N. Islam, Personal Communication, November 05, 2015).

3.3.6 Pallitathya Help Center

Pallitathsya Help Center (PHC) is the first enterprise initiated by a NGO-D. Net (Development Research Network). It links target beneficiaries with information providers through a combination of mobile phones and computing with Bangla content. This content is housed on D. Net's internal website and is disseminated in softcopy form. A helpline facilitated by a trained 'infomediary' in each Pallitathya Kendra (PK). Infomediaries use a mobile phone to contact the local PK office or Dhaka for answering users' questions. D. Net has established a sliding fee scale based on the timeliness of answers (Ahmed & Lentz, 2008). Questions asked via mobile phone and answers given immediately by mobile phone are most expensive; answers given by mobile later are cheaper; answers given by letter are cheapest. Questions submitted by letter receive a free reply by letter. D. Net has four pilot PKs throughout Bangladesh. The four PKs are located in Babrijhar village, Bangmari union, Nilphamari Sadar upazila in 2005.

3.3.7 Ghat: Rural ICT Centre

The Rural ICT Center (RIC) is run by Digital Equality Network (DEN) with its own investment and support from Katalyst. It established four RICs in 2006 located in three different upazila headquarters in Bogra district. RICs provide a physical infrastructure with basic ICT facilities. The facilities include phone, computers, printer, scanner, internet connectivity, digital camera, etc. Their target is to ensure access to business and social information, developing a sustainable model by addressing local need. The focus of this model is to meet the information and advisory service needs of SMEs in rural Bangladesh. RICs disseminate business information on poultry, agriculture, fisheries and other non-farm rural activities dominating the relevant upazila.

3.3.8 Plant Doctor

'Plant Clinic', a concept of the Centre for Agriculture and Bioscience International (CABI), was first proposed for Bangladesh in 2004. By 2005 there were 19 regular clinics run by the Rural Development Academy, Bogra, the Agricultural Advisory Society, Natore and Shushilan, Satkira. It was based on an original model from Bolivia in 2003 and supported by the 'The Global Plant Clinic' (GPC). Crops Doctors assist the farmers regularly by using information technology. If plant doctors being unable to give solution, collect samples through prescribed format, take snaps of plants, pests or weeds & send through internet to agricultural scientists for advice. From 2005 to 2007, 19 clinics received over 15 000 queries, covering an impressive range of crops and types of problems (Boa and Kelly,2007).

3.3.9 Batighar (Light House)

Batighar was initiated by BIID. It was developed as a network of Tele-centres for information and outreach in quest of facilitating provision of convenient, reliable and affordable access to ICT and its application to people at the bottom of the pyramid. On the whole, the Batighar model aims to create a sustainable provision for easy access to information on different vital livelihood sectors such as agriculture, health, education, and other relevant services by using ICT tools (http://www.biid.org.bd).The goal of Batighar is to establish a knowledge –based sustainable network of information centres to deliver social and commercial services in Bangladesh in order to empower the local communities.

3.3.10 Gyaner Haat (Knowledge Shop)

Practical action, an international charity organization, initiated a pilot project in 30 centres and established the Gyaner Haat (knowledge shop). Gyaner Haat provides a place where communities can access technical and knowledge services and support. Each Gyaner Haat has internet connectivity and is managed by a private entrepreneur who charges a small fee for additional

services (photocopying, letter writing etc.). Linkage to the wider community is assured through a team of 15-30 Rural Technology Extension personnel (RTEs) operating as info-mediaries. Having received technical training in agriculture or animal health, the RTEs can generate their own income by selling technical services (inputs, vaccinations, and other treatments) alongside the provision of free advice and knowledge. They are often located in a room as part of the local union council office and are managed by a committee with local representatives, local technical and administrative departments, and other key stakeholders. They usually manage this through selling ICT services, photocopying and similar activities. From each Haat a network of 12 reach out to the community, gathering people's queries about agriculture, fisheries and livestock and spreading knowledge and skills about best practice– particularly when it comes to the use of technologies. Gyaner Haats based within existing Union Parishad buildings receive more visits from the local community and greater support from local government. Practical Answers also operate successful Gyaner Haat from rural high school where the knowledge shop provides a place for students, parents, farmers and teachers for accessing knowledge information they need.

3.4 Electronic Media Initiatives

The initiatives related to electronic media are radio, television, private channels, different radio and TV programs that are included in this section.

3.4.1 Radio Programmes

Electronic media can reach a large number of people at a faster rate. Radio is a complementary component in promoting agriculture and rural development. It has proved to be the most effective media in promoting agriculture and development in rural areas in Bangladesh. It is cheaper and conveniently usable even where there is no electricity supply.

3.4.1.1 Bangladesh Betar (Radio)

The Bangladesh Betar, a public service broadcaster, broadcasts various types of agriculture related programs from its national centre in Dhaka (the capital city) and other centres in Chittagong, Khulna, Rangpur, Rajshahi, Sylhet, Rangamati, Barisal, Cox'sbazar and Thakurgaon. With the aim of agriculture development in different types of names the Bangladesh bater broadcasts programmes. Desh Amar Mati Amar, Krishi Samachar, Sonali Fashal, Krishikatha, Krishi Khamar, Krishi Samachar, Chashabad, Ajker Krishi, Khet Khamare, Khet Khamar Samachar, Sabuj Bangla, Ajker Chashabad, Shamol Sylhet, Khamarbari, Krishikatha, Sonali Prantor, Ajker Krishi etc. are worth mentioning programmes.

Bangladesh Betar has been broadcasting 220 hours 25 minutes programmes daily from its 11 regional stations (www.betar.bd.org). It transmits over five hours of agricultural programmes, plus regular news items. In particular, radio is effective at spreading general awareness and creating an interest in farming innovations, giving timely warning about possible pest and disease outbreaks, or urgent advice about action that could be taken; facilitating farmer-to-farmer extension by broadcasting the success stories of farming, announcing major forthcoming extension events such as district or thana fairs; reinforcing and repeating extension messages that are also passed on at other extension events; weather forecasting; providing information about the prices and availability of inputs and market prices for outputs; providing agricultural development information from varied sources such as research scientists and sector specialist, who are not available for face-to-face extension events.

Table 3.1: Agriculture related programs broadcast by Bangladesh Betar, Krishi Radio and Radio Today

Betar Kendro	Programme	Broadcasting time	Duration	Type	Comment
Dhaka	Desh Amr Mati Amr	7.05 pm-7.30 pm	25 min.	National	Daily
	Krishi Somachar	6.25 am-6.30 am	5 min	National	Daily
	Sonali Foshol	6.5 am-6.35 am	30 min	Regional	Daily
	Sobus Prantor	5.50 pm-6.00 pm	10 min	National	Every Friday
	Sosho Shamol	8.30 pm-9.00 pm	30 min	National	Thursday in every month
	Amr desh	4.05 pm-4.35 pm	30 min	National	Everyday
Chittagong	Krishi Somachar	6.25am-6.30 6.55-7.00	5 min	Regional	Summer/Winter
	Krishi Khamar	6.10-6.50	40 min	Regional	Daily
Khulna	Krishi Somachar	6.25 am-6.30 6.55-7.00 am	5 min	Regional	Summer/Winter
	Cahasabad	6.10-6.50	40 min	Regional	Daily
Rangpur	Krishi Somachar	6.25 am-6.30 6.55-7.00 am	5 min	Regional	Summer/Winter
	Khet khamare	6.05-6.35 pm	30 min	Regional	Daily
Rajhshai	Khet Khamare Somachar	6.25 am-6.30 am 6.55-7.00 am	5 min	Regional	Summer/Winter
	Sobus Bangla	6.05-6.45 pm	40 min	Regional	Daily
Sylhet	Ajker Chashabad	6.25 am-6.30 am 6.55-7.00 am	5 min	Regional	Summer/Winter
	Shymol Shylet	6.05-6.45 pm	40 min	Regional	Daily(Except Friday)
Ragamati	Kamar bari	3.20 pm-3.30 pm	10 min	Regional	Daily
Barishal	Krishi kotha	3.15 pm-3.35 pm	20 min	Regional	Daily (Except Sunday & Wednesday)
Bandorbon	Krishi kotha	4.15 pm-3.35 pm	20 min	Regional	4 days in a week (Sunday to Wednesday)
Cox'sBazar	Sonali prantor	3.05 pm-3.30 pm	25 min	Regional	4 days in a week (Fri., Sat.,Sun.& Tues.)
Dakurgai	Kisan Mati Desh	6.05 pm – 6.30 pm	25 min	Regional	4 days in a week (Fri, Sat., Mon. & Wed.)
Comilla	Sujola Sufola	5.20 pm-5.30	10 min	Regional	3 days in a week (Sun.,Tues.& Thus.
Radio Today	Green F.M	7.00 am-8.00 am	1 hour	National	Daily
Krishi Radio		From Morning to Night	8 hours	Regional	Three times a Day

Source: AIS

3.4.1.2 Privately-owned Radios

The first private radio station is Radio Today which was launched in 2006. By 2012 there were just five privately owned commercial FM stations on air. The five stations are 1) Radio Foorti (88.0 FM), 2) Radio Today (89.6 FM), 3) ABC Radio (89.2 FM), 4) Radio Amar (88.4 FM) and 5) Metrowave. Besides these stations, there are more stations that have been established during the recent time. They are Asian Radio 90.8 FM, City FM 96.0 FM, Color's Radio 101.6 FM, Dhaka FM 90.4, People's Radio 91.6 FM, Radio Bhumi 92.8 FM, Radio Shadhin 92.4 FM. Radio Metropolitan 88.8 is only state-run FM station (Wikipedia). All these stations amuse the listeners with modern music, folk music and many other entertaining programmes. Green Hour by FM Radio Today for 30 minutes every day regarding the selection of season based tropic and talker.

3.4.1.3 Community Radio

Community Radio is an emerging media in that launched in the country in 1998. Bangladesh NGOs Network for Radio and Communication (BNNRC) along with other like-minded organizations and representatives of the civil society started the movement for community radio operation. BNNRC addressed the community radio & community TV access issue in 2000. (http://www.bnnrc.net/network/communityradioinbangladesh). In 2008, government declared Community Radio Installation, Broadcast, and Operation Policy Now 32 Community Radios got Government's approval. Among them 16 Community Radio Stations are on-air in the country (https://en.wikipedia.org/wiki/List_of_Bangladeshi_television_and_radio_channels). Fifteen community radios are privately run and one state-governed. These stations are located in the sixteen district. They broadcast the agricultural programs locally through entertainment among the farmers. These programs come to farmers in great use with expert advice and agricultural guidelines.

3.4.1.4 Community Rural Radio (Agriculture Radio)

Community Rural Radio popularly known as Krishi Radio (FM 98.8) is the only government community radio. It was established by AIS, under MoA with the support of FAO. It is located at tropical cyclone prone coastal district at Amtoli Upazila Complex, in Borguna district. It started its test transmission on January 2012 with the slogan that 'Amar Radio, Amar Kotha Bole' ('My Radio, My Voice'). The station has four rooms in the studio; On Air room, Editing Panel, Recording Room and Transmission Room. At present its special program is run for 8 hours only for the interests of the community listeners. This programme is scheduled from 9.00 am to 11.00 am and 3.00 pm to 9.00 pm. About 30 types of program are aired from different development issues. The radio broadcast programs including Agriculture, Trade, Education of the community, Health & Society, Women

Rights, Rural Development, Environment, Weather and Culture. A news program at local, national and international level is aired everyday at 4pm. There are about 1 lac listeners in 50 listener clubs covering two district (Barguna and Potuakhali) in the locality (Krishi Diary, 2016).

3.4.2 Different Television Programs

Popular farms programs are now telecast by two state-run TV channels namely BTV and BTV World and some private TV channels in Bangladesh. The BTV initiated agricultural programmes attracted farming community. Now some private channels have developed to great extent catering special events, bulletins on agriculture. Channel-I, Bangla Vision, Boishakhi TV are mentionable in line with modern agricultural programmes.

3.4.2.1 Bangladesh Television (BTV)

Bangladesh Television (BTV, a public run channel, began its operations in 1964. It telecasts wide range of programs aiming at presenting information, promoting values, ethics & culture and motivating people towards democracy and development activities. It started its satellite Transmission on April 11, 2004. It has two stations in Dhaka and Chittagong and fourteen sub-stations across the country. BTV's terrestrial transmission covers 95% geographical area of Bangladesh. It is not only an entertainment channel but also a public service broadcaster and is committed to the people for its overall activities (http://www.moi.gov.bd/about.php). BTV transmits 18 hours program terrestrially and 24 hours through satellite daily.

3.4.2.1.1 Major Agricultural TV Programmes

Mati O Manush (soil and men), originally called *Amar Desh*, was a pioneer programme in Bangladesh Television. It started in the mid-1980s and focused on the agricultural sector of Bangladesh. This is the first agricultural development based program telecast by BTV. In 1985, the show's title was changed from *Amar Desh* to *Mati O Manush* (Soil and Men). Now it casts at 7 am on every Sunday and Wednesday and again at 1.30 pm on every Tuesday. It is very popular among the farmers.

3.4.2.2 Privately-owned TV Channels

Of the private channels, channel-I comes first for special programmes including news, bulletins on agriculture. It has successfully penetrated into the society both in rural and urban dwellers. This Bulletin is presented everyday at 5.20 pm. Besides scheduled prime time news, important agricultural news is presented with priority on this channel. Besides, two famous programs on

agriculture titled 'Ridoye Mati O Manush' (Soil and Man in the Heart) and 'Ridoye Mati O Manuser Dak' (Call of Soil and Man in the Heart) have been telecast. The agricultural programmes received national and global recognition for its diverse and far-reaching programmes and popularity. Bangla Vision too broadcasts a very important and famous program 'Shymol Bangla' which is at 10.10 on every Saturday. Besides, Boishaki Television has named the Program 'Krishi 0 Jibon' that is telecast on 8.20 Pm on every Sunday.

Table 3.2: Agriculture related programs broadcast by television

TV Chanel	Programme	Broadcasting day & time	Re-broadcasting day & time	Duration
Bangladesh Television	Mati O manus	Sunday-1.30pm Wednesday-7.05pm Thursday & Friday	Monday,Tuesday-8.10pm, Wednesday Thursday & Saturday	25min
	Krisi Divanishi	Every Monday-5.20pm		
	Banglar Krishi	Every day-7.25am		
	SAARC Krishi			
	Krishi kotha			
	Krishi Sangbad	Daily		
Chanel-I	Rhidoye Mati O manaus	Saturday---9.35pm		25 min
	Rhidoye Mati O manauser Dak	Thursday-3.05pm	----	30 min
	Complete Krishi Sangbad	Daily-5.20pm		
ATN Bangla	Matir subash	Monday-4.20pm		25min
Bangla Vision	Shymol Bangla	Thursday-5.50pm	Thursday-3.30 am	
			Friday-8.30 a.m	
			Wednesday-9.30 am	
	Shymol Bangla live	First Thursday of a month-5.50pm	Thusday-3.30 am	
			Friday-8.30 am	
			Wednesday-9.30 am	
Boishaki TV	Krishi o Jibon	Tuesday- 7.45pm	Wednesday-8.30 am& Sunday-3.45 pm	25 min
GTV	Sobus Bangla	Friday-6.30pm	Friday-9.45 am	
			Saturday-11.30 am	
			Monday-5.30 pm	
R TV	Amr desh	Tuesday-5pm		25 min
71 TV	Krishi Sogjog			
Mohona TV	Mohonar Krishi o Krishok	Sunday -10:30pm		20 min
Bijoy 71	Krishi Kormo			
My TV	Khamar Bari			
Islamic TV	Krishi Biplob	2nd&4th Friday-12.00am		25min

3.5. Print Media-based Initiatives

The press has contributed to the growth and development of society in terms of political, economic, culture, education, agriculture and social systems etc. (Okorie and Tunji, 2011). Media has become an essential part of our life. Among the popular dailies, there are almost 7 Bangla dailies and 3 English dailies which publish feature on agriculture in separate names and in separate days. All important news and views of farming and farm holders are published on particular page of Newspaper. The country's famous newspaper 'The Daily Ittefaq' publishes special full page feature on integrated agriculture 'Mati o Manuser Krishi' on every Sunday. In the catchy name 'Allar Eshara' in the full page volume is published every Monday on 'The Daily Jugantor'. Though not a regular feature weekly, some agriculture related important news is published daily in the most popular daily 'The Daily Protom Alo'. 'The Noya Diganta', in the name 'Chashabad' 'The Daily Destiny' in the name of 'Agriculture and Environment' and 'The Daily Amar Desh' as in the same name publish a special feature weekly to focus on the important seasonal agri-products flower, fish etc. Besides, 'The Daily Bangladesh Protidin' tries to publish agricultural news collected from Agro Bangla (Krishi Diary, 2016).

Table 3.3: Agriculture related publications

Publication	Daily/Monthly	Page	Topic name
Protom Alo	Saturday	Half Page	Khet Khamar(Greater Agri.)
Daily Ittefaq	Sunday	Full Page	Integrated Agriculture
Jugantor	Saturday	Full Page	Krishi Kotha(Greater Agri.)
Kaler Kondo	Saturday	Full Page	Chasbash(Integrated Agri.)
Jonokondo	Sunday	Half page	Bichitro Bonooisodi(Greater Agri.)
Daily Noa Digonto	Saturday	Half page	Chachabad(Greater Agri.)
Jai Jai Din	Sunday	Full page	Krishi o Somvobona(Greater Agri.)
Songbad	Tuesday	Full page	Sombovona(Greater Agri.)
Daily Bangladesh Potidin	Saturday	Full page	Krishi o onnoun(Greater Agri.)
Ajker kagos	Everyday	Last page	Jibon sutro(Vejosh udvit
Daily Destiny	Monday	Full Page	Krishi 0 Poribesh(Greater Agri.)
Shekor			Greater Agri.
Krishi Biplob	Forth nightly	32 pages tabloid	Greater Agriculture Integrated Agriculture
Krishikotha	Monthly	32 pages Magazines	Greater Agriculture & Research oriented
Amr Khamar Amr Jibon	Monthly	16 pages tabloid	Integrated Agriculture
Farm House	Monthly	48 pages Magazines	Integrated Agriculture
Urbora	Monthly	24 pages Magazines	Integrated Agriculture
Krishi Khamar	Monthly	56 pages Magazines	Integrated Agriculture
Krishi Bangla	Monthly	32 pages Magazines	Integrated Agriculture
Krishi Barta	Monthly	32 pages Magazines	Integrated Agriculture
Khamar Bichita	Monthly	70 pages Magazines	Integrated Agriculture
Folok	Three		Greater Agriculture

Foshol	Six		Greater Agriculture
Ruti Rosi	Irregular		Greater Agriculture
Somposaron Barta	Monthly	4 pages bulletin	Agriculture News
SAARC Agrinews	A quarterly	12 pages	SAARC countries agriculture
SAARC Journal of Agriculture	Half yearly	120 pages	Research papers of SAARC countries
Bangladesh Journal of Agriculture (BJA)	Half yearly	200 pages	Research papers
BARC Newsletter	A quarterly		Research Highlights & Activities,

Source: AIS

3.6 Web-based Services

Almost every agriculture based organizations both government and private have their own websites. Here some important websites are briefly discussed.

3.6.1 AIS Website

Agriculture Information Service established a web based e-content service (www.ais.gov.bd). The website is having the highest digital agricultural validated content (e-krishi). Their prime focus is to serve the farmers with local Bangla language. The site is being updated regularly with simple interface. It provides opportunity for question answering, putting comments and contributes by posting any articles. The vast information on crops, basic information on fisheries and livestock are also available on this site. Electronic copy of print/video materials: Krishikotha (Agriculture news), Somprosharon Barta (extension news), different posters, leaflets, books, folders etc. are being published from AIS. The web site has reduced the digital divide between urban and rural areas.

3.6.2 Jatiyo e-Tathyakosh

Access to Information (a2i) programme has taken the initiative to provide a one-stop solution for sharing livelihood-related information, through an online knowledge bank, the Jatiyo e-Tathyakosh (www.infokosh.bangladesh.gov.bd). This is a national e-Content repository having the largest pool of livelihood contents in Bangla delivered through audio-visual, text and animation formats. The target group for such communication has also been widened to a great extent. To ensure the best usage of e-Tathyakosh content, it is developed in two versions: Online and offline version. The Offline version is developed to address issues of slow connectivity and is used in 4501 UISCs and other tele-centres. Access to Information (a2i) programme has taken the initiative to provide a one-stop solution for sharing livelihood-related information, through an online knowledge bank, the Jatiyo e-Tathyakosh. A total number of 350 partners, from both public and non-state sectors, came together in creating this national information portal which is enabling citizens to acquire information in less time. It is

also to be noted that the National Portal of Bangladesh has been created in the vernacular to increase usability of the contents by the vast majority of Bangladeshies. The online platform regularly supplies content on pertinent livelihood topics such as health, education, agriculture, law and human rights, non-farm activities, environment, disaster management, employment, science and technology, trade and commerce among others (http://www.a2i.pmo.gov.bd/content/jatiyo-e-tathyakosh).

3.6.3 Digital Archive on Agricultural Theses and Journals of Bangladesh

With the financial support from Higher Education Quality Enhancement Project (HEQEP) of University Grants Commission of Bangladesh (UGCB), Digital Archive on Agricultural Theses and Journal (DAATJ) was established in 2012. In this project, the agricultural theses and journals published from agricultural universities, namely- Bangladesh Agricultural University (BAU), Mymensingh; Sher-e-Bangla Agricultural University (SAU), Dhaka and Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur and others were being archived and made publicly available through a common webportal DAATJ (http://www.saulibrary.edu.bd/daatj/public/) built on Joomla, a Content Management System software.

3.6.4 Extension Portal

'Extension Portal' is an online platform in agricultural extension. BIID and Sher-E-Bangla Agricultural University (SAU) jointly launched the www.extension.org.bd portal to establish an ICT based knowledge sharing platform for various stakeholders of agricultural extension. It accelerates the existing knowledge of researchers, extension personnel educators, policy maker in the field of agriculture using information technology. This online platform fosters usage of ICT in agricultural extension to faster growth in the agriculture sector through knowledge sharing. It coordinates among these stakeholders and maintains linkage with the research to field; provide relevant and updated extension related information to the people on a more regular basis. BIID foresees this platform as a knowledge hub for policy makers, academicians, and extension personnels.

3.6.5 Infolady

'Infolady' is symbolically a woman who brings the web on wheels to thousands in country's remotest villages. An Infolady serves the community through forming numerous groups (housewives, adolescent girls, farmers, youths, senior citizens etc.), plans around an hour long enlightening sessions with her groups at an agreed venue, once a week. She serves citizens at doorsteps riding bi-cycle. Citizens also visit her residence for receiving services. She makes internet connections to thousands in impoverished farming villages creating a group of about 50 women. The 'Infoladies' project was launched in 2008 by D.Net (http://infolady.com.bd). An 'Infolady' is equipped with a laptop computer, a tablet, a digital camera, a glucometer and a Smartphone, and internet connection, which allows her to update daily transaction data through an integrated system. She keeps her in touch with regionally established Hub for regular mentoring and support services for business enhancement. Infoladies help villagers with a range of digital tasks, setting up Skype (MSFT) calls.

3.6.6 Bangla Agri Web Portal

This portal caters information services for the farmers. It is known as KrishiBangla.com and is retrievable from http://www.krishibangla.com. The largest of Bangladesh Initiative for Total Reform (ITR) as a non-profit social organization takes initiative to state this KrishiBangla.com in the Bengali language for the quick dissemination of modern and updated agricultural technology to all stakeholders of agriculture. ITR got technological support from Department of Agriculture Extension. This Bengali knowledge website provides contents on location-specific problems on agriculture, fisheries, livestock, market system development etc.

3.6.7 DAE Website

The Department of Agricultural Extension (DAE) under ministry of agriculture is the largest public sector extension service provider in Bangladesh. Its mission is to provide needs based extension services to all categories of farmers and enable them to optimize their use of resources in order to promote sustainable agricultural and socio-economic development. DAE has a wonderful website (http://www.dae.gov.bd) that contains different important links like online fertilizer recommendations, nutrient manager, rice crop manager, IRRI crop doctor etc. It always serves the farmers with different modern agricultural technology like leaf color chart, AWD, Floating vegetables, cultivation techniques, summer onion cultivation techniques etc.

3.6.8 DAM e-service

The Department of Agricultural Marketing (DAM) of the Ministry of Agriculture, Government of Bangladesh has undertaken an e-government initiative that would utilize the power of ICT to develop and disseminate critical Agricultural Market Information to farmers, traders, government, policy makers, development agencies and other stakeholders. Several E-Commerce sites like amardesheshop.com**,** bikroy.com**,** cellbazar.com in Bangladesh normally offer various items for sale. Under the overall coordination and support of the Government's Support to ICT Task Force, DAM has developed the first phase of its programme to automate data entry at the district level where market information of agricultural products is collected from local markets. The initiative also attempts at developing the capacity of the DAM head office in Dhaka to consolidate and coordinate dissemination of the information to government, farmers, and other stakeholders. The daily price information is available for use in many ways including from the DAM website (http://dam.portal.gov.bd). Farmers got direct benefit using these sites and buyers were able to make direct conversation with the owners / farmers.

3.6.9 e-Krishok

Bangladesh Institute of ICT in Development (BIID) initiated a web based agricultural service (www.ekrishok.com) for the farmers' services in farming activities and facilitating market linkage opportunities. A rural telecentre operator is trained to use the user friendly Bangla language content available on the eKrishok website(Akbor & Sumaiya, 2013). Since October 2008, e-Krishok has been using information and communication technologies (ICT) to deliver information and advisory services to farmers in rural and remote locations at an affordable cost. e-Krishok extension services are provided with the integration of ICT. Owners or operators of tele-centers act as resource persons at the ground. They help farmers to access information on the e-Krishok website. Queries that prove too technical for the telecenter operator are sent on the e-Krishok webmail. e-Krishok offers information and advisory services through mobile phones (call back and SMS) and email (www.biid.org.bd). All information is sourced from the government and private sector and e-Krishok collates and disseminates this directly to farmers.

3.6.10 IRRI Rice Doctor

This service retrieved from http://www.knowledgebank.irri.org/decision-tools/rice-doctor**,** bridges the gap between research and practice in rice production. The International Rice Research Institute (IRRI) developed the Rice Knowledge Bank (RKB)—a digital extension service that provides practical

knowledge solutions, specialized for small-scale farmers in developing countries. RKB showcases rice production techniques, agricultural technologies, and best farming practices based on IRRI's pool of knowledge from research findings, learning and media resources, and in-country projects. To facilitate easy access to information, RKB highlights the Step-by-step Production Stages from pre-planting to postproduction management, Decision Tools, and Agronomy Guides to help people make informed farming decisions. RKB serves to address the biggest challenge to agricultural development by supporting fast and effective transfer of technologies from the research laboratory to the farmer's field. Besides these, the site has different international links**.**

3.6.11 MEAS Website

Modernizing Extension and Advisory Services (MEAS) website (www.meas-extension.org) supported by USAID. It focuses on the integration of Information and Communication Technologies (ICT) into agricultural extension services. It is regularly developed and updated. This is a complementary extension support program. The Agricultural Extension Capacity Building (AECB) is intended to strengthen extension and advisory services in Bangladesh. MEAS would provide technical support for four tasks of AECB: 1) Development of a Strategy for Extension of the use of Information and Communication Technologies ICT in Extension Services. 2) Training of Farmers and Extension Agents in the use of ICT. 3) Trainings held by Extension Agents using ICT. 4) Multimedia Extension Products created using ICT.

3.6.12 Amardesh e-shop

Amar Desh Amar Gram Is the first e-commerce solution in Bangladesh (http://amardesheshop.com/) for rural producers as they can easily sell their products at anywhere of the world by Amar Desh Amar Gram. It is a project powered by FSB (Future Solutions for Business) ltd. (http://www.fsb.com.bd) which is an IT solution provider company. Amar Desh Amar Gram is the first project of its kind that takes computers and web access to the lowest income group and empowers them with a possibility that was not ever previously available to them before. This project takes the products from producers all around Bangladesh and then opens up national and international markets for them A recent report of "Amar Desh Amar Gram e-shop" indicated that they have around 16,000 people in Dhaka alone who buy even vegetables from them. Their contribution is recognized in 2012 with the winning of WITSA Global ICT Awards.

3.6.13 Kiosko (Electronic Touch Screen)

Kiosko as popularly known as electronic touch screen is a very wonderful medium to easily use much information, Audio-Video content etc about agriculture. Agricultural Information Service set up 12

Kiosko in the headquarters and regional centres. In the kiosko different E-book, video materials, audio materials are very carefully set up by AIS. Moreover high speed internet connection has been included in Kisoko. Without the help of others, a farmer with the touch of hand can easily get expected information from this Kiosko.

3.6.14 DoF Website

The Department of Fisheries (DoF) established a website for rendering technologies on aquaculture, marketing, research highlights etc. This website is known as www.fisheries.gov.bd. Fish farmers could get the different modern technological information /advice for modern aquaculture. This website has also various national & international links from which fish farmers get important latest information and thus be benefitted.

3.6.15 DLS Website

Department of Live Stock (DLS) Website is an informative website (http://www.dls.gov.bd/). It provides different technological information like poultry breed, cow breed, duck breed, fodder etc. It displays generation of technologies in the website. Information on different on-going project activities related to livestock is available here. Besides, this website has different important national and international links.

3.6.16 Some Other Agriculture-related Websites

There are many websites that are available and being updated with latest agricultural programs. The daily problems in farming and their easy solution are also given in the websites. New inventions and new stories of successful farmers are to be updated in those web pages. Some of them are given here:

URL:http://www.agrobangla.com
URL:http://bangladeshagri.com
URL:http://www.ruralinfobd.com
URL:http://www.jeeon.com.bd
URL:http://www.krishibangla.com
URL:http://www.krishimarket.com
URL:http://banglarkrishi.nic.in
URL:http://www.bdfish.info/bangla
URL:http://www.ekrishok.com
URL:http://www.moa.gov.bd
URL:http://www.badc.gov.bd
URL:http://www.knowledgebank-brri.org
URL:http://www.dae.gov.bd
URL:http://www.bari.gov.bd
URL:http://www.bina.gov.bd

URL:http://www.sca.gov.bd
URL: http://www.ekrishi.com
URL: http://www.brri.gov.bd
URL: http://www.barc.gov.bd

3.7 Telephone and Mobile Based Initiatives

The increasing penetration of telephone and mobile network and handset in Bangladesh presents an opportunity to make useful information more widely available. This network helps agricultural markets operate more effectively. The widespread use of telephone and cell phone results in speedy communication in any sector including agriculture. Mobile phone technology helps farmers enter easily into the world of ICT. Therefore, telephone and mobile phone network is at present found to be very essential for the enhancement of farm output.

3.7.1 Agricultural Call Centre

Agricultural Call Centre, under the AIS, Ministry of Agriculture (MoA) is first government initiative. The center was financed by Practical Action and its technical assistance is performed by BD Online Ltd. Its first piloting was done in 2012. In June 2014, it finally launched in operation. Every day except Fridays and public holidays from 9 am to 5 pm, farmers can dial 16123 from any operators for help with any problem related to livestock, aquaculture and agriculture production. Its aim was to give the latest technology, service and information about agriculture among farmers. It renders practical answers of a problem related to livestock, aquaculture, and agriculture production. Per call costs 25 paisa without vat (AIS Krishi Diary, 2016).

3.7.2 Krishi Jigyasha 7676

Krishi Jigyasha was launched by WIN Incorporate and Banglalink as the first mobile based agro information service in Bangladesh. It provides suggestions and answers to the farmers' query on the issue of harvests, pesticides, agro diseases seeds, fertilizers, fisheries, livestock services and much more. In December 2008, WIN Incorporate and Banglalink, one of the leading telecom companies in Bangladesh launched 'Jigyasha 7676' Mobile Phone Service' as the first mobile based agro info service in Bangladesh (http://www.winbd.org). With the help of short-code 7676 farmer specific question/queries on cultivation techniques, such as irrigation, planting, disease treatment and other related issues like poultry, livestock, fisheries etc.

3.7.3 Krishibazaar 2474

Banglalink Krishibazaar empowers the farmers with important market information addressing the price syndication and thus weakens the middlemen through Banglalink subscriber 2474. krishibazaar is an IVR (Interactive Voice Response) based service that allows customers to know the latest market prices of essential agro goods in 18 major markets across the 7 divisions of Bangladesh and find other agro buyers and sellers. Agro buyers and sellers can post or browse their desired agro product info in the service for selling or buying. The seller or buyer can also call up his/her desired seller or buyer instantly by pressing "8" and finalize the deal. The information of the products is available by categories, prices, locations, etc. to make the process easier. The service charge is 30 paisa/ 10 second (15% vat & 3% supplementary duty charge) (http://www.banglalink.com.bd/ en/services /services/information-based-services/banglalink-krishibazaar).

3.7.4 Krishi Sheba 27676

This is a Grameen Phone mobile-based agro info service monitored in collaboration with WIN Incorporate in Bangladesh. It provides suggestions and answers to the farmers' query on the issues of crop cultivation, soil nutrition management, fertilizer information, poultry, fisheries, weather update and much more through SMS, Voice Calls etc. Through the service of Krishi Sheba, Customers are able to get a direct voice conversation by dialing 27676 for updated agro information and advice on agricultural service from agro-specialists. Customers get services on crop cultivation, soil information, fertilizer information, poultry, livestock, and fisheries. Per phone call (27676) costs BDT 5 per minute (http://www.grameenphone.com/mobile-lifestyle/information/agri-info-service).

3.7.5 e-Services 16250

BIID has taken the initiative to launch a new service to offer e-Information through Short Code 16250, as a helpline service dedicated to providing information covering a wide range of areas ensuring people's right to information at the right time. The areas of this service are agriculture, livestock, fishery and poultry. The features of this service are: 1) Call back & voice service- any query related to the information areas, 2) SMS service- registration, subscription, individual content, 3) Vast, in- depth, validated, reliable and updated content, 4) Service provided by trained agriculturists and experts, 5) Feedback mechanism to improve the service and 7) Reporting system to analyze customer needs.

3.7.6 Win Miaki Agro Call Center

Win Miaki Call Center is a full-fledged live call center with agriculturists/ horticulturists to receive calls from the farmers about their problems related to agriculture. The center records interactive voice for agro-related information. It serves farmers through SMS and call back. It answers the queries on soil & diagnostics, plant tips & calendars, pest & insecticide. It provides fertilizer information, livestock & aquaculture information, disease & remedy information, weather forecast and fertilizer recommendation system. The center is reached through **win.miaki**.co/.

3.7.7 Farmer Query System

The farmer query system is (mobile and web based tool) an ICT solution developed by mPower Social Enterprises Ltd. for the USAID Ag-Extension project. 'mPower' is designed to mitigate the gap between farmers & agro-experts. It provides agricultural solutions to the farmers within 12 hours after a question has been submitted to the query system (http://www.mpower-social.com/agriculture). The system enhances smallholder farmer's access to agro-based information and knowledge by enabling them to interact with agricultural experts directly or via an infomediary through a mobile application or IVR system that directs them to available experts in the system.

3.7.8 E Purji

E-Purji is a data-base software service. E-purji system jointly implemented by Prime Minister's Office-run Access to Information programme (A2I), Bangladesh Sugar and Food Industries Corporation (BSFIC) under the Ministry of Industries and UNDP, is the issuance of permit through Short Message Service (SMS) to the growers for selling sugarcane to the 15 state-owned sugar mills (http://epurjee.info/purjee/en_index.php).It diminishes the sufferings of the farmers for purchasing sugarcane from sugarcane farmers. It sends information to the farmers by using information technology. Under the new e-purji system, the sugarcane growers are issued permits through SMS (http://www.bsfic.gov.bd/). Like the traditional purji, e-purji also contains farmer's name and other relevant information. Instead of any hand written slip, purji supplies from sugar mills' server (where all information like farmers' name, mobile number, quantity of sugarcane cultivation, pass book number, name of the unit and centre etc.). As soon as sugarcane is matured, it communicates with farmers by sending SMS through the farmer's cell phone. Then the sugarcane farmers supply sugarcane to the mills on the basis of date and time sent by SMS.

3.8 Application of ICT in National Agricultural Research System

National Agriculture research system in Bangladesh has also taken some good ICT based initiatives for accelerating the research activities to the policy makers, researchers, students, and farmers.

3.8.1 Agro-ecological Zone

In Agriculture, the necessity of GIS application was first felt by Bangladesh Agricultural Research Council. It developed GIS based crop suitability assessment maps, AEZ based crop vulnerable areas, soil nutrient status etc. BARC developed database of human resources of the scientific professionals and maintains linkages with national and international partners. In Bangladesh GIS was started in early 1990s with BARC initiated GIS project to establish a GIS based computerized land information system; utilize the AEZ/GIS for technology generation and transfer on crop production, crop diversification and disaster preparedness program planning. Altogether, 30 Agro-ecological Zones (Regions) were identified in Bangladesh. These regions again, due to differences in soils and/or land levels in relation to flooding were sub-divided into 88 sub regions. The crop zoning maps were produced considering bio-physical classification. In classifying the crop zone, some criteria were followed which are described in the book 'Land Suitability Assessment and Crop Zoning of Bangladesh' by BARC. The crop zoning provides the opportunity to grow the selected crops in different zones according to suitability for achieving higher return.

3.8.2 MIS Software

BARC has established an online Management Information System (MIS) of 13 NARS institutes including BARC. Management Information System as an essential instrument enhances research efficiency and strengthens research activities. It works with nine Modules. It improves agricultural research information system and widens access to information technology tools to research scientists. Through MIS, finance, human resources, inventory, library, procurement, research, training, vehicle and gene bank of the NARS Institutes are to controlled (http://www.barc.gov.bd/). For the first time, eight institutes have been brought under MIS.

3.8.3 National Resources Database

BARC maintains a large number of both spatial and non spatial –databases from which agriculturists, researchers, students, teachers, extension personnel and govt. & non-govt. organizations can get services. At national level, spatial data are available at 1:250,000 scale. Datasets include administrative boundaries, land resources, climatic and hydrological resources, cropping patterns and farming systems information. Attribute datasets have also been generated and updated for all the above mentioned datasets (http://www.barc.gov.bd/). Important ones are discussed below:

Soils and Land Resources Datasets

Agro Ecological Zones (AEZ) inventory maps at 1:250,000 scale were published in 1988 with the initiation of BARC. All kinds of soil attribute in the Land Resources Inventory (LRI) includes soil texture, drainage, soil series, relief, slope, General Soil Type, pH, soil moisture, top soil erosion, effective soil depth, plough pan, consistency, nutrient status, salinity, alkalinity, calcic/acid sulphate phase, permeability, hazards frequency were incorporated.

Land Type Datasets

It was generated based on the LRI and Digital Elevation Model (DEM) at 300 m grid (based on the soil resources database and DEM of 500 m spot elevation). An application for DEM processing and land type database creation has been developed, which can be applied for further updating of land type when better resolution DEM and 1: 50,000 scale soil polygons are available.

Climatic Datasets

Climatic data on rainfall, temperature (maximum and minimum), relative humidity, wind speed and cloud cover collected from BMD for 30 Climatic stations. Besides, rainfall data for 203 rainfall stations of BWDB are also available. These data are available on daily basis for a period ranging from 20 to more than 50 years. Location map of Climatic stations of BMD and rainfall stations of BWDB has also been created.

Agroclimatic Resources Datasets

It is agro metrological e-service for researchers, students, teachers, and govt. non-govt. organizations. They can get services on climate from Climate Information Management System. Agroclimatic Resources for the whole of Bangladesh includes Moisture regime (Length of pre-kharif and kharif and rabi growing periods, beginning of kharif growing period, beginning and end of humid period, pre-kharif transition period, end of kharif growing period, end of rabi growing period etc.) and Temperature regime (Frequency of days of having different level of cool temperatures T<5 ºC, T<10 ºC, T<15 º C and frequency of days having different levels of extreme summer temperature T>35 ºC, T>40 ºC, T>45 ºC).

Cropping Pattern Database

The BARC GIS Project generated Cropping Pattern Database for 30 AEZ and 88 sub-zones by Land type with all necessary details of cropping pattern including extent, cropping sequence, planting and harvesting dates, and water management (irrigated/rainfed).

AEZ Land Resources Database

Ago-Ecological Zone (AEZ) Land Resources Database is created by computerizing landform, soil, inundation and climatic information generated by different organizations of the country. Soil, landform and inundation information was generated by Soil Resource Development Institute through reconnaissance soil survey carried out between 1963 and 1974. This database also contains climatic data on rainfall, temperature (maximum and minimum), relative humidity, wind speed, sunshine/solar radiation, cloud cover and dry-wet bulb temperatures collected from Bangladesh Meteorological Department (BMD) for 30 Climatic stations. Besides, rainfall data for 203 rainfall stations of Bangladesh Water Development Board (BWDB) are also available. These data are available on daily basis for a period ranging from 20 to more than 50 years. Location map of Climatic stations of BMD and rainfall stations of BWDB has also been created. Further detailed may be obtained from BARC Computer Centre.

3.8.4 BARC Display Centre

It is the first national museum of national agricultural exhibition developed by Bangladesh Agricultural Research Council (BARC). The center has been developed in BARC premises with provision of touch screen based information to create greater awareness among students, researchers, policy-makers, and general people. The history and tradition of agriculture and the exhibition center has been set up for display. The inspection center makes visitors know about the invented technologies. Moreover, the country's agricultural history and heritage, continuous evolution and development, contribution to the national economy and the lives and livelihoods of the issues are available in the center.

3.8.5 ARMIS

BARC also developed Agricultural Research and Management Information System (ARMIS) which is an online data base of past research, programs/projects in all research institutes and universities. This data base can be accessed with a key word where users can get information of all past research in Bangladesh. This unique opportunity is very helpful for avoiding duplication of research and developing knowledge of research outputs.

3.8.6 The Essential Electronic Agricultural Library (TEEAL)

Agricultural Information Centre of BARC renders literature search from full text database. This service is called The Essential Electronic Agricultural Library (TEEAL). TEEAL provides CD database literature to satisfy the researchers, agricultural scientists, planners, and policy makers. It also

provides search services on specific requests received from teachers, students, and users from NARS Institutes and other organizations.

BARC maintains an online archive where books, reports, journals, policy documents, circular, achievements etc. are available on http://archive.barcapps.gov.bd/.

3.8.7 BARI Mobile Apps (Krishi Projukti Bhandar)

BARI initiated mobile apps called Krishi Projukti Bhandar (Agricultural Technological Pool). It has developed database of 859 technology (commodity and non-commodity) as complete technology package. It is a mobile web apps technology (baritechnology.org/m) which helps farmers to get into technology solution and reduce cost for production. It disseminates production technology available to the crop production package at right time at stake holder's door step.

3.8.8 Online Fertilizer Recommendation Software (OFRS)

Online Fertilizer Recommendation Software (OFRS) is fertilizer recommendation guide in software, developed by Soil Resource Development Institute (SRDI) in partnership with Katalyst. The software assists farmers with the accurate information for location specific soil nutrition solution for different crops(www.srdi.gov.bd).The software enables any beneficiary group or individual to log in www.frs-srdi.gov.bd. As an input, it requires only three information viz. land types-High, medium, low land, crops name, variety and location of farms. The guideline has been developed by BARC in cooperation of crop based NARS institutes (BARI, BRRI, SRDI, BINA, BTRI, BJRI) which is updated regularly.

3.8.9 Bangladesh Rice Knowledge Bank (BRKB)

Bangladesh Rice Research Institute (BRRI) contains rice knowledge to address the regional and national issues. BRKB is a treasure of rice knowledge. It is a dynamic source of rice knowledge, rice production technology. It is a repository of rice knowledge and online rice and rice based knowledge hub prepared and maintained by senior scientists of BRRI (Bangladesh Rice Research Institute). Most materials- fact sheets, training manuals, booklets, leaflets, brochures, posters, videos have been prepared in Bangla, which are easily understandable to farmers and extension workers. Main sections of BKRB 1) Cultivation method rice, 2) Variants of seasonal rice and its cultivation method, Rice and its cultivation method, 4) AUS rice variants and its production method, 5) Fertilizer and soil management, 6) Rice insects and their managements, 7) Rice diseases and their managements, 8) Quality rice seed production and preservation methods, 9) Irrigation and water management etc. (http://knowledgebank-brri.org/).

3. 9 Some World Successful Initiatives

In the present world, attitude regarding access to agricultural information has been dramatically changed because of the exercise of Information Communication Technologies. There are many challenges particularly in most developing countries of Asian region. Besides, there are various obstacles in establishing ICT initiatives such as lack of infrastructure, lack of IT knowledge, literacy etc. Despite such enormous challenges, there are some unique success stories in the world agriculture and those demonstrate how the (new) information and communication technologies (ICT) can play a significant role in rural development by empowering the rural farmers with new knowledge, up-to-date information and entrepreneurship (Singh, 2012). Some successful ICT initiatives in the world are briefly delineated below:

e-Choupal is a successful initiative in India. It is an initiative of ITC Limited 'Indian Tobacco Company', Innovative platform in trading and e-Commerce in agriculture. It links directly with farmers via the internet for procurement of agricultural and aquaculture products like soybeans, wheat, coffee, and prawns. It started as a cost-effective means of dealing directly with farmers to buy agricultural products for export.

Agriculture Resources Information System Network (AGRISNET) is also a successful initiative in India. It is run by a mission mode project funded by the Ministry of Agriculture to develop a comprehensive online knowledge portal to disseminate relevant information to farmers. Under this scheme, most State Governments established information rich agricultural websites.

EID Parry, the group company of Murugappa Group, is one of the pioneers in the pesticides and agro-products. It was the first company to start sugar mill in India. The company launched the Parry's Corner ICT initiative to derive the synergies from its vast experience and the farmers knowledge pool (Bowonder & Yadav, 2005). EID Parry provides information and knowledge solutions through Cane Management System and other support services to farmers at seventy Namadhu Parry Mayyam outlets. SMS alerts for farmers and cane field staff were used to plan their activities. Centre establishment, operating and service charge are recovered from the farmer from the sugarcane payments (www.eidparry.com/agriland.asp).

IKissan is an important initiative. It renders solutions of many problems related to agriculture information, crop specific package, practices of crops, animal husbandry, aromatic and medicinal plants, agricultural machinery, allied agriculture, sprayers, rural credit, insurance iKisan crop solutions to Indian farmers on time basis (http://www.ikisan.com).

Krishi Vigyan Kendras (KVKs) is an initiative by Indian Council of Agricultural Research (ICAR). The KVK is considered as an institutional innovation that works as interface between research and extension. It renders mobile advisory services to the farmers since 2010. It is a multidisciplinary educational institution situated at the district level and funded and technically supervised by ICAR and attracted to SAUA. There are currently 569 KVKs in India. Each center is under the administrative control of a state agricultural university, NGO, or central research institute (Dash and Mishra, 2004).

Kisan Call Centre (KCC) is another successful initiative ever taken by the Indian Government. It is a central government scheme introduced to provide information to the farmers on demand. This program began in January 2004. It is a content processing and dissemination system providing online information, video channel; Tele-advisory, SMS and GIS based agro-services (www.kissankerala.net).

Village Knowledge Centres (VKC) was established by M.S. Swaminathan Research Foundation, Puducherry, Maharashtra, Orissa, Andhra Pradesh and Kerala. VRCs and VKCs work with 315 partners for implementation and location specific content generation (Senthilkumaran, 2011). Demand driven information and knowledge with support services, social inclusion, community ownership and partnership proved critical for the success and sustainability (www.mssrf-nva.org).

The aAQUA eAgriService is a successful initiative. It is a problem-solving system dedicated to find solutions to problems posed by Indian farmers. It is online discussion, archived, multi-lingual and multimedia based. It achieved already 27674 posts, 3.3 million views by 12,964 viewers (www.aaqua.org).

Punjab Government & Punjab Information Technology Board jointly launched Agriculture Marketing Information Service (AMIS). The purpose of AMIS is to disseminate prices of agriculture commodities prices from 135 markets located across the province of Punjab. Exchange of information across international exchanges and internal market places enable AMIS to gain comparative analysis of local and international commodity prices and also provide benefit to traders, exporters and other stakeholders (https://mahtabrasheed.wordpress.com...).

PhilAgriNet is the most successful initiative in Philippines. It stands for Philippine Agricultural Information Services Network. It was created in 2004. The network aims to bridge the gap between information and researchers by creating a web-accessible database. It aims to link member institutions as well as other researchers for efficient scholarly access to agricultural knowledge (http://www.fao.org/docs/eims/upload/295298/4711....).

Esoko is a successful initiative that provides information and communication services for agricultural markets in Africa. It is a response to the explosive growth of cellular services across the continent. It provides farmers with market prices, weather forecasts and growing tips to help them increase yields and profits & solutions to businesses (https://en.wikipedia.org/wiki/Esoko#cite_note-2).

3.10 Conclusion

The chapter discussed the present status of the agricultural information services in Bangladesh. Many ICT centers, electronic media, print media, web-based services and telephone and mobile based services with their activities are pointed out to have an idea about the potential of ICT. Some world successful initiatives are also mentioned in the chapter. Most of them are Asian and African. The chapter adopts the way of what methods the study will follow. The study of the different types of initiatives will help the researcher find suitable methodology stated in the next chapter.

Chapter Four

Research Methodology

4.1 Introduction

The study of present agricultural information services all over the world including Bangladesh has been conceptualized in the previous chapter and out of secondary data; methodology followed in the study has been described in the section. The methodology is based on the research problems and questions. It includes data-collection techniques, instruments and statistical means of analysis.

4.2 Research Design

This chapter describes the overall research methodologies and techniques employed in this study. Conceptual structure, within which research is conducted, constitutes the blueprint for the collection, measurement and analysis of data (Kothari, 2005). The study was made mainly on the concept of action research in terms of practical and continuous development for agricultural information dissemination services in rural Bangladesh. The method used in this study was usually a mixed one- descriptive and quantitative and the main methodology is placed to illicit correlation between two major variables- the service area and its income and production. The total population size for this study was 1990 farmers of both service areas, who were selected randomly from 30 AEZs and 48 Districts (common districts -33, additional ICT district-9, additional non-ICT district-6). The main tool of the data collection was questionnaire along with interview, direct field observation and focus group discussion.

The main dependent variable of this study was agricultural production and income and that was measured by perception of respondents from about 48 Districts out of 64. Besides, the other dependent variable in this study was implication of using ICT in agriculture. Using descriptive statistics, measures of central tendency (Mean, median, mode) and variability indexes (variance and standard deviation) were calculated. For measuring the study hypotheses and relationship between independent and dependent variables, correlation coefficients, Chi-square test, DiD model and step wise multiple regression analysis were used; after data extraction, statistical analysis was done.

Questionnaire was designed through consultation process with relevant experts and finalized after pre-testing. The separate questionnaire was used for interview with the farmers of both ICT area and non ICT area. The purpose was to collect evidence concerning the use of information resources and

the techniques of different practices used by their farmers to retrieve the required information. The analysis and critical evaluation of the data drew an overall picture of the real fact of use of agricultural information and technologies in their farming.

4.3 Study Area

Bangladesh comprises thirty agro-ecological zones and rice is common in almost every District. The study covers almost all agro-ecological zones keeping crops in particular region. ICT service areas encompass Agricultural Information Communication Center, Farmers' Information Advisory Center, Union Information Service Center, Community Information Center, Community Radio, Krishi Radio, Batighar, Plant Doctor etc.

The study was conducted in all administrative divisions of Bangladesh- Dhaka, Chittagong, Rajshahi, Khulna, Barisal, Rangpur and Sylhet and covered almost 42 out of 64 District (65.63%) of ICT area and 39 District (69.94%) from non-ICT area under direct supervision of the researcher. Districts were purposively selected to take care of healthy proportion of ICT dependent areas as well as non-ICT based traditional farming areas. Areas range from South-east Rangamati to North-east Netrokona and South-west Satkhira to North-east Sylhet.

4.4 Population of the Study

The population comprises farmers all over the country and it is categorized into two types. One type was ICT supported farmers who responded and another set of respondents was non-ICT supported farmers. Both male and female farmers are targeted as population to find influences of ICT on gender and make potential and comparative participation in the study. To consider total agriculture, rice, vegetables, fisheries and livestock farmers are given priority to distribute the questionnaire. However, useful data were gathered from the information of the surveyed population. While collecting data, the researcher made intensive consultation with extension workers (both government and NGO), local leaders, and local knowledgeable people.

4.5 Sample Size and Sampling Techniques

Table 4.1: Characteristics of the study area and participants

Sample Categories	Variables	Number	Percentage
Farmers of Both categories	Male	1030	88
	Female	140	12
	Total	**1990**	**100.00**
Service Area (ICT & Non ICT)	ICT	1170	58.79
	Non ICT	820	41.21
	Total	**1990**	**100.00**
ICT Service Centres	AICC	660	56.41
	FIAC	212	18.12
	UISC	128	10.94
	Community Radio	102	8.72
	Agriculture(Krishi) Radio	20	1.71
	Others (Pvt. Initiatives)	48	4.10
	Total	**1170**	**100.00**

In order to get the expected size of the population for this study, the researcher visited 145 spots from 42 District of Bangladesh under ICT service area and 110 spots from 39 District under non-ICT service area. It was found that there were two categories of farmers. The total number of questionnaire served among the respondents was 1990 of which ICT related farmers were 1170 and non-ICT respondents were 820. While selecting population race, religion, caste and creed were over looked to generalize farmer class.

4.6 Data Collection

Data were collected through two sources– primary and secondary. Secondary data were collected by consulting literature review and for primary data, survey method was applied. This included the use of questionnaires, direct interviews, observation and focus group discussion in obtaining data from a large number of respondents. A combination of data collection instruments was used in order to increase the reliability of the data. With the help of four enumerators, data collection process was accomplished.

The necessary data for this study are obtained from the respondents of the selected areas. A total of 1990 copies of the questionnaire were distributed to the farmers of selected areas in 214 Upazilas in 48 District. The data for the present study were collected under a planned procedure and schedule. All the data were collected during February-December in 2014. Before the survey of final questionnaire, pre-test and pilot tests were done during October-November in 2013. One year later the first survey was taken with the same questionnaire. Data has been analyzed using multiple regression at $P<.05$ level of significance.

The researcher has distributed structured questionnaires in Bangla Version to the respondents, and requested to provide information spontaneously. All the questionnaires have been administered in the face-to-face sittings. While administering questionnaire survey in different sites, the researcher collected the follow-up and baseline production and income. The baseline time was calculated as 2012 and follow-up time as 2014. So here recall method was applied to collect all the data that determined the follow-up and baseline income and production. Thus the researcher has collected the respondents' past and present income and production by this method. After collection of data, the scripts are processed for analysis and interpretation.

4.6.1 Consulting Relevant Literature

The researcher searched literature on the use of ICT addressing the farmers' information needs. Many national and international publications, books, reports, online papers and M Phil/PhD dissertations regarding the use of ICT tools used in agricultural information disseminations were gone through.

4.6.2 Questionnaire

The present study is mainly a quantitative research in nature. So the questionnaire method is adopted for data collection. A set of ninety two questions was designed as data collection instrument. The questionnaire comprises nine sections. Personal information, demographic information of the respondents, financial information of the farmers of the two groups, the various sources of information using ICT tools, the information of the respondents related to fisheries and livestock, gender involvement in agriculture were included in the questionnaire. The questions are closed ended items in different farming methods that influence on farmers production and income. The validity and reliability of the questionnaire have been tested. The questionnaire has been pilot tested in order to ensure that the respondents would have no problems in understanding them. The questions are closed-ended on different issues. The final survey was conducted during February - December 2014. The completion of individual questionnaire took approximately 45 minutes.

4.6.3 Interviews

Formal and informal interviews were held to explore the views, experiences, beliefs and motivations of individual participants. A semi-structured interview was conducted for finding answers to the main research questions of this study. The arrangement of interviews was assisted by the local farmers in the non-ICT area and that was managed by the secretary and president of the ICT centers. The whole process was assisted by the SAAOs in the certain unions. That came to help to the

researcher to fill the gaps that were observed in the questionnaires. Some items were not properly answered in the questionnaires.

4.6.4 Focus Group Discussion

Fifteen (15) FGDs were conducted for generating information on collective views and the meanings that lie behind those views. The discussion helped to increment the findings through questionnaire, interviews and observation As a standalone method, those FGDs were intended to be included for research relating to the norms of farmer group, exploring the ICT addressed services, collecting the dialect or challenging data collected through other methods or feed backing results to research participants. The composition of every focus group was done with great care to get the best quality of discussion on the issues like the mix of ages, sexes, income, input supply, production, yield, marketing and other social professional statuses of the farmer participants. Interaction came out from each focus group as successful indication. The average participation was 11 ranging from 8 to 13 farmers covering District like Khulna, Dhaka, Netrokona, Mymensingh, Comilla, Bogra, Kustia, Norsigdhi, Jhenaidah, Potuakhali, Borguna, Moulivibazar, Rangpur, Manikganj and Magura.

4.6.5 Direct Field Observations

The researcher utilized a number of different techniques to collect data from observation. She made extensive field visits in those ICT and non-ICT areas, formal and informal talks/meetings with individual farmer and concerned organization. Observation was made in some places with the activities of farmers while collecting the data in order to capture some additional information that was not revealed by the questionnaires and the interviews. Observations included the presence of ICT tools provided by the extension service providers, access to internet use, availability of the internet, presence of computers, and presence of modem in the centers. The researcher also observed the speed of the internet and the usage of the internet by farmers. Moreover, the enthusiasm of the farmers, poverty situation, and women's involvement in farming were also observed.

4.7 Variables of the Study

Based on the analysis of the general and specific objectives of the study eleven broad categories of variables for ICT and non-ICT service area and more than nine hundred variables for users are identified. In the present study, production and income are dependent and farmers of ICT area, those of non-ICT area, gender participation and ICT centers are independent variables.

4.8 Data Analysis

The huge data were collected directly by the researcher along with the help of some enumerators. The collected data were organized in order to remove errors that were presented. It was classified, coded and analyzed. Categories were selected and the data were sorted into each category to facilitate analysis. Data were presented in the form of tables and the frequency of responses was presented as percentages. The Statistical Package for Social Sciences was used in analyzing quantitative data. Data were presented graphically, mathematically and also necessary tables were generated through correlation and regression analysis. DiD model is used to compare the production of two service areas through counterfactual. Reliability for internal consistency is calculated using the Cronbach's (1970) Alpha Coefficient. The findings are graphed in histograms to allow a clear view of understanding at a glance. The two categories of service areas (ICT) and (non-ICT) respectively have been collaborated to allow for comparative discussion of the results.

4.8.1 DiD Analysis

DiD (difference in differences) is a statistical technique used in econometrics and qualitative sociology through experimental research design using observational study data. DiD calculates the effect of a treatment (an independent variable) on an outcome (dependent variable) by comparing the average change over time in the outcome variable for the treatment group to the average change over time for the control group. These periods are the baseline year (2012) and the follow-up year (2014). The follow-up year is treated as the current year whereas the baseline year is treated as the previous year. DiD model was used to find the production difference between the past and the present of the two service areas.

4.9 Ethical Considerations

This research was conducted at all stages in an ethical manner. All research participants were given the opportunity to sign a form that explained considerations of anonymity, confidentially, privacy, and risk of potential harm. Proper permission was obtained from the local administrative authority. The farmers and extension officers (SAAO) who participated in the interviews, Focus Group Discussion, observation and informal conversation had been told clearly about the aim of the research and their right to ask questions. This study posed a minimal risk of harm to any participant; however there is always the possibility of unforeseen or unintended harm whenever research involves human participants. The informed consent document addressed areas such as data collection, participant identification and data management. Research ethics were discussed with all participants at every contact. Some young and educated farmers got ashamed to be interviewed but

they came to focus even when they were assured that no personal information such as identifying data would be revealed. The privacy, anonymity and confidentially of participants were carefully guarded while talking every measure to ensure they are not harmed in anyway. There were some sensitive answers from interviews and that was ensured secret. Acknowledgement of sources used and appreciating all sorts of assistance were extended through the acknowledgement section in this dissertation as well as individual letters to thank the participants. Intellectual honesty was implemented by avoiding plagiarism, cooking up data and interpretation and such dishonest approaches in research.

4.10 Conclusion

In this chapter, the methodology adopted for this study has been discussed. The different phases that constituted the study are discussed in detail together with the quality criteria. The different samples of the study are also described together with the various instruments that were used. The analyses of data collected in the first phase of the study are discussed in the next chapter. The respondents of the present study, the method, the instrument, data analysis procedures, are all validated and supported by the previous research studies carried out during the last decades. The next chapter, Chapter Five, presents and discusses the summary and findings of the Focus Group Discussions in a cohesive manner.

Chapter Five

Summary and Findings of Focus Group Discussion

5.1 Introduction

The main purpose of the focus groups of present research is to draw upon respondents' attitudes, feelings, beliefs, experiences and reactions in a way in which it would not be feasible by using other methods, for example observation, one-to-one interviewing, or questionnaire surveys. Focus groups can help to explore or generate hypotheses (Powell & Single, 1996) and develop questions or concepts for questionnaires and interview guides (Hoppe et al. 1995; Lankshear, 1993). The methodology in the previous chapter led the researcher to create ways so that new concepts could be generated to get some findings. FGDs can be used to explore the meanings of survey findings that cannot be explained statistically, the range of opinions/views on a topic of interest and to collect a wide variety of local terms (www.odi.org/publications/5695....). The topics for the FGDs were heterogeneously selected for each group. Fifteen topics were accrued into a greater theme that led to the role of ICT in dissemination of information services to the farmers of Bangladesh.

5.2 Details of the Focus Groups

Fifteen FGDs were conducted in fifteen districts in different divisions on different topics relevant to research area. Thirteen FGDs were conducted in the ICT service area and two in non-ICT service area. It is commonly believed that the ICT respondents are supposed to experience the difference between the baseline and follow-up production and thus are able to find the difference in differences in the production of the two service areas. Besides, the aim of the study is to find out what motivates people to use ICT tools or to adopt modern ICT tools for better agricultural information. Such background information can be essential to farmers who need to know how the various agricultural problems could be solved. The desired FGDs have been named according to different agricultural clubs like IPM, ICM, FIAC, AICC and other service centers. The detail of the FGDs is shown in the table:

Table 5.1: Focus group discussion with location and subjects

SL	Location/ Place	Upazila	District	Division	Partici-pants	Male/ Female	Main theme/ Discussion subject
1	BIRISIRI Adibashi Krishok Kalayan Sommitte, (Tribal Farmer Welfare Association)	Durgapur	Netrokona	Dhaka	12	Male -6 Female-6	Importance of ICT based information services to the farmers
2	Bangladesh Agriculture University Extension Centre	Rakobpur	Mymensingh	Dhaka	9	Male-9	ICT based farmers vs Non- ICT based farmers in context of production
3	Alishor IPM Club	Sadar Dokkhin	Comilla	Chittagong	13	Female-13	Involvement of rural women in using ICT tools in their farming
4	Garidoho Krishok Union Association	Sherpur	Bogra	Rajshahi	11	Male-7 Female-4	Agricultural information needs to the farmers
5	Dokkhin Bhabanipur Malithapara ICM Club	Veramara	Kustia	Khulna	9	Male-9	Use of ICT Tools in the Proper Dissemination of Agricultural Information
6	Rahimer Kandi IPM Club	Belabo	Norsigdhi	Dhaka	9	Male-7 Female-2	Impact of ICT Use in the Increasing Production
7	Nrisighopur IPM Club	Sodor Jhenadah	Jhenaidah	Khulna	13	Male-7 Female-6	Existing Agricultural
8	Doriapur AICC	Sodor Magura	Magura	Khulna	10	Male-8 Female-2	Role of ICT based Rural Centre
9	Mishripara	Kuakata	Potuakhali	Barisal	11	Male-6 Female-5	Low cost & User Friendly ICT Tools for the Farmers
10	Krishi Radio	Amtoli	Borguna	Barisal	9	Male-6 Female-3	The Impact of Role of Community Radio in Disseminating Agricultural Information
11	Nasirabad Kulaura Provati Songha	Kulaura	Moulivibazar	Sylhet	10	Male-9	Different Media Initiatives and its Impact on Agriculture
12	Amvita Bazar	Dumuria	Khulna	Khulna	14	Male-7 Female-7	ICT Role and its Impact on Rural Community
13	Lahirir Hat	Rangpur Sador	Rangpur	Rangpur	9	Male-9	Comparison between Past Agriculture Production and the Present One
14	Borobila	Ghior	Manikganj	Dhaka	11	Male-9 Female-2	Information Access Technique of the Rural Community
15	Satkomol Para IPM krishok Club	Bandorban	Bandorban	Chittagong	10	Male-8 Female-2	Powerful Media in Disseminating

Source: Data Survey

5.2.1 FGD (1): BRISHRI

It is a very internationally famous tourist spot in Shusong Durgapur upazila under Netrokona Zilla, north-east part of the country. The location is blessed with charismatic natural beauties. The FGD was arranged at the office room of Adibashi Krishok Kalyan Sommitte. This Sommite has recently been reformed into Agricultural Information Communication Centre (AICC). This AICC is run by the Garo tribe and this FGD was attended by 6 male and 6 female participants. All participants were directly or indirectly engaged in farming activities but they were of different professions. Among them, two were teachers, two were service holders and the rest were pure farmers. All the members were Garo ethnic and belonged to matriarch. Maximum educational qualification among the participants was Master degree while minimum was below S.S.C. The topic of the FGD was 'Importance of ICT based information services to the farmers'. Most of the members are conscious of modern technology. They want their expected information in a quick manner. Some of them visited some agricultural websites for getting information. They are well conscious and so they can widely practice IPM like parching, feromantap, light tap, hand net. They also obtain information through documentary film, TV programmes (Mati o Manus) etc. They are also receiving information from Krishi Call Centre, AIS website etc. The members of this centre regularly communicate through mobile phone with the regional AIS personnel and extension officers for their good agriculture practice. However, participants prefer getting agricultural information from a toll free mobile based service. But due to low mobile network and low internet speed, smooth access is interrupted to get information in time. Especially they talked about Banglalink network. So they fail to enjoy the benefits from Banglalink helpline (service 7676). They strongly believe that ICT based information could make their farming activities easier. Female members in the area involved in agricultural activities being aware of latest technology.

5.2.2 FGD (2): Rakobpur

The FGD was arranged at the office room of Raghobpur Sholmari Krishi Gojagog O Tathyo Kendra Mymensingh Sador, north-east of Bangladesh. This centre is the combination of three local samitees (Co-operative) - BAU Grameen Sanchay and Kalayan Samitee, Ragobpur Gangpara Samitee and Charnilertila Sammite (Co-operative). Out of 9 participants, 6 were AICC members, one local teacher, one local journalist and the last person was the sub-assistant agriculture officer of the union concerned. The main discussion point was 'ICT based farmers vs Non- ICT based farmers in context of production'. Some participants who use modern technologies like IPM, ICM, Fertilizer and soil management, agricultural machinery, harvesting and storage management techniques etc., totally agreed that production has increased than past years. Most of the members use organic fertilizer and apply different IPM methods for their farming. They regularly watch TV programme like Mati o

Manus, Krisi Dibanishi and visit different AIS website regularly. They also take part in different trainings like IPM, soil testing, aquaculture, basic computer etc., and consult with SAAO. The Sub Assistant Agriculture Officer (SAAO) told the group that his colleagues regularly go to the farmers' field for knowing the real problems and try to give them solution they need.

5.2.3 FGD (3): Alishor

It is situated in the Sodor Dokhin under Comilla district in the middle east region of the country. The FGD was conducted at the club room of Alishor Mohila IPM. This club is well-organized and maintained by the female members. They generate a co-operative idea. All members pay subscription for creating a fund. They also rent multimedia and different types of agricultural tools and machineries for increasing their fund. They also lend money to the member farmers with very minimum interest. They also earn money by composing, emailing, phoning and skype communication abroad etc. They purchase agricultural tools and machineries like riboner, power tiller, thresher, paddler, and different types ICT tools like TV, mobile, computer, printer, modem etc with the help of this fund. FGD was attended by 13 female participants. The highest education was B.A and the lowest was below class six. The main theme of the FGD was 'Involvement of rural women in using ICT tools in their farming'. The participants were very much aware of different ICT tools. They regularly use computer, multimedia and laptop and explore AIS website. A female member is expert in composing, emailing, phone call and skype communication with abroad. Participants thought that the print and electronic media like computer, laptop with web camera, modem, mobile, printer, digital camera, multimedia, documentary CDs, folder, leaflet, poster, booklet, magazine, krishi dairy, phone book etc. are catering new and updated knowledge and technologies on agriculture and thus reducing the information gap between farmers and the researchers.

5.2.4 FGD (4): Garidoho

Garidoho Krishok (Farmer) Union Association is located at Sherpur Upazila under Bogra district, northern central region. The FGD was conducted at the office room of the association. It was attended by seven male and four female participants. One AIS representative was also present in the FGD. The discussion point was 'Agricultural information needs to the farmers'. All the participants agreed that agricultural information is indeed quite important for the farming and without right information at the right time it is very difficult to adopt new technology in agriculture. They informed that some get needful information for good agricultural practice like pest management (IPM, ICM), weather forecast, proper use of fertilizer, soil health, market price etc. They get information from neighbors, SAAO and also from TV programs.

5.2.5 FGD (5): Dakkhin Bhabanipur Malithapara

It is situated at Vharamara Upazila under Kustia district. The FGD was arranged at Dakkhin Bhabanipur Malithapara ICM Club office. The FGD was attended by nine male participants whose age is ranged from 22 to 55. Except one SAAO and one college teacher, all members are farmers. The main theme of FGD was 'Use of ICT tools in the proper dissemination of agricultural information'. The participants opined that they need right information in right time and they strongly believe that in getting right information, ICT tools could be the main weapon. Here most of members are expert in operating computer. They regularly use computer, multimedia and laptop and they also explore AIS website and krishi bangla.com for their queries. However, their internet speed remains very low (10kbs) which hinders the use of internet based information. They purchase agricultural tools and machineries like, paddler, different types ICT tools like TV Card, dish connection, mobile, computer, printer, modem etc with the help of this fund. They also organize basic computer training course free of cost for the students of this village.

5.2.6 FGD (6): Rahimer Kandi

Rahimer Kandi is a village situated at Belabo upazila under Norshigdi district. The FGD was arranged at Rahimer Kandi IPM Club office. It is a very old club having name and fame among other IPM/ICM clubs. This FGD was attended by nine participants. Among them, seven were male and two were female members whose age is ranged from 22 to 55. Participants were extensional personnel, university student and farmers. The main theme of FGD was 'Impact of ICT use in increasing production'. The member participants opined that appropriate information and communication tools to these information centers could potentially enhance and improve the efficiency and effectiveness of service and information delivery to the farmers of grass root level. The participants are very much aware of modern agricultural technology. They are able to solve their farming problems by using AIS website, Krishi call centre and other agricultural website. They are also using www.amardesh and eshop.com for selling their products. They purchase agricultural tools and machineries like gutiurea applicator, power tiller, thresher, paddler and different types of ICT tools like TV, mobile, computer, printer, modem etc. Some young members are expert in operation of ICT materials. They are active in performing their AICC services. They are also using www.amardesh eshop.com for selling their product. The agriculture extension personnel opined that the usage of this ICT tools has been increased much more. He thought illiterate farmers could hardly use this ICT tools so they still depend on agriculture extension service.

5.2.7 FGD (7): Nrishighapur

It is located at Sodor upazila under Jhenaidah district, south-west of the country. The FGD was conducted at Nrishighapur Agricultural Information and Communication Centre (AICC) office. FGD was carried out by 12 participants. The key discussion point was **'**Existing agricultural information services'. It was found that the members regularly get together at AICC office and share their knowledge and solve agricultural problems by exploring Krishikotha, Somosaron barta, phone call to AIS personnel and local extension officer. One computer operator helps them solve their problems. They specially mentioned krishi call centre and krishi jighasa (7676), a mobile based Banglalink service. They also solve their agricultural problems by watching agricultural programs on television. They mentioned 'Mati O Manus' (BTV) and 'Rhidoye Mati 0 Manus' of 'Channel i' as popular programs. But they opined that due to scarcity of electricity and slow internet speed, the existing services are hampered to receive.

5.2.8 FGD (8): Doriapur

It is located at Hazipur Upazila under Magura district. The FGD was conducted in the household of a local person who is the general secretary of Agricultural Information and Communication Centre (AICC). The main theme of FGD was 'The Role of ICT based rural information service centre.' The participants appreciated the step of the government to establish different ICT based rural information service centres namely UISC, AICC etc. They also suggested improving power supply of electricity, recruiting trained manpower and increasing internet facilities. They also opined for campaigning to make rural centres more useable of rural people. Four member participants told that they often visit BRRI and AIS website for solving their agriculture problems. Nevertheless, for low speed they fail to get their expected result. They also depend on SAAO and AICC members for their farming. They have acquired knowledge by watching the Mati O Manus program and agriculture training on irrigation system, IPM as well as computer and internet browsing.

5.2.9 FGD (9): Mishripara

It is located at Kuakata Upazila under Potuakhali district. The site is a Southern coastal location. The FGD was conducted in a local household. This FGD was attended by six male and five female persons. The main theme of FGD was 'User friendly and low cost ICT tools for farmers.' The participants opined that their main problem regarding information is that they don't know where to go and whom to approach for the application of right information. Perhaps it was found that only a few understand about ICT (Information and Communication Technologies). To most of them, ICT means mobile and TV. Only five participants heard the name of popular TV show 'Mati O Manus'. They complained that they are deprived of getting modern information services due to the extreme

scarcity of electricity. They have hardly TV set. They are poor, weather-beaten but hard-working. Now they largely depend on solar energy.

5.2.10 FGD (10): Amtoli

Amtoli is located at Amtoli Upazila under Southern coastal Borguna district. The FGD was conducted in Krishi radio station. Community Rural Radio (Krishi Radio 98.8) has been initiated by AIS, Govt. (MoA) and this radio station is housed at Amtoli Upazila Complex in Borguna. The FGD was arranged with the participation of nine members. The main theme of FGD was 'The Role of Community Radios in disseminating agricultural information'. The participants appreciated the Ministry of Agriculture for establishing such a Krishi Radio Station in their area. It is only Krishi Radio that is directly run by the Govt. They informed that the station covers 30 kilometers. They informed that they participated in different programs organized by the Krishi Radio. All participants agreed to the fact that the community/ krishi radios play an important crucial role in the field of agricultural information for the rural farmers.

5.2.11 FGD (11): Nasirabad

It is located at Kulaura Upazila, Northeastern part of Moulovibazar district. The FGD was conducted in the house of Nasirabad Kulaura Provati Songha (local club). This club has recently been reorganized into AICC. Maximum educational qualification among participants was graduation while minimum was below secondary school certificate. The main theme of FGD was 'Different media initiatives and its impact in agriculture'. Particularly they talked about Agricultural Radio and TV programs. They mentioned the popular BTV program 'Mati O Manus' and 'Krishi Dibanishi' by Channel i. Sometimes they miss some agricultural programs as these are telecast in farmers' inconvenient time. Therefore, they opine to telecast these programs in their favourable time.

5.2.12 FGD (12): Amvita Bazar

It is located at Dumuria upazila under Khulna district the South coastal area of the country. The FGD was conducted at Amvita Padma IPM club office. FGD was arranged by the club secretary in presence of 12 members. Among twelve participants, seven were farmers, one was a college teacher, one was SAAO and three were housewives. The agriculture extension official was volunteered to attend the discussion. **'**ICT role and its impact in rural community' was the issue of discussion. The overall discussion was very fruitful. The participants noticed that the sub assistant agriculture officer assigned in the area helped them considerably. They also took part directly in some phone calls and get suggestion for solving their farming problems. The members get services like computer short training, compose, downloading of mail and reports, answer from AIS

(Khamarbari, Dhaka) and showed 17 multimedia drama for awareness development of farmers regarding agriculture problem based solutions. Nevertheless, because of scarcity of electricity, computer and multimedia related works are badly affected every day. For many reasons GPRS based internet speed was very slow and untimely.

5.2.13 FGD (13): Lahirir Hat

It is located at Sodor Rangpur under Rangpur district, North central part of the country. The FGD was conducted at Lahirir Hat Agricultural Information and Communication Centre (AICC) office. This FGD was attended by nine male participants. The discussion point was **'**Comparison between past agriculture production and the present one'. The participants agreed that present production has increased more than the previous years. They thought the reasons behind this production were good seed, improved variety, hybrid variety, proper fertilizer, proper irrigation etc. They are also thankful to AIS for their initiatives for the better cultivation practices that help them get yield.

5.2.14 FGD (14): Borobila

Borobilla village is located at Poila union under Ghior upazila, Manikganj District in Dhaka Division. This was a non-ICT based area, FGD was arranged in a local household that was participated by six male and three females. The participants were farmers, students, teacher, extension stuff, businessman and housewives. The main theme was 'Information access technique of the rural community'. Most of the participants opined that they still rely on traditional farming. They have no access of ICT facilities as they live in a very remote area from upazila headquarters and have no access to electricity. They have no radio, television or any other ICT tools where they can search their expected information. They are dependent on their neighbor farmers and extension officers.

5.2.15 FGD (15): Satkomol Para

It is a tribal dominated region in South-eastern hilly district. The site is located at Bandorban under Chittagong division. The FGD was conducted at Satkomol Para IPM krishok Club office. This FGD was arranged by the president and the secretary of the club and ten participants who attended were the members of the club. The discussion topic was **'**The use of ICT in Hilly agriculture'. It was observed that agriculture practice is different and at the same time difficult in hilly area. Most of the participants agreed that poor communication infrastructure is the main problem in receiving timely information. Besides, because of frequent failure of power supply, they fail to receive information timely from television and internet as well. But those members are active and they explore different agricultural websites like bd fish bangla, krisi bangla.com. www.ais.gov.bd etc.

5.3 General Findings of the FGDs

The sources of information, modern technologies, pest management etc. were the discussion points in some FGDs. The choice of services for obtaining agricultural information services, the most-used pest management technology, gender involvement and participation in agriculture activities, the barriers to information from ICT based information centres were also come out as a result of the discussions. Some important general findings are briefly discussed:

1. It was expressed by the farmers that ICT services contribute to agricultural production.
2. Some farmers opined that ICT services reduce information gap.
3. Farmers agreed to the fact that ICT services create new income generation.
4. ICT based farmers supported that ICT services strengthen rural institutions and livelihood.
5. ICT centers improve market access and reduce the influence of middlemen in agri-business.
6. Farmers pointed to the issue that ICT based services strengthen capacity and women empowerment.

5.4 Major Findings of the FGDs

The Focus Group Discussions facilitated the researcher to have an in-depth knowledge of fifteen topics related to the research areas. Some important ones are discussed below:

1. Shortage of ICT skill among the farmers was common finding in almost all FGDs.
2. Farmers of non-ICT areas lack in awareness of existing ICT services.
3. Low literacy is the burning issue among the farmers of the both groups.
4. Age barrier is a common factor to gaining center services as the young farmers are more inclined to ICT knowledge than the aged ones.
5. Female farmers of both groups have little access to ICT facilities because infrastructural supports for women are not adequate for increasing their ability to function as independent farmers.
6. Scarcity of electricity supply is a common thing for implementing ICT based implications in rural area.
7. Poor telecommunication and ICT infrastructure is also a weak point of disseminating ICT based services.
8. Lack of finance and resource is the barrier to establishing ICT backbone.

5.5 Conclusion

Many important interactive findings are revealed from the discussions of 15 focus groups. One of the key findings in these discussions is that farmers have a good perception of agricultural information communication centre as they perceive the centre as an important means of getting up-to date knowledge needed to boost their agricultural production. The FGD in the non-ICT service area focused on the current agricultural information facilities and obstacles for the farming community. The farmers of those locations are deprived of the ICT facilities and thus they are eager to accept the ICT facilities. The result from focus group discussions reflects on the later chapter that discusses, presents and analyzes the survey data.

Figure 5.1: Pictorials from FGDs

Chapter Six
Data Presentation, Discussions and Analysis

6.1 Introduction

The study followed questionnaire as a main instrument for data collection. A large size of questionnaire compacted with a set of 92 questions for the respondent (farmers). The questionnaire is divided into nine sections. First section consists of farmers' basic information. Financial status of the respondents comprises section two. The different sources of information about ICT tools are used by the respondents in section three. Description of crops with annual production per hectare, different technologies are shown in the next section following fisheries and livestock. Gender involvement activities in agriculture constituted seventh section. The questions related to the services of ICT based centres assumed greater portions of the survey instruments.

The chapter discusses the details of the respondent farmers, the tools they have or they use in farming, the production they produce, and the income they get along with crop farming, fish farming and livestock rearing. Moreover, due to time and volunteers constraints, each and every district and upazila was not possible to cover but all agro- ecological zones of Bangladesh were included in the study by the researcher.

The chapter presents and discusses the findings of the analyses of the data collected from the population and sources based on the respondents' use of ICT, production and income. It presents and discusses the findings of the questionnaire survey that was carried out among the farmers of the two service areas. The quantitative analysis in this study involved descriptive statistics. Some inferential statistics such as t-test, regression analysis, Difference-in-Differences model were also performed. Chi-square test is also performed. The SPSS & excel for Windows was used for the statistical analyses. Most of the tables are drawn to compare various results between ICT and non-ICT farmers. Some tables (where different types of production, respondents' age, education, farm category, pond/gher ownership, television programs, watching TV, radio station and listening, mobile phone user, weather forecast, crop variety, sources of irrigation, quality fingerling, quality water management, quality fish, fish variety etc. are directly shown in percentage) are added to the annexure for more clarification.

The questionnaires were filled by the researcher and enumerators on the basis of answers of the farmers. The technical answers of the questions such as variety, amount of fertilizer, use of machinery were helped by the extension personnel. The visit of ICT center was approved by the local authority of agriculture office. Two enumerators helped a lot in collecting data.

6.2 Population and Sample Size

The study takes relevant population with an expected sample to rightly describe research respondents. The number of the respondents with their work-nature has been mentioned here as the fundamental information about them. The population of the present research is the heterogeneous group (different types) of farmers all over Bangladesh. Diversified farmers such as rice farmers, fish farmers, vegetable cultivators and livestock rearers are included in the population of the study. The farming area covers most of the agro-ecological zones of the country.

Sample farmers were not selected from a particular region but randomly from different regions. Thousand nine hundred and ninety is the sample size of the study. Out of this sample, 1170 are found ICT based and 820 are non-ICT based respondents.

6.2.1 Service Area

In the ICT service area, ICT based service centers are generally located and in the non-ICT service area, farmers are not involved in those service centers or where there is no ICT based center. The number of sample sizes of ICT and non-ICT service areas varied. However, all divisions, most of the district along with thanas/Upazilas were visited and the FGDs were conducted. Some farmers were also interviewed face-to-face.

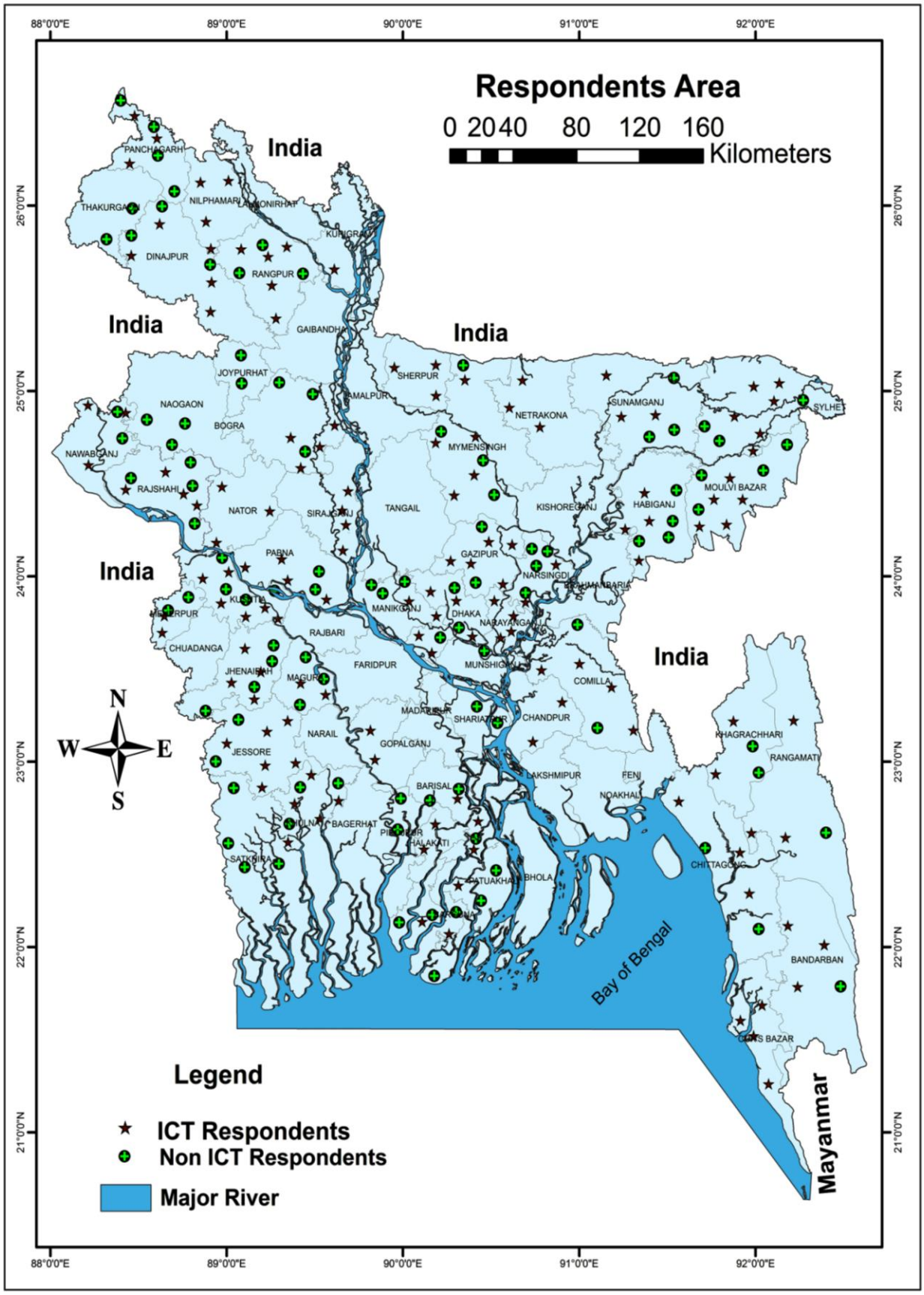

Figure 6.1: ICT & non-ICT respondents area

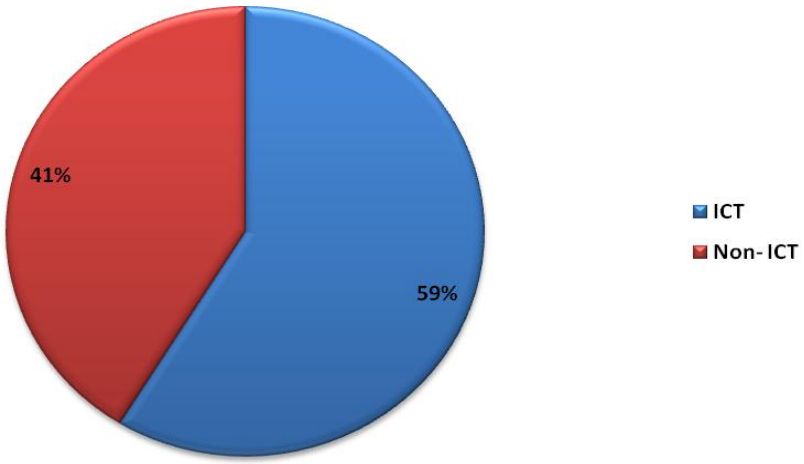

Figure 6.2: Service area of the respondents

Source: (Author Survey 2013-2014).

The figure (6.2) above shows the respondents representing the distinct areas. The study covers 58.8% of ICT and 41.2% of non-ICT based respondents. Here the proportion of two types of respondents is not the same. This is unintentionally sketched from the same questionnaire.

6.2.1.1 ICT Service Area

Now Bangladesh is updated with digital device in agriculture which is best visualized for the acceleration of agricultural production. Many development projects have been taken in agriculture along with and the initiation of AICC and other ICT based service centers were set up all over the country to accelerate production which helped to make the country as food surplus. All seven divisions of the country were selected to have knowledge on production systems and cultivation methods of different agricultural commodities (crops, fisheries and livestock) as influenced by ICT services.

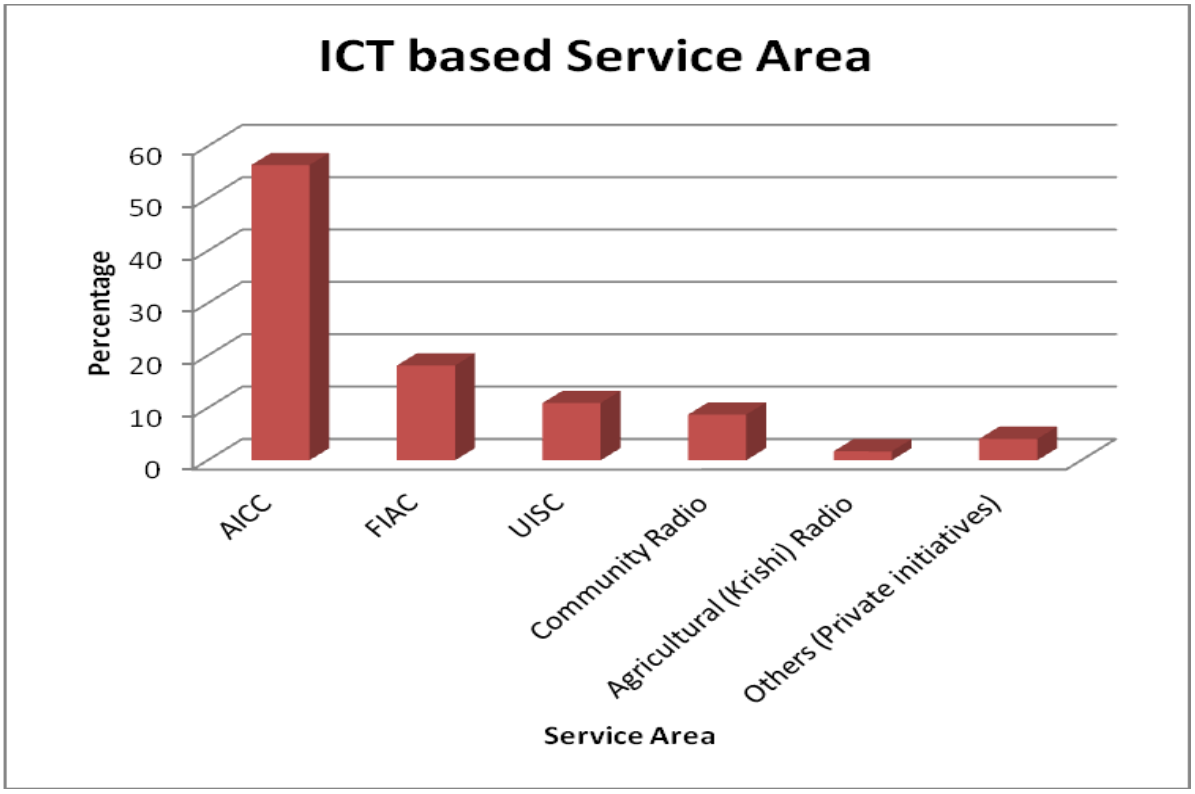

Figure 6.3: Frequency distribution of ICT center respondents

Table 6.1: Frequency distribution of ICT center respondents

ICT based Services	Respondents	Percent
AICC	660	56.41
FIAC	212	18.12
UISC	128	10.94
Community Radio	102	8.72
Agricultural (Krishi) Radio	20	1.71
Others (Private initiatives)	48	4.10
Total	**1170**	**100.00**

Source: (Author Survey 2013-2014)

56.41% out of 1170 ICT based respondents were from AICCs, 18.12% from FIACs, another agricultural service center, 11% respondents from UISC and 8.72% from community radios and rest of the respondents were from Krishi Radios, Batighar, Plant Doctor etc.

6.2.1.2 Non- ICT Service Area

Most of the farmers in Bangladesh follow traditional methods in cultivation. The farmers who for their production and marketing do hardly use tools are not related to information communication technologies. Those farmers are considered non-ICT respondents in the present study. The number of farmers in the non-ICT areas is comparatively less than that of ICT service area.

Table 6.2: Frequency distribution of non- ICT respondents

Division	Frequency	Percentage
Barisal	90	10.98
Chittagong	60	7.32
Dhaka	135	16.46
Khulna	150	18.29
Rajshahi	105	12.80
Rangpur	105	12.80
Sylhet	175	21.34
Total	**820**	**100.00**

Source: (Author Survey 2013-2014)

For the survey of the questionnaire, 42 district and more than one hundred thana/Upazilas were visited in 2013 and 2014 and visiting was accompanied by two enumerators to collect the data through interviewing the farmers. For random simple sampling, the surveyed areas were unequal. Of these areas, Sylhet Division is the highest responding area in the non-ICT service area. It covers 21.34%. Khulna is the second highest representing 18.29% of 820 respondents. Chittagong is the lowest responding area where only 7.32% of the respondents were collected. Rajshahi and Rangpur having equal number of respondents (12.80%) are outnumbered by Dhaka 16.46%. Barisal is in between of the two, having 10.98% of the non-ICT respondents.

6.2.2 AEZ Population Coverage

AEZ is defined as land areas recognized based on hydrology, physiography, soil types, water regime, cropping patterns and seasons. So cropping pattern of a definite AEZ is mostly same. As Bangladesh is located with different types of land in its different regions and it is a riverine country, its maximum area is floodplain and basin type. For the speeding up with overall agricultural development of Bangladesh, agro-ecological zones were crafted into a publication in 2012 by BARC.

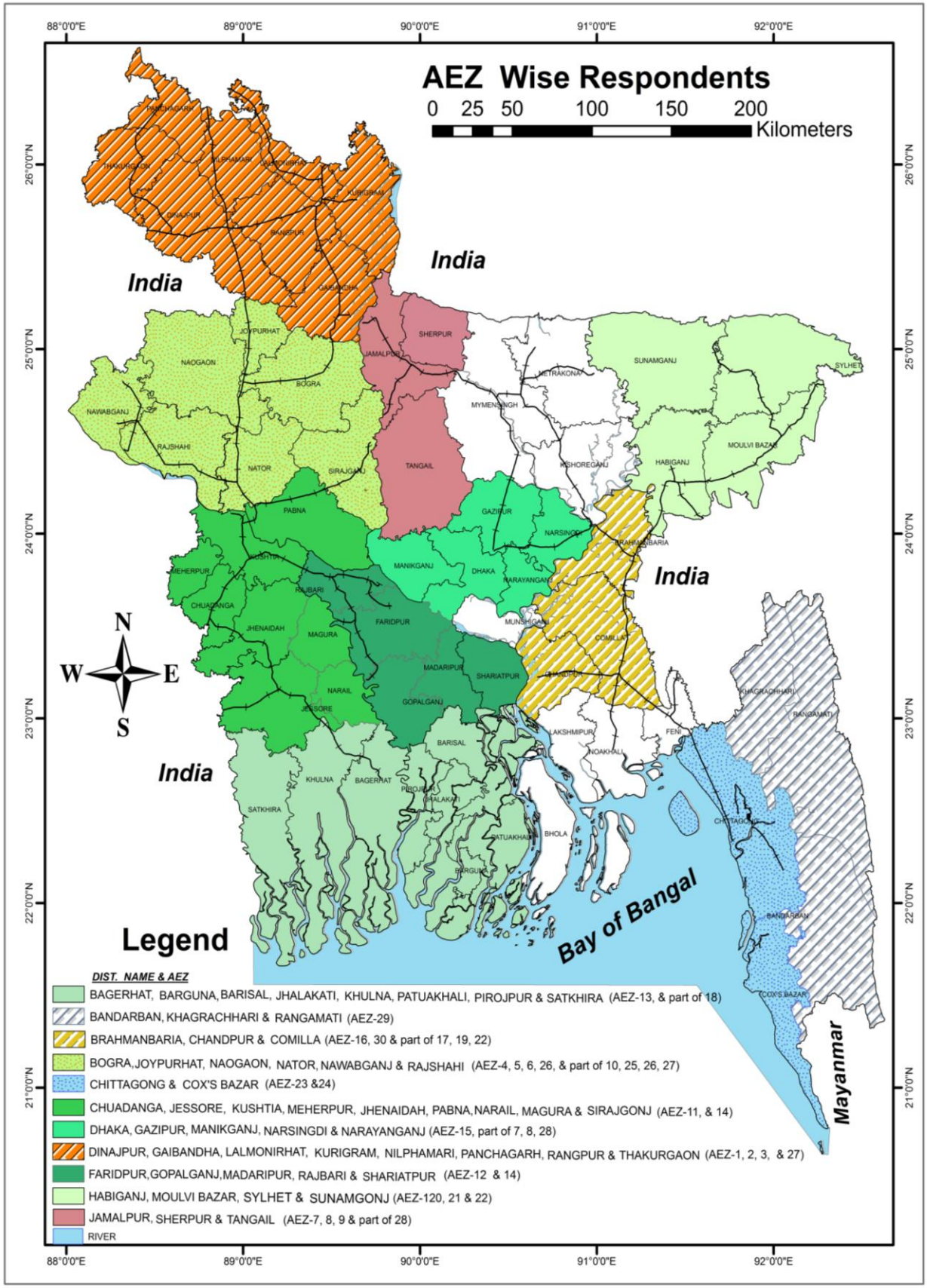

Figure 6.4: AEZ wise respondents area

Agro-Ecological Zones of Bangladesh are determined based on some definite characteristics. They are of physiography (soil parent materials and land forms of particular area), hydrology (on the basis of water holding capacity of soil and inundation types), cropping pattern (length of Rabi & Kharif season & major & minor crops grown in a particular area), season (on the basis of the depth and duration of seasonal flooding in a particular area), soil types and tidal activity. There are 30 Agro-Ecological Zones in Bangladesh. These AEZ are sub divided into 88 agro-ecological sub regions. Again the sub regions are divided into 535 agro-ecological units. Each region was the aggregate of a number of administrative district. Each of the regions was not equally endowed with the nature with their geographical areas.

As the population of the present research is determined on all agricultural zones with each administrative unit, studying the ins and outs as well as the pros and cons of AEZs are important to influence sampling and accordingly data were set to collect from the respondents. The names of the agro-ecological regions with surveyed district and their nature are shown in the following table:

Table 6.3: AEZ wise respondents

Name of Region	Surveyed District Included in the Region	AEZ covered in the Region	Land type/ Soil type
Greater Dhaka	Dhaka, Gazipur, Manikgonj, Narayangonj, Narshingdi	AEZ 15 Part of 7, 8, 28	Low-lying, upland, alluvial Dark Grey, silt loam, clay loam
Karatoya Floodplain And Atrai Basin	Rajshahi, Nawabgonj, Naogaon, Natore, Bogra, Joypurhat	AEZ 4, 5, 6, 26	High, medium high, medium Silt loam to silt clay-loam
Brahmaputra-Jamuna Floodplain	Jamalpur, Sherpur,Tangail	AEZ 7, 8, 9, Part of 28	Floodplain, Silt loam, Silt clay-loam
High Ganges River Floodplain	Pabna Sirajgonj, Jessore, Jhenaidah, Magura, Narail, Kustia, Meherpur Chuadanga	Major part of AEZ 11, 14	High, medium high Silt loam, Silt clay-loam
Low Ganges River Floodplain	Faridpur, Rajbari, Gopalgonj Madharipur, Shariatpur	Major part of AEZ 12, 14	Medium high, medium low Silt loam, Silt clay-loam
Ganges Tidal Floodplain	Jhalkati, Pirojpur, Barguna, Patuakhali, Khulna, Bagerhat, Satkhira	AEZ 13	Medium low, low Heavy silt clays, alkaline
Old Himalayan Piedmont Plain and Tista Floodplain	Dinajpur, Panchagar, Thakurgaon, Rangpur, Gaibandah, Nilphamari, Kurigram, Lalmonirhat	AEZ 1, 2, 3, 27	High and medium high Sandy loam, loamy, Silt clay-loam
Middle Meghna River Floodplain	Comilla, Chandpur, Brahmanbaria	AEZ 16, 30 Minor part of 17, 19, 22	Medium low, low, very low
Eastern Hills	Bandarban, Rangamati, Khagrachhari	AEZ 29	High
Sylet Basin and	Sylhet, Sunamgonj, Moulavi	AEZ 20, 21, 22	Medium low, low, very low

Surma Kusiara	Bazar, Habigonj		Heavy silt clay loam, Grey Colour
Chittagong Coastal Plain & St. Martin's Coral	Chittagong, Cox's Bazar	AEZ 23, 24	High, medium high, medium low Grey silt loam, Silt clay loam
Active Ganges Floodplain	Rajshahi	AEZ 10	Unstable alluvial land within and adjoining Ganges river low in organic matter and mildly alkaline in reaction
Young Meghna Estuarine Floodplain	Chittagong, , Patuakhali and Barguna district	AEZ 18	young alluvial land in and adjoining the Meghna estuary calcareous silt loam and silty clay loams
Level Barind Tract	Dinajpur, Gaibandha, Joypurhat, Bogra, Naogaon, Sirajganj and Natore district	AEZ 25	The soils are low in available moisture holding capacity and slightly acidic to acidic in reaction.
High Barind Tract	Rajshahi, Nawabganj and Naogaon district	AEZ 26	Flood plain land The soils are strongly acidic in reaction. Organic matter of the soils is low
North Eastern Barind Tract	Dinajpur, Rangpur, Gaibandha, Joypurhat and Bogra district	AEZ 27	Flood plain land. The soils are strongly acidic in reaction

6.2.3 Division wise Population

The ICT and non-ICT service areas are divided into seven divisions non- equally. Seven divisions as stated in table 6.4 enveloped as North-South-East-West were selected as major areas with an intention of covering all land categories (low and high, plain and hilly) of the country. Both the ICT and non-ICT respondents based on division are shown in detail in the following table.

Table 6.4: Frequency distribution of division wise ICT & non-ICT respondents

Division	Service Area					
	ICT		Non-ICT		Total	
	No.	Percentage	No.	Percentage	No.	Percentage
Barisal	100	52.63	90	47.37	190	100
Chittagong	160	72.73	60	27.27	220	100
Dhaka	210	60.87	135	39.13	345	100
Khulna	270	64.29	150	35.71	420	100
Rajshahi	190	64.41	105	35.59	295	100
Rangpur	90	46.15	105	53.85	195	100
Sylhet	150	46.15	175	53.85	325	100
Total	**1170**	**58.79**	**820**	**41.21**	**1990**	**100**

Source: (Author Survey 2013-2014)

The picture of division-wise ICT based and non-ICT based respondents as indicated in the above table (6.4) delineates a comparative study between the two groups of farmers. Chittagong holds the highest percentage (72.73%) of the ICT based respondents. It is much more than non- ICT respondents 27.27% in the same division. The utmost gap (46.46%) between two groups in the same division is found. 46.15% ICT respondents that are held by three divisions like Rajshahi, Rangpur and Sylhet whereas 53.85% non-ICT respondents are questioned from the same divisions and are seen in the table. Here the gap is less between two groups of respondents. The lowest percentage (52.63:47.37) between ICT and non-ICT respondents in the same division is found in Barisal Division. Dhaka Division holds 60.87% of ICT and 39.13% of non-ICT respondents. The ratio of ICT and non-ICT respondents in Rajshahi Division is 64.41:35.71. Here the second highest gap (28.7%) is found between two groups of farmers in this division. Khulna stands first holding frequency of 420 and its percentage covers 21.1% of the total respondents (1990). In this respect, Sylhet is in the second line having 16.33% of the total respondents (1990).

6.2.3.1 Division wise ICT Respondents

ICT respondents are also divided into seven divisions. Rangpur, Barisal and Sylhet Divisions are comparatively smaller in size in terms of land area. So usually the respondents would be fewer than Dhaka, Khulna, Chittagong and Rajshahi. All those three divisions cover 39% of the total respondents.

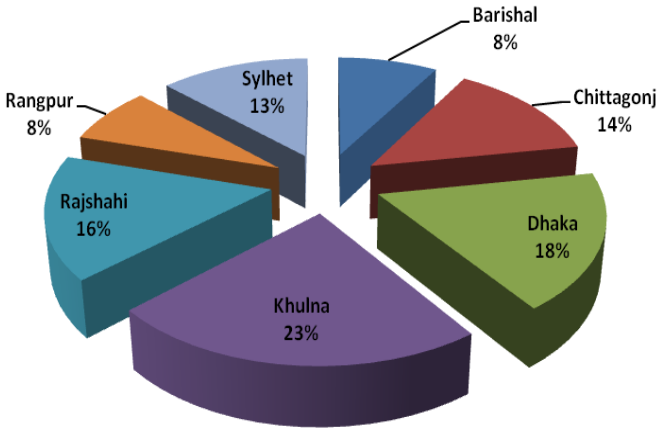

Figure 6.5: Division wise ICT respondents

The figure 6.5 indicates the division wise respondents of ICT service area. 23% of the ICT based farmers were from Khulna Division (highest) whereas the lowest (8%) were Barisal and Rangpur. The second highest was Dhaka which covered 18 % of total ICT based respondents. Next, Rajshahi and

Chittagong are aggregated as 30% to the number of the respondent group. Sylhet is in the least position. It covers about 13% of the total ICT respondents.

6.2.3.2 Division wise Respondents of ICT Centers

There are five major ICT based service centers brought under the survey of the study. Theses centers are AICC, FIAC, UISC, Community Radio and Krishi Radio and some other small centers have been visited for data collection. The data have been collected from the respondents of these ICT centers.

Table 6.5: Frequency distribution of respondents of ICT centers

Division	Type of ICT Centers													
	AICC		FIAC		Community Radio		Krishi Radio		UISC		Others		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
	24	24.00	9	9.00	9	9.00	20	20.00	38	38.00	0	0.00	100	100
Chittagong	116	72.50	20	12.50	13	8.13	0	0.00	11	6.88	0	0.00	160	100
Dhaka	150	71.43	50	23.81	0	0.00	0	0.00	10	4.76	0	0.00	210	100
Khulna	114	42.22	70	25.93	50	18.52	0	0.00	16	5.93	20	7.41	270	100
Rajshahi	101	53.16	11	5.79	30	15.79	0	0.00	20	10.53	28	14.74	190	100
Rangpur	51	56.67	22	24.44	0	0.00	0	0.00	17	18.89	0	0.00	90	100
Sylhet	104	69.33	30	20.00	0	0.00	0	0.00	16	10.67	0	0.00	150	100
Total	660	56.41	212	18.12	102	8.72	20	1.71	128	10.94	48	4.10	1170	100

Source: (Author Survey 2013-2014)

The table (6.5) shows the respondents from the ICT based service centers. Five major ICT based service centers such as AICC, FIAC, UISC Community Radio and Krishi Radio cover 95.9% (56.41+18.12+8.72+1.71+10.94) and some small portion of the respondents from Batighar, Plant Doctor etc. designated as “other” cover only 4.1%. AICC dominates the other service centers having frequency of 660 out of 1170 stakeholders. AICC is the first ICT initiative serving farmers at large scale on many platforms and a prominent initiative originated from IPM and ICM clubs introduced in the late eighties by AIS, MoA. Dhaka Division covers the highest (22.73%) of AICC respondents whereas 3.63% data was collected from Division. FIAC bears 18.12% of the total respondents of which the highest 33.01% is from Dhaka and the lowest 4.24% from Division. UISC is another vital center having frequency of 10.94% where covers the highest percentage (29.69%) and Dhaka the lowest 7.81%. Community Radio with 102 frequencies and Krishi Radio with 20 frequency lead to 10.43% of the total respondents.

6.2.3.3 Division wise Non-ICT Respondents

Agro-ecological zone and crop zone were considered as preference for the collection of non-ICT respondents. So, proportionate data collection was obliterated from the plan.

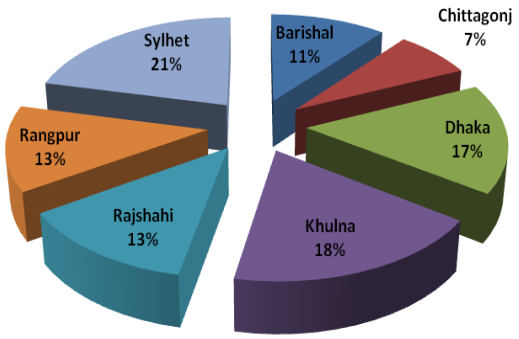

Figure 6.6: Division wise non-ICT respondents

The pie chart (6.6) shows that the highest respondent (21%) was got from Sylhet Division whereas the lowest (6%) came from Chittagong Division. The second highest was Khulna which covered 18 %. Next highest number of respondents came from Dhaka as 17%. Rajshahi and Rangpur Division scored the same amount 13% of respondents

6.2.4 Upazila wise Respondents

As Upazila is the lowest administrative unit held responsible for the account of the input and output of all agricultural activities. It is the administrative head for the Sub Assistant Agricultural Officers (SAAO) that are the field level professional leaders of Department of Agricultural Extension. SAAO is generally working in a particular area (block for average 900 farm families) at union under the supervision of Upazila Agricultural Office (UAO). The survey was conducted with the cooperation of UAO. SAAOs assisted the researcher and enumerators to fill the questionnaire.

Some areas were particularly selected for the service area of ICT centers and some areas that follow traditional farms. A few districts under the survey were visited for both of the service areas. Some locations were selected for AICCs, some for FIACs, some for UISCs, a few for CRs and KR. The surveyed Upazilas under the individual district with the respondents (%) of ICT and non-ICT service areas are set for display in the following manner (table 6.6).

Table 6.6: Frequency Distribution of Upazila wise ICT and non-ICT respondents

Division	ICT Service Area				Non-ICT Service Area			
	No of District	No of Upazila	No of Respondent	%	No of District	No of Upazila	No of Respondent	%
Dhaka	9	30	210	17.95	8	22	135	16.46
Chittagong	7	21	160	13.68	6	10	60	7.32
Khulna	7	28	270	23.08	7	22	150	18.29
Rajshahi	6	23	190	16.24	6	19	105	12.80
Barisal	4	8	100	8.55	4	11	90	10.98
Rangpur	5	17	90	7.69	4	12	105	12.80
Sylhet	4	18	150	12.82	4	14	175	21.34
Total	**42**	**145**	**1170**	**58.79**	**39**	**110**	**820**	**41.21**

Source: (Author Survey 2013-2014)

It is shown in the table 6.6 that 145 Upazilas under 42 districts were covered for data collection of ICT areas whereas 110 Upazilas under 39 district for non-ICT service areas. In both areas number of division is seven. Mymensingh is a new division that has recently been approved by the government as a Division. As survey was conducted during 2013-2014, so, newly established division was not considered separately.

6.2.4.1 Upazila wise ICT Respondents

The table (6.7) shows upazila wise respondents along the Division and district. Forty-two district of seven divisions were covered for eleven hundred seventy (1170) sets of questionnaire. There are one hundred forty two Upazilas swathing all AEZs covered in the study. Either AICC or FIAC or UISC or CR or KR was located any of these Upazilas. UISCs are located in each and every Upazila of the district visited for the data collection. All these locations were selected for collecting data from any of ICT based centers. The centers of all ICT based initiatives were given preference in the survey.

Table 6.7: Upazila wise ICT respondents

Division	District	Upazila	Respondents
Dhaka	Dhaka	Savar, Dohar, Damrai, Keranaganj, Nawabganj	31
	Gopalganj	Gopalganj Sadar, Kashiani	19
	Manikganj	Manikganj Sadar, Singair	18
	Sherpur	Nokla,Sreebardi, Nalitabari	12
	Gazipur	Gazipur, Kaliakair, Kaliganj, Sreepur, Kapasia	25
	Narayanganj	Araihazar, Rupganj, Sonargaon, Bandar	15
	Mymenshigh	Bhaluka, Haluaghat, Mymensingh Sadar, Trishal, Muktagachha	36
	Narsighdi	Narsingdi Sadar, Belabo	25
	Netrakona	Durgapur, Netrokona Sadar, Purbadhala	29
Chittagong	Comilla	Comilla Sadar, Debidwar, Daudkandi, Chauddagram	35
	Chandpur	Faridganj, Kachua	09
	Cox'sBazar	Chakaria, Maheshkhali, Ukhia, Cox'sBazar Sadar	22
	Rangamati	Rangamati Sadar, Baghaichhari, Kawkhali	21

	Bandarban	Bandarban Sadar, Lama, Ruma	14
	Chittagong	Mirsharai, Patiya, Raozan	31
	Khagrachhari	Panchri, Ramgarh	28
Khulna	Khulna	Batiaghata, Dumuria, Phultala, Rupsha, Paikgachha	42
	Jessore	Jessore Sadar, Jhikargachha, Manirampur, Bagherpara, Abhaynagar, Keshabpur	48
	Jhenaidah	Harinakunda, Jhenaidaha Sadar, Kaliganj, Kotchandpur	51
	Sathkhira	Kaliganj, Satkhira Sadar,Tala	35
	Kushtia	Bheramara, Daulatpur, Khoksa, Kumarkhali, Kushtia Sadar, Mirpur	43
	Meherpur	Meherpur Sadar, Muzibnagar	25
	Magura	Magura Sadar, Mohammadpur	26
Rajshahi	Rajshahi	Mohanpur, Durgapur, Godagari, Puthia	40
	Bogra	Bogra Sadar, Dhunat, Sariakandi, Sherpur, Shajahanpur	37
	Pabna	Atgharia, Ishwardi, Pabna Sadar, Sujanagar	35
	Natore	Natore Sadar, Gurudaspur, Lalpur	20
	Sirajganj	Belkuchi , Kamarkhanda, Shahjadpur, Sirajganj Sadar	33
	Chapainababganj	Bholahat, Gomastapur, Shibganj	17
Barishal	Barishal	Bakuganj, Sadar, Babuganj	27
	Barguna	Amtali, Barguna Sadar	21
	Jhalokati	Jhalokati Sadar, Rajapur	29
	Patuakhali	Patuakhali Sadar	27
Rangpur	Rangpur	Kaunia, Mithapukur, Pirganj, Rangpur Sadar, Taraganj	15
	Nilphamari	Domar, Nilphamari Sadar, Saidpur,Demla	23
	Panchagarn	Atri, Panchagarh Sadar, Tentulia	23
	Dinajpur	Birganj, Bochaganj, Parbatipur, Phulbari	18
	Kurigram	Ulipur	11
Sylhet	Sylhet	Fenchuganj, Gowainghat, Jaintiapur, Kanaighat, Sylhet Sadar, Golabganj	41
	Moulibazar	Kamalganj, Kulaura, Srimongal, Rajnagar, Moulibazar Sadar	31
	Hobiganj	Baniachang, Habiganj Sadar, Lakhai, Madhabpur,	37
	Sunamganj	Jamalganj, Sunamganj Sadar, Tahirpur	41
Total	**42**	**142**	**1170**

The table (6.7) reveals that Dhaka Division consists of nine district having thirty one Upazilas from which data have been collected from 210 respondents. The highest number of district is found in Dhaka Division. There are seven districts and twenty one Upazilas in Chittagong Division. In Khulna Division, the same number of district is surveyed but data has been collected from the highest number of respondents (270). Rajshahi consists of six districts having twenty Upazilas and 190 respondents. Rangpur and Sylhet have the same number of district but with different Upazilas. All these areas cover most of the AEZs.

6.2.4.2 Upazila wise non-ICT Respondents

The Upazilas of non-ICT area are outnumbered by those of ICT area. District and Upazilas are not the same in the two service areas. Six new district in ICT and three in non-ICT service areas have been added to the existing ones. The selection was random and the collection was accomplished in simple

method. The smooth geographically distance from the capital was ignored but adjacent district were on the top of the selection for the data collection of the non-ICT respondents. Some new Upazilas were in the addition as to compare the data from farmers representing traditional farms.

Table 6.8: Upazila wise non-ICT respondents

Division	District	Upazila	Respondents
Dhaka	Dhaka	Savar, Keranaganj, Nawabganj	21
	Faridpur	Modukhali, Nagarkanda, Boalmari	18
	Manikganj	Ghior, Doultpur, Saturia	15
	Shariatpur	Shariatpur Sadar, Naria	23
	Gazipur	Tongi, Sreepur	15
	Narayanganj	Narayanganj Sadar	9
	Mymenshigh	Gaffargaon , Haluaghat, Muktagachha, Trishal	15
	Narsighdi	Narsingdi Sadar, Belabo, Monohardi, Shibpur	19
Chittagong	Comilla	Laksham,Muradnagar	12
	Cox'sBazar	Teknaf, Maheshkhali	9
	Rangamati	Juraichhari	11
	Bandarban	Thanchi	8
	Chittagong	Satkania, Sitakunda	13
	Khagrachhari	Khagrachhari Sodor,Mahalchhari	7
Khulna	Khulna	Dumuria, Paikgachha,Terokhada, Koyra	28
	Jessore	Sharsha, Chaugachha	21
	Jhenaidah	Jhenaidaha Sadar, Kaliganj, Maheshpur, Shailkupa	26
	Sathkhira	Debhata, Kalaroa, Kaliganj	27
	Kustia	Bheramara, Kumarkhali, Kushtia Sadar, Mirpur	29
	Meherpur	Gangni, Meherpur Sadar	9
	Magura	Shalikha, Sreepur, Mohammadpur	10
Rajshahi	Rajshahi	Bagmara, Charghat, Durgapur, Godagari	20
	Bogra	Sherpur, Shibganj,Sonatala, Gabtali	19
	Pabna	Sujanagar,Santhia	13
	Naogao	Mohadevpur, Niamotpur, Manda	15
	Joypurhat	Panchbibi, Joypurhar Sadar	19
	Chapainababganj	Gomastapur, Nachole, Shibganj	19
Barisal	Barisal	Bakerganj, Banaripara, Babuganj	21
	Barguna	Amtali, Barguna Sadar, Patharghata	23
	Pirajpur	Pirajpur Sadar, Nazirpur	24
	Patuakhali	Bauphal, Galachipa, Kalapara	22
Rangpur	Rangpur	Badargachha, Pirgachha, Rangpur Sadar	29
	Thakurgoan	Thakurgoan Sadar, Pirganj	19
	Panchagarn	Boda, Debiganj, Panchagarh Sadar, Tetulia	31
	Dinajpur	Birganj, Bochaganj, Parbatipur	26
Sylhet	Sylhet	Balaganj, Jokiganj, Bishwanath	55
	Moulibazar	Kulaura, Srimongal, Barolekha, Moulibazar Sadar	45
	Hobiganj	Chunarughat, Bahubal, Habiganj Sadar, Madhabpur	39
	Sunamganj	Jagannathpur, Doharabazar, Derai	36
Total	**39**	**110**	**820**

The table (6.8) uncovers Upazila wise respondents under their district. Dhaka Division consists of seven district having eighteen (18) Upazilas from which data have been collected from 135 respondents. The highest number of district is found in Sylhet Division. There are six district and ten Upazilas in Chittagong Division. In Khulna Division the seven district were surveyed. Rajshahi consists of six district having nineteen Upazilas and 105 respondents. Rangpur and Sylhet have the same number of district but with various Upazilas. All these administrative units are located in different AEZs.

6.3 Demographic Data

This section is divided into different sub-sections under which respondent's age, education, sex, land holding, availability and source of electricity, source of electricity, status and category of pond/gher ownership, agricultural machinery ownership and credit are included.

The main purpose of this section is to discuss social, financial and demographic status and comparison of the farmers of both groups (ICT & non-ICT service areas). The district and Upazila wise male-female ratio, literacy rate of ICT and non- ICT respondents are narrated with statistical means in the figures.

6.3.1 Gender Distribution

The gender gap in agricultural operation exists in Bangladesh and elsewhere. It is associated with assets, inputs, services, including land, livestock, labour, education, extension and financial services, and technology. The present research draws gender distribution of the farming society all over Bangladesh. The data presented in the statistical figures found the gender gap in agriculture.

It is seen that the number of female respondents of the research has been disproportionately lower than the male ones. Therefore, gender disparity in farm holding is severe in Bangladesh. The reasons behind this number of female farmers are many. In socio-culture aspect, almost all farmers are male in Bangladesh. By family law, most farm property belongs to male members of the family in almost all the communities of the society. On the other hand, most of the post harvest agricultural activities are accomplished by the female counterparts of the society. Yet they cannot be called farm holders except the tribal people who are mainly female-headed families where mothers possess all the estates and property having full authority with them unlike male-dominated society in the rest of country.

Now-a-days women are opting to work not only in the farms but also at the agricultural science and technology as well as in the extension activities with male counterparts without farm property

possession. More female farmers are added to the least existing quantity from the tribal female farmers who are the owners of their land property. Professionals opine that closing the gender gap in agriculture would generate significant gains for the agriculture sector and for society.

Table 6.9: Frequency distribution of gender respondents by service area

Gender	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Male	1030	56.94	779	43.06	1809	100.00
Female	140	77.35	41	22.65	181	100.00
Total	**1170**	**58.79**	**820**	**41.21**	**1990**	**100.00**
χ^2 = 28.28, Sig = 0.00						

The table shows gender wise ICT and non-ICT respondents. In ICT service area, male farmers constitute 88 % whereas female farmers are only 12 (fig. 6.4) and non-ICT service area male farmers 95% but female ones are only 5% (fig. 6.6). The present analysis uncovers the gender biasness in agricultural activities. The table 6.10 shows that 56.94% from ICT service area and 43.06% from the non-ICT service areas constitute the male respondents as population. On the other hand, 77.35% from ICT and 22.65% from the non-ICT service areas make the female respondent group. It needs no telling that more female farmers are engaged in ICT service areas than non-service areas. In the ICT service areas, the ratio of male-female farmers is 11.96 and 2.99 and in the non-ICT service it is 19:1. Here it is significant to see that more female participants are now engaged in farming activities in the ICT service area.

Here it is noted that there is significant relationship between gender and the ICT service areas as Chi-square is 28.28 and p-value is less than 0.01.

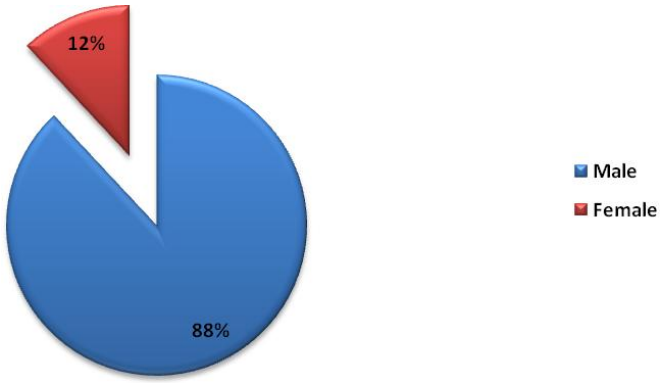

Figure 6.7: Gender wise ICT respondents

6.3.1.1 Gender wise ICT Respondents

In the ICT service area gender disparity to some extent is less than that of non- ICT service area. It means that female farmers in the ICT centers are more conscious than in the traditional service area. The female farmers with their husbands are getting involved in different activities with extension worker.

The graph indicates that 12% of the total ICT farmers are female who possess farm property according to Bangladeshi law. On the other hand, 88% of them are male farmers. It is noted that working class or day labourers are not included in the gender farming list. In Bangladesh, law allows male farmers to possess land property. It means that most of our farmers are male, so farming is dominated by them.

Gender equality is the time winning slogan for the present agriculture though the real scenario is quite different. Through another test, it is proved that gender parity tends to ICT center members more than to non-ICT farmers. This is revealed in the table 6.7.

6.3.1.1.1 Gender-wise Respondents of ICT Centers

As mentioned earlier, the main ICT centers considered in the study are AICC, FIAC, UISC Community Radio and Krishi Radio, Batighor, Farm Book, Plant Doctor etc. in the study. These five major ICT based service centers have been brought under the survey and data collection was followed from these centers.

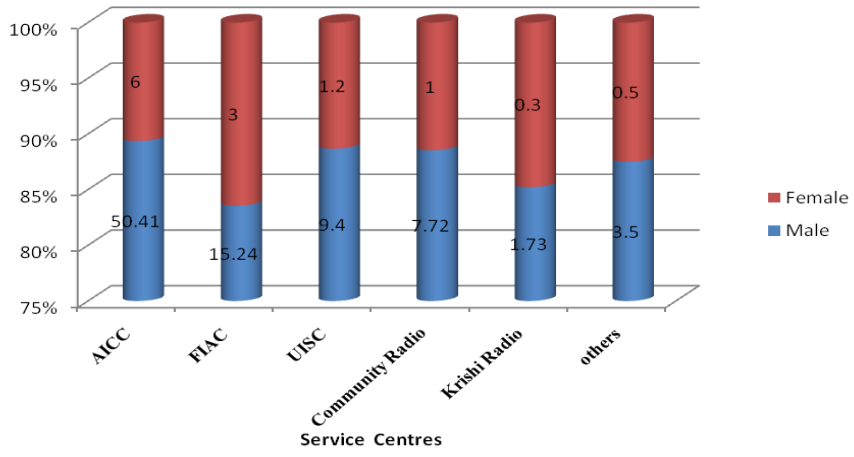

Figure 6.8: Gender wise respondents of ICT centers

The figure shows the gender wise respondents from the ICT based service centers (AICC, FIAC, UISC Community Radio, Krishi Radio and some small centers). 50.41% male and 6% female farmers

constitute the AICC respondents. In FIAC, the male farmers represent 15.24% and female farmers, 3%. In UISC the male farmers stand for 9.4% and female farmers, 1.2%. In Community Radio the male farmers represent 7.72% and female farmers, 1%. In Krishi Radio the male farmers stand for 1.73% and female farmers, 0.3%. So, it is seen that in AICCs the percent of female farmers is higher than that of other service centers.

6.3.1.2 Gender wise Representation in Non-ICT Respondents

Agricultural sector is traditionally marked by male domination as a rule of succession, the mode of production, the division of labour and the access to education whereas women are the pillar of family and agricultural enterprises. In some cases, women play an important role in pre-harvest activities whereas in most of the cases of post harvest activities, women play more important role than the male. Yet, women are not regarded as farmers as they do not possess the farm proprietorship. So, in the non-ICT service area / traditional service area the percent of female is far less. The following graph makes it clear that only 5% of the farmers hold farm proprietorship.

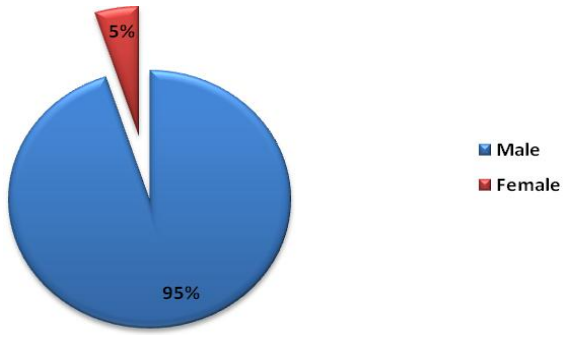

Figure 6.9: Gender wise non-ICT respondents

6.3.2 Age Profile of the Respondents

Age of a respondent reflects his activity and their ability to work. Farmer's age is an important factor as it affects their health and safety. This independent variable influences education, income, production and many other things from farmers to farmers. Different respondents belong to different age groups. The age range of respondents varies from 15 to 75 years.

Table 6.10: Frequency distribution of ICT respondents by age

Age (in years)	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
A (20-30)	260	94.55	15	5.45	275	100.00
B (30-40)	310	53.45	270	46.55	580	100.00
C (40-50)	360	70.59	150	29.41	510	100.00
D (50-60)	170	36.56	295	63.44	465	100.00
E (60-70)	70	43.75	90	56.25	160	100.00
Total	**1170**	**58.79**	**820**	**41.21**	**1990**	**100.00**

The age calculation in detail is shown in the table 6.10 and reference table no. 1. The age range of the respondent farmers varies from 15 to 70 years. Farmers were of different age. There were five age groups of farmers. The groups were A -20 -30 years, B- 30-40 years, C- 40-50 years, D- 50-60 years and the last E-60-70 years. Most of the farmers (360) were between 40 to 50 years old in the ICT service area and in this category, 70.59% of the respondents reprsents ICT service area and 29.41% in the non-ICT service area. The farmers in the category of 50 to 60 years are highest in number (295) in non-non-ICT area. In this category, 36.56% of the respondents belong to ICT service area and 63.44% in the non-ICT service area. The number of the most aged farmers (group-E) 8.04% of the total respondents (1990) is less than any other group of the farmers surveyed where ICT 43.75% and non-ICT 56.25%. No other group is so large as group B and their number is 58o in total. So it is clear that most of young farmers (Group A, B and C) belong to ICT service area and the aged farmers (D and E) to non-ICT service area.

6.3.3 Educational Status

Illiteracy grapples most of the ICT based activities. The findings of the study reveal that recently engaged young farmers with standard education are now entering into farming and are more efficient in ICT equipments. The ICT based farmers possess higher education than that of non-ICT based farmers. The education range like Illiteracy, Primary, Junior high school, SSC, College and University are set for the farmers of both groups.

Table 6.11 Frequency distribution of respondents by education

Level of Education	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
A (Illiterate)	170	45.21	206	54.79	376	100.00
B (Primary)	369	58.85	258	41.15	627	100.00
C (Junior High School)	309	62.68	184	37.32	493	100.00
D (SSC)	184	64.11	103	35.89	287	100.00
E (College)	105	63.25	61	36.75	166	100.00
F (University)	33	80.49	8	19.51	41	100.00
Total	**1,170**		**820**		**1,990**	

In ICT service areas, farmers having education level of JHS and MA are more in number than those of non-ICT service areas. However, illiterate and PSC holder farmers are more engaged in traditional farming non-ICT. The analysis clarifies that literacy rate among ICT based farmers is higher and so their consciousness level is higher. The total percentage of illiterate farmers in this service area is 14.53 (170/1170*100) whereas that of non-ICT service area is 25.12. 31.5% of the respondents have completed the primary education and many farmers had completed at least Junior High School level (ICT 62.68% and non-ICT 37.32%). It means that almost a quarter (24.77%) of the total sample (1990) had education level of middle school/ upper primary level. A significant number (8.34%) of the total respondents (1990) completed Intermediate Level (ICT 63.25% non-ICT 36.75%). The highest educational qualification among the respondents was Graduate or Masters. There was a trifling amount (2.06%) of farmers who completed master degree (ICT 80.49% non-ICT 19.51) in category F. It was encouraging to note that there is a growing tendency among the farmers to educate their children even the females. The young generations engaged in the formal education were interested in ICT based farming. Especially in the ICT area, the higher education rate is higher than that of the non-ICT based area.

6.3.3.1 Educational Status of the ICT Respondents

In improving farmers' knowledge of new techniques and technologies, education is second to nothing. In addition, it provides them with any physical resources necessary for being adept in techniques for the best practices of farming. Therefore, farmers' education is an important parameter for turning themselves from traditional farmers to modern farmers. Figure 6.10 shows that the educational status among the ICT based farmers:

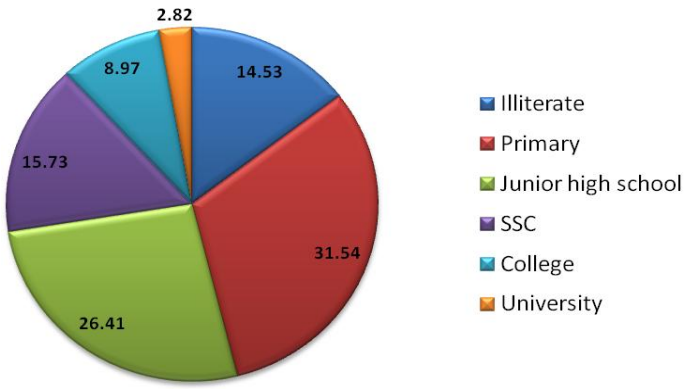

Figure 6.10: Education of ICT service area

The graph above indicates percentage education of the ICT based farmers. In a comparative study it is seen that the level of education is more among the farmers of the ICT area than among those of non-ICT area. The lowest percent (2.82%) of farmers is found with university education. The illiterate farmers constitute 14.53% of the respondents. The highest percent (31.54%) of the farmers is found with primary education. A quarter of the total respondents are engaged in farming with junior high school education. The number of the farmers (8.97%) with college education is less than the farmers (15.73) with SSC.

6.3.3.2 Educational Status of the non-ICT Respondents

Illiteracy among the farmers of non-ICT service area discourage them to adopt new knowledge and techniques. Therefore, they lag behind in growing crops and generating income in comparison with those of ICT service area.

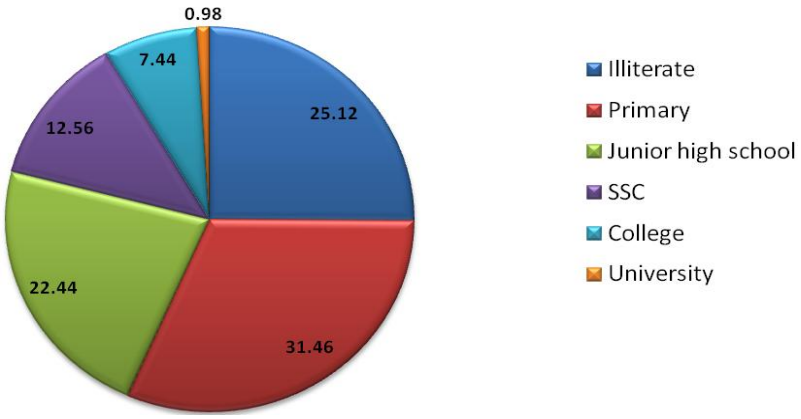

Figure 6.11: Education of non-ICT service area

The graph 6.11 specifies that about 1% of the farmers have university education. It is less than in the ICT service area. The highest percent (31.46%) of the farmers is found with primary education. It is almost equal to ICT farmers. 22.44% of the farmers with junior high school education are engaged in farming. The number of the farmers (7.44%) with college education is less than the farmers with SSC (12.56).

6.3.4 Farm Category

Farm size is determined by farmers' socio-economic factors that influence their livelihood and agro-diversity. Though farm size varies from area to area, a certain measurement determines the classifications of farmers with their farm size. There are five categories of farm size in Bangladesh 1) Landless 0.00-0.49 Acre, 2) Marginal 0.50-1.49 Acre, 3) Small 1.50 to 2.49 Acre, 4) Medium 2.50 to 7.49 Acre and 5) Large 7.50- above Acre (BBS, 1996). In Bangladesh, small & marginal farmers dominate all other groups. Social norm and structure is responsible for the fragmentation of cultivable land. The small and marginal farms are more than any other category.

Table 6.12 Frequency distribution of farm category by service area

Farm Category	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Landless	38	49.35	39	50.65	77	100
Marginal	444	54.21	375	45.79	819	100
Small	542	62.16	330	37.84	872	100
Medium	132	66.00	68	34.00	200	100
Large	14	63.64	8	36.36	22	100
Total	**1170**		**820**		**1990**	

Source: (Author Survey 2013-2014)

The table (6.12) shows that 44% of the total respondents belong to small farming. In ICT service area, 62.16% and in non-ICT 37.84% farmers are in this category. It also indicates that the number of large farmers is considerably less. It is only 1.2% (0.7% in ICT service area and 0.98% in non-ICT service area) stated in the figure no. 6.9 and 6.10). The second highest is marginal farmers 41.16%. In this category ICT is 54.21% and non-ICT is 45.79%. The landless category consists of 3.87% (40.35% in ICT and 50.65% in non-ICT). The rest is in the medium group 10%. The number of small farmers is more than those of any other group in the survey. The fact remains that the farm size has been diminishing as a result of fragmentation and also because contact farming is yet to be developed. (Detail in ref. table no 3)

6.3.4.1 Farm category of the ICT Respondents

The ICT farm category is different from that of non-ICT service area. The large farm category in ICT service area is little more than that of non-ICT service area. The five categories are found in both groups.

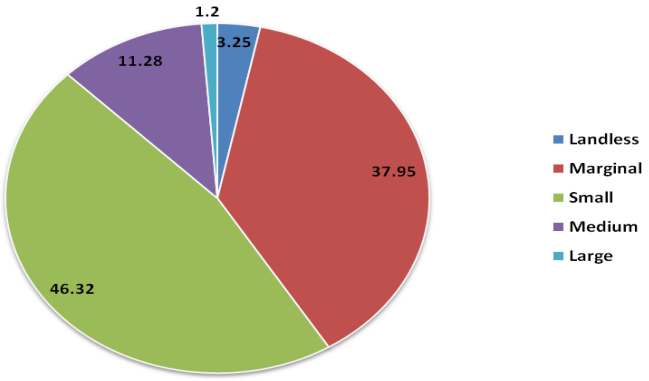

Figure 6.12: Farm category of ICT respondents

The survey result indicates that in ICT service area, small farmers represent 46.32%. The landless farm category is proportionately 3.25% in ICT service area. The marginal category farm is 37.95% in the ICT service area. The aggregation of small and marginal farm category is 84.27%. So it is seen that this category dominates all other categories in the service area.

6.3.4.2 Farm Category of Non- ICT respondents

Large farmers are less in both service areas due to fragmentation and absence of contact farming. In the non-ICT service area the percent of large and medium farmers is less than that of non-ICT group. Therefore, the small and marginal farmers are far more and all other categories are dominated by these two categories.

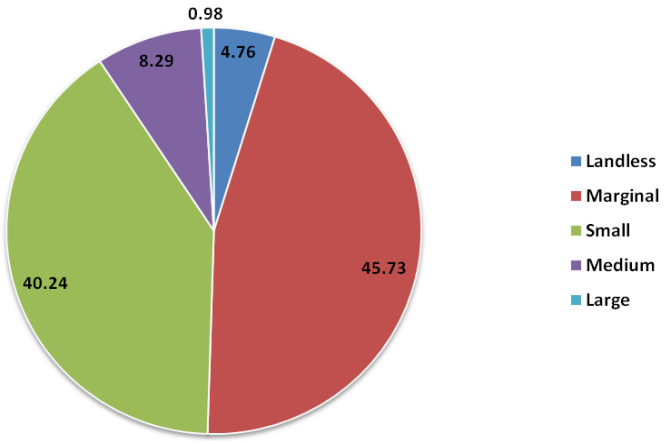

Figure 6.13: Farm category of non-ICT respondents

The result shown in the graph (6.13) indicates that in non-ICT service area, the percentage of small farmers is 40.24 whereas in ICT service area, it is 46.32. The category of small farmer is 45.73% whereas in ICT service area it is 37.95%. The aggregation of these two categories is 85.97% whereas that in ICT service area it is 84.27%. The medium farm category (8.29%) is smaller than each of these two categories but larger than landless and large categories. It is important to note that the large farmer group is lower (0.98%) than that (1.2 %) of non-ICT service area.

6.3.5 Power Supply

The development in agriculture depends on smooth supply of power in rural area. There are two types of power supply in our country- national grid and Solar Panel. Solar home helps the individual farmer do the homestead and agricultural works as well especially where there is no electricity supply from the national grid.

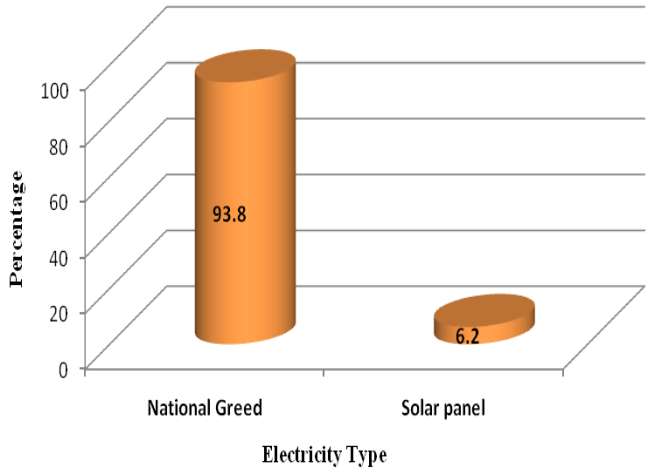

Figure 6.14: Types of power supply

A significant amount (93.8%) of power comes from national grid and only 6.2% comes from solar panel.

6.3.5.1 Access of Electricity

Lack of smooth power supply baffles boosting production and processing agricultural produces. Many a person in rural areas is deprived of the blessing of electricity. More people have no access to electricity supply in some non-ICT service area.

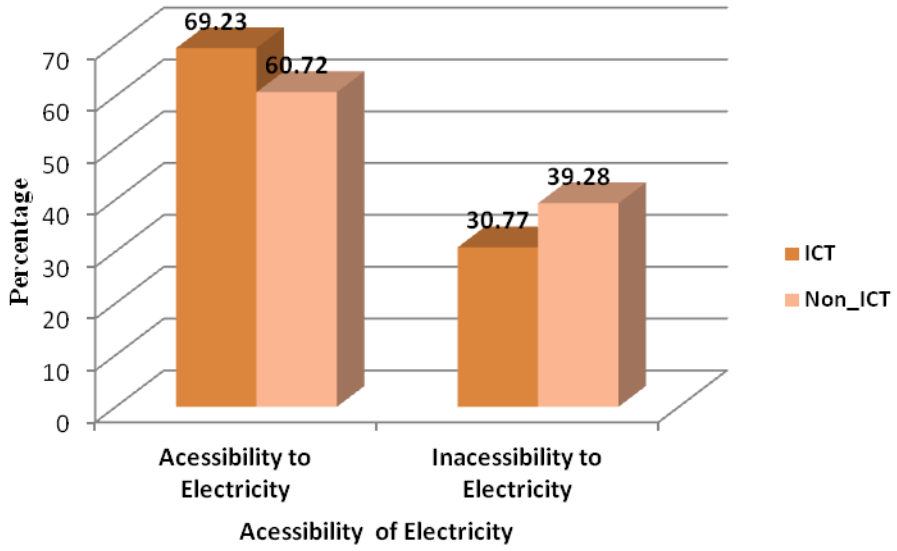

Figure 6.15 Respondents' access to electricity

The table displays the electricity holding (%) in the ICT and non-ICT service areas. It also indicates that 92.76% of the total respondents (1990) have electricity and 7.24% do not. In the ICT service area, 96.58% of the farmers enjoy electricity whereas in the non-ICT service area is 87.32%. On the other hand, 3.42% of the ICT and 12.68% of the non-ICT based farmers do not have access to electricity. It also means that 9.26% more farmers in the non-ICT service area are deprived of electricity in Bangladesh.

6.3.5.2 Electricity Holding and Service Area

To justify the relationship between the access of electricity and the service area, a Chi-Square Test has been performed. The farmers in the ICT areas are more conscious and their agricultural infrastructure is more developed.

Table 6.13 Frequency distribution of access to electricity by service area

Cross Tabulation			
Service Area	**Electricity**		**Total**
	Yes	**No**	
ICT	810	360	1170
Non-ICT	498	322	820
Total	**1846**	**144**	**1990**
χ^2 =61.641, sig. 0.000			

Electricity is now in rural areas set up with different kinds of farm holdings. Unlike the past, electricity at present is about to reach to the doorstep of every farmer. Very few farmers like 7.24% do not have electricity. The table shows that electricity covers more 9% more farmers in ICT areas than in non-ICT ones. The probability associated with the Chi-square test of 61.64 where p-value is less than 0.01 indicates that there is a strong relationship between access to electricity and service area.

6.3.6 Category of Pond /Gher

There are two categories of ponds/ ghers in the study area. One is the seasonal and the other is annual. The seasonal ponds/ghers are used for fish once a year and the rest of the time of the year farmers grow crops mainly rice. The annual ponds/ ghers are used for fish of different species all the year round as aqua-culture.

Table 6.14: Frequency distribution of Pond/Gher category by service area

Service Area	**Category**					
	Seasonal		**Annual**		**Total**	
	No.	**%**	**No.**	**%**	**No.**	**%**
ICT	120	53.33	430	61.43	550	59.46
Non-ICT	105	46.67	270	38.57	375	40.54
Total	**225**	**100.00**	**700**	**100.00**	**925**	**100.00**

It is important to see that 53.33% ICT and 46.67% of non-ICT farmers practice aquaculture in their ponds seasonally. It means these farmers use their ponds /ghers once a year to rear fish and rest of the year they grow crops or remains fallow. On the other hand, 61.43% of the ICT and 38.57% of the non-ICT farmers grow fish in their ponds / ghers all the year round. Here the impact of ICT is seen significantly that comparatively more 10 % of ICT farmers use their ponds/ ghers for aquaculture all the year round. They know better to utilize their ponds for productive purpose.

6.3.6.1 Status of Pond /Gher Ownership

Ponds/ ghers are owned by farmers either individually or jointly. It means that some ponds/ghers are solely owned by some individual farmers and some ponds/ghers are jointly cultured by farmers along with their kith and kin. The number of ponds/ ghers of single ownership in ICT service area is more than that of non-ICT service area.

Table 6.15: Frequency distribution of pond/gher ownership by service area

Ownership	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Individual	490	89.09	360	96.00	850	91.89
Jointly	60	10.91	15	4.00	75	8.11
Total	**550**	**100.00**	**375**	**100.00**	**925**	**100.00**

The table shows that 46.48% of the total respondents are fish farmers of which about 59 % are ICT based and about 41% are non-ICT based farmers. All fish farmers do not have the ponds /ghers of their own. Most of the ponds/ ghers are individually owned. 89% of ICT and 96% of non-ICT based farmers have their own ponds/ghers. 11% of the ICT and 4% of the non-ICT farmers possess the ponds/ ghers jointly either with their relatives or with their kith and kin. (For further analysis ref. table no. 4)

6.3.7 Agricultural Machinery

Seven types of agricultural machineries are found with farmers in the study. Some are traditional tools for cultivation and some are modern tools. Irrigation pump, power tiller, weeder and thresher are regarded as modern tools and country plough, ladder, fish-net are traditional tools. Both groups of farmers possess these types of tools but ICT based farmers have more modern tools whereas the traditional farmers have more traditional tools of cultivation.

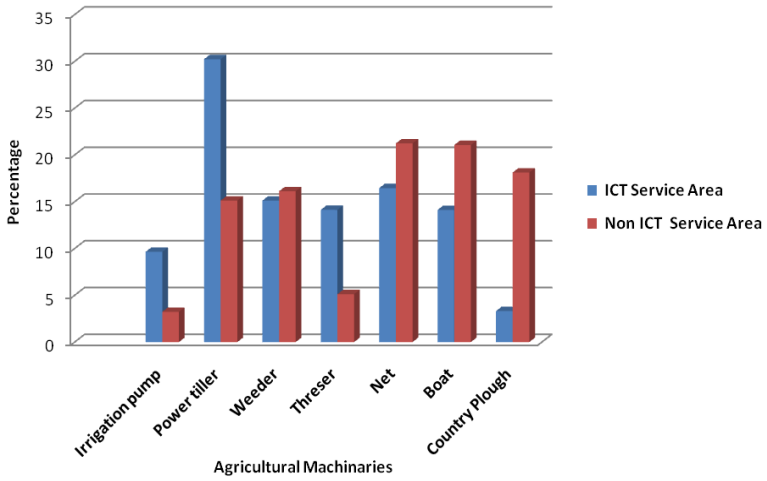

Figure 6.16: Respondents' agricultural machinery

Here blue bars indicate the items of agricultural machinery/tools that the ICT farmers possess. ICT based farmers have more irrigation pumps and power tiller than non-ICT based farmers (9% and 3%) and power tiller (30% and 15%). Thresher is in possession of ICT farmers (14.13%) and non-ICT (5.12%). Farmers of both groups have almost same number of weeder (ICT 15.12% and non-ICT 16.12%).On the other hand, non-ICT and ICT farmers have net in proportion of 16.45% - 21.23%, boat (14.12%-21.06%) and in country plough they have 3.3% - 1812%.

6.3.8 ICT Tools

ICT tools are regarded as the best means of communication. ICT tools play a vital in making agriculture more efficient and effective. E-agriculture largely depends on the proper application of these ICT tools. Radio, Television, Mobile and Computer includes as the ICT tools in the both service areas of the present study. TV is a very common tool that is available in almost every house of all farmers. Computer is rarely used by farmers in the non-ICT service area. Now mobile is the easy and quickest means of ICT tools. All the four tools are not equally used by the farmers in the same area. The use and holding of ICT tools differ from area to area.

Table 6.16: Frequency distribution of ICT tools and other assets by service area

Assets		Service Area					
		ICT		Non-ICT		Total	
		No.	%	No.	%	No.	%
Radio	No	620	47.00	655	20.00	1275	64.07
	Yes	550	53.00	165	80.00	715	35.93
Mobile	No	35	3.00	205	25.00	240	12.06
	Yes	1135	97.00	615	75.00	1750	87.94
Television	No	468	40.00	492	40.00	960	48.24
	Yes	702	60.00	328	60.00	1030	51.76
Computer	No	770	65.81	730	89.02	1500	75.38
	Yes	400	34.19	90	10.98	490	24.62
Bicycle	No	462	39.49	285	34.76	747	37.54
	Yes	708	60.51	535	65.24	1243	62.46
Motor Cycle	No	790	67.52	700	85.37	1490	74.87
	Yes	380	32.48	120	14.63	500	25.13

The table shows the frequency and the percent of ICT tools in the two service areas. 1855 farmers (93.22%) have at least one set of mobile phone. Of them 61.46% belong to ICT and 38.54% to non-ICT based farmers. More farmers are seen holding mobile phone in ICT service area. Television is next to the frequency of mobile phone. It is held by 77.89% of the total farmers where ICT possess 64.31% and non-ICT 35.69%. The number of radio and computer is far less than those of TV and mobile. Yet computer using farmer is outnumbered by that of radio. Out of the total farmers, 31.41% have radio sets and only 24.62% have computer. It is important to find in ICT area more farmers use these ICT tools. On other hand, bicycle is possessed by 62.46% and motor cycle by 25.13% of the total respondents.

6.4 The Impact of ICT on Production and Income

This section presents the findings of the study that aimed at establishing the contribution of ICT to the access and utilization of agricultural information by the farmers of Bangladesh towards production. The section further examines the potential of the farmers of both groups in production gain. It correlates their present production with that of the past. The comparative study of their income as well as their ICT use is shown here. The main purpose of the study was to draw a line of income and production variables between two certain groups of farmers in Bangladesh. The result was intended to be built on the experiences of both ICT and non-ICT service area in farming in ecological zones.

Famers' source of income, their annual income, their net profit and the production cost are serially shown in different tables. The impact of ICT on farmers' production and income reflects their income.

6.4.1 Income and Service Area

Table 6.17: Frequency distribution of income by service area

Service Area	Total income from agriculture and non-agriculture (in thousand BDT)					Total
	0-100	100-200	200-300	300-400	400 and above	
ICT	360	400	170	90	150	1170
Non-ICT	295	240	90	105	90	820
Total	**655**	**640**	**260**	**195**	**240**	**1990**
χ^2 = 26.481, sig.- 0.000						

Using cross-tabulation analysis between the income of the ICT and non-ICT based service area it is found that in every range the income of ICT service area is higher than that of non-ICT service area. From the range of income 0 to 1, 00,000, the respondents of the ICT service area are more of non-ICT service area (360>295). On the other hand, the income range of 1,00,000-2,00,000 the non-ICT farmers are 240 but in the same range of income, ICT farmers are 400. So, it is seen here that non-ICT is less than that of ICT. In other range of income such as 2,00,000 to 3,00,000 the ICT respondents are more than those of non-ICT respondents (170>90). In the next slap the non-ICT respondents are more than those of ICT respondents (90<105) but in the income range of 3,00,000 to above, the ICT respondents are found more than those of non-ICT farmers (150>90). The comparative income presented in the table above reveals that the average income of farmers of the ICT service area is more than that of the non-ICT service area as their p-value is 0.000 associated with df 4 respectively. The hypothesis of the research is rejected here and it has established that the use of ICT influences farmers' income positively and it varies from one service area to other.

6.4.2 Regression Analysis

Gender, farmer's age, years of schooling, operational farm size, cowshed, electricity, radio, mobile, television, computer are independent variables in the study. These items have impact on ICT service area.

Table 6.18: Regression line of income on different independent variables

Parameters	Coefficients		Statistic t	Sig.
	B	Std. Error		
(Constant)	-74313.32	93064.60	-0.80	0.42
Gender (dummy: Female =0, Male =1)	119091.18	26964.18	4.42	0.00
Age of the Farmer	4952.22	1019.68	4.86	0.00
Years of Schooling	10247.05	2630.09	3.90	0.00
Service area (dummy: ICT=0, Non-ICT=1)	49430.44	25909.21	1.91	0.06
Operational farm size (ha)	39696.84	23061.18	1.72	0.09
Cowshed (dummy: Yes =0, No=1)	198512.48	23746.18	8.36	0.00
Electricity (dummy: Yes=1, No =0)	105883.05	38808.10	2.73	0.01
Radio (dummy: Yes=0, No =1)	129867.89	21252.51	6.11	0.00
Mobile (dummy: Yes=1, No =0)	-11643.85	62046.91	-0.19	0.85
Television (dummy: Yes=1, No =0)	82978.19	27465.59	3.02	0.00
Computer (dummy: Yes=1, No =0)	176839.60	22746.73	7.77	0.00
Bicycle (dummy: Yes=1, No =0)	99416.89	18753.09	5.30	0.00
Motor Cycle (dummy: Yes=1, No =0)	81427.43	22295.90	3.65	0.00
Sources of Loan (dummy: Bank =1, Otherwise=0)	40736.15	23796.43	1.71	0.09
F= 30.028, df=12, Sig = 0.000; R2=0.438 and Adj R2 = 0.423				

Source: (Author Survey 2013-2014)

The table above indicates that the multiple regression analysis show the best in the sense of involving no multicollinearity, that is ensuring no two independent variables has a correlation in excess of 0.80.Through backward elimination and forward selection, fourteen explanatory variables were selected and their effect on quantity of annual income behavior determined.

The estimated regression model of quantity of annual income (Y) on fourteen explanatory variables such as gender (x_1), Age of the farmers (x_2), Years of schooling (x_3), Service area (x_4), Operational farm size (x_5), Cowshed (x_6), Electricity (x_7), Radio (x_8) Mobile phone (x_9), Television (x_{10}), Computer (x_{11}), Bicycle (x_{12}), Motor cycle (x_{13}) and Sources of loan (x_{14}) out of fourteen explanatory variables is as follows:

$Y=-74313.32+119091.18x_{1}+4952.22x_{2}+10247.05$

$X+_{349430.44}X_{4}+39696.84x_{5}+198512.48x_{6}+105883.05x_{7}+129867.89x_{8}-$

$11643.85x_{9}+82978.19x_{10}+176839.60x_{11}+99416.89x_{12}+81427.43x_{13}+40736.15x_{14}$

This multiple linear regression model with fourteen explanatory variables has an R^2 value of 0.438 which indicates that 43.8 percent of the variation of farmers' annual income can be explained with the combined effect of these fourteen variables by this model and the other 56.2 percent remained unexplained.

The F-statistic has numerical value 30.028 with associated significance of 0.000. So the null hypothesis is rejected and concludes that the regression model is well fitted (Table 6.18). Hence, the R^2 value is significant at the 0.000 level. It is also revealed from the table that combined effect of all the explanatory variables such as gender (x_1), Age of the farmers (x_2), Years of schooling (x_3), Service area (x_4), Operational farm size (x_5), Cowshed (x_6), Electricity (x_7), Radio (x_8) Mobile (x_9), Television (x_{10}), Computer (x_{11}), Bicycle (x_{12}), Motor cycle (x_{13}) and Sources of loan (x_{14}) significantly contribute on the quantity of annual income of the farmers in the manner described by the multiple linear regression equation.

To evaluate individual regression coefficients were carried out t-statistic to test the hypothesis. The null hypothesis is that there is no linear relationship exists between explanatory variables (x_i) and quantity of farmers' annual income (y) i.e.

H_0: $\beta_j = 0$ (no linear relationship exist between the use of ICT in agriculture and the enhancement of farmers' production and income)

H_1: $\beta_j \neq 0$ (linear relationship does exist between the use of ICT in agriculture and the enhancement of farmers' production and income)

To justify the above argument on empirical basis it was found that t-value gender is t = 4.42 with associated level of significance 0.00, t-value for age of the farmers is t = 4.86 with probability level of significance 0.00, t-value for years of schooling is t = 3.90 with probability level of significance 0.00, t-value for service area is t = 1.91with 0.06 probability level, t-value for operational farm size is t = 1.72 with probability level of significance 0.09, t-value for cowshed is t = 8.36 at 0.00 probability level of significance, t-value for electricity is t = 2.73 with associated probability level 0.01, t-value for radio is t = 6.11 with 0.00 level of significance, t-value for mobile is t = -0.19 with associated significance level 0.85, t-value for television is t = 3.02 with associated significance level 0.00, t-value for computer is t = 7.77 with associated significance level 0.00, t-value for bicycle is t = 5.30 with associated significance level 0.00, t-value for motor cycle is t = 3.65 with associated significance level 0.00 and t-value for sources of loan is t = 1.71 with associated significance level 0.09. So there is evidence that among all the explanatory variables exist linear relationship i.e. affect the quantity of annual income of the farmers.

Except mobile phone; all other thirteen parameters have positive coefficients which revealed that for each explanatory variable a greater unit is associated with a higher level of quantity of the annual income of the farmers. This means that these variables have positive impact on quantity of annual income of the farmers.

It is interestingly revealed that mobile phone has a negative sign that shows an inverse relationship between the using of mobile phone and the annual income of the farmers. It indicates that an increase in using mobile phone decreases the chances of annual income of the farmers by about -11643.85 BDT (Lac) that having controlled for gender, Age of the farmers, Years of schooling, Service area, Operational farm size, Cowshed, Electricity, Radio Television, Computer, Bicycle, Motor cycle and Sources of loan.

The use of mobile phone has a negative sign indicating an inverse relationship with quantity of annual income as the respondents of the two groups use mobile phone for different reasons but a large number of farmers use mobile phone for other reasons than in agricultural activities. Therefore, the inverse use of mobile phone has turned the result into negative.

6.4.3 DiD Analysis

DiD means difference in differences. It is a statistical technique used in econometrics and qualitative sociology through experimental research design using observational study data. It calculates the effect of a treatment (an independent variable) on an outcome (dependent variable) by comparing the average change over time in the outcome variable for the treatment group to the average change over time for the control group. Difference in differences requires data measured at two time-periods.

These periods are the baseline year and the follow-up year. The former is regarded as 2012 and the latter as 2014. Data were collected in 2014 from the farmers of two service areas by recall method. The product information of the past and the present was asserted by the respondents and the follow-up year is treated as the current year of the crop production whereas the baseline year is treated as the concurrent year. While data were presented with statistical means, the difference in production in both service areas was found. The production was displayed with metric ton per hectare. The production difference was found in the analysis to meet the objectives of the study area.

Because of the weather patterns, the seasons are divided into three categories in Bangladesh- the Rabi, the Kharif-1 and Kharif-2. The Rabi season comprises the time October mid to March mid. The Kharif-1 is made up of four months (March mid to July mid). The Kharif-2 consists of three months (July mid to October mid). Cultivation is suited to climatic condition of the land. Some crops need much water and these rain-fed crops are cultivated in the two seasons– Kharif-1 and Kharif-2. On the other hand, Rabi season is characterized by dry sunny cropping. There are some crops in this season, which need less water.

Different types of crops are cultivated in different seasons. In Rabi season, the production of Boro rice, wheat, maize, mustard, pulses, sugarcane, vegetables and onion are estimated in the survey. In Kharif-1, the production of rice (Broadcast), rice (Aus), jute, different types of vegetables, and in Kharif-2, rice (T-Aman), maize, onion, and many types of vegetables are estimated in the section. The production of these crops is dependent variable that changes by the influence of ICT use in cultivation process. The follow-up production of both groups has increased but the rate of increase of ICT farmers is higher than that of non-ICT service areas.

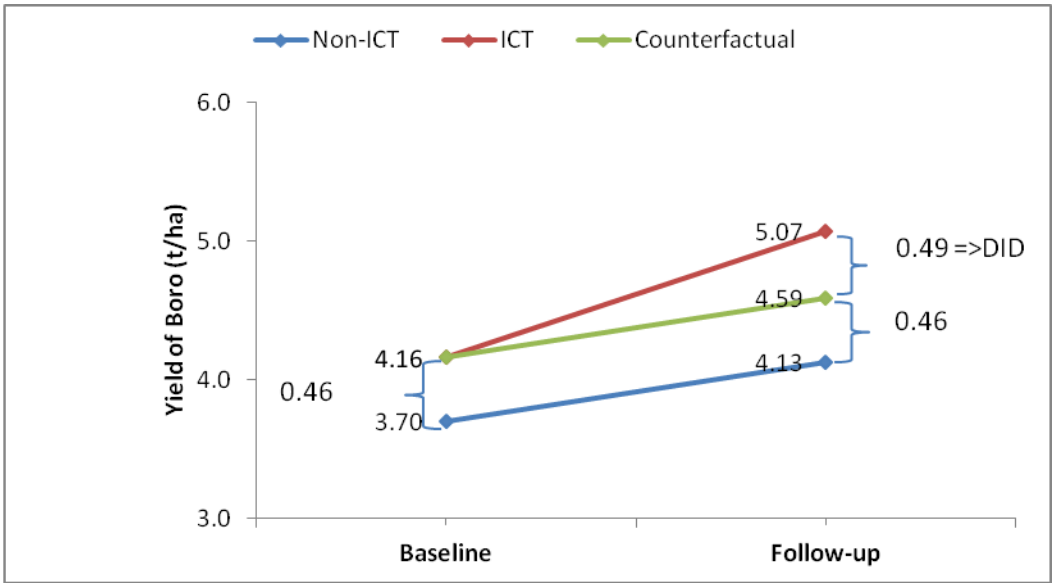

Figure 6.17: Production performance of Boro rice by baseline and follow-up

This figure shows counterfactual conditionals that take the generic form of difference of differences. The counterfactual marked yellow in the figure reveals the difference of rice production from non-ICT based service area that did not actually occur. It is argued here that such propositions play a necessary and fundamental role in the whole effects of ICT on production system and it enables us to assess the hypotheses the study employed.

Here it is found that the follow-up (2014) production of both ICT and non-ICT areas has gradually increased but to a greater extent, the increase rate of ICT service area is higher than that of non-ICT service area. The figure indicates that the follow-up production of non-ICT based area is higher by 0.43 than that of baseline production (2012) (4.13-3.70=0.43 mt.). Here it is seen that the baseline production of non-ICT 3.70 mt. and that of ICT and the counterfactual is 4.16 (mt.). The follow up of the counterfactual is 4.59 mt. but follow-up production of ICT is 5.07 (mt.). The degree of increase of ICT is so higher that it exceeds to the counterfactual by 0.49 (5.07-4.59) (shown in the figure). Therefore, it is significantly proved that the Boro rice production from ICT based service area has increased than the increase of production of non-ICT based area.

Table 6.19: production performance of Boro (rice) by baseline and follow-up

Parameters	Unstandardized coefficients		T	Sig.
	B	Std. Error		
(Constant)	3.70	0.09	41.04	0.00
Treatment	0.46	0.08	5.64	0.00
Time	0.43	0.09	4.66	0.00
Interaction between trxtime	0.49	0.06	7.89	0.00
Dependent variable: yield of Boro rice (t/ha)				

The table (6.19) indicates that the *counterfactual* or *potential outcome* reflects the perspective weaker treatment of non-ICT service area and stronger treatment of ICT service area. The follow-up production of ICT and non-ICT farmers is higher than that of the baseline one. So the research hypothesis has been assessed rejecting the null one, "the use of ICT does not influence to increase the production of the farmers".

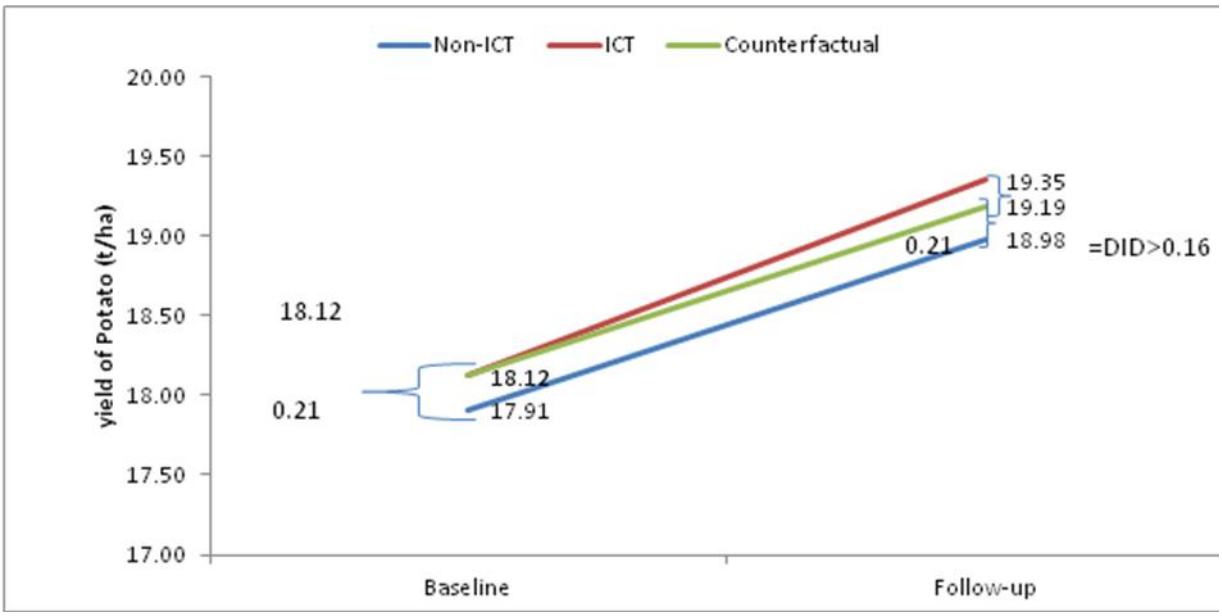

Figure 6.18: production performance of potato by baseline and follow-up

The figure (6.18) shows counterfactual conditionals of the production performance of potato that take the generic form of difference of differences. The counterfactual marked yellow in the figure shows about the difference of production from non-ICT based service area that did not actually occur. It is argued here that such propositions play a necessary and fundamental role in the whole effects of non- ICT service area.

Here it is found that the follow-up production of both ICT and non-ICT areas has not gradually increased. The figure indicates that the follow-up production of non-ICT based area is less than that of baseline production (18.98-17.91=1.07 mt.). Here it is seen that the baseline production of ICT

and baseline counterfactual and ICT production is 18.12 mt. but the follow-up production of ICT is 19.35 mt. The degree of increase of this service area is higher that it exceeds to the counterfactual by 0.16= (19.35-19.19 mt.) (shown in the figure 6.18). Therefore, it is significantly proved that the potato production from ICT based service area has increased than the increase of potato production of non-ICT based area.

Table 6.20: production performance of rabi (potato) by baseline and follow-up

Parameters	Unstandardized Coefficients	Std. Error	t	sig.
	B			
(Constant)	17.91	0.00	11,435.81	0.00
Treatment	0.21	0.00	105.41	0.00
Time	1.07	0.00	491.73	0.00
TrxTime	0.16	0.00	59.51	0.00
Dependent Variable: Potato (t/ha)				

The *counterfactual* or *potential outcome* reflects the perspective weaker treatment of non-ICT service area and stronger treatment of ICT service area. So the research hypothesis has been assessed rejecting the null one, "the use of ICT does not influence to increase the production of the farmers" though the baseline of non-ICT is higher than that of its follow up production.

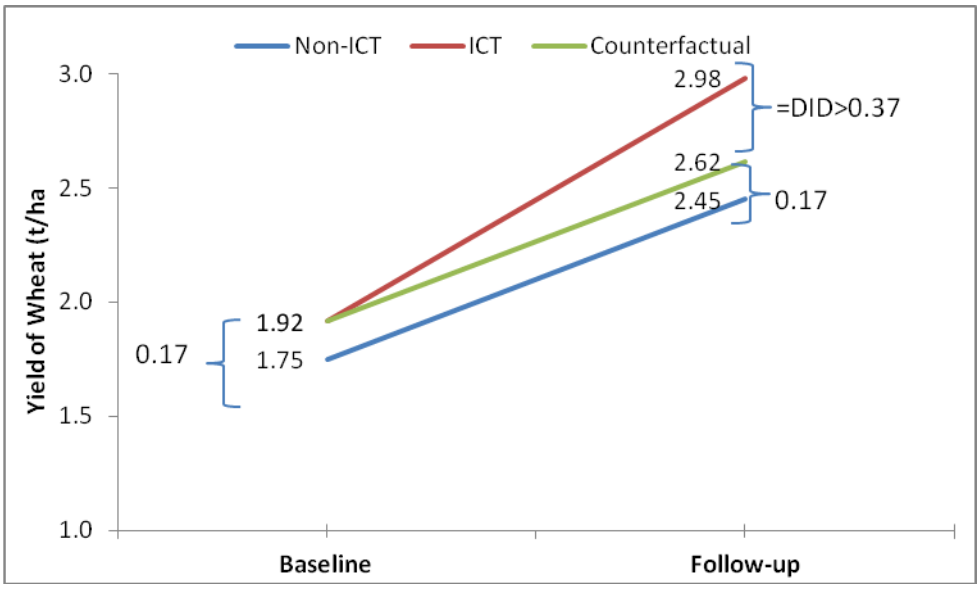

Figure 6.19: production performance of wheat by baseline and follow-up

The figure indicates that the follow-up production of non-ICT based area is higher by 0.7 than that of baseline production (2012) (2.45-1.75=0.71). Here it is seen that the baseline production of non-ICT 1.75 and that of ICT and the counterfactual is 1.92 (mt.). The follow up of the counterfactual is 2.62 but follow-up production of ICT is 2.98 (mt.). The degree of increase of ICT is so higher that it

exceeds to the counterfactual by 0.37 mt. (2.98-2.62) (shown in the figure 6.19). Therefore, it is significantly proved that the wheat production from ICT based service area has increased than the increase of wheat production of non-ICT based area.

Table 6.21: production performance of wheat by baseline and follow-up

Parameters	Unstandardized coefficients	Std. Error	t	sig.
	B			
(Constant)	1.75	0.16	11.11	0.00
Treatment	0.17	0.02	8.60	0.00
Time	0.70	0.09	7.61	0.05
Trxtime	0.37	0.07	5.03	0.06
Dependent variable: wheat (t/ha)				

The table shows that the *counterfactual* or *potential outcome* reflects the perspective weaker treatment of non-ICT service area and stronger treatment of ICT service area. The follow-up production of non-ICT is lower than that of ICT farmers. So the research hypothesis has been assessed rejecting the null one, "the use of ICT does not influence to increase the production of the farmers".

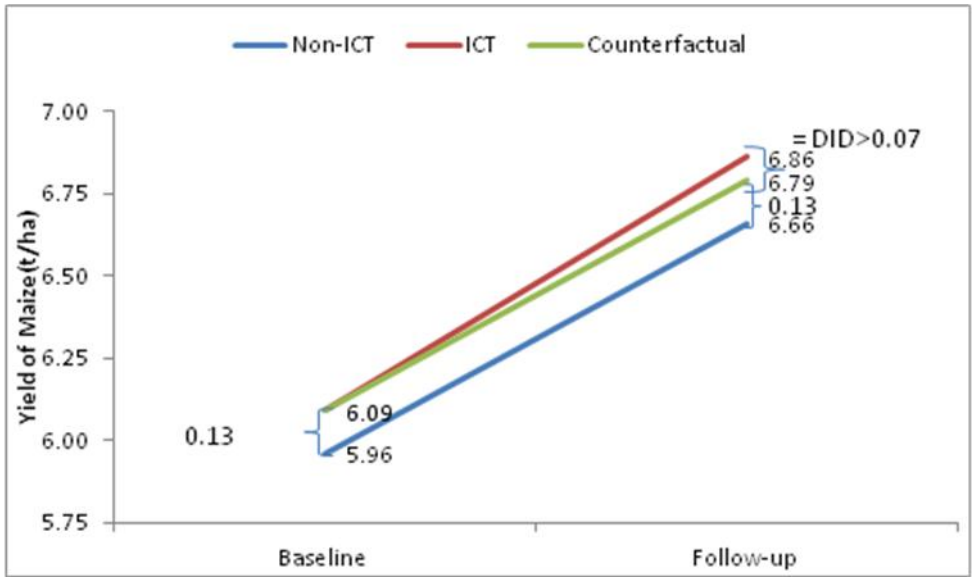

Figure 6.20: production performance of maize by baseline and follow-up

The figure indicates that the degree of increase of ICT is so higher that it exceeds to the counterfactual by 0.07 mt. (6.86-6.79) (shown in the figure 6.20). The follow-up production of non-ICT based area is higher by 0.7 than that of baseline production (2012) (6.66-5.96=0.7). Here it is seen that the baseline production of non-ICT 5.96 and that of ICT and the counterfactual is 6.09 (mt.). The follow up of the counterfactual is 6.79 but follow-up production of ICT is 6.86 (mt.).

Therefore, it is significantly proved that the maize production from ICT based service area has increased than the increase of maize production of non-ICT based area.

Table 6.22: production performance of Maize by baseline and follow-up

Parameter	Unstandardized coefficients	Std. Error	t	sig.
	B			
(Constant)	5.96	0.03	233.33	0.00
Treatment	0.13	0.03	3.93	0.05
Time	0.70	0.13	5.24	0.05
Trxtime	0.07	0.04	1.49	0.07
Dependent variable: maize (t/ha)				

The table (6.22) points out that the *counterfactual* or *potential outcome* reflects the perspective weaker treatment of non-ICT service area and stronger treatment of ICT service area. The follow-up production of ICT is much higher than that of non-ICT farmers. So the research hypothesis has been assessed rejecting the null one, "the use of ICT does not influence to increase the production of the farmers".

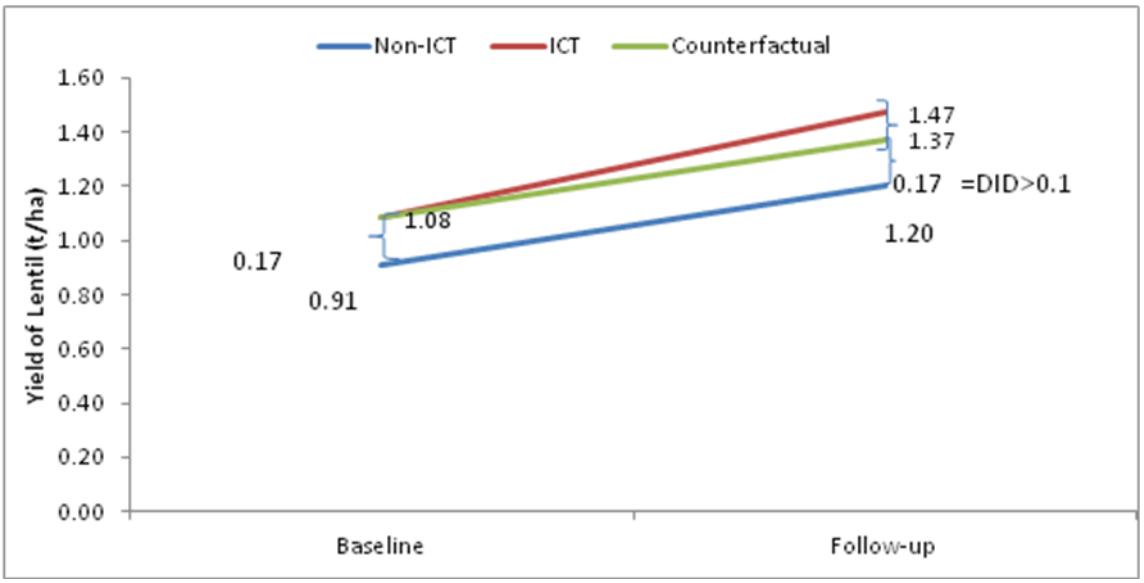

Figure 6.21: production performance of pulse (Lentil) by baseline and follow-up

The figure (6.21) shows that the follow up of the counterfactual is 1.37 but follow-up production of ICT is 1.47 (mt.). The degree of increase of ICT is so higher that it exceeds to the counterfactual by 0.1 (1.47-1.37 mt.) (shown in the figure 6.17). The follow-up production of non-ICT based area is less by 0.29 than that of baseline production (2012) (1.2-0.91=-0.29). Here it is seen that the baseline pulse production of non-ICT 0.91 mt.and that of ICT and the counterfactual is 1.08 (mt.). Therefore, it is significantly proved that the pulse production from ICT based service area has increased.

Table 6.23: production performance of pulse (Lentil) by baseline and follow-up

Parameter	Unstandardized coefficients	Std. Error	t	sig.
	B			
(Constant)	0.91	0.00	1291.37	0.00
Treatment	0.17	0.00	193.41	0.00
Time	0.29	0.00	296.14	0.00
Trxtime	0.10	0.00	77.95	0.00
Dependent variable: pulse (t/ha)				

The table indicates that the *counterfactual* or *potential outcome* reflects the perspective weaker treatment of non-ICT service area and stronger treatment of ICT service area. The non-ICT follow-up production is lower than that of ICT. So the research hypothesis has been assessed rejecting the null one, "the use of ICT does not influence to increase the production of the farmers".

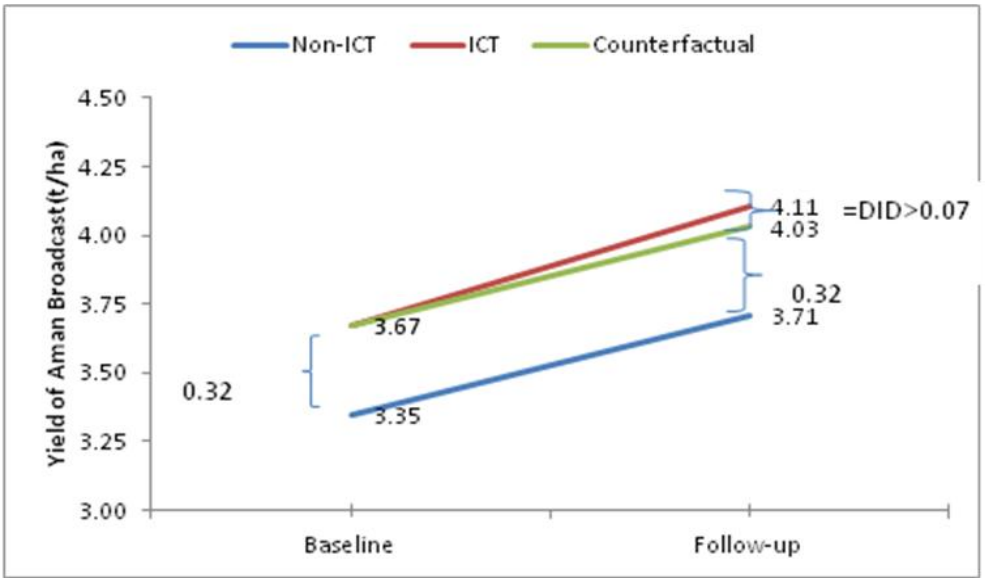

Figure 6.22: production performance of Broadcast Aman by baseline and follow-up

The figure indicates that the degree of increase of ICT is so higher that it exceeds to the counterfactual by 0.07 (4.11-4.03) (shown in the figure 6.22). The follow-up production of non-ICT based area is higher by 0.36 than that of baseline production (2012) (4.35-4.71=-0.36). Here it is seen that the baseline production of non-ICT 3.35 mt. and that of ICT and the counterfactual is 3.67 (mt.). The follow up of the counterfactual is 4.03 but follow-up production of ICT is a little bit higher by 0.07 (mt.) (4.11-4.03). Therefore, it is significantly proved that the broadcast Aman production from ICT based service area has increased than the increase of the production of non-ICT based area.

Table 6.24: production performance of broadcast Aman by baseline and follow-up

Parameter	Unstandardized coefficients	Std. Error	t	sig.
	B			
(Constant)	3.35	0.00	4,290.63	0.000
Treatment	0.32	0.00	322.71	0.000
Time	0.36	0.00	332.50	0.000
Trxtime	0.07	0.00	53.19	0.000
Dependent variable: broadcast aman (t/ha)				

The table shows that the *counterfactual* or *potential outcome* reflects the perspective weaker treatment of non-ICT service area and stronger treatment of ICT service area. The ICT follow-up production is higher. So the research hypothesis has been assessed rejecting the null one, "the use of ICT does not influence to increase the production of the farmers".

6.4.4 T-Test for Farmers' Income

Table 6.25: T-Test of income difference between ICT and non-ICT farmers

Earning Sources	Average Income (Tk.)		t-test for Equality of Means		
	ICT	Non-ICT	t	Df	sig.
Crops	143174	98424	3.27	1988	**0.001**
Poultry	29161	14828	2.94	1088	**0.003**
Fishery	106818	37333	9.57	718	**0.000**
Annual Income	**278288**	**215632**	**3.41**	**1988**	**0.001**

Source: (Author Survey 2013-2014)

The above table is a t-test about the annual income of the farmers from crops, poultry and fishery. It reveals the supposed difference between the income of the ICT and non-ICT based farmers. Here the crops, poultry and fishery are independent variables and the income from these sectors is counted as dependent variable. The income result from ICT service area is greater (1, 43,174>98,429) is adjusted with 0.001 significance where df is 1988. The income from poultry is also significantly different (t=2.94) associated with 0.003 significance. The income from fishery between ICT and non-ICT service areas is highly significant (as 1, 06,818>37,333) where df is 718 associated with 0.000 significance level. Fishery was perceived as the most important variable in the table.

The t-value of the annual income of the farmers is 3.41 with df 1988 and associated significance of 0.001. So the null hypothesis 'The use of ICT in agriculture does not enhance farmers' production and income" is rejected as the income from three independent variables between the ICT and non-ICT based farmers is significantly different and thus the table is well fitted.

6.5 ICT Tools and Sources of Information

This section describes the sources of information from different ICT tools. It analyses access to television, and farmers' favourite television programs with channels. Its different subtitles describe different technologies, access to mobile phone, purpose of using mobile phone, access to radio, radio listener with their station and programs along with weather forecast, crop variety selection.

6.5.1 Access to Television

At present a great number of farmers possess a television set and most of them watch it regularly. Those who do not have a TV set can have an access to watching TV programs in a common place like tea stall or in neighbours' house. The number of TV watching farmers is more than that of TV owners. ICT based farmers have more TV sets and they watch TV programs regularly more than those of the non-ICT based farmers.

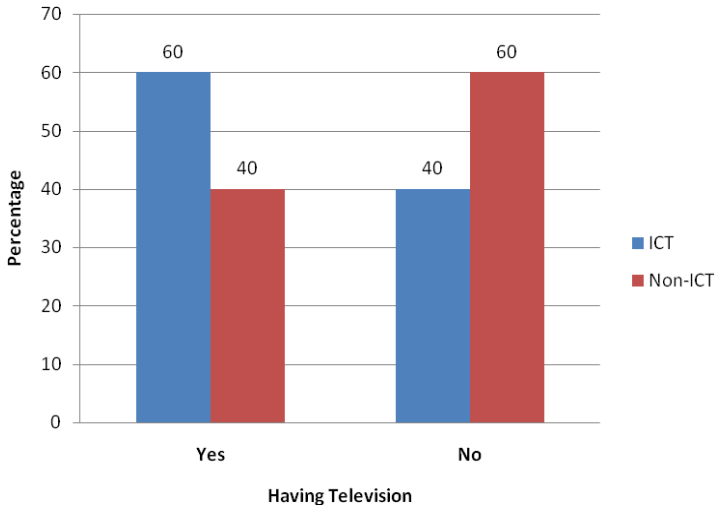

Figure 6.23: Access to television

The figure illustrates that 94.87% of the ICT respondents have television sets and 74.39%. 20.48% more ICT farmers have access to TV. On the other hand, 25.61% of the non-ICT farmers do not have television sets and only 5.13% of the ICT farmers are deprived of the access to TV.

6.5.1.1 Usefulness of Agricultural TV Programs

Communication gap is to some extent filled by TV which plays a vital role in the promotion of agriculture and rural development. So the usefulness of TV programs can't be denied.

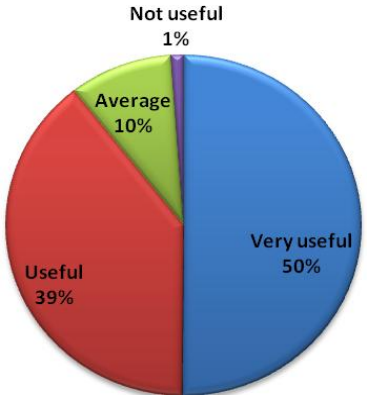

Figure 6.24: Usefulness of TV programs

The figure shows that 50% of the respondents opined that TV programs are very useful, 39% think that these are also useful and 10% think are in between the two. Lastly 1% of the farmers think that these programs are not useful at all. The figure verifies that half of the farmers realize the necessity of TV programs.

6.5.1.2 Grading of Agricultural TV Programs

Farmers watch TV for different purposes. They watch TV for agricultural programs too. Almost all TV Channels telecast some programs related to agricultural at least once a week. Channel I and BTV have more focus on agriculture and the programs are becoming more popular and penetrated into urban and rural life as these channels broadcast special bulletin on agricultural activities and development every day. These agricultural programs have been graded by the farmers with a view to assessing their needs.

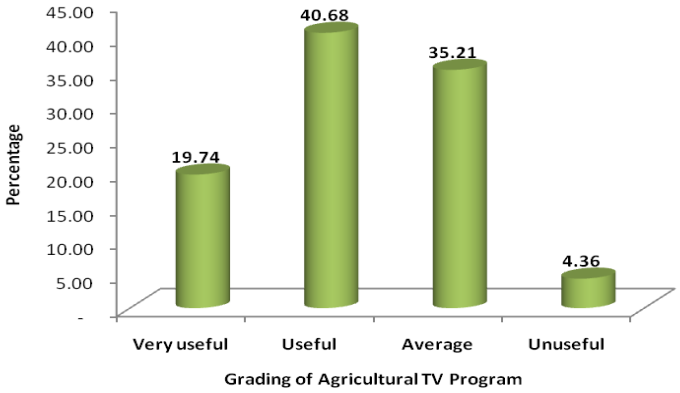

Figure 6.25: Grading of agricultural TV programs

About 41% of the farmers consider that these services are useful, about 20% consider them to be very useful but some farmers (35%) think that these services are neither useful nor useless.

However, a small portion of the respondents (4%) are in favour of assessing that the services are not useful at all.

6.5.1.3 Farmer's Favourite TV Programs

Farmers choose different programs for different purpose. Some of their favourite programs are mentioned here as news, movies, agricultural programs and some other programs like drama, short film, reality show (agriculture success stories). Farmers of both groups opt their favorite TV programs at will.

Table 6.26: Frequency distribution of television programs by service area

Television Program	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
News	870	74.36	580	70.73	1450	72.86
Movies	80	6.84	135	16.46	215	10.80
Agricultural Programmes	200	17.09	75	9.15	275	13.82
Others	20	1.71	30	3.66	50	2.52
Total	1170	100.00	820	100.00	1990	100.00
χ^2=71.54, Sig=0.00						

Source: (Author Survey 2013-2014)

The table 6.26 (also ref. table no. 5) shows that about 70.73% of non- ICT farmers listen to news whereas 74.36% respondents of the ICT area do the same. Agricultural programs are watched by about 17% ICT farmers and 9.15% non-ICT farmers. It is proved that ICT farmers are more conscious in watching agricultural programs than non-ICT based farmers. Movies are watched by 16.46% non-ICT farmers and 6.84% ICT farmers. Farmers watch TV for other purposes too.

6.5.1.4 Watching TV and Service Area

Service area also affects watching TV. ICT farmers watch agricultural programs on TV regularly more than those of non-ICT service area.

Table 6.27: Frequency distribution of television watching by service area

Status of TV watching	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Yes	1110	94.87	610	74.39	1720	86.43
No	60	5.13	210	25.61	270	13.57
Total	**1170**	**100.00**	**820**	**100.00**	**1990**	**100.00**
χ^2 = 172.45 , Sig= 0.000						

Here out of 1170 ICT-based farmers, 94.87% watch TV regularly and 5.12% do not whereas 74.4% of the non-ICT farmers watch TV regularly and 25.6% do not. Out of the two groups, 64.53% ICT farmers and 35.46% of non-ICT farmers watch TV regularly where only 22.22% of ICT farmers and 77.28% of non-ICT farmers do not watch TV regularly. This percentage indicates more tendencies of ICT farmers for watching TV regularly than non-ICT farmers. Therefore, the relationship between regular watching TV and service areas is highly significant whereas chi-square is 172.45 and p value is < 0.05. (ref. table no. 6)

6.5.2 Access to Radio

In the past, radio was the only common source of entertainment for the rural people when TV set was very expensive for them. In the early twentieth century TV occupied its place. But very recently Band radios with FM, community and Krishi radios have become more popular among the farmer society. Mobile radio is another addition to easy and cheap access to information and entertainment world.

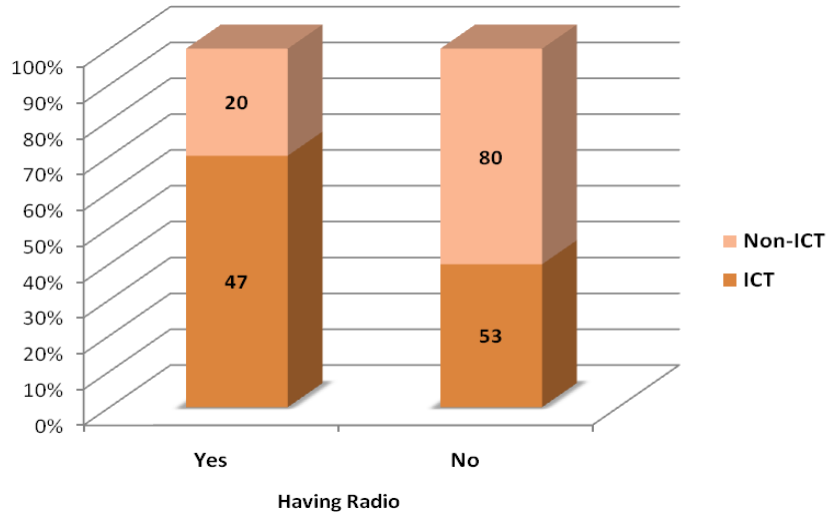

Figure 6.26: Access to radio

The figure (6.26) illustrates that farmers (35.93%) possess radio. ICT based farmers have more radio access. 47% of the ICT based farmers have access to radio and they listen to radio programs regularly more than the non-ICT based farmers. On the other hand, 20% of the non-ICT based farmers have radio.

6.5.2.1 Period of Radio Listening

Farmers' radio listening period varies from one service area to another. Famers of some area listen to radio for longer and some for shorter. Listening time is divided into three periods 1-10 year, 10-20 year and 20-30 year. Here the ICT farmers are regarded as long time radio listener.

Table 6.28 Frequency distribution of radio listening by service area

Listening Period	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
01-10 years	273	66.59	137	33.41	410	100
10-20 years	251	89.96	28	10.04	279	100
20-30 years	26	100.00	0	0.00	26	100
Total	**550**	**76.92**	**165**	**23.08**	**715**	**100**
χ^2 =59.21, Sig. = 0.000						

The table (6.28 & ref. table no. 7) shows the relationship between farmers' listening period (radio) and the service area. 36% of the total respondents listen to radios whereas 28% of the ICT based farmers do the same. 66.58% of the ICT and 34% of the non-ICT based farmers listen to radio programs for one to ten years. 38.18% ICT based farmers of the total respondents (listening radio) listen to radio for this period. This is the highest percentage of radio listening farmers. For 10 to 20 years, radio is listened to by 90% of the ICT and 10 % of the non-ICT based farmers. This group is the second highest radio listening group of respondents. However, 30 to 40 years of listening radio is done by 5% of only ICT based farmers.

It is also shown in the table that the ICT based farmers are more alert and thus their listening period is longer than any other age group. Here the relationship between farmers' period of listening radio program and the service area is highly significant as Chi-square is 59.21 and p value is < 0.05.

6.5.2.2 Farmer's Favourite Radio Station and Programs

Farmers of two groups listen to different radio at different degrees of times. Bangladesh Betar, F M Radio, Regional Radios and Community Radios are listened to by the farmers for amusement, recreation and agricultural activities. Among these stations, they prefer Bangladesh Betar for the reason that the station is available to them and its frequency is smooth and after all, they are habituated to listening Bangladesh Beter.

Table 6.29: Frequency distribution of radio station by service area

Different Stations	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Bangladesh Betar	380	73.80	135	26.21	515	100.00
FM Radio	70	89.75	8	10.25	78	100.00
Regional Radio	30	66.70	15	33.33	45	100.00
Community Radio	70	90.90	7	9.10	77	100.00
Total	**550**	**76.92**	**165**	**23.08**	**700**	**100.00**
χ^2 = 48.97, Sig = 0.000						

The table above indicates that 550 ICT farmers listen to radio and out of them 69.09% listen to Bangladesh Betar and out of 820 non-ICT respondents only 165 farmers listen to radio and of them 81.8% farmers listen to Bangladesh Betar. In comparison, Bangladesh Betar is listened to by 73.8% of the ICT based farmers and 26.21% farmers of the non-ICT areas listen to Bangladesh Betar. 46.59% ICT farmers listen to this govt. station more than those of non-ICT service areas. Besides, a few farmers of both groups listen to Community Radio, FM Radio and Regional Radio. (For detail ref. table no. 8)

The analysis result between service area and preference of radio station for agricultural program is highly significant as the Chi-square is 48.97 and p-value is less than 0.01.

6.5.3 Access to Mobile Phone

Now-a-days farmers at large use mobile phones for various purposes. The number of mobile phone users among farmers is increasing day by day. Their number in ICT service area is far more than that of non-ICT ones. Some of these farmers use cell phone for farming activities more than for their family communication. Mobile inaccessibility of the non-ICT based farmers set matters much to their backhandedness in agricultural production.

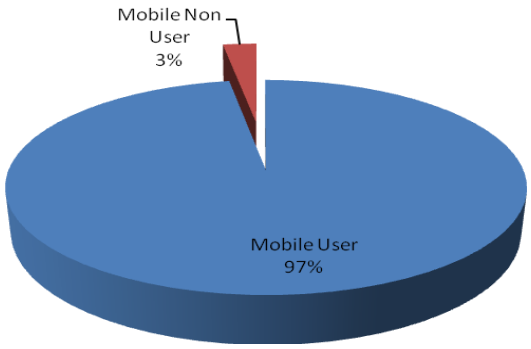

Figure 6.27: Mobile access to ICT farmers

The figure informs of the mobile access to the ICT farmers. 97 of the ICT respondents hold a least one mobile set to use it in different purposes. Only 3% of them do not use mobile phone.

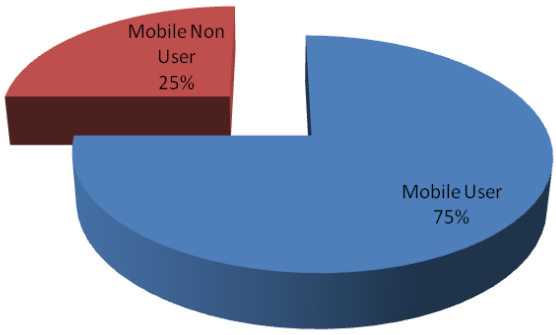

Figure 6.28: Mobile access to non-ICT farmers

The figure 6.28 states the mobile access to the non-ICT farmers. For communication, farmers usually use mobile phone. 75% of the non-ICT respondents hold a least one mobile set to use it in different purposes and the rest do not have. On the other hand, 25% of them do not have any mobile set.

Table 6.30: Frequency distribution of mobile phone use by service area

Status of Mobile	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Yes	1135	64.85	615	35.14	1750	100
No	35	14.58	205	85.41	240	100
Total	**1170**	**58.79**	**820**	**41.21**	**1990**	**100**
χ^2 = 327.15, Sig=0.000						

Source: (Author Survey 2013-2014)

The table shows the number of mobile phone user. 97% of the ICT based farmers and 75% of the non-ICT based farmers have mobile phones. From the two groups 64.85% of ICT respondents and 35.14% of the non-ICT respondents use mobile phone. On the other hand, 14.58% of ICT respondents and 85.41% of the non-ICT respondents don't have mobile phone. The existing analysis retrieves that more 22% of the ICT based farmers use mobile phone than non-ICT based farmers. Therefore, the relationship between holding mobile phone and service area is highly significant where Chi-square is 327.15 and P-value is less than 0.01. (For further analysis ref. table no. 9)

Out of 1750, 1135 ICT based farmers use mobile phones and only 615 farmers from non-ICT group use mobile phone. In the same way, only 35 ICT based farmers have no mobile phone and a large amount of farmers - 225 out of 240 do not use mobile phone for any purpose. 64.85% differs much from 35.15% and in the same way 85.42% is far different from 14.58%.

6.5.3.1 Status of Mobile Phone User

Now-a-days the mobile sets are very cheap and SIM is being sold at a minimum price. Therefore, the members of some famer families have access to more than one mobile set. They need to communicate for their familial purpose. That is why, some of them hold more than one set.

Table 6.31: Frequency distribution of mobile user by service area

Number of Mobile Users	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
One (self)	1135	64.85	615	35.14	1750	100.00
Two (self and wife)	40	80.00	10	20.00	50	100.00
Three or above	20	100.00	0	0.00	20	100.00
Total	**1195**	**68.09**	**625**	**31.90**	**1755**	**100.00**
χ^2 = 20.995, Sig=0.000						

Source: (Author Survey 2013-2014)

Most of the farmers of both groups are single user. The number of one user farmer from ICT group respondents is 64.85% and in comparison, it is 35.14% in non-ICT group respondents. In other way, it is noticed that in the ICT area, the number of one-user farmers is 94.98% and in the non-ICT service area, the number of one-user farmers is 98.4%. Therefore, both service areas are dominated by one-user farmers. The two user farmers are 3.35% out of 1195 ICT respondents and 2.6% out of 625 non-ICT respondents. Only 20 ICT based farmers are multiple users (100%). It means that they have more than two mobile sets in their family. Of the two groups, one-user farmers from ICT area are 64.85% and from non-ICT areas are 35.14%. (Ref. table no. 10)

Here the relationship between mobile phone user and service area is highly significant where Chi-square is 20.995 and p-value is less than 0.01.

6.5.3.2 Purpose of Using Mobile Phone

The reasons of using mobile phone by farmers are many. Among these reasons communication is one of the common and important reasons. Most of the farmers, as found in data analysis, communicate with their families through cell phone. They do this communication with their family members.

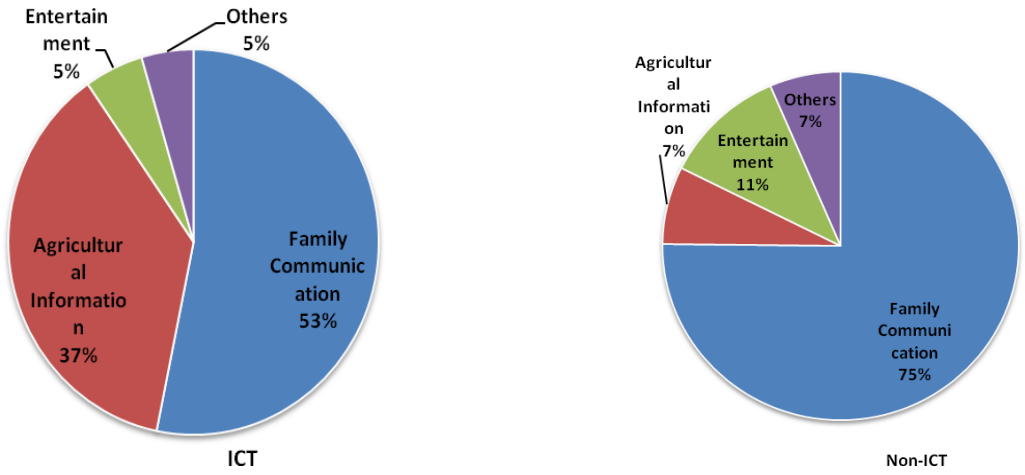

Figure 6.29: Purpose of using mobile phone

The findings in the figure 6.29 reveal that more than 75.17% of the non-ICT farmers use mobile phone for the purpose family communication whereas 53.21% of the ICT farmers do the same. Later on the purpose of information for their agricultural activities comes. 37.1 % of the ICT farmers hold cell phones for obtaining information for their agricultural activities but only 7.21% of non-ICT based farmers do the same. ICT farmers (5.15%) and non-ICT farmers (11.16%) use mobile for the purpose of entertainment. Farmers also use mobile phone for other small purposes. Some farmers (ICT 4.54% and non-ICT 6.46%) use mobile phone for those purposes. They run business on mobile phone and other businesses with mobile phone. These types of farmers do micro credits with phone sets.

6.5.4 Sources of Weather Forecast Information

Agro metrological information is an integral part of farm practice. Farmers use their common indigenous knowledge in farming. In fact, indigenous knowledge is a big resource for weather forecast information. Farmers' farming strategy and production largely depend on proper source of weather forecast that can change their production radically. Therefore, they are very eager to obtain weather forecast information from many sources. The information sources have been changed and are changing day by day. Some are traditional means and some modern sources have been added. The respondent groups still depend on TV, a widespread source of modern entertainment, for weather forecast. This service is more important for coastal farming as the region is prone to frequent cyclone attack for the Bay of Bengal.

Table 6.32: Frequency distribution of the means for weather forecast by service area

Means of Information	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Radio	330	70.97	177	29.03	465	100.00
Television	645	62.80	410	37.20	1035	100.00
Mobile	160	66.67	120	33.33	240	100.00
Ext. worker	25	32.26	105	67.74	155	100.00
Call centre	10	71.43	8	28.57	28	100.00
Total	**1170**	**58.79**	**820**	**41.21**	**1990**	**100.00**
χ^2 = 185.46, Sig = 0.000						

Source: (Author Survey 2013-2014)

About 53% information about weather forecast comes from TV. Out of 1990, 1055 farmers affirmed about this though 62.8% answer is derived from ICT farmer group. The second option is radio. 465 farmers (330 from ICT group and 177 from non-ICT group) gather weather news from radios including mobile FM stations. Therefore, it is an important finding in the study that mobile phone as information 25.48% means plays an important role in delivering reports of humidity, cloud, rainfall drought, fog, heat etc. Call center plays a little role in providing the farmers with this necessary information. Radio and TV are chosen as source of information more in ICT areas than non-ICT areas.

6.5.5 Loan Status

Loan disbursement system by Bangladesh Banks has been made easier for the farmers in Bangladesh. They get loan from three major sources like Bank, NGOs and money lenders. There are some other small sources of farmers' loan like co-operative society, mortgage, barter system etc.

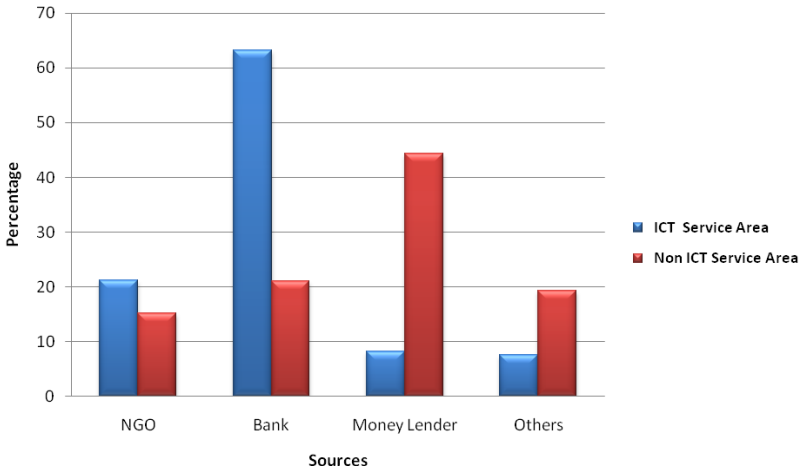

Figure 6.30: Source of farmers' loan

ICT based farmers borrow loans from the sources of banks 63.13%, NGOs (21.21%) more than non-ICT based farmers (bank 21.09% and NGOs 15.23%. On the other hand, non-ICT farmers (44.34%) borrow loans from money lenders more than ICT based farmers (8.12%). Bangladesh is housed by various types of NGOs, Micro-credits, co-operatives etc. Some other sources like village co-operatives, micro credits etc. are used for loan-borrowing more by non-ICT based farmers (19.36%) than ICT based farmers (7.54%). Therefore, it is clear that ICT based farmers are reliable to permanent institutions like banks, NGOs more than non-ICT based farmers. Moreover, non-ICT based farmers go to the local money lenders for borrowing loans.

6.5.6 Sources of Information for Crop Variety Selection

Farmers get informed of crop variety from several sources. Variety is important for desired yield, based on season, soil, climate etc. Moreover, crop varieties are regularly released by the research institutes with different characters. Farmers need to get updated with the newer varieties for maximizing yield. The released varieties are promoted by both public and private sector seed agencies. Radio, TV, Mobile, ICT based Service Centre, SAAO, Progressive Farmer, Website, and Print Media (Krishi Katha) are the mentionable information sources which the farmers come across to know about the crop variety.

Table 6.33: Frequency distribution of information source for crop variety by service area

Information Source	Service Area					
	ICT		Non-ICT		Total	%
	No	%	No	%		
Radio	15	45.45	18	54.55	33	100.00
Television	211	73.01	78	26.99	289	100.00
Mobile	299	75.31	98	24.69	397	100.00
ICT based Service Centrre	239	20.43	0	-	239	100.00
SAAO	325	38.51	519	61.49	844	100.00
Progressive Farmer	35	34.65	66	65.35	101	100.00
Website	11	0.94	0	-	11	100.00
Print media (krishi katha)	35	46.05	41	53.95	76	100.00
Total	**1170**	**58.80**	**820**	**41.20**	**1990**	**100.00**

Source: (Author Survey 2013-2014)

The table (6.33 & ref. table no. 12) shows different sources of information for crop variety selection. Radio as an information source, is used by 45.45% ICT and 54.55% non-ICT farmers. Television is used most by 73% ICT and 30% non-ICT farmers. On the other hand, 75.31% ICT and 24.69% non-ICT farmers use mobile phone for the purpose. In other way, ICT farmers get the information about crop variety 18% from television, 25.56% from mobile, 20.43% from ICT based Service Centre, 27.78% from SAAO and 3% from progressive farmers whereas non-ICT farmers get the same information

9.51% from television, 11.95% from mobile, 63.29% from SAAO and 8% from progressive farmers. Besides, different websites and print media are also consulted for the respective information.

6.5.7 Sources of Information for Market Price

Source of information for market price is a vital issue for the farmers. Farmers get the information from various sources- traditional sources and modern sources. At present, radio, television, mobile phone, call centers and ICT based information centers along with different websites are preferred by the ICT based farmers. For example, Aktar Hossain, an active member of Dariapur AICC, Magura Sadar and Abdul Hye, another active member of Nrisinghopur AICC of Jenaidah Sadar asserted that they use ICT tools like radio, TV, mobile communication more for obtaining the information of market price of agricultural commodities. They also informed that different zilla and Upazila wise websites (such as DAM website, MoA) are effective for wholesale and retail price of various agricultural commodities.

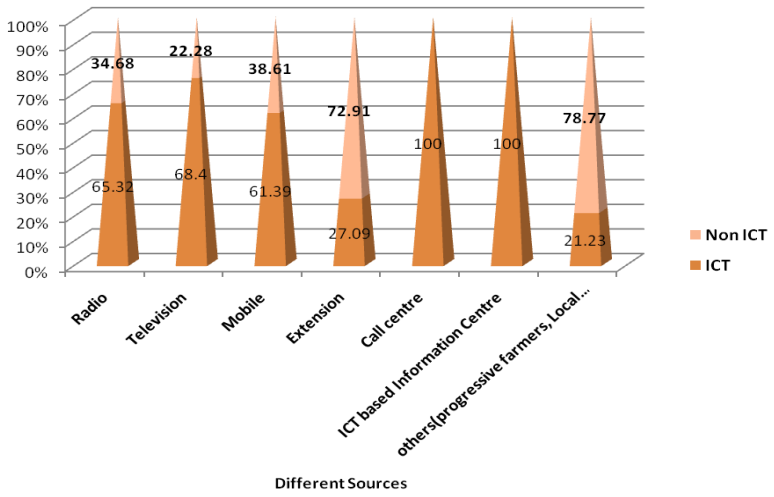

Figure 6.31: Sources of information for market price

The figure (6.31) illustrates that ICT farmers obtain information 65.32% from radio, 68.4% from television, 61.39% from mobile whereas 27.09% from extension workers, 21.23% from progressive farmers and local agents. 100% information comes from call center and ICT based centers to the ICT based farmers. So, traditional farmers depend on the extension workers, progressive farmers and local agents for the information of market price.

6.6 Crops, Fisheries and Livestock

For crops, many relevant issues like sources of irrigation, types of canal, status of soil test, effective pest management technology and information source of quality fingerling, proper fertilizer use in

pond/gher and quality water maintenance are presented in the section. Many important issues on fisheries and livestock are analysed in the section. Then section describes source of information for animal vaccination, animal health care, cattle deworming and source of media for proper fertilizer in crops. Here the number of vegetables cultivators, fish cultivation as well as variety and the training status of fish farmers are also mentioned in the section.

6.6.1 Sources of Water Resources (Irrigation)

Farmers fetch water for irrigating their fields from different sources. The sources are river/canal, pond, rain, tube-well, and some other sources. Most of the farmers from both service areas obtain a common source as tube-well. Tube-well is of two types-deep tube-well and shallow tube-well. For irrigation, shallow tube-well is sunk in shallow aquifer (water bearing strata beneath soil surface) and it is usually managed by individual farmer.

Table 6.34: Frequency distribution of source of irrigation by service area

Source of Irrigation	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No	%
River/Canal	179	57.74	131	42.26	310	100.00
Pond	111	67.27	54	32.73	165	100.00
Rain	60	48.00	65	52.00	125	100.00
Tubewell	820	58.99	570	41.01	1390	100.00
Total	**1170**	**100**	**820**	**100.00**	**1990**	**100.00**

The table shows that tube-well water among other sources is the most common and convenient to all areas for proper irrigation. 69.85% of the total respondents depend on this source (Annexure table 6.34). About 58.99% of the ICT based farmers and 41.01% of the non-ICT based farmers use tube-well water for their irrigation. Second highest is river/ canal water. 15.58% of the all farmers in the survey depend on river/canal water for irrigation. 57.74% of the ICT and 42.26% of the non-ICT service areas get access to this source. Pond water and rain water are used by some farmers (14.57%). It is remarkable to note that non-ICT farmers depend on rain water most whereas pond water is used less by ICT based farmers. But both types of farmers use tube well water from most of all sources for irrigation.

6.6.1.1 Types of Irrigation Canals

Different types of irrigation system used by the farmers are Kacha irrigation canal, Adha (Semi) pacca irrigation canal, Polythene made irrigation canal, Pacca irrigation and Fero-cement. As agricultural infrastructure is developed, most of the farmers use Kacha irrigation canal for irrigation.

Table 6.35: Frequency distribution of irrigation system by service area

Irrigation System	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Kacha Irrigation Canal	470	40.17	670	59.83	1140	57.29
Semi Pacca Irrigation Canal	320	27.35	92	72.65	412	20.70
Polythene made Irrigation Canal	119	87.50	17	12.50	136	6.83
Pacca Irrigation Canal	145	85.80	24	14.20	169	8.49
Fero-cement Canal	116	87.22	17	12.78	133	6.68
Total	**1170**	**100.00**	**820**	**100.00**	**1990**	**100.00**

The table shows different types of irrigation system. 57.29% of the total respondents use Kacha Irrigation Canal (Annexure table 6.35). About 40 % ICT and 60% non-ICT based farmers used this Kacha Canal for the irrigation of water. About 87.22 % of the farmers from ICT areas and only 14.2% farmers from non-ICT group use this pacca canal. 7% farmers have also the polythene & 7% fero-cement made canal in ICT service area. 20.7% use Semi- kacca canal where 27.35% ICT and 72.65% non-ICT based farmers follow this system for irrigation. Therefore, the farmers of the ICT based area have more knowledge regarding advanced technology & financially more powerful and thus they use Pacca Irrigation Canal more. On other hand, most of the farmers from the traditional farming group use Kacha Irrigation Canal. Semi Pacca, Fero-cement Canal and Polythene made irrigation canal are comparatively more than those of Non-ICT based area. (For further analysis ref. table no. 14)

6.6.2 Facilities of Soil Fertility Test

Soil test is one of the due works that farmers do not usually perform as a lack of consciousness. Many a farmer does not test their soil. However, the farmers of ICT area have tested the soil of their land more than the farmers of non-ICT service area.

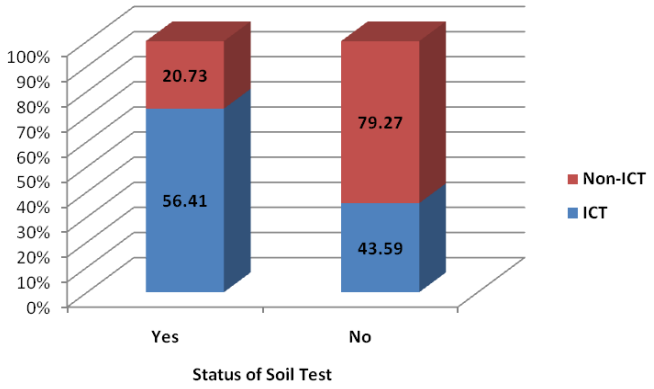

Figure 6.32: Facilities of soil test

Source: (Author Survey 2013-2014).

The figure indicates the status of soil test. From the overt result it is found that 56.41% farmers of the ICT group and about 43.59% of the non-ICT farmers have tested their soil. On the other hand, 79.27% of the non-ICT farmers have not tested their soil and so is the 20.73% of the ICT based farmers. So the number of non-ICT farmers who have not tested their soil is far more than that of ICT based area.

6.6.3 Information Sources of Quality Fingerling

Quality fingerling is very important for fish farmers to enhance fish production and to boost income. There are six items of information sources required for quality fingerling. Radio, television, mobile, extension worker including dealers, call center, ICT based services and neighboring farmers.

Table 6.36: Information source of quality figureling

Information Source	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Radio	20	44.44	25	55.56	45	100.00
Television	37	51.39	35	48.61	72	100.00
Mobile	158	61.48	99	38.52	257	100.00
Extension	75	41.67	105	58.33	180	100.00
Call centre	54	84.38	10	15.63	64	100.00
ICT based Information Centre	119	100.00	-	-	119	100.00
Others	87	46.28	101	26.93	188	100.00
Total	**550**	**59.46**	**375**	**40.54**	**925**	**100.00**

Source: (Author Survey 2013-2014).

The table shows that fish farmers obtain quality fingerling from different information sources. Here it is seen that 21.64% of the farmers get information about quality fingerling from ICT based information centers (Annexure table 6.36). 13.64% ICT and 28% non-ICT farmers obtain information from extension worker. It is the most common and reliable source that both the farmers use for quality fingerling. Radio covers 3.64% of ICT and 6.67% of non-ICT based farmers. From television 6.73% of ICT and 9.33% of non-ICT farmers get information. Mobile communication is one of the highest sources of quality fingerling. It is covered by 28.73% ICT and by 26.4% non-ICT farmers. Farmers also use some other information sources like progressive farmers, input dealers, NGO workers. (For detail ref. table 15)

6.6.4 Maintenance of Quality Water

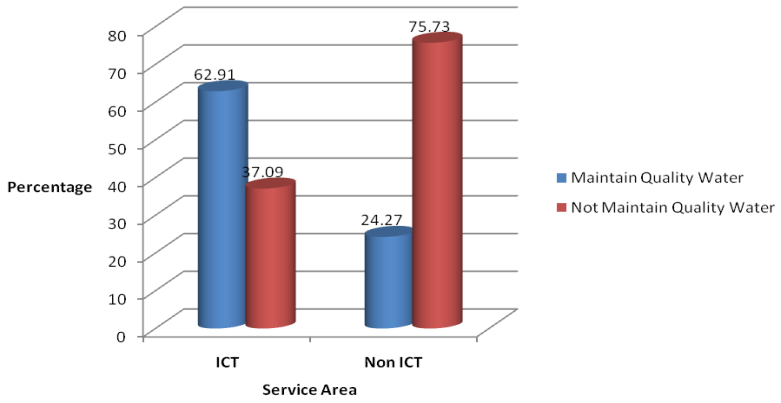

Figure 6.33: Status of maintaining the quality of the pond water

The figure shows that 63% of the ICT and 24% of non-ICT farmers maintain the quality of water in the ponds/ghers whereas 37.09% of ICT and 75.73% of non-ICT farmers don't quality in pon/gher water.

6.6.4.1 Source of Information for the Maintenance of Quality Water

Many sources of information come to use to both groups of service areas. Some sources are more effective to the farmers and some are not. Here mobile is very powerful information source that plays an important role in ICT service area. Besides this, television, radio, extension worker, call centers, ICT based service centers, and smother sources like progressive farmers, input dealers, and NGO workers.

Table 6.37: Frequency distribution of information source for quality water by service area

Source of Information	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Radio	17	62.96	10	37.04	27	100.00
Television	67	59.82	45	40.18	112	100.00
Mobile	142	59.17	98	40.83	240	100.00
Extension worker	89	40.45	131	59.55	220	100.00
Call centre	23	100.00	0	0.00	23	100.00
ICT Centre	137	100.00	0	0.00	137	100.00
Others	75	45.18	91	54.82	166	100.00
Total	**550**	**59.46**	**375**	**40.54**	**925**	**100.00**

Source: (Author Survey 2013-2014).

The table (6.37 & ref. table 16) shows that 35.82% of the total ICT based farmers (550) gather proper information about maintaining the water quality in the pond/ghers from mobile communication.

Among them, 59.17% ICT and 40.83% non-ICT farmers use this source to obtain the information. 34.93% of the total (375) non-ICT farmers get proper information about the same from the extension workers. Among them, 40.45% ICT and 59.55% non-ICT farmers collect information from the extension workers. 12.10% of the total farmers (925) use television as an information source for the purpose. The table shows that 24.90% of the ICT based farmers get information from ICT based service centers in maintaining quality water in their ponds or ghers. About 3% of the ICT farmers use radio for information and 4.18% of them use call center for the information of this source. Farmers use other small sources like progressive farmers, input dealers and NGO workers.

6.6.5 Measurement to Maintain the Quality of Water in Ponds/ Ghers

Water quality parameters that may cause problems in ponds/ ghers should be detected by the fish farmers to control water in quality level. Two types of problems- external and internal affect water. Fish farmers take different steps to maintain the quality of water in their ponds/ghers. Among them, they use manure, lime and different kinds of aquatic fertilizer for the purpose.

Table 6.38: Frequency distribution of measurement for quality water by service area

Measurement	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Lime	310	51.67	290	48.33	600	64.86
Zeolite	168	77.05	50	22.95	218	23.57
Nitrogen	39	68.42	18	31.58	57	6.16
Phosphate	33	66.00	17	34.00	50	5.41
Total	**550**	**59.46**	**375**	**40.54**	**925**	**100.00**

The table illustrates some measurement steps that are taken by the farmers to maintain the quality of water in their ponds/ghers. The findings found in the table indicate that the farmers use lime 64.86% where ICT 51.67% and non-ICT farmers 48.33%. In the same way, Zeolite is used by 23.57% where it is used by 77.05% by ICT and 22.95% non-ICT farmers. Nitrogen is an important element in refreshing pond water. 6.16% farmers of both service areas use as urea. 5.41% of the respondents use phosphate to purify water. All these ingredients are mixed up and then it is used in the pond water. (ref. table no. 17)

6.6.6 Source of Information for Quality Fish Feed

Manufactured fish feed is an important part of modern aquaculture as it provides the balanced nutrition. The real information of this feed is an important factor to the farmers to boost production. Fish farmers collect the information about quality fish feed from various sources like radio, television, mobile, extension workers, call centers, ICT center and some other sources like progressive farmers, NGO worker and input dealers.

Table 6.39: Frequency distribution of information source for quality fish feed by service area

Information Source	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No	%
Radio	25	69.44	11	33.56	36	100.00
Television	39	52.70	35	47.30	74	100.00
Mobile	219	62.57	131	37.43	350	100.00
Extension worker	89	38.34	81	61.36	170	100.00
Call centre	21	100	-	0.00	21	100.00
ICT Centre	97	100	-	0.00	97	100.00
Others (neighbors)	60	33.90	117	66.10	177	100.00
Total	**550**	**59.46**	**375**	**40.54**	**925**	**100.00**

The table states that 37.84% (ref. table no. 18) of the ICT farmers gather proper information of quality feed from mobile phone. 62.57% ICT and 37.43% non-ICT farmers collect this information from mobile. 18.38% of the total fish farmers in the study get this information from extension workers. 38.34% ICT and 61.36% non-ICT farmers obtain the information from this source. 8% farmers of both service areas get proper information about the quality fish feed from television. 19.14% (lowest) of farmers use radio as source for the respective information. 21.45% of the ICT based farmers get information from ICT based information centers and call centers in maintaining quality feed in their ponds or ghers. A good number of farmers consult progressive farmers, input dealers and NGO workers for the same purpose.

6.6.7 Source of Information Regarding Animal Vaccination

In rural areas, livestock farmers are commonly faced with animal diseases. Therefore, animal health care is an important factor to animal rearing. Thus, they have their animals vaccinated by animal health practitioners. They get information on vaccination from various sources like radio, television, mobile, extension worker, call canters, ICT centers and some other sources.

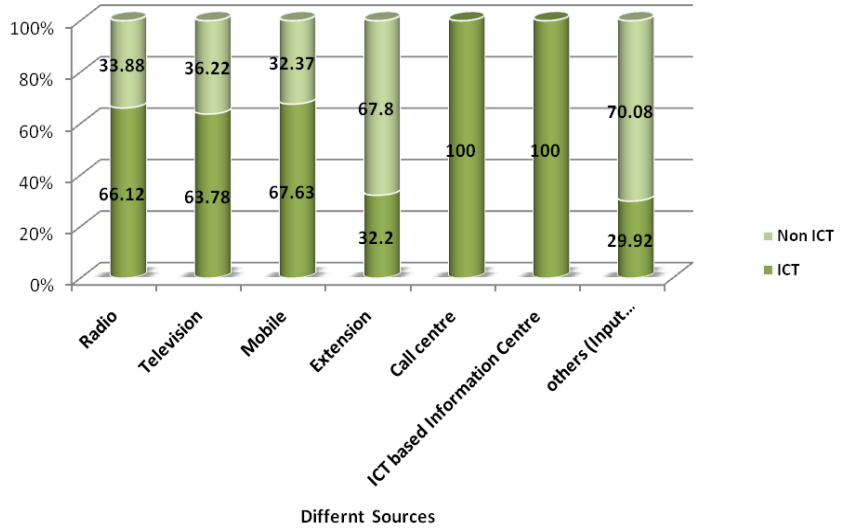

Figure 6.34: Information source regarding animal vaccination

The highest percent of ICT farmers use radio, television and mobile for animal vaccination. About 65% of the ICT based farmers obtain information from radio, television and mobile. On other hand, most of the non-ICT farmers obtain information from extension workers, progressive farmers, input dealers and NGO workers. Call centers and ICT based information centers are used by only ICT based farmers. Non-ICT farmers do not use these sources.

6.6.7.1 Source of Information for Animal Healthcare

Animal health and production depend on proper care and food. Animal health is a crucial to farmers. Proper health must be ensured due to good sources of information. The number of animal health practitioners in the rural areas is not sufficient to meet the demand of information. That is why, farmers have to depend on radio, television, mobile, extension workers and other sources.

Table 6.40: Frequency distribution of information source for animal healthcare by service area

Source of Information	Service Area					
	ICT		Non-ICT		Total	
	Frequency	%	Frequency	%	No	%
Radio	80	59.70	54	40.30	134	100.00
Television	145	59.43	99	40.57	244	100.00
Mobile	268	70.71	111	29.29	379	100.00
Extension	176	27.76	458	72.24	634	100.00
Call centre (Krishi call centre)	148	100.00	-	-	148	100.00
ICT based service centre (AICC, FIAC, CR,KR)	301	100.00	-	-	301	100.00
Others (Pharmacy, Input dealer, Progressive Farmer)	52	34.67	98	65.33	150	100.00
Total	**1,170**		**820**		**1,190**	**100.00**

Source: (Author Survey 2013-2014)

The table (6.40) illustrates different information sources for animal health care. Livestock health care information is obtained in many ways. 31.86% of the total farmers (ref. table no. 19) depend on livestock officer or SEAL (Annexure table 6.40). Of them, 27.76% is ICT and 72.24% is non-ICT. 19.04% information comes from mobile, next 12.26% from television and 6.7% from radio. 7.53% of the information is obtained by the farmer from other sources like progressive farmers, input dealers and pharmacy and NGO workers. The impact of ICT is found on animal health care as ICT farmers get information more from ICT tools like radio, television and mobile. Most farmers have information from programs from BTV, Channel I, ATN Bangla etc.

6.6.8 Method of Fish Culture

The methods of aquaculture followed by fish farmers are single method, combined method, cage system and integrated system. Single method is a method where one specs of fish is cultured. Combined method (poly culture) is a method where different species of fish are cultured in the same pond. Cage fish farming is one of the methods used in fish culture. The practice of cage fish farming is very simple and is widely used by most commercial fish farmers. In Bangladesh, single and combined (poly culture) methods are mainly followed by the farmers. Aquaculture is becoming more popular with Southwestern district where profit margin is more than carp cultivation.

Table 6.41: Frequency distribution of information source for fish culture by service area

Method	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Single	65	59.09	45	40.91	110	100.00
Combined (poly culture)	395	55.63	315	40.36	710	100.00
Cage	10	100	0	0.00	10	100.00
Integrated system	80	84.21	15	15.79	95	100.00
Total	**550**	**59.46**	**375**	**40.54**	**925**	**100.00**

The table (6.41) shows that the combined method (poly culture) is the most common method that about 76.76% fish farmers of two groups adopt (ref. table no. 20) where as cage method is followed by 1.01% ICT farmers. In non-ICT group, no farmers follow cage method. 55.63% ICT and 40.36% non-ICT farmers follow the combined method. 11.89% of the farmers follow the single method where ICT is 59.09% and non-ICT is 40.91%. 10.27% farmers of both groups follow the integrated system of cultivation where ICT is 84.21% and non-ICT is 15.79%. A very few farmers of both service areas rear single fish in their ponds/ghers.

6.6.8.1 Fish Variety

Various species of fish are cultivated in the ponds/ghers. In southern parts of the country, a large area of paddy field are cultivated with fish is called ghers where fin fish, shrimp (Brackish water Bagda) and galda (fresh water prawn) are mainly cultured. Poly culture of fish is practiced where mixed fish species are cultured.

Table 6.42: Frequency distribution of fish variety by service area

Variety of Fish	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Telapia	73	57.94	53	42.06	126	100.00
Carp	135	59.73	91	40.27	226	100.00
Prawn	57	61.29	36	38.71	93	100.00
Mrigel	10	58.82	7	41.17	17	100.00
Mixed	201	58.09	145	41.91	346	100.00
Grass carp	25	62.50	15	37.50	40	100.00
Galda	30	63.83	17	36.17	47	100.00
Others	19	65.52	10	34.48	29	100.00
Total	**550**	**59.46**	**375**	**40.54**	**925**	**100.00**

Source: (Author Survey 2013-2014).

The table above shows the fish species percentage of fish. 37.41% of the farmers of both service areas culture mixed species of fish (Ref. table no. 21)where 58.09% ICT and 41.91% non-ICT farmers follow the method. Carp is cultivated by 11.36% of the farmers of two service areas. About 59.73% ICT and 40.27% of the non-ICT based farmers follow this species. Carp is the highest single fish that is cultured by ICT and non-ICT based farmers. Prawn is reared by 61.29% ICT and 38.71% non-ICT based farmers whereas Galda cultivation is adopted by 63.83% ICT and 36.17% non-ICT based farmers. Telapia is a common fish which is reared by 57.94% ICT-based and by 42.06%. Non-ICT based farmers. Mrigal fish is cultivated in the least amount. Grass Carp culture is also followed by both groups of the farmers.

6.6.9 Most-used Pest Management Technology

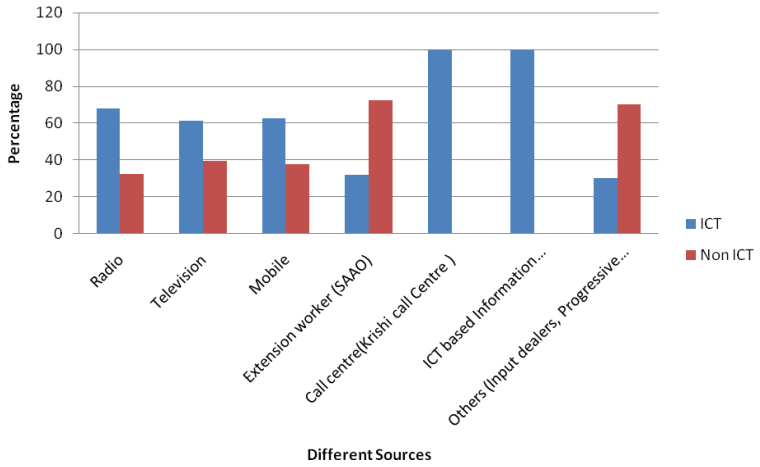

Figure 6.35: Information source of pest management

Source: (Author Survey 2013-2014).

The figure points out that 67.9% of ICT farmers collect information about pest management from radio, 60.91% from television and 62.5% from mobile. 100% ICT farmers collect information from call centers and ICT-based information centers. 72.19% of non-ICT based farmers get information from extension workers. The farmers also use some other information sources like progressive farmers; input dealers and NGO workers. 70% of non-ICT farmers have this information from other sources like progressive farmers, input dealers and NGO workers.

6.6.10 Source of Media for Proper Fertilizer rate in Crops

Nutrition supply to plants is done through application of fertilizer in the soil. Plant nutrition in the form of Urea (Nitrogen), Triple Super Phosphate (TSP) and Murat of Potash are mainly supplied in Bulk. The rate of application varies from crop to crop which farmers get information from different sources.

Table 6.43: Frequency distribution of information source for plant nutrition by service area

Source of Information	Service Area					
	ICT		Non-ICT		Total	
	Frequency	%	Frequency	%	No	%
Radio	51	62.96	26	32.10	77	100
Television	124	62.94	86	43.65	210	100
Mobile	161	67.08	76	31.67	237	100
Extension	302	38.18	571	72.19	873	100
Call centre (Krishi Call Centre)	171	100.00	-	-	171	100
ICT based Information Centre	337	100.00	-	-	337	100
Others	24	28.24	61	76.25	85	100
Total	**1170**	**58.79**	**820**	**41.21**	**1990**	**100**

There are many sources of information that farmers use to utilize best plant nutrition. 43.87% of the total respondents (1990) obtain information from extension. Usually 38.18% of ICT and 53.29% of non-ICT based farmers get information for proper fertilizer in growing crops from extension workers but those non-ICT farmers never do a phone call for that purpose. Radio is the source of information which is used by 62.96% ICT farmers and 32.10% non-ICT. 62.94% ICT based farmers and 43.65% non-ICT based farmers get the information from television and in the case of mobile phone 67.08% of the ICT and 31.67% of non-ICT farmers are seen getting the same information. Krishi call centers ICT based service center are used by farmers of that service area. Farmers use other sources too to obtain information for fertilizer application. Those information sources are progressive farmers, input dealers, NGO workers, ward commissioner etc. (ref. table no. 22)

6.6.11 Influential Media for Growing Vegetables

During recent time, some media influence farmers to grow vegetables. The impact of ICT on vegetables cultivation is found in this analysis. The media provide them with market price, seed variety and proper insecticide and other input. So, farmers get inspired to grow vegetables more.

Table 6.44: Frequency distribution of media for growing vegetables by service area

Media	Service Area					
	ICT		Non-ICT		Total	
	Frequency	%	Frequency	%	N0	%
Radio	40	57.97	29	42.03	69	100
Television	201	68.60	92	31.40	293	100
Mobile	150	64.38	83	35.62	233	100
Extension Worker	245	33.33	490	66.67	735	100
Call centre(Krishi)	179	100.00	-	-	179	100
ICT Centre	288	100.00	-	-	288	100
Others	67	34.72	126	65.28	193	100
Total	**1170**	**58.53**	**820**	**41.47**	**1990**	**100**

The media mentioned in the table are extension workers, television and ICT center. 36.94% of the total respondents opined that extension workers are the most powerful media (ref. table 23). Of them, 33.33% ICT and 67.67% non-ICT farmers think so. 14.72% of the total ICT and non-ICT farmers think television is the most powerful media. ICT center is regarded as powerful media by 14.47% ICT based farmers. 9.70% farmers think that progressive farmers, input dealer, NGO workers and ward commissioners are the media that influence them to grow vegetables.

6.7 Gender Involvement in Agricultural Operation

This section analyzes different agricultural activities done by women, training for the respondents, main barriers of women in agricultural activities, women decision making in farming activities and ICT tools used by women in farmer family. Women in Bangladesh are involved in the post harvest operations like drying, processing, grading, storing and livestock rearing. Women are heavily engaged in these activities besides household chores. They share responsibility with men and children for the care of animals, birds and other operations.

6.7.1 Gender Involvement in Agricultural Works

About 99% of post harvest agricultural activities is done by women in rural villages. After reaping, crops are ground, husked, dried up and stored by mainly women. Besides these, women have to preserve seed, process crops, sow seed, rear poultry and livestock.

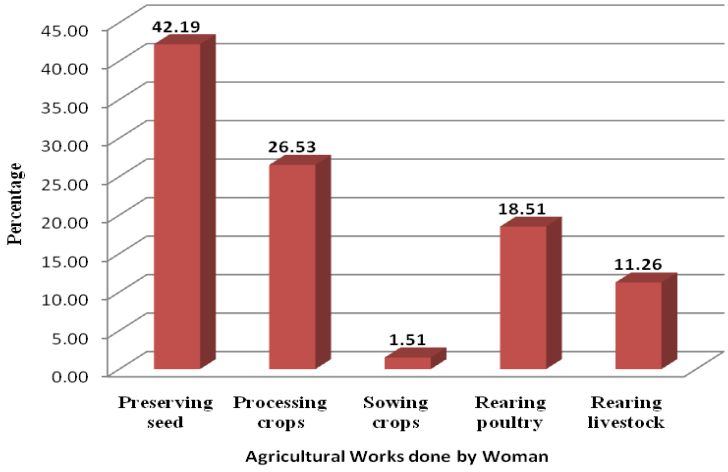

Figure 6.36: Women involvement in agricultural works

Source: (Author Survey 2013-2014).

The figure shows that five agricultural activities are done by women. 42% of the women preserve seed, 19% rear poultry, 11% women rear livestock, 27% women process crops and 1% women sow seed. The activity like preserving seed dominates all four activities.

6.7.2 Women Decision Making in Farming Activities

Many farmers ask their wives to do different pre-and-post agricultural activities. Sometimes female members take important decision about different agricultural activities like selection of crop or crop variety, use of fertilizer, fish species, and selection of nutritional vegetables, marketing and health care of livestock.

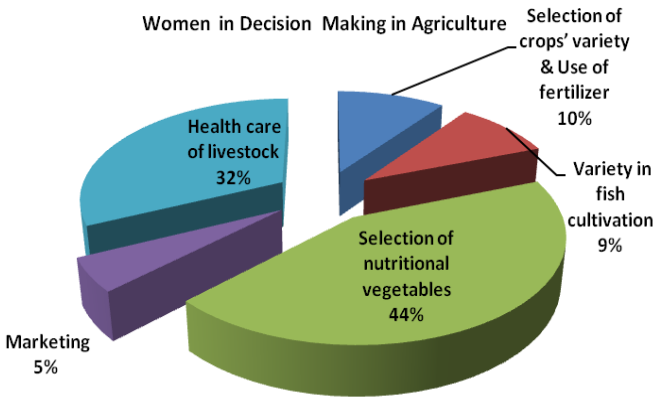

Figure 6.37: Women in decision making in agriculture

The figure shows that 44% decision about the selection of nutritional vegetables from women, 32% for the healthcare of livestock, and 9% for fish variety, 5% for marketing and 10% for the selection of crop variety. It means that as a home maker, women play a powerful role in selecting nutritional vegetables that help her family members to remove malnutrition. Women are livestock keepers. Therefore, they look after their animals like their family members. They collect food for them, they bathe them and they rear them at shed. A healthy sum of decision comes from the women folk.

6.7.3 ICT Tools Used by Women in Farmer Family

Communication and interactions are the best ways to carry the information or source of knowledge. ICT tools are regarded as the best bridges for communication. Like male farmers, women use some ICT tools like radio, computer, television and mobile. They use these items to communicate with family members, to share knowledge, to obtain agricultural information and to get amusement.

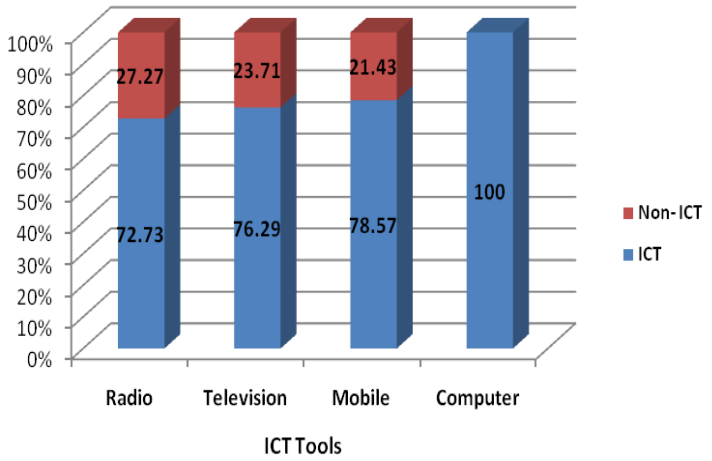

Figure 6.38: ICT tools for women

Source: (Author Survey 2013-2014).

The figure shows that 75.29% of the women respondents have TV set and watch it for agricultural programs. 23.71% of the non-ICT women have TV set. The survey further analyses about 72.73% of the ICT and 27.27% of non-ICT respondents have ICT tool like radio. Besides, at present 78.57% of the ICT and 21.43% of the non-ICT female farmers have mobile to use in different purposes. Hundred percent women farmers in ICT area have computer as a ICT tool. The overt result indicates that the present women farmers are more potential to take the shoulder of a full family burden let alone perform pluralistic activities including agriculture. They start using ICT tools for production acceleration along with developing living status.

It is also noted that Sathi who is an active member of Comilla Alishar IPM Club is expert in ICT tools. She is able to handle computer, modem, and internet and even she often holds Skype calls on abroad. Boishaki Ragsha of Adibashi Krishak Kalyan Samitee at Durgapur opined that women are interested in using ICT tools for solving farming problems and they have started applying technology based on these tools to gain benefits.

6.7.4 Gender Issue and ICT Center Visit

About 12% female and 88% male respondents constitute the sample population. Of them, center visit (means ICT centers) at different times is important to mention their interest. Respondents of both gender opined that they have interest but for time constraint they can't visit the center daily.

Table 6.45: Frequency distribution of center visit by gender

Gender	Frequency of Visit											
	Not at all		Every day		Once a week		Once a fortnight		More than twice a month		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Male	20	1.94	580	56.31	330	32.04	60	5.83	40	3.88	1030	100.00
Female	10	7.14	60	42.86	40	28.57	20	14.29	10	7.14	140	100.00
Total	**30**	**2.56**	**640**	**54.70**	**370**	**31.62**	**80**	**6.84**	**50**	**4.27**	**1170**	**100.00**
χ^2 = 33.51, Sig=0.00												

The table (6.45) indicates that the relationship between gender and their frequency of ICT center visit. Most of the male and female farmers visit the centers every day. 56% of the male farmers and 42% of the female farmers visit the ICT centers every day. 32% of male farmers and 29% female farmers visit the centers once a week. 6% of the male farmers and 14% of the female farmers visit the centers once a fortnight. More than 3% of the male farmers and 7% of the female farmers visit the centers more than twice a month. Some member farmers of the ICT centers do not visit the centers at all. Here the relationship between the farmers' gender and their engagement period is highly significant as Chi-square is 33.58 and p value is < 0.05.

6.7. 5 Training Status for Respondents

Gender disparity is the burning issue in almost every sector in Bangladesh. Agricultural sector is not exceptional to this. Though women accomplish most of the post harvest operation, they do not possess land property as per legal system and norms or even they do not take any authoritative decision. They enjoy less training than the male farmers do.

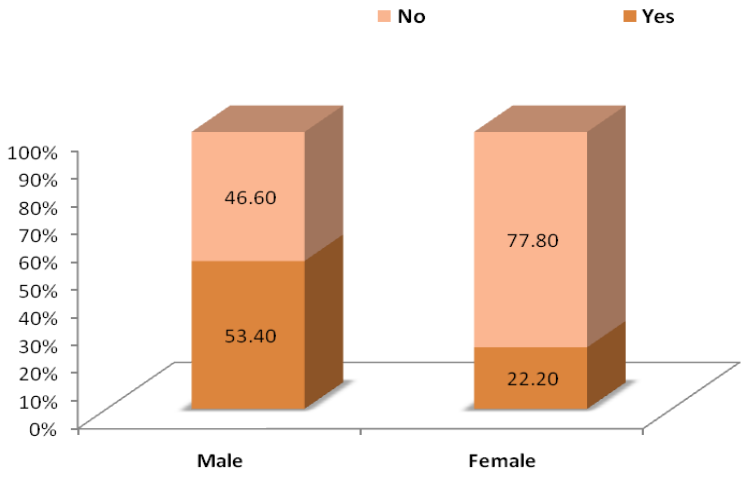

Figure 6.39: Training status of gender wise respondents

Source: (Author Survey 2013-2014)

In the study women constitute 7% of the total respondents but 22.2% of them received training and the rest 77.8 % did not get training whereas 53.4% of the male farmers received training and 46.6% of the farmers did not get training at all. It means that only 31 women had trainings on different improved production practices. It is proved that the male farmers had 31.2 % more opportunities and scope for training than that their female counterparts.

Table 6.46: Frequency distribution of training and farmers' educational status

Level of Education	Status of Training					
	Received		Not Received		Total	
	No.	%	No.	%	No.	%
Illiterate	55	32.35	115	67.65	170	100
Primary	169	45.80	200	54.20	369	100
Junior high school	199	64.40	110	35.60	309	100
SSC	135	73.37	49	26.63	184	100
College	77	73.33	28	26.67	105	100
University	25	75.76	8	24.24	33	100
Total	**660**	**56.41**	**510**	**43.59**	**1170**	**100**
χ^2 =92.30, Sig=0.00						

The table shows the relationship between farmers' frequency of training on improved farming and the level of their education. Most remarkably, 56.42 % of the ICT based farmers have received training and 43.59% have not received training. However, 67.65% of the illiterate farmers have not obtained training. This is the highest percentage. The percent of the farmers who have completed primary education and simultaneously have received training is 45.8%. 64.4% of the farmers who earlier had completed grade 8 in school have been able to attain training on agriculture. 73.37% of the SSC and 73.33% HSC completed farmers have received training. A large number of farmers holding Bachelor and Masters Degree have obtained training. Their percentage is 75.76. Only 24.24% of them have not been able to get trainings.

It is also shown in the table that the highly educated (University) farmers are more conscious and thus their receiving training is more than any other education group of farmers. Here the relationship between the farmers' age and their receiving training is highly significant as Chi-square is 92.30 and p value is < 0.05

6.7.5.1 Training by Service Area

Farmers of the two service areas are provided with trainings on different items by various agents. As the ICT farmers are involved in many govt. offices and non-govt. organizations, they get this opportunity more than those of non-ICT service area.

Table 6.47: Frequency distribution of training by service area

Name of Training	Service Area					
	ICT		Non-ICT		Total	
	No	%	No	%	No	%
Rice Production Techniques	79	65.83	41	34.17	120	100.00
Seed Management	61	63.54	35	36.46	96	100.00
Fertilizer and Weed Management	69	58.47	49	41.53	118	100.00
IPM/ICM	92	64.34	51	35.66	143	100.00
Poultry Management	57	61.96	35	38.04	92	100.00
Integrated Fish Farming	49	56.32	38	43.68	87	100.00
Computer Application	115	82.14	25	17.86	140	100.00
Hatchery Management	39	55.71	31	44.29	70	100.00
Soil Management	47	79.66	12	20.34	59	100.00
Application of Agricultural Machinery	22	66.67	11	33.33	33	100.00
Total	**630**	**65.76**	**328**	**34.24**	**958**	**100.00**

The table points out that the ICT respondents have availed themselves to receive training more than the farmers of the non-ICT service area. 31.65% ICT and 16.48% non-ICT respondents (total 48.14%) of the total respondents (1990) have obtained training on different agricultural activities. On the

other hand, 53.85% respondents from total ICT service area (1170) and 40% from the total non-ICT service area (820) have received training on improved farming practices.

The table elicits that respondent farmers are trained on ten important subjects. Among them, training on computer application is received more than on any other subject. About 18.25% of the ICT respondents are the highest amount of farmers who have received training on computer application. Furthermore, 82.14% of the ICT and 17.86% of the non-ICT based farmers have received it. Therefore, it is obvious that the ICT respondents tend to adopt with computer literacy more than the farmers of other groups do. Besides, Rice Production Techniques, Seed Management, Fertilizer and Weed Management, IPM/ICM, Poultry Management, Integrated Fish Farming, Hatchery Management, Soil Management and Application of Agricultural Machinary are the training subjects that are received more by ICT than non-ICT based farmers. Therefore, the analysis uncovers the fact that the use of ICT and the application of ICT tools have significant impact on the ICT service area.

6.8 The Impact of ICT Services on Agricultural Development

The section is divided into many subtitles about needful technologies for agricultural productivity, market prize, pest management, assessment of ICT-based services and AICC services as well. Many important issues like the impact of agricultural programs, farmer-friendly technologies, the barriers to information-obtaining from ICT based information centres, rate of computer literacy and advantage of internet use from AICC are also described in the section. Graphs, charts and tables described the ICT media for information source, evaluation of different ICT-based services, and expectation about those services and reasons of upgrading ICT- based service centers in the section.

6.8.1 Farmers' Engagement/Visit with/to ICT centers and Education

Farmers' education is a key factor to build up their production knowledge and remove their technology-gap. Education can ensure better living condition, nutritional improvement and poverty elimination. The more educated and conscious they are, the longer they are engaged in the ICT centers and more frequent their visits are to the centers. The findings go with the relationship between their engagement and visit and their education.

Table 6.48: Frequency distribution of center visit by education

Level of education	Frequency of ICT Centre Visit											
	Not at all		Every day		Once a week		Once a forth night		More than twice a month		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Illiterate	13	7.65	18	10.59	28	16.47	51	30	60	35.29	170	100
Primary	9	2.44	31	8.40	92	24.93	150	40.65	87	23.58	369	100
Junior high school	0	0	48	15.53	86	27.83	101	32.69	74	23.95	309	100
SSC	0	0	62	33.70	95	51.63	16	8.70	11	5.98	184	100
College	0	0	53	50.48	42	40	10	9.52	0	0	105	100
University	0	0	23	69.70	10	30.30	0	0	0	0	33	100
Total	**22**		**235**		**353**		**328**		**232**		**1170**	**100**
χ^2 = 190.13, Sig=0.00												

The table makes acquainted with relationship between level of education and their frequency of ICT centre visit. Most of the ICT based farmers visit ICT centers every day. The farmers having junior high school, SSC, college and university level education do not visit the centers more than twice a month. Most of the farmers have primary school education. Centers are visited by 8.4% of them every day, 25% once a week, 40.65% once a fortnight, 23.58% more than twice a month but 2.44% of them visit those centers at all. 15.53% of the junior high school level farmers visit the centers every day, 27.83% once a week, 32.69% once a fortnight and 23.95 more than twice a month. There are 184 farmers (15.72%) who, with optimum qualification is secondary school certificate, visit the ICT centers 33.7% everyday, 51.63% once a week, 38.7% once a fortnight and 5.98% more than twice a month. Centers are visited by 50.48% of college education farmers everyday, 40% once a week, 9.52% once a fortnight but none of this category visit more than once a month. There are 2.82% of farmers having university education. Of them 69.7% visit the centers everyday, 30.3% once a week but none of them frequent the centers once a fortnight and more than twice a month.

Higher the education level the farmers have, the more they visit ICT center. This tendency is found among the farmers. The relationship between education level of the farmers and the frequency of the farmers' ICT center visit is highly significant as their Ch-square is 190.13 and p value is > 0.05.

Table 6.49: Frequency distribution of period of engagement by education

Educational Level	Engagement period				
	Initiation to three months	Three months to six months	Six months to one year	One to two years	Total
	%	%	%	%	%
Illiterate	0.00	0.00	1.69	98.31	100.00
Primary	12.32	2.90	17.39	67.39	100.00
Junior high school	4.11	9.04	15.89	70.96	100.00
SSC	10.59	17.76	16.82	54.83	100.00
College	12.50	12.50	18.75	56.25	100.00
University	10.24	7.87	4.72	77.17	100.00
χ^2 = 93.14, sig = 0.00					

The table shows the relationship between farmers' engagement period with ICT centers and the level of their education. The percent of the farmers who have the highest degree of education have been engaged in ICT centers for longest time is higher than that of those who have lower education. The farmers having illiteracy have not been engaged in the centers for the period of initial stage to three months but most of these farmers have been engaged in the centers for the period of one to two years. Most of the farmers having completed their primary education have been engaged in the centers for the period of one to two years. 71% of the farmers having completed junior high school education (grade 8) have also been engaged in the centers for this period. Almost half of the farmers who earlier had SSC certificate from school have also been engaged in the ICT based farmers in the same period.

However, it is noted that the farmers having college and university education have been engaged in the centers for the periods of six months to above time. The relationship between education level of the farmers and the farmers' engagement period with ICT centers is highly significant as their Ch-square is 93.14 and p value is > 0.05.

6.8.1.1 Farmers' Age and Engagement with ICT centers

Respondents of ICT service area are of different age ranges. Their mentality, attitude to ICT centers, their education reflect their activities. The survey result discloses that young farmers tend to visit the centers more frequently than the aged farmers do. They have been engaged in the centers for longer period. It is important to see that the aged farmers shoulder the family and mainly accomplish the farm activities and thus they get less time than the young farmers do.

Table 6.50: Frequency distribution of engagement period by age

Engagement Duration	Age (in years)					
	20-30	30-40	40-50	50-60	60-70	Total
Initiation to three months	6	68	5	10	10	99
Three months to six months	20	14	40	40	10	124
Six months to one year	50	41	64	10	8	173
One to two years	184	187	251	110	42	774
Total	**260**	**310**	**360**	**170**	**70**	**1170**
χ^2 = 163.66, Sig= 0.00						

The table indicates that the relationship between the farmers' age and their engagement period with ICT centers. It is proved that the farmers whose age range is from 30 to 40 years and 40 to 50 years have been engaged in the ICT centers for longer period. The number of those farmers is higher than those who are aged from 50 to 60, 60 to 70 and 20 to 30 years. 26.50% of the total respondents are in the age group of 30 to 40 and 22.22 % of them are in the age group of 20 to 30 but 30.77% of them are in the age group of 40 to 50. 44.53% of the total farmers having age range from 40 to 50 have been engaged in the centers from one to two years whereas 66.15% of the farmers of all age groups are engaged in the centers for one to two years.

It is also shown in the table that the younger farmers are more conscious and their engagement is longer as they realize the real benefits of the ICT. Here the relationship between the farmers' age and their engagement period is highly significant as Chi-square is 163.66 and p value is < 0.05.

6.8.2 Popular Media

Mobile, radio, television and computer are powerful media to create a positive impact in human networks of agriculture. These media play a role in making 'Connected Agriculture'

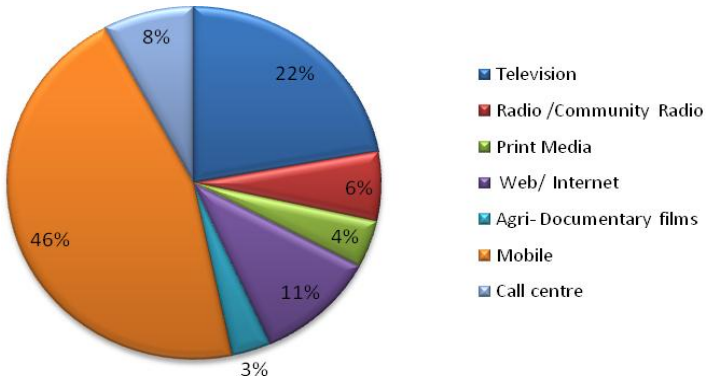

Figure 6.40: Popular media to the respondents

The figure shows that 45.48% of the ICT based farmers think mobile is the most powerful media to them. Next ranked service is TV program on agriculture TV that was in the first category in the past. It covers 22.16%, internet 10.50%, call center 7.84%, radio/community radio 6.33%, print media 4.32% and agricultural documentary films 3.37%. It translates that now-a-days farmers especially ICT based farmers use mobile phone to exchange the opinions in sharing technologies, agri-business and other information. Farmers are much benefited by the TV programs on agriculture. Therefore, the media is more powerful than most other ones. This demand for strengthening TV programs and farmers' access to TV.

6.8.3 Agriculture Call Center

Krishi (agriculture) Call Center is a popular information dissemination service for farmers. Now-a-days farmers are getting services on farming from different agriculture call centers. Among them, Agriculture call center (16123) operated by AIS, MoA, Agri-help Line (27676) by Grameen Phone and Krishi Jigasha (7676) by Banglalink and Win in Corporate are mentionable in the country. There are some other call centers initiated by private organizations such as BIID Call Center, Win Miki Agro-call Center etc.

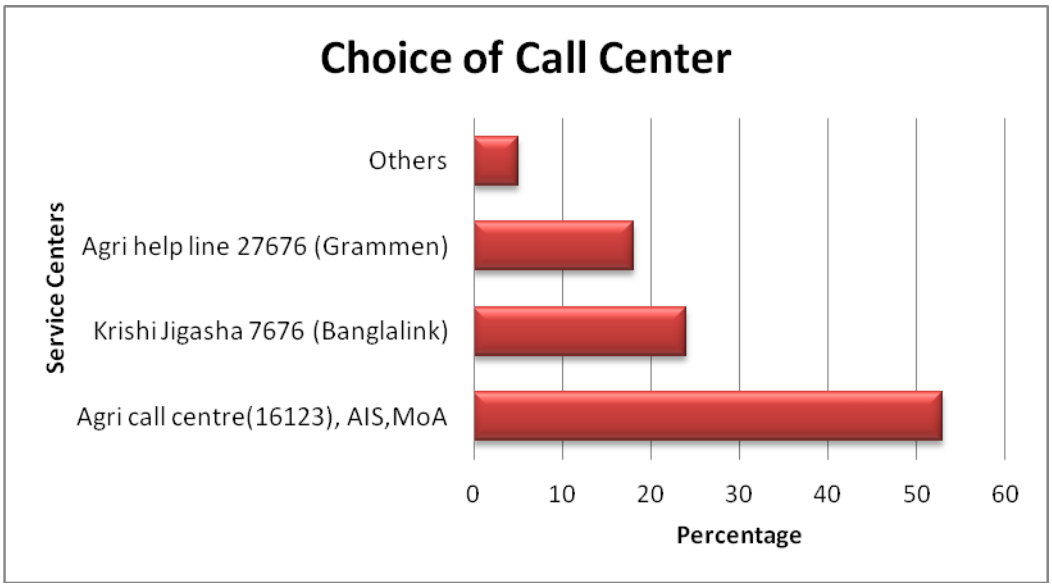

Figure 6.41: Choice of Krishi (agriculture) call centers

The figure illustrates that more than 53% of respondents have calls to govt. initiated call center (16123). Each call costs 0.25 TK according to BTCL regulations though it was primarily free of costs. 23% of the farmers choose Krishi Jigasha (7676) by Banglalink and Win in Corporate, 18% select Grameen Phone initiated call center and 6% choose other call centers like BIID Call Center, Win Miki Agro-call Center.

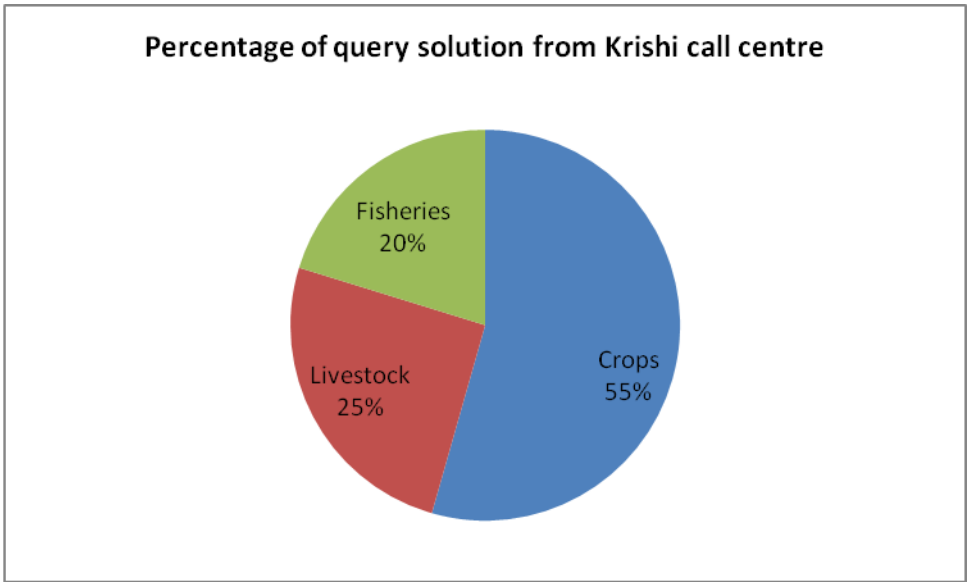

Figure 6.42: Sector wise query solution by Agriculture Call Center (16123)

Three experts from three trends of agriculture such as crop, livestock and fishery solve instant queries from 9 am to 5 pm every day except Friday and other govt. holidays. The figure (6.42) shows that 55% of the calls from the farmers are related to crops, 25% to the livestock and 20% to the fisheries.

6.8.4 Most Demand-led Agricultural Information

Technologies have had a tremendous change in agriculture. Different demand-led information and technologies have helped farmers improve the quality of seeds, proper fertilizer application, irrigation, harvesting, storing quality of fish feed (post larvae), proper vaccination of animals and marketing. Some information and technologies are of great demand to the farmers but some are not.

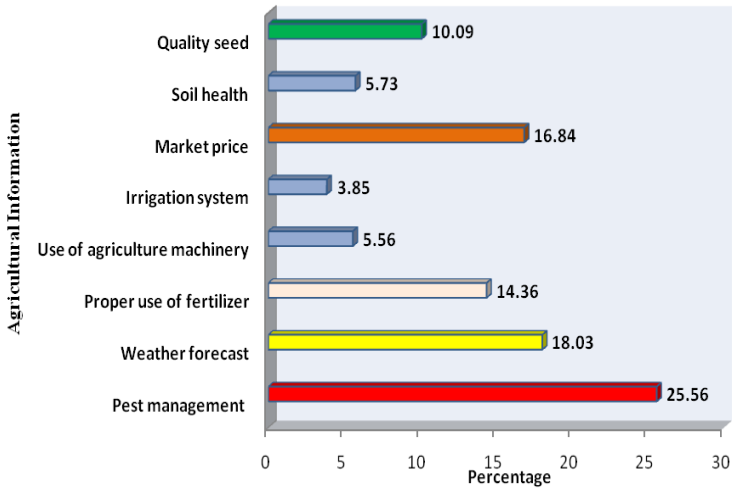

Figure 6.43: Most demand-led agricultural information

Source: (Author Survey 2013-2014).

At present farmers use many technologies or agricultural information of which all are not of equal demand and they do not likely need them all equally. The figure (6.43) specifies different technologies with different demand indication. It is overtly estimated that pest management like IPM and ICM is the most needful technology that about 25.56% of all the respondents learn from ICT tools. Then about 18.03% farmers think that they use technology like weather forecast from these tools and about 14.36% obtain technology like proper use of fertilizer. Some farmers almost 5.56% consent for use of agricultural machinery, 3.85% for irrigation system, 16.84% for market price, 5.73% for soil health and the rest 10.09% for quality seed.

6.8.5 Technologies Learnt from ICT Services

ICT centers like AICCs, FIACs, UISCs, Community radios, Krishi radios have emerged to all farmers in many ways. The ICT farmers have learnt many technologies from those centers practically. Institutional learning and knowledge inherent in them have blended into some resultant technologies that the farmers can use in cultivation. Of them, method of different natural manure is the most learnt technology.

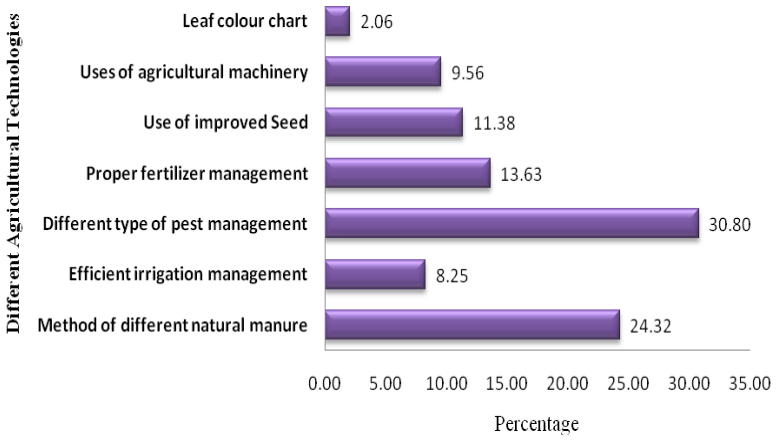

Figure 6.44: Technologies learnt from ICT based services

The figure (6.44) shows that method of making different organic fertilizer as is the technology (35.8%) that the farmers have learnt from the ICT based service centers. The less-learnt technology 2.05% is using the leaf colour chart (This relates plant leaf colour into plant nutrient status). It is noticed that about 26.32% of the ICT based farmers learnt the different types of pest management like IPM and ICM from ICT based service centers. They have learnt about the uses of agricultural machinery. There are some other technologies that the farmers learnt proportionately such as making improved seed bed 2.56%, managing proper fertilizer 13.63% and efficient irrigation management 8.25%.

6.8.6 Assessment of ICT Center Services

The farmers of non-ICT service area are much benefited by the farmer-friendly services rendered by the ICT based centers. Yet, not all farmers can enjoy the fruits of those services. Therefore, some farmers express their opinion about the relevance of the services rendered by ICT based service centers**.** Most of the farmers agreed to the fact that the services provided by ICT based services centers are relevant.

Table 6.51: Frequency distribution of assessment for ICT services

Category	Frequency	%
Very good	330	28.21
Good	600	51.28
Average	230	19.66
Not good at all	10	0.85
Total	**1170**	**100.00**

This table describes the assessment of the services rendered by AICC, FIAC, CR and other ICT based services. It is noticed from the table that 28.21% (330 out of 1170) respondents think that the services are very good as this meets all of my problems related to agriculture and opinion. On the other hand, 51.28 % the respondents opined regarding ICT based service centre that the service is good because it meets all of my problems related to agriculture. 19.66% of the respondents think as average as it meets up most of problems related to agriculture and rest only 1 % think these services are not good at all as it does not meet up any necessity related to my agricultural Problem

6.8.7 Impact of ICT Services on Agriculture Production

Modern agricultural development can not be thought of without the use of modern technologies. These technologies are the blessing of ICT centers that provide the farmers with opportunities for opening the doors of opportunities. Many things like increasing average production, high value crops, reducing expenses of production, increasing of selling price, use of agricultural technology and pesticide free vegetables are the impact of ICT center services to the farmers.

Table 6.52: Frequency distribution of AICC services

Services	Frequency	%
Average increase of crop production	545	46.58
Increase of High value crops	111	9.49
Reducing the production cost	99	8.46
Use of modern technology	239	20.43
Pesticide free vegetables	176	15.04
Total	**1170**	**100.00**

Source: Survey data 2013-2015

What the figure shows is the expected result of the study as it meets partially the research questions. It discloses the impact of the services provided by the ICT based service centers like AICC, FIAC, USIC, etc. Farmers eagerly put opinions on various items that are counted the real impact of ICT based services. Most of the farmers voted for mainly one agenda – increase of average production. It means more than 46% farmers agreed that due to these services they have already been able to increase their production on average. Some of the farmers opined that the services have enabled them to find or select the high value crops. Their number is about 10% of the total population. 8.46% of the farmers expressed that they have been able to reduce their production cost. 20.43% of the farmers see positive impact in the use of modern technology. 15.04% of the farmers are in the opinion of increasing the production of pesticide free vegetables.

6.8.8 Problems Faced in Getting Information from ICT Centres

Though the ICT centers impart blessing-like-activities to the farmers, they (F) think the facilities rendered by the centers are interrupted by the drawbacks. There are some problems that the farmers feel as barriers to obtain information from the centers.

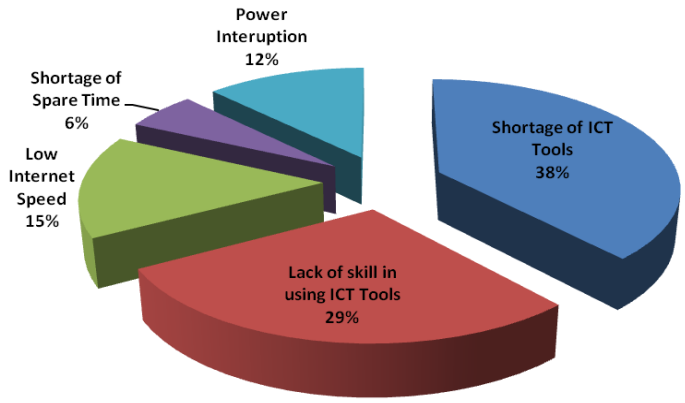

Figure 6.45: Problems in getting information from ICT centers

Source: (Author Survey 2013-2014).

The figure brings out the barries or obstacles that the farmers face to get information from the ICT based service centers. Though friendly in some respects, farmers actually faced with at least four major problems. Of them the result displays lack of farmers' skill in using ICT. About 29% of the total ICT respondents farmers think so. Next 38% of the farmers suffer from the shortage of ICT tools. 15% of the respondents agree to low internet speed and 12% blame the power interruption. A few farmers almost 6% identified shortage of spare time as problem. These are the problems that the farmers faced with.

6.8.9 Rate of Computer Literacy

The computer literacy among the respondents was judged by their opinions to classify the farmers. It helps the selection of the expertise to run the centers. Most of the aged farmers in Bangladesh hardly hold formal literacy let alone computer literacy. Computer is a fear to them. The backwardness of their formal education and lack of computer proficiency retards them to the access of computer. Nevertheless, ICT initiatives make them encouraged to handle the ICT tool hurdles.

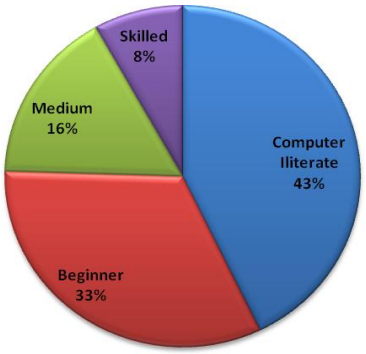

Figure 6.46: Rate of computer literacy

Source: (Author Survey 2013-2014).

The table indicates that 43 % of the ICT based farmers have computer literacy. 33% of the repondents are beginners. They are about to start learning computer skill, 16% of them are medium. It means they have started leaning but they are not expert and the rest of the respondents 10 % are expert in computer and those farmers perform different operational jobs- commercial activities of computer for public.

6.8.10 Internet Facilities

AICC was a matter of interest among the farmers. It is a vital one among the ICT centers in the present surveyed study. It is fully computer-operated center. Computer facilities with internet browsing are available in these centers. The member farmers have only access to facilities. They come to center once a day or twice a week.

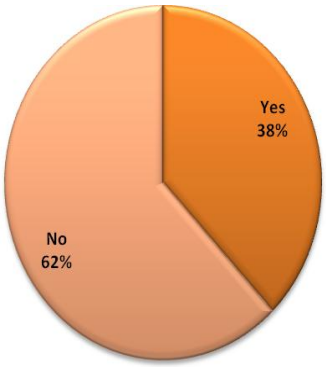

Figure 6.47: Advantage of internet use by AICC

62% of the ICT farmers think that there is advantage of internet use but 38% of them think that there is no advantage of internet use. It is an important finding that the young farmers come across computer leaning and they think they should learn it but a section of farmers keep themselves aloof. These farmers are unaware in modern technologies.

Internet facilities are not available for all the members of the centers as one computer and one modem is provided with by the extension. One farmer gets an access to computer operation at one time.

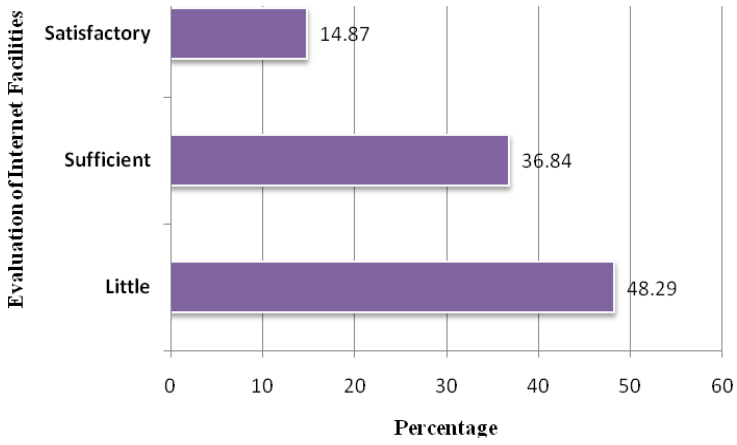

Figure 6.48: Internet facilities

The figure shows that about 48% of the respondents think that they are satisfied with internet facilities, 37% of them think that the facilities are sufficient and 15% farmers are satisfied little with the internet facilities. It means that less than half of the respondents consented that the internet facilities are at satisfactory level and more than half of the respondents are not content with the facilities.

6.8.11 Evaluation of Different ICT Services

ICT centers cater different services to farmers. The centers provide the farmers with many up-to-date services. The services are assessed by the farmers. Some farmers are satisfied with the services but some are not at all. They are up to the satisfaction level as those services have been able to meet the farmers' agricultural problems. In addition, those who are up to the mark of satisfaction with the services think that there is a fault either in their assessment or the centers are weak enough to cater them with their expected services with adequate content, timely flow of information etc.

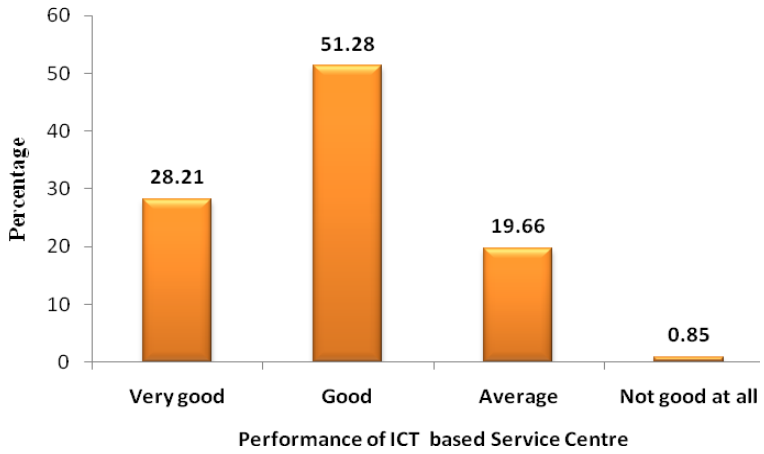

Figure 6.49: Evaluation of different ICT services

Source: (Author Survey 2013-2014).

The figure justifies the evaluation of different ICT based services determined by the farmers. About 51% of the ICT based farmers pointed out that these services rendered by the ICT based farmers are good, 28% expressed that those services are very good to them and only one percent farmers did not feel good about the services. But the farmers who thought the services are neither good nor bad are made of about 20% of the total respondents. The result is bended forward more than half of the total respondents who think the ICT based services are really good.

6.8.12 Reasons of Upgrading ICT Service Centers

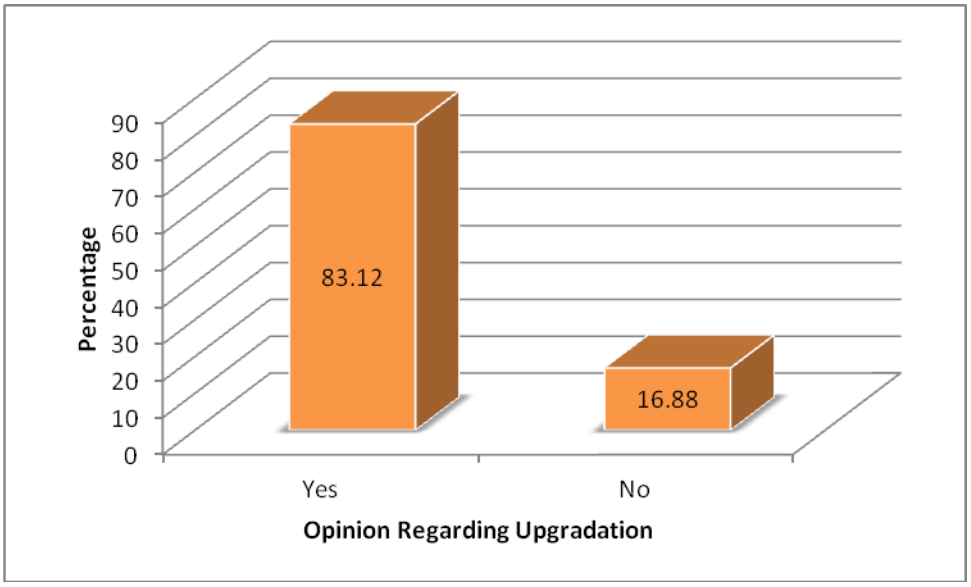

Figure 6.50: Reasons of upgrading ICT service centers

Source: (Author Survey 2013-2014).

For the reasons of upgrading ICT service centers shown in the figure (6.50) above, the respondents conspicuously expressed some opinions. The ICT centers are thought to be upgraded for the ICT tools need to be modern. The slow speed internet and infrastructure development are main barriers behind this reason of up-gradation. About 83.12% of the farmers think that the centers should be upgraded by the authority but about 16.88% of the respondents are not feel interested in upgrading the ICT centers. The result indicates that the real picture of maximum dissatisfaction about the modernization of the ICT based service centers. It means that maximum farmers are in the opinion of upgradation.

6.8.13 The Barriers to Information-obtaining from ICT Centres

ICT centers are not free from problems that farmers feel to getting information from the ICT centers. Out of many problems, four major problems are found here to be notified as the barriers to obtaining information from the ICT centers.

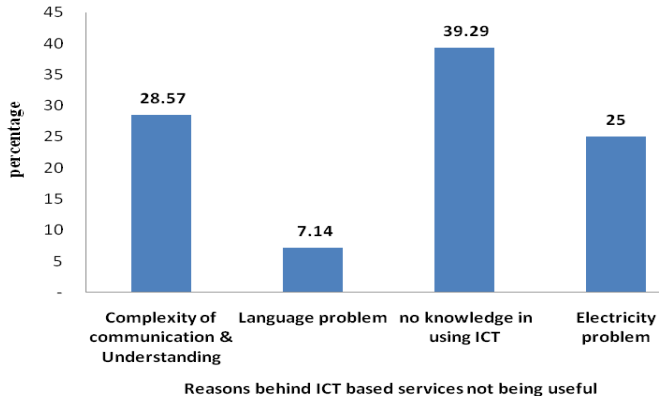

Figure 6.51: The barriers to information-obtaining from ICT centers
Source: (Author Survey 2013-2014).

The figure (6.51) shows some barries or obstacles brought about obtaining information from ICT centers. The farmers feel to get information from the ICT based service centers. Though friendly in some respects, farmers are actually faced with at least four major problems. Of them, the figure displays lack of farmers' knowledge in using ICT tools most. About 40% of the total respondents farmers think that it is the complexity of communication and understanding that imped them to getting information from the centers. Next 28% of the farmers suffer from the lack of knowledge using in running the ICT activities. 25% of them feel that electricity is the problem for which they can't obtain information from the ICT centers. A few farmers almost 7% identified langauge as problem. This language to them is surely English or their dialect that appears to be difficult to them.

6.9 Conclusion

This chapter has presented a brief overview of the influences of ICT on the production and income of farmers of ICT and non-ICT service areas. The service areas, educational status, gender, age of the respondents are analyzed with the respect to ICT use within the service area. A brief explanation of what role the ICT play on agriculture has also been presented graphic illustrations. This chapter comprises a number of sections and their sub-sections; every section offers different items and their contribution to agriculture in Bangladesh. The gender operation in agricultural activities has been shown with Chi-square, histogram and tables.

The statement of the problem was imparted before identifying the research questions. Together with the significance of the study, delimitations and limitations of the study have been identified. This chapter builds upon the answers to the research questions that were posed in Chapter One. The first section of the chapter provides a brief preview of the chapter, and then the main findings and their significance are discussed. The role of ICT reflects in the information sources of fertilizer use,

soil test, livestock healthcare, vegetable cultivation, fish cultivation, weather forecast. The economic status/social class, gender disparity in farming, computer literacy, prospects and problems of ICT centers have also been investigated, discussed and interpreted with illustrations.

This chapter has shown that all the facilities from ICT centers, internet facilities, expectations and evaluation of the centers have been elicited and discussed in the chapter. However, it has discovered that among all the respondents, the non-ICT service area has less influence on the use of ICT than ICT service area. The chapter has also established how and what reasons contribute to accelerate income and production in the Bangladeshi agriculture. This chapter also shows what causes poor performance in production of non-ICT service areas

In every section, the researcher has tried to examine how the findings revealed the evidence of ICT use. The researcher has also sought the answers to the research questions through discussions. She has examined and re-examined the findings by cross-referencing with the findings obtained from a number of statistical analyses. References to previous studies and expert opinions have also been presented in support of the findings of the present study. Any research is normally carried out in a particular setting, and researchers do have constraints related to their studies to deal with. The implications of the findings for the use of ICT in agriculture in Bangladesh to accelerate production are then stated in the chapter. The next chapter, Chapter Seven, presents the generation of a standard model in brief, offers answers to the research questions, touches upon the implications of the findings, and puts recommendations forward. It also points out some directions for further research for adequate evidence of the influence of ICT use in agriculture in Bangladesh.

Chapter Seven

Model for ICT based Agricultural Information Dissemination System in Bangladesh

7.1 Introduction

A model is a simplified representation of a process or system used as a way of analyzing and solving problems or making predictions. In the previous chapter, the research data were presented and analyzed. New findings have been revealed and accordingly some ways to reach the culmination of a result were elicited. Based on the study result, an idea of generating a model was developed for information rich farming community with a view to enhancing agricultural production in a sustainable way. To enrich farmer's knowledge regarding modern technology, it is proposed to develop an ICT based information dissemination system. The proposed model is designed with the aim to enhance farm profitability based on updated knowledge delivery system. Agricultural production system is directly dependent on the commonly known inputs like seed, fertilizer, irrigation and pesticides. Post harvest factor and marketing plays also an important role to ensure fair prices of products that farming communities grow. However, the agro-climatic factors have important role in influencing production system of agriculture. For example, the high soil moisture in standing water situation associated with high humidity induces incidence of insect-pest like brown plant hopper in rice. Similarly, it is said that virus attack of poultry industry (avian influenza) is linked with low temperature during winter.

With the affect of climate change, the agricultural production will be directly affected, not only with crop but also livestock and fisheries. The chances of prevalence of pest and disease infestation increase with increasing cropping intensity. Incidence of extreme climatic events like flood, drought, high rainfall, and cyclones are expected to appear more frequently than before due to climate change which will damage crops, livestock and aquaculture farms. This will require well organized ICT based climatic advisory services to the grass root level.

7.2 Present Farm Advisory Services

Initially the extension service delivery has become public sector responsibility to popularize improved seed, fertilizer and pesticide for crops, improved fish species, pond fertilizer management etc. Three relevant Ministries are responsible for delivering extension services to the farmers. These are Department of Agriculture Extension (DAE), Department of Livestock Services and Department of Fisheries with wide spread network in the country. The role and the extent of those departments are described in the earlier chapters. However, delivery of extension service to about 16 million farm families with diversified farming remains a challenge. About 12,000 grass root extension agents in crop agriculture find it challenging to cover the diversified needs of farmers. Agriculture Information Service (AIS) of Department of Agriculture Extension (DAE) has its efforts with number of activities including use of ICT tools to cater the need of farmers. However, the capacity needs to be strengthened in terms of logistics, know how to address wider areas of rural knowledge delivery.

The Agricultural Information and Communication Centers (AICCs) are spreading over the country with the advent of government's declaration to put ICT in the centerline of development with a campaign of 'Digital Bangladesh'. On the other hand, the establishment of 22,000 IPM and ICM club with the membership of males and females in the community developed coherence among the society as well as enriched them with present knowledge base. The practice of such clubs though enhanced the capacity of the farmers in pest management through IPM and other improved farming practices. However, lacking of such approaches in other sub-sectors of agriculture like fisheries and livestock need to be developed. Presently, private and NGO led initiatives including mobile call center have been getting popular, and understanding the complexity of diversified need of the farmers, the efforts are being strengthened with widening of content of the answers.

Based on national dialogue of providing necessary farm advisory service in the rural Bangladesh, the following model is developed in proposed form for implementation. The objective of the model is to ensure crop, livestock (poultry, cattle) and fishery production through knowledge based advisory services.

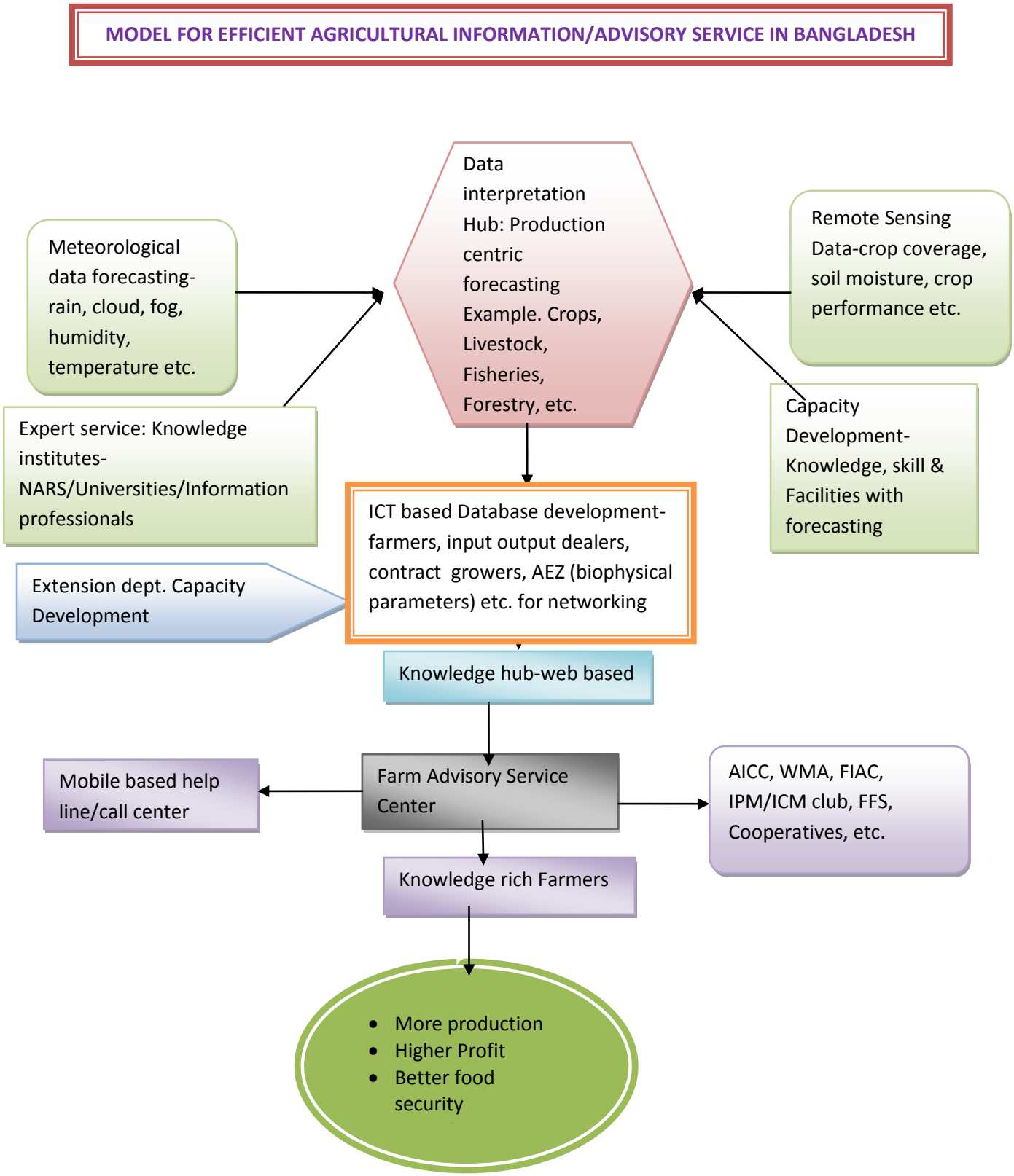

Figure 7.1: The proposed model

7.3 Model Parameters

Each of the activities under the purview of the model has definite role to play to make the process of making efficient information delivery system successful. In developing this model, both public and private sector participation have been considered important. The main idea of the conceptual framework is to deliver authentic, location specific, real time answers to the production problems. For example, mango growers in Rajshahi may need information of pest management (controlling fruit flies) during fruit formation stage in March with rising temperature or aquaculture farmers may require knowing feeding pattern of fin fish in Satkhira in June. To make the process successful, the individual parameters of the cycle must be well understood and proper attention to be given.

7.3.1 Meteorological Data

The data to be collected by the public agency (Department of Meteorology) associated with production of various crops, fisheries and livestock. The data to be provided will contain ten days' forecasting of parameters (temperature, sunshine/cloudiness, relative humidity, rainfall etc.) that influence agricultural production. The precision of forecasting data depends on the skill and capacity of the agency.

7.3.2 Remote Sensing Data

It is of great significance to obtain the crop condition information at early stages in the crop growing season. Sometimes it is even more important than acquiring the exact production after harvest time, especially when large-scale food supply shortage or surplus happens. Accurate monitoring can actually avert a disastrous situation and help in strategic planning to meet the demands. Remote sensing data to be used in the advisory service will include real time image of cloud cover, fog, soil moisture, climatic depression in the bay, cyclones, rainfall in the upstream of Bangladesh, pest migration pattern etc.

The images will be collected from SPPARSO (Bangladesh Space Research & Remote Sensing Organization) (format to be decided by the expert groups) on the crop coverage, extend and depth of water bodies, forecasting of occurrence of climatic extremes and possible route. The climatic parameters will be used by the pool of expert panel with a view to protecting crops, livestock and fisheries under cultivation. The information of extreme events may also be used for potential opportunity of agricultural insurance schemes. Tracking of trans-boundary pest and diseases monitoring will have to be accomplished through remote sensing.

7.3.3 The Data Interpretation Hub

The above climatic data and remote sensing images will be analyzed, interpreted and forecasting will be made in relation to the standing crops or other agricultural enterprises (fisheries and livestock). The input of experts in individual commodity will be crucial in this stage. Knowledge based interpretation of agro-climatic data will lead to advice agro-enterprises to take relevant management options (fertilizer, irrigation, pest and disease management, seed, selection of fish fingerlings, vaccination of animal, animal feed) to protect the farm output and increase profitability.

7.3.4 Expert Service: Knowledge institutes- NARES/Universities

A panel of experts will be fixed nationally and regionally in each of the discipline in production system (e.g. crops-breeding, pathology for disease, entomology for pest, post harvest for quality and milling, fisheries-feed, fingerling fertilizer, water quality, livestock-disease, feeding, vaccination and so on). A network of expert panel will be maintained to interpret the meteorological data base to create production related issues and queries. The pool of experts will be taken from information professionals & scientists of research institutes, extension departments, universities and this will be updated periodically.

7.3.5 ICT based Database Development

A farmers' database will be developed with details of farm sizes (marginal, small, medium etc.) and farm categories (owned or tenant etc.) to determine the possible answers of production constraints. Also to facilitate the farmer's advisory service, a strong Agro-ecological database will be maintained where the experts may strengthen their answers supported by bio-physical parameters. The bio-physical data base will include soil type, inundation, hydrology to suggest crop/fisheries suitability in a given area and advice on soil and water, fertility management.

Information delivery system may be institutionalized through Farm Advisory Service (FAS) which will be interactive, location specific and capable to address ever evolving farm problem. The FAS will be center of network of experts having experience with highly dynamic bio-physical and agro-climatic variables towards addressing farmers' day to day questions.

7.4 Justification of the Model

The research outcomes has revealed that the use of ICT through different rural organizations, either supported by public or NGO initiatives resulted favorably towards increasing productivity and farm income. The research further recommended that if organized properly and replicated further throughout the country, may benefit farmers and the society as a whole. Further to this

contemporary experience through a number of studies also support the development of the model to enhance the efficiency of the ICT based initiatives and makes these sustainable. Through the model, the farmers empowerment will be augmented and it will enrich them with knowledge with a view to enhancing the skill towards higher profit margin in the production system. All kinds of ICT based media will be used and linked to disseminate the knowledge in the relevant field.

7.5 Conclusion

In fine, the proposed model for ICT based initiative will have to consider some clusters of issues related to information dissemination. The Model will accelerate national production, increase GDP and strengthen the farmer society. The model will help to develop a strong ICT based National Agricultural Information System. The system will tend to boost national capacity to collate access, share and use agricultural information. This will assist to govern and regulate information flow and use to protect national interests related to development and intellectual property. Designing and implementing a next generation, The Model will integrate and coordinate information flows and access in a country's agricultural research system to benefit its stakeholders through informed research and development activities.

Chapter Eight

Recommendation and Conclusion

8.1 Recommendation

An informed society is an asset for development. Information is a critical development tool and so it needs to be utilized to its fullest extent. Globally and nationally information and communication technology is growing very fast. On the other hand, agriculture being the larger segment of economy and employer of major population, technological advancement in agriculture needs to take advantage of information tool to bring it to the grass root to accelerate the growth in agriculture.

This study aims at creating more information and knowledge based services for accelerating the production of agriculture. The study attempts to find some technological gaps between agricultural scientists and extension agents, extension agents and farmers and the farmers of ICT areas and those of non-ICT areas. The study aims at enhancing the role of ICT in agriculture; it has also been able to find the areas of technological gaps which affect farmers much at the root level.

Most of the time, farmers of Bangladesh are not much aware about where and whom to approach for solutions to their problems under public sector agency in the locality. Farmers are becoming more enthusiastic about modern production techniques. The front line extension agents called Sub-assistant Agriculture Officers (SAAO) are first to appear to the farmer problems associated with farming questions. The more the agents are equipped with modern tools and techniques, better the farmers are served with production systems. However, the service area of SAAO is too large to cover the wide range of farmers to meet their problems face to face. This gap calls for enhancing the capacity of the grass root extension agents with ICT based knowledge to reach the farmers in time. The study found that some farmers who belong to ICT service areas are able to meet the agricultural problems quickly as they are well-informed about modern technologies. The present study also highlights the need for more openness in agricultural research information to be reached to the end users in their routine decision making process.

The study focused on the use of ICT in some representative areas of agro-ecological regions of Bangladesh and also on some non-ICT based areas where farmers are not using ICT to greater

extent. The study also investigated the different forms of ICT use in agriculture, how they are being used to improve the agricultural practices for better livelihood. It also emphasizes on the role of information professionals to be aware of the potential benefits of technologies for the betterment of the users, the techniques the information professionals adopt to get more relevant information and some new mechanisms they devise to improve access to information (Das, 2012). Therefore, this study focused on both ICT and non-ICT based service areas and observed the differences of their way of farming activities. The farmers of two groups were interviewed face-to-face to get insight on how, when and where they use different forms of ICT tools in their day-to-day agricultural activities. Survey was conducted on the participants to investigate among other things, their use of ICT, ICT literacy, trainings on ICT use and challenges of using ICT. Nineteen hundred ninety (1990) farmers from different parts of the country responded to the questionnaire and most of them participated in the face-to-face interviews. This chapter presents a summary of the study and highlights the main recommendations and conclusion drawn from the analysis. From the survey result and analysis, the following recommendations are depicted:

i. Content Development and Management

The Ministry of Agriculture and relevant research institutes could work together with both public and private sector to develop effective multimedia content for facilitating agricultural extension workers and tele-centers. They can help farmers including farm women with delivery of complex messages into a simpler form. A well-organized information professionals should be dedicated to support the designing of the user-friendly content and database.

The content of the ICT based service centers should be standardized and validated through authenticated information sources. The database content should be a living document that has to be updated regularly with newer knowledge and technology developed by the research.

The delivered content of the service centers should be well organized through linking with the pool of experts in individual commodity (ex. rice, wheat, vegetables, fruits, large/small ruminants, poultry, fishes, crustaceans, pest and disease management etc.) and non-commodity (ex. agro-climate, marketing, mechanization, soil nutrient management etc.).

The pool of experts should be organized through a leadership of national level committee and members taken from senior level officials of research (NARS), extension (crops, fisheries and livestock) and universities. There may be several sub-sectoral sub-committees in the regional level to develop, update and disseminate information/knowledge to the service centers.

ii. Knowledge Management & Supervision

The number of ICT based community information delivery centers like AICC, FIAC, call centers etc. should be upscaled to a larger extend to reach the producers, farmers, entrepreneurs at the door step of the farming community. More self-sustaining ICT centers may be enhanced with a business plan. An ICT based inspection system needs to be developed to assist farmers with timely and accurate detection, diagnosis, prevention, and control of diseases; and, to manage data of input and subsidy distribution. This system will provide accurate information for evaluating impact of policies and programs for growth and sustainable development of the sector.

The ICT based centers should be adequately supported by the trained and dedicated members from the locality. The national committee should monitor the service delivery of the centers periodically with experts of relevant discipline and information professionals for the center sustainability. Duplication of services should be avoided to improve the quality of services.

A national farmer database software in containing their basic information could be maintained by MoA and MoFL so that it could help policy makers to reach them in emerging services.

iii. Research and Development (R&D)

Relevant research and extension institutions and international research and extension organizations may take an initiative to create a 'research network' where needs based mechanism for small holder farmers will be developed and researchers and extension workers will provide modern information technology to farmers and other players in the agri-value chain using different media (internet, mobile phone, radio and television) for application on the field. In this context, SAARC partnership with NARS and extension can be developed.

iv. Extension System

The relevant ministries need to equip extension workers with ICTs so that they can take services to farmers' doorsteps. The ICT based service centers like AICC, FIAC, call centers, plant clinic and other government and NGO based initiatives should be developed to support the extension agents (including input dealers), farmers and other end-users with location specific farming practices, technologies and best practices. Extension should increase social mobilization as a powerful instrument in decentralization policies and programmes aimed at strengthening human and institutional resources development at local level to strengthen the participation of rural poor in local decision-making. Young and educated farmers should be organized as new ICT generation

follower in modern farming. Female progressive farmers should be encouraged in farming and the number of female extension worker needs to be increased for serving woman farmers.

v. Human Resource Development

For continuous professional development, training courses should be organized with the members of the service centers in both hardware and software for efficient service delivery. All information and library professionals should be equipped with modern ICT tools for smooth and instant services. The service centers should be knowledgeable on the innovative practices which have potential for replication in a given ecology. Capacity of Information Professionals should be enhanced to accelerate information service delivery as information professionals have critical role to play to cope up with recent agricultural research and development. Seminar, symposium, workshop, and other discussion panel should be arranged to make awareness among them.

The government needs to strengthen agricultural ICT curricula in formal and informal educational and training programs focusing ICT for teachers/researchers/extension personnel on practical implementation. Farmer friendly database software should be updated and uploaded for the ICT farmers. It helps farmers improve their productivity and profitability.

vi. Power Supply

Power is considered vital for ICT based service delivery. Electricity supply should be interruption free. The government should consider ensuring electricity supply either through national grid or cheaper source of power like renewable one (like solar and wind) particularly in the rural areas.

vii. ICT Infrastructure

A national IT infrastructure should be developed so that all rural households could have effective access to ICTs for catering the information and knowledge needs and service through various channels. The government could provide appropriate incentives for value added service providers through mobile telecommunications and internet through regulatory arrangement so that providers can protect their investments. The government needs to expedite the installation of second submarine cable connection for expanding high speed internet facilities which will help the country get an additional bandwidth of 1400 Gbps (Gigabytes per second). It may be mentioned here that the government has already subscribed membership of SEA-ME-WE- 5 (South East Asia-Middle East-Western Europe-5) submarine cable consortium and signed an MOU in this respect to lay a new

undersea cable. This agreement needs proper steps for quick implementation. This Digital inclusion must be addressed as a policy priority within all ICT infrastructure issues.

The government needs to reduce price of bandwidth which will facilitate increasing number of net users, enhancing demand for local content and applications and developing a connected Bangladesh. For example, the lowest recorded price of fixed-broadband (as a percent of GNI per capita) is 0.7 percent in case of China, it records 7.3 percent in Bangladesh (ITU, 2013).

viii. Telecommunications

The government needs to accelerate the process of introduction of new technology (e.g., 3G, 4G, and LTE (Long-Term Evolution) in the mobile telecom segment through transparent licensing system in rural areas. The Rural Telecommunications Network Development and Utilization Guideline 2010 should be implemented to make sure that the existing network infrastructures have been optimally utilized for commercial communication and key social services. Farmers should be provided mobile phone based apps with easy contents and local language so that they get information about seasonal crop problems. The strong growth in mobile Internet uptake, an increasing number of people are joining, and participating actively in, the information society. For wider range of network, the central server must connect to higher GB bandwidth optical fiber. Farmer friendly smart phone at affordable price should be ensured. All calls with agricultural call centers should be toll free to the small and marginal farmers. The government may revise taxation policy for mobile telecommunications industry for creating opportunity for reaching out to the poor in rural Bangladesh. The Telecommunication Company might construct another international line for internet connection.

ix. Early Warning and Disaster Recovery

ICT tools like mobile phone, VHV/UHF radio, and broadcast radio are common in Bangladesh. Given its nature, the government will need to amend related rules so that all cell phone operators reduce fees for their customers. The mobile communication network will be upgraded to leverage 'location based service' which will allow a message to reach to all phones of a particular geographic location. Farmers are to be provided with agriculture apps of Agro meteorological information in their mobile phone in a timely and efficient manner. The Ministry of Disaster Management may consider launching an initiative to equip sea fishermen with Global Position System (GPS) to locate their movement to guide them from emergency services like cyclone, depression or piracy etc.

x. Market Chain

Agencies involved with market chain development under the Ministry of Agriculture, Ministry of Commerce, Ministry of Industry and other relevant ministries, alongside the private sector, may develop ICT based approach for promoting fair price for growers, transporters, buyers, traders, consumers etc. so that farmers are able to access market for receiving better price which reflects the marketing realities. The Ministry of Agriculture may be global examples of e-services being provided to farmers to protect their investment and improve their livelihoods. Widely cited example is the e-Soko (agricultural market information platform) initiative in Rwanda. This initiative aimed at easing access to information on the market price of agricultural products, where over 75 per cent of its population depends on agricultural business. e-Soko was designed and developed to enable them to make effective market decisions, based on the information provided, which covers more than 60 agricultural products in the country's 41 markets. It is managed on the web and delivered to farmers, agri-business, and the government via mobile phone. e-Soko has eliminated the middlemen who used to capture a significant share of profits in the supply-chain.

xi. Rural Finance

Bangladesh Bank in association with commercial banks and financial institutions should explore potential for introduction of automated teller machine (ATM), a point-of-sale (POS) device located at a local retail or postal outlets, to understand whether it can be a sustainable and affordable alternative to connect rural farmers to formal banking system. Remote mobile loan payments will also be initiated using SMS and wireless application protocol (WAP) technologies, GPS and radio-based system.

xii. ICT Tools for the Change Agent

The number of SAAO, CEAL, LEAF, NGO workers should be increased and they must be equipped with ICT data base tools (mobile, laptop etc.) for disseminating updated and prescribed information from DAE to the farmers. Tablets/ laptops with farm data base are to be provided with SAAOs for better service. (For example, the community clinic health workers are provided 12,000 tablets for sharing electronic health records (EHRs) of individual patient or population.)

xiii. Promotion of advanced technology in production, planning and forecasting

In Bangladesh, there is an immense opportunity of improving productivity of agriculture through sustainable manner utilizing remote sensing technology. The precision interpretation of remote sensing data through satellite image will bring a newer dimension of agriculture production system.

Present global development of remote sensing technology offers great opportunity in predicting production, prevalence of pest and disease infestation, climatological events, soil moisture status. This opportunity should be harnessed along with agro-climatological data interpretation to advise farmers and policy planners to take adequate measures to protect agriculture against hazards and risks. This will require establishing an organized pool of experts drawn experts from different fields of agriculture, remote sensing and meteorology to correctly interpret the data for the benefit of the farmers in a given area. In this regard, the proposed model (chapter-8) can be implemented for better services. The database of the farmers and agro-enterprises, and relevant policy makers should be created to disseminate such information through various modes of communications. GIS based soil mapping system helps to analyze detailed data to provide information relating to crop suitability, land zoning, nutrient status, and fertilizer dosage. Attempt should be made to disseminate GIS based crop suitability assessment map for wider awareness and develop policy framework for growing appropriate crops in a given area as per suitability for higher profit margin.

xiv. Media Services

Expansion of agricultural call centre will be required to be implemented at the regional levels. The number of Krishi radio should be increased with more facilities and knowledge to be enhanced to back up to the existing one. Separate full-fledged agricultural radio station and TV channel should be set up with emphasis on local farm based contents. Other TV channels should broadcast agricultural programs in farmers' convenient time.

Synergistic opportunities could be explored between diverse communication media (e.g. FM Radio, Satellite TV, Cellular Phone services, etc.) to reach out to maximum number of people at the shortest possible time with valuable information. Community radio stations can emerge as another channel of last mile connectivity for the bottom-of-the-pyramid population.

A media cell can be set up at Agricultural Information Center (AIC) of Bangladesh Agricultural Research Council (BARC) for disseminating research highlights and NARS activities.

xv. Indigenous Knowledge

For sharing indigenous knowledge and innovations of agriculture related to crop cultivation, disease and pest management, seed preservation, soil conservation, animal care, a digital indigenous

knowledge bank need to be established. District and upazila level digital indigenous knowledge & innovation fairs may be organized nationally to create demands for e-Service and to make people aware of the indigenous knowledge based e-services available at the government and nongovernment level.

xvi. Strengthening research-extension-farmer linkages

A close working relationship between national agricultural research and extension organizations, and with different categories of farmers and farm organizations will have to be developed to meet the farmers' information needs. MoA can develop mechanism to materialize research-extension linkage for quick dissemination of research results in the farmers' field. In this regard, virtual research-extension linkage may be introduced for quick dissemination of research findings and implementing farmers' needs based techniques. Separate wing in ICT in agriculture may be established in BARC under MoA.

xvii. Rural e-Libraries and Information Centers

Rural e-Libraries may be established for farmers to acquire specialized knowledge in agricultural issues e.g. sustainable agricultural practices, organic farming, new production techniques, marketing approaches, agricultural policy framework.

xviii. Agriculture ICT Policy for Rural Development

Separate agriculture ICT policy needs to be developed for contributing to many aspects of rural regions' development such as the improvement of agricultural production and productivity, the production of safer and nutritional food, the support of businesses and entrepreneurship etc. More ICT enabling institutional structures should be set up to implement ICT policy. In this context, the local administrators & leaders could be the main actor for establishing an ICTs culture in rural regions.

8.2 Concluding Remarks

The research conducted in the dissertation clearly concludes a dividend in production and profitability by the ICT users. It also examined the present ICT based initiatives by the public and private sectors and response of the initiatives by the users is very encouraging. However, there is a room for further development through better integration, infrastructure development and skill

enhancement of ICT professional. The research further concludes that strengthening ICT infrastructure, spreading and integrating the facilities needs to be accelerated, designed in chapter one and hypothesis formulated in chapter four was analyzed and discussed in the later chapters. The productivity gain in different agricultural commodity has been found to be higher with the families under ICT based service area compared to the farmers having less access to ICT enabled service area.

Considering the significant advantage of ICT use in agriculture, further investment in ICT development is suggested. The development of ICT based service in the rural areas is worthy as a long term benefit which is associated not only to the agriculture alone but for inclusive development of the country and society as a whole.

Farmers acknowledged the importance of ICT in delivering information dissemination to them, although some of them cannot afford to adopt all the new ICT that are essential in their farming activities. While the information society is growing worldwide, digital divides remain – and are even widening – in some segments. In particular, there is a significant and persistent urban-rural digital divide, whereby urban citizens enjoy ubiquitous mobile network coverage, affordable high-speed Internet services and the higher levels of skills required to make effective use of online content and services, while the opposite is often the case in rural and remote areas of Bangladesh.

Therefore, the analysis indicates that there is technological gap between agricultural scientists and extension agents, extension agents and farmers and the farmers of ICT areas and those of non-ICT areas and farmers of developing countries and those of developed countries.

Clearly, it is only a first in moving towards a new technology-based artifact. However, even such a small- scale effort has provided many useful insights and positive findings regarding the possibilities or even poor farmers in developing countries like Bangladesh to achieve increased capabilities and sustain their livelihood. This research creates hope and scope for the future researchers to continue further studies.

References

Abbas, M., Sheikh, A. D., Muhammad, S., & Ashfaq, M. (2003). Role of print media in the dissemination of recommended sugarcane production technologies among farmers in the central Punjab- Pakistan. *Int. J. Agri. Biol.*, 5: 26–9.

Abbas, M., Hassan, S. A., & Lodhi, T. E. (2009). Role of extension services in promoting Agroforestry in district Bahawalpur. *J. Agri. Res. 47*(2), 211-219.

Abraham, R. (2007). Mobile Phone and economic development: Evidence from fisheries industry in India,' *Information Technology and International Development*, MIT Press, *4(* 1), 5-17.

ABS (2000). Use of the internet by householders, Australian Bureau of Statistics 2000, Cat. no. 8147.0, ABS, Canberra, Australia.

Age, A., Obinne, C., & Demenongu, T. (2012). Communication for sustainable rural and agricultural development in Benue State, Nigeria. *Sustainable Agriculture Research 1* (1) 118-129.

Ahmed, M. I. & Lentz, E. C. (2008). Enhancing the livelihoods of the rural poor throughout ICT: A knowledge map. *Working paper no.* 11, Bangladesh Country Study, infoDev.

Ahmed, S. M.Z., Munshi, N. U., & Ahmed, M. U. (1996-1997). Library and information services to the rural community in Bangladesh: CDL's experience. The Dhaka University Studies, 54(1), 129-138.

Akbar, S. U., & Sumaiya, N. (2013). e-Krishok- A Service Brand to Develop and Promote ICT Enabled Solutions Targeted to Farmers and Agro- Business

Aker, J. C., & Mbiti, I. M. (2010).Mobile and Economic Development in Africa, *Working papers*, Center for Global Development, ICT for Development, *Working Paper Series, 3(*2), December, 2013 , Dhaka.

Aker, J. C. (2008). 'Does Digital Divide or Provide? The Impact of Cell Phones on Grain Markets in Niger', *mimeo*, 61.

Alam, M. K., & Haque, Md. A. (2014). Contribution of Television Channels in Disseminating Agricultural Information for the Agricultural Development of Bangladesh: A Case Study. *Library Philosophy and Practice (e-journal).* Paper 1048.

Ani, A. O., & Baba, S. A. (2009). Utilization of selected electronic mass media as sources of agricultural information by farmers in Northern part of Taraba state, Nigeria. *Tropical Agric. Res. & Ext. 12* (1), 17-21.

Ani, A.O., Undiandeye, U. C., & Anogie, D. A. (1997). The role of mass media in agricultural information in Nigeria, *Educational forum, 3*(1): 80-*85.*

Annual Report (2012). Practical Action, Bangladesh, Retrieved from file:///C:/Users/USER/Downloads/Annual%20Report%20%202013.pdf

A2I. (2011). *Strategic Priorities of Digital Bangladesh.* Dhaka: Access to Information (A2I)

Bamka, W. J. (2000). Using the internet as a farm-marketing tool. *J. Ext.* 38(2).

BBS (2009). *Statistical Pocketbook of Bangladesh 2008*, Bangladesh Bureau of Statistics (BBS), Planning Division, Ministry of Planning, Government of People's Republic of Bangladesh.

BBS (2013). *Statistical pocketbook of Bangladesh 2012*, Bangladesh Bureau of Statistics (BBS), Planning Division, Ministry of Planning, Government of People's Republic of Bangladesh.

BBS (2014). *Yearbook of Agricultural Statistics 2012*, Statistics and Information Division, Ministry of Planning, August, Government of the People's Republic of Bangladesh.

BBS (2015). *Statistical pocketbook of Bangladesh 2014*, Bangladesh Bureau of Statistics (BBS), Planning Division, Ministry of Planning, Government of People's Republic of Bangladesh.

Bannister, F., & Remenyi, D. (2003). The societal value of ICT: First steps towards an evaluation framework. *Electronic Journal of Information Systems Evaluation*, *6*(*2*): 197-206.

Bangladesh Economic Review (2015). Economic Advisor's Wing, Finance Division, Ministry of Finance, Government of People's Republic of Bangladesh.

Bell, J. (1999). Doing your research project: a guide for first-time researchers in education and social science (3rd ed.). Buckingham; Philadelphia: Open University Press.

Bertolini, R. (2004). Making Information and Communication Technologies Work for Food Security in Africa .2020.IFPRI Brief-Africa Conference brief II, International Food policy Research Institute, Washington, USA, October 2004. http://www.ifri.org/publication/making -information -and-communication -technologies-work-food-security-Africa

Birkhaeuser, D., Evenson, R. E., & Feder, G. (1991). The economic impact of agricultural extension: A review. *Economic Development and Cultural Change* 39, 607–650.

Bless, C. & Higson-Smith, C. (2000). Fundamentals of social research methods (3rd ed.). *An African perspective*. Cape Town: Juta.

Boa, E. & Kelly, P. (2007). Policy and Planning Workshop on Plant Health Services. Spectra Convention Centre, Dhaka, Bangladesh, 5-6 December 2007. Retrieved from http://aas-bd.org/wp-content/uploads/2014/05/xiii-Bangladesh-Policy-and-Planning-Workshop-on-Plant-Health-Services-2007.pdf

Bowonder, B. & Yadav, Y. (2005).Developing ICT platform for enhancing agricultural productivity: The Case Study of EID Parry. Int. J Services Technology and Management, *6*(3), 4/5/2005.

Bolorunduro, P. I., Iwuanyanwu, I. E. J., Aribido, S. O., & Adesehinwa, A. O. K. (2004). Effectiveness of extension dissemination approaches and adoption levels of livestock and fisheries technologies in Nigeria. J. Food Agri. Environ., *2*(1).

Buren, E. D. (2000). Cultural Aspects of communication for development. Translator: *Falsafi,S. Tehran. IRIB Press. Iran*, 110-114.

Butt, S. (2002). *Role of television in the dissemination of agricultural technologies among the farmers of Tehsil Faisalabad*, Masters Dissertation, University of Faisalabad, Punjab, Pakistan.

Cash, D. W. (2001). In order to aid in diffusing useful and practical information: Agricultural extension and boundary organizations. *Science Technology and Human Values*, 26, 431–453.

CEDA. (2001). *Impact Evaluation of AICC's Publication, Radio and Television Program*, Final report. Economic Survey. 2011, Government of Nepal.

Chapman, R. & Slaymaker, T. (2002). ICTs and rural development: review of the literature, current interventions and opportunities for action. In: *Working Paper 192*, *Overseas Development Institute*, London.

Chapman, R., Blench, R., Kranjac-Berisavljevic, G., & Zakariah, A.B.T. (2003). Rural Radio in Agricultural Extension: The Example of Vernacular Radio Programmes on Soil and Water Conservation in Northern Ghana, *Agricultural Research & Extension Network*; Network Paper No. 127 January 2003 ISBN 0 85003 640 2.

Chhachhar, A. R., & Hassan, Md. S. (2013). The Use of Mobile Phone Among Farmers for Agriculture Development. *International Journal of Scientific Research* (IJSR), *2*(6), June 2013: ISSN No 2277- 8179.

Cronbach, L. J. (1970). Essentials of psychological testing (3rd ed.). New York: Harper & Row.

Das, S., & Kabir, W. (2014). Rural innovations in agricultural information service delivery in Bangladesh. *Asia-Pacific Journal of Rural Development (APJORD)*, 14(1), July 2014, 55-66.

Das, S. (2011). Improving Information Services and their Characteristics in the National Agricultural Research System. Unpublished M Phil Thesis. University of Dhaka, Bangladesh.

Das, S. (2012). The present status of Bangladesh NARS information system and a proposed model for the digital up-gradation. Knowledge Society: Innovation in librarianship (ILAKSIL 2012), 57th All India Library Conference Proceedings, Manglore, February 23-25, 2012. 485-495.

Das, H. P., Doblas–Reyes, F. J., Garcia, A., Hansen, J., Mariani, L., Nain, A., Ramesh, K., Rathore, L. S., and Venkataraman, R. (2010). *Chapter 4: Weather and Climate Forecasts for Agriculture*. In in *Guide to Agricultural Meteorological Practices (GAMP)*. Geneva, CH: WMO.

Dash, A. K., & Mishra, M. (2004). Krishi Vigyan Kendra : The Light House for Rural People. Orissa Review, October 2004, Orissa, India. Retrieved from www.orissa.gov.in/e-magazine/.../oct2004/.../krishivigyankendra.pdf

Defleur, M. L., & Dennis, E. E. (1981). *Understanding mass communications*. Boston: Houghton Mifflin.

de Silva, H. & Ratnadiwakara, D. (2008). Using ICT to Reduce Transaction Costs in Agriculture through Better communication: A case- study from Sri Lanka. LIRNeasia, Colombo Sri-Lanka. Research carried out with the aid of a grant from the International Development Research Centre, Ottawa, Canada, Nov. 2008, http://www.lirneasia.net.

de Janvry, A., Fafchamps, M., & Sadoulet, E. (1991). Peasant household behaviour with missing markets: some paradoxes explained. *Economic Journal*, *101*(409). 1400 1417.

Dey, B. L., Prendergast, R., & Newman, D. (2008). How can ICTs be used and appropriated to address agricultural information needs of Bangladeshi farmers? GlobDev 2008, 21.

Dhanraj, A. P. (2010). A Voice for the Voiceless: The Role of Community Radio in the Development of the Rural Poor, International Journal of Rural Studies (IJRS).*17*(1), April 2010 ISSN 1023–2001. Retrieved from www.vri-online.org.uk/ijrs Article 3, 7-9.

Diso, L. I. (1994). Information polices and government guidance in Nigeria : what hope for communities? Resources sharing and Information Networks, *9*(2), 141-151.

Ekbia, H. R., & Evans, T. P. (2009). Regimes of information: Land use, management, and policy. *The Information Society*, *25*(5) 328–343.

Ekoja, I. I. (2004). Sensitising users for increased information use: the case of Nigerian farmers. *African Journal of Library, Archives and Information Science, 14*(2), 193-204. en.wikipedia.org/wiki/ sample size determination.

Carmen, E., & Tjia, P. (2005). Offshoring Information Technology', Cambridge University Press, preface. http://people.uwec.edu/piercech/researchmethods/data.

FAO (2001). Knowledge and information for food security in Africa from traditional media to the Internet *Communication for Development Group, Sustainable Development Department. Rome.*

FAO (2005). FAO Final report. Rome: France. Jamison, D.T. & McAnany, E.G.(1997). Radio for education and Development, Sage Publication: UK.

FAO. (2009). Global Mobile Connections to Surpass 6 Billion by Year-end. 2011. Wireless

Intelligence. Accessed September 15 2011. *How to Feed the World 2050*. 2009. UNFAO. Retrieved from https://www.wirelessintelligence.com/analysis/pdf/2011-09-08-global-mobile-connections-to-surpass-6-billion-by-year-end.pdf

Fafchamps, M. & Vargas Hill, R. (2005). Selling at the farmgate or travelling to market. *American Journal of Agricultural Economics 87*(3), 717-734.

Forum for Agricultural Research in Africa FARA, (2009). Inventory of Innovative Farmer Advisory Services using ICT.W3c Workshop April 1-2 2009, Maputo, Mozambique.

Fong, M.W. L. (2009). Digital Divide between Urban and Rural Regions in China. *The Electronic journal on Information Systems in Developing Coutries*, EJISDC Vol. 36, No.6, Pp 1- 2.http://www.ejisdc.org/ojs2/index.php/ejisdc/article/viewFile/ 532/268.

Fossard, E. D. (2005). *Writing and Producing Radio Dramas*. Sage Publications, New Delhi. 286 *J. Basic. Appl. Sci. Res., 4*(1)281-288, 2014.

Gakuru, M., Winters, K., & Stepman, F. (2009). Inventory of Innovative Farmer Advisory Sciences

Galloway, L., & Mochrie, R. (2005). The use of ICT in rural firms: A policy orientated literature review. *The Journal of Policy, Regulation and Strategy for Telecommunications* (*7*) 33–46.

Gill, J., & Johnson, P. (2002). Research methods for managers, 3rd, SAGE publication, London

Gommes, R., Acunzo, M., Baas, S., Bernardi, M., Jost, S., Mukhala, E., & Ramasamy, S. (2010). Communication approaches in applied agro meteorology. Chapter II.D in Stigter, K. (Ed.), Applied agrometeorology, Springer Verlag, (Heidelberg etc.), pp. 263-286. ISBN: 978-3-540-74697-3

Government of India. (2001). *Report of Prime Minister's task force on India as knowledge superpower*. New Delhi: Planning Commission, Government of India. New Delhi, June 2001

Goyal, A. (2010). Information, direct access to farmers, and rural market performance in Central India. American economic. *Journal Applied Economics, 2* (3), 22-45.

Gupta, D. K. (2005). Modern encyclopedia of media and mass communication. Vol.1, *Rajat Publications*, New Delhi, India.

Hafkin, N. J., & Odame, H. H. (2002). Gender, ICTs and agriculture. A situation analysis for the 5th Consultative Expert Meeting of CTA's ICT Observatory meeting on gender and agriculture in the information society. Retrieved from http://www.cta.int/ observatory 2002/ back ground _paper.pd

Hanumankar, H . R. (2011). Application of ICT in Agricultural Extension: An Evaluation Study of Kissan Call Centres (KCCs). In: Saravanan, R., Kathiresan, C., and Indra Devi, T., (Eds). Information and Communication Technology for Agriculture and Rural Development, New India Publishing Agency, New Delhi.

Hassan, M. S., Hassan, M. A., Samah, B. A., Ismail, N., & Shaffril, H.A.M. (2008). Use of information and communication technology (ICT) among agri-based entrepreneurs in Malaysia. *Proceedings of the World Conference on Agricultural Information and IT* (753 - 762). Japan: Atsugi.

Herselman, M. E. (2003). ICT in rural areas in South Africa: Various case studies. *In Proceedings of Informing Science + Information Technology Education Joint Conference* 945–955).

High, J., & Jacobson, M. (2005). Internet-based natural resource extension. *J. Ext. 43* (3).

Hasan, M. (2015). Mobile phone: an instrument of disseminating Requisite agricultural information for the Agricultural development of Bangladesh: A case study.

Hasan, Md. N., Hossain, S. M., Islam, Md. R., & Bari, Md. A. (2013).Trend in the availability of agricultural land in Bangladesh. *Soil Resource Development Institute (SRDI),* Dhaka.

Hoppe, M. J., Wells, E. A., Morrison, D. M., Gilmore, M. R., Wilsdon, A. (1995). Using focus groups to discuss sensitive topics with children. *Evaluation Review, 19*(1), 102-14.

Hoq, K. M.G. (2011).*Information for rural development: Assessment of needs and designing a dissemination system for Bangladesh.* Unpublished Ph D Dissertation, University of Dhaka, Bangladesh.

Hussain, M. (2005). Mass media. In: Memon, R.A. and E. Bashir (eds.). Extension Methods (3rd ed.). National Book Found, Islamabad, Pakistan. 208-261.

Hussain, S. G., Chowdhury, M. K. A., & Chowdhury, M . A. H. (2012). Land Suitability Assessment and Crop Zoning of Bangladesh. Bangladesh Agricultural Research Council, Farmgate, Dhaka, 110.

IICD (2006). ICTs for Agricultural livelihoods: Impact and Lessons learned from IICD supported activities. IICD. Retrieved from http://www.ftpiicd .org/flies/publications/IICD-agri-impact-2006.pdf.

IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308, *4*(4), April 2015. Retrieved from http://www.ijret.org

Irfan, M., Muhammad, S., Khan, G. A., & Asif, M. (2006). Role of mass media in the dissemination of agricultural technologies among farmers. *International Journal of Agriculture and Biology*, *8* (3), 417- 419.

Islam, S., & Jamal, A. A. (2003). *Banglapedia: National Encyclopedia of Bangladesh (*ist ed.*)*. Dhaka, Bangladesh: Asiatic Society of Bangladesh.

Islam, M. A., & Hoq, K. M. G. (2010). Community Internet Access in Rural Areas: A study on Community Information Centres in Bangladesh. *Malaysian Journal of Library & Information Science, 15*(*2*) August 2010,109-124.

Islam, M.S. (2006). Status of rural library and information services in Bangladesh: Directions for the development. *The Social Science Review, 1*(11), 15-21.

Islam , M. A., & Bijlmakers, H. W. L. (2007). Changing the strategies of Farmer Field Schools in Bangladesh, *LEISA Magazine, 23(*4), December 2007.

Islam, M. S. (2011). Creating Opportunity by connecting the Unconnected Mobile phone based Agriculture Market Information Service for Farmers in Bangladesh, Orebro Sweden November 2011.

Islam, A., & Islam, M. (2008). Community information services in Bangladesh: A case study on community information Centre (Cic). *Library Herald, Journal of The Delhi Library Association,* 46(4), 225-280.

ITU. (2010). World Telecommunication/ICT Development Report 2010: Monitoring the *WSIS (World Summit on Information Society) targets –A mid-term review*. Geneva, Switzerland; International Telecommunication Union.

ITU. (2013). *Measuring Information Society*. Geneva, Switzerland: International Telecommunication Union.

Javaid, N., Yousaf, M., Ahmad, A., Naveed, A., & Djouani, K. (2011). *Evaluating impact of mobility on wireless routing protocols*. *Paper* presented at the Wireless Technology and Applications (ISWTA), 2011 IEEE Symposium on.

Javaid, N., BiBi, A., Javaid, A., Khan, Z., Latif, K., & Ishfaq, M. (2013). Investigating quality routing link metrics in Wireless Multi-hop Networks. annals of telecommunications-annales des télécommunications, 1-9.

Jensen, A. L., & Thysen, I. (2003). Agricultural information and decision support by SMS. Proceedings of the EFITA 2003 Conference (pp. 286 – 292). Hungary: Debrecen.

Jones, G. E., & Garforth, C. (1997). The history, development, and future of agricultural extension. In B. Swanson (Ed.), *Improving agricultural extension: A reference manual* (3rd ed.). Rome, Italy: FAO.

Kabir, M. H. & Rainis, R. (2013). Sustainable development strategies and challenges for promotion of Integrated Pest Management (IPM) Program in Bangladesh Agriculture. American-Eurasian Journal of Agriculture & Environment Science, 13 (7), 988-995.

Kalirajan, K. P., & Shand, R. T. (1984). Types of education and agricultural productivity: a quantitative analysis of Tamil Nadu rice farming. *J. Dev. Stud., 21,* 232-243.

Kallioranta, S. M., Vlosky, R. P., & Leavengood, S. (2006). Web-based communities as a tool for extension and outreach. *J. Ext*. *44* (2).

Kashem, M. A., Faroque, M. A. A. (2010). Agricultural Technology: A challenge to way forward sustainable development. Bangladesh J. Train. and Dev. *21*(23), (1&2) 2008-10:97-108.

Kavulya, J. M. (2007). Digital libraries and development in Sub-Saharan Africa: A review of challenges and strategies. The electronic library, 25(3), 299-315.

Kee, J., Lomas, J., Milford, A., Ravelo, R., Samui, D. R., Walker, P. S., Shili, W., & Weiss, A., (2010). Meeting farmers' needs for agro-meteorological services: An overview and case studies, Agromet Vision, P.O. Box 16, Bruchem, Bondowoso, The Netherlands, Indonesia.

Kefela, G. T. (2011). The impact of mobile phone and economic growth in developing countries. *African Journal of Business Management*, *5*(2), 269-275.

Kelsey, T.W., Dougherty, M. J., & Hattery, M. (2002). Information technology use by local government in northeast: assessment and needs. *J. Ext. 40* (5).

Kenny, C. (2002). Information and communication technologies for direct poverty alleviation: costs and benefits. *Dev. Policy Rev*. *20* (2): 141-157.

Khan, S. R. A. (2002). *Agriculture of Pakistan: Challenges and remedies*: Environ Publications.

Khan, G. A. (2010). *Present and prospective role of electronic media in the dissemination of agricultural technologies among farmers of the Punjab, Pakistan*. (Unpublished Ph.D. Dissertation) University of Agriculture, Faisalabad, Pakistan.

Khushk, A. M., & Memon, A. (2004). *Impact of Devolution on Farm Extension System*. P: III. *The Daily Dawn*, November 1–7, 2004.

Kiplang'at, J. (1999). An analysis of the opportunities for information technology in improving access, transfer and the use of agricultural information in the rural areas in Kenya, *Library Management, 20(*2),115-127.

Klonner, S. & Nolen, P. (2008). Does ICT benefit the poor? Evidence from South Africa University of Essex – mimeo.

Kothari, C. R. (2005). *Research Methodology, Methods & Techniques*, New age International (p) Ltd, Publishers, New Delhi, India.

Krishi Diary (2016). Agriculture Information Service, Ministry of Agriculture, Govt. of the People's Republic of Bangladesh.

Kushwaha, H. S., Menkamehra, H. K. R., & Singh, R. S. (2008). Economic impact analysis of Agro-meteorological services for farmers of tarai and Bhabar. *Journal of Agro-meteorological service for farmers*, 187-194.

Kyem, K., Kweku, P. A., & Le Maire, P. (2006). Transforming recent gains in the digital divide into digital opportunities: Africa and the boom in mobile Phone, Central Connecticut State University, USA. *Electronic Journal of Information Systems in Developing Countries (28).*

Lall, A., & Sahi, S. (2009). Taking ICT to the grassroots: A case study of the Lifelines India initiative. *Information Technology in Developing Countries*, *19*(1), 13-16.

Lankshear, A. J. (1993). The use of focus groups in a study of attitudes to student nurse assessment. *Journal of Advanced Nursing*, *18*, 1986-89.

Lee, Y. H., Hsieh, Y. C., & Hsu, C. N. (2011). Adding Innovation Diffusion Theory to the Technology Acceptance Model: Supporting Employees' Intentions to use E-Learning Systems. *Educational Technology & Society, 14* (4).

Lee, K. H., & Bellemare, M. F. (2013). Look Who's Talking: The Impacts of the Intrahousehold Allocation of Mobile Phones on Agricultural Prices. *Journal of Development Studies*, *49*(5), 624-640. 10.1080/00220388.2012.740014

Leeuwis, C., & Van den Ban, A. (2004). Communication for rural innovation: Rethinking agricultural extension (3rd ed.). Blackwell Science, CTA, Oxford/ Wageniengen.

Locke J. C. W, Millar, A. J., & Turner, M. S. (2005). Modelling genetic networks with noisy and varied experimental data: the circadian clock in Arabidopsis thaliana. *Journal of Theoretical Biology,* 234 (2005) 383–393. Retrieved from millar.bio.ed.ac.uk/AJM%20refs/Locke%20JTB%2005.pdf

Loges, W.E. (1994). Canaries in the coal mine: perceptions of threat and media system dependency relations. Commun. Res. *21*(1), 5–23.

Lwoga, E. T. (2010). Bridging the agricultural knowledge and information divide: The case of selected telecenter and rural radio in Tanzania. *EJISDC*, 43: 1-14.

Mahmood, M. A., & Sheikh, A. D. (2005). Crop yields from new technologies. pp 3. Daily Dawn. Accessed on 15 May 2012. Retrieved from dawn.com.

Mahmood, K. (2005). Multipurpose community telecenters for rural development in Pakistan. *Electronic Library*, *23*(2), 204-220.

Malhan, I.V., & Rao, S. (2007). Impact of globalization and emerging information communication technologies on agricultural knowledge transfer to small farmers in India. World Library & Information Congress,73rd Ifla General Conference & Council, 19-23 Aug. 2007, Durban, South Africa.

Mangstl, A. (2008). Emerging issues, priorities and commitments in e-Agriculture. *Agriculture Information Worldwide, 1*(1), 5 – 6.

Mannan, S. M., & Bose, M. L (1998). Resource sharing and information networking of libraries in Bangladesh: a study on user satisfaction. *Malaysian Journal of Library & Information Science*, *3*(2), 67-86.

Mannan, S. M., & Ahemd, M.U. (1994). A plan for rural development information system in Bangladesh. *The Dhaka University Studies*, *51*(2), 52-60.

Mears, C. L. (2009). Interviewing for education and social science research: The gateway approach. NewYork: Palgrave Macmillan.

Meera, S. N., Jhamtani, A., & Rao, D. (2004). Information and communication technology in agricultural development: A comparative analysis of three projects from India. *Agren. Network Paper* (135), 1-14.

Malone, P., Akbar, U.S., Bell, M., & Bohn, A. B. (2013).MEAS Report on the Status of ICT for Agricultural Extension in Bangladesh, MEAS ICT Support Project , USAID, January, 2013. Retrieved from http://www.meas-extension.org/meas-offers/country_studies/country-overview/Bangladesh

Mittal, S. & Tripathi, G. (2009). Role of mobile phone technology in improving small farm productivity. *Agricultural Economics Research Review*, Agricultural Economics Research Association *(*India*),*vol. 22(2009).

Mittal, S., Gandhi, S., & Tripathi, G. (2010). *Socio-economic impact of mobile phones in Indian agriculture* (Working Paper no. 246). Indian Council for Research on International Economic Relations.

Mital, S., & Mehar, M. (2012). How Mobile Phones Contribute to Growth of Small Farmers? Evidence from India, *Quarterly Journal of International Agriculture, 51(* 3), 227-244.

Mittal, S., Gandhi, S., & Tripathi, G. (2010). *Socio-economic impact of mobile phones in Indian agriculture* (Working Paper no. 246). Indian Council for Research on International Economic Relations.

Mohammad, R. N., Salleh, M. D, & Hasbullah, A. H. (2010). Radio as an Educational Media: impact on Agricultural Development *The Journal of South East Asia Research Centre for communication and Humanities*, *2*(1), 13-20.

Muhammad, S. (2005). Agricultural Extension: Strategies and Skills. Unitech Commun. Faisalabad, Pakistan.

Munyua, H., Adera, E., & Jensen, M. (2008). Emerging ICTs and their potential in revitalizing small scale agriculture in Africa. *Proceedings of the World Conference on Agricultural Information and IT,* 707 - 718. Japan: Atsugi.

Murithi, A. G., Bett, E., & Ogaleh, S. A. (2009). Information technology for agriculture and rural development in Africa: Experiences from Kenya. Paper presented at the conference on International research on Food Security, *National Resources Management and Rural development*, Tropetag: University of Hamburg, October 6-8 2009.

Murthy, C. S. H. N. (2009). Use of convergent mobile technologies for sustainable economic transformation in the lives of small farmers in rural India. *The Turk. Online J. Dist. Educ.10* (3): 32-4.

Murty & Albino. (2012). Electronic media in rural agricultural business- A promotional injection. *National monthly refereed journal of research in science & technology*. *1* (11), 63-68.

Muto, M., & Yamano, T. (2011). Mobile Phone Coverage and Market Participation: The Case of Banana Marketing in Uganda Emerging Development of Agriculture in East Africa. *Springer,* 99-113.

Muto, M., & Yamono, T. (2009). The impact of mobile phone coverage expansion on market participation: Panel data evidence from Uganda, World development *37*(1), 1887-1886.

Nakabugu, S. B. (2000). The role of Rural Radio in Agricultural and Rural Development Translating Agricultural Research Information into Messages for Farm Audiences. First International Workshop on Farm Radio Broadcasting. Retrieved from http://www.fao.org/docrep/003/x6721e/x6721e31.htm.

National Agricultural Extension Policy (NAEP), (Draft). (2012). Government of the People's Republic of Bangladesh, Ministry of Agriculture (MoA). Retrieved from dae.portal.gov.bd/...bd/page/.../National%20Agricultural%20Extension%...

National Integrated Pest Management Policy (2002). Government of the People's Republic of Bangladesh, Ministry of Agriculture (MoA). Retrieved from dae.portal.gov.bd/...gov.bd/.../National%20Agricultural%20Extension%...

Nazari, M., & Hasbullah, A. (2008). Farmers' approach and access to information and communication technology in the efficient use of modern irrigation methods. Europ. *J. Sci. Res., (EJSR*), *21*(1), 38-44.

Nazari, M. R., & Hassan, M. S. B. H. (2011). The role of television in the enhancement of farmers' agricultural knowledge. *African Journal of Agricultural Research, 6*(4), 931-936.

Nazaril, M., Bin, H., & Hassan, S. (2011). The role of television in the enhancement of farmers' agricultural knowledge. *African Journal of Agricultural Research*, *6*(4), 931-936.

Nyareza, S. & Dick, A. L. (2012). Use of community radio to communicate agricultural information to Zimbabwe's peasant farmers. *Aslib Proceedings*, *64(*5), 494-508.

Oakley, P. & Garforth, C. (1985). Guide to Extension Training, FAO, Rome, Italy.

Okwu, O. J., Kaku, A. A., & Aba, J. I. (2007). An assessment of use of radio in agricultural information dissemination: a case study of radio Benue in Nigeria. *African J. Agri. Res*., *2*(1): 014-018.

Okorie, N., & Tunji, O. (2011). Newspaper reportage and its effect towards promoting agricultural development in Nigeria. *Journal of Media and Communication Studies*, 3(2), 27-32. Retrieved from http://www.academicjournals.org/jmcs ISSN 2141-2545.

Olowu, T. & Oyedokun, O. (2000). Farmers' Accessibility of Agricultural Marketing Information: The Case of Oyinladun Radio Programme. J. Econ. Rural Devpt, *14*(1), 109-125.

Ommani, A. R. & Chizari, M. (2008). Information dissemination system (IDS) based e-learning in agricultural of Iran (perception of Iranian extension agents*). World Academy of Science, Engineering and Technology*, 38, 468–472. Retrieved from http://www.waset.org/journals/waset/v38/v38-84.pdf.

Opara, U. N. (2008). Agricultural Information sources used by farmers in Imo State, Nigeria. *Information Development*, *24*(4), 289–295.

Oppenheim, A. N. (2001). Questionnaire, Design, Interview and Attitude measurement. London: Continuum.

Overa, R. (2006). Networks, Distance and Trust: Telecommunications Development and changing Trading Practices in Ghana. *World Development*, *34*(7), 1301–1315.

Parikh, T. S. (2009). Engineering rural development. *Communications of the ACM*, 52(1), 54 – 63.

Powell, R. A., & Single, H. M. (1996). Focus groups. *International Journal of Quality in Health Care. 8*(5), 499-504.

Prasada, R., G. S. L. H. V., & Manikandan, N. (2008). Economic impact of agro-meteorological advisory services over the Central Zone of Kerala. *Journal of Agro-meteorology* (Special issue – Part I): 230–234.

Qamar, K. (2006). Agricultural extension in Asia and Pacific: Time to revisit and reform. In: Sharama, V. P. (ed.), Enhancement of Extension System in Agriculture. Asian Productivity Org. (Report of the APO Sem. Enhancement of Ext. Systems in Agric. held in Pakistan, 15-20 Dec. 2003 (03-AG-SEM-06).

Quamal, S. B. & Ozawa, S. (2013). Acceptance of ICT-Enabled SERVICES ANMONG Bangladeshi Farmers, ICT for Development, Working Paper Series, *3(*2), December, 2013.

Qaisar, T.M., Khan, M. M. A., & Alam, S. (2011). Innovative Agricultural Information Services by ICT Projects in India, International Journal of Trade, Economics & Finance; August 2011, *2*(4), 276.

Rahman, M. G. (1999). *Communication Issues in Bangladesh*. Har-Anad Publication: India.

Rao, N. H. (2007). A framework for implementing information and communication technologies in agricultural development in India. *Technological Forecasting and Social Change*, *74*(4), 491-518.

Rao, G.S.L.H.V.P., Manikandan, N. (2008). Economic impact of agrometeorological advisory services over central Kerala. Journal of Agrometeorology, (India) (Special issue) 10, 230-234.

Rashid, S. (2011). Changing Wetland Ecosystem and Inland open Water Fisheries of Bangladesh: the case of Koibortta fishers of Kishoregonj, Social Review, *28*(2),134.

Rashid, A. T. & Elder, L. (2009). Mobile phones and Development: An Analysis of IDRC-supported projects. *The Electronic Journal on Information Systems in Developing Countries*, EJISDC *36*(2), 1-16. Retrieved from http://www. Ejisdc.org/ojs2/index.php/ejisdc/article/view File/529/265.

Richardson, D. S. (2000). Skill and economic value of the ECMWF ensemble prediction system. Quart. *J. Roy. Meteor. Soc.*, 126, 649–668.

Rolle, R., & Satin, M. (2002). Basic requirements for the transfer of fermentation technologies to developing countries. *International journal of food microbiology*, *75*(3), 181-187.

Saravanan, R., & Bhattacharjee, S. (2014). Mobile Phone Applications for Agricultural Extension in India, In: Saravanan, R (Ed.).Mobile Phones for Agricultural Extension: *Worldwide mAgri Innovations and Promise for Future, New India Publishing Agency*, New Delhi. 1-75.

Saadi, H., Mahdei, K. N., & Movahedi, R. (2008). Surveying on wheat farmers' access and confidence to Information and Communication Channels (ICCs) about controlling eurygaster integriceps in Hamedan province, Iran. *Amer. J. Agri. and Biol. Sci*. *3*(2): 497-501.

Sadaqath, S., & Mariswamy, H. K. (2007) Analysis of Usefulness and Credibility of Radio as Perceived by Literate Farmers, Department of Extension Education University of Agricultural Sciences, Dharwad - 580 005, Karnataka, India Karnataka J. Agric. Sci., 20(4), 784-787.

Salam, S. A. & Arman, Z. R. (2013). Use of Information and Communication Technologies in the Fisheries Sector: A study on the Fisherfolk from Kutubdia Island of Bangladesh ICT for Development working Paper Series, vol-3 Number-2 December 2013, Bangladesh.

Schumuck, R. A. (2006). Practical action research for change (2nd edition).California: Corwin press, Inc.

Senthilkumaran, S., (2011), Village Knowledge Centres and Village Resourse Centres: An overview. In: Saravanan, R., Kathiresan, C., and Indradevi, T. (Eds). Information and Communication Technology for Agriculture and Rural Development. New India Publishing Agency, New Delhi, India.

Settle, W. H., Milki, A.K.M. G., & Halim, A. (2000). Integrated Pest Management (IPM), Report of the Evaluation Mission of IPM Projects in Bangladesh November 2000 Mission Members. Food and Agriculture Organization of the United Nations.

Sharma. N. K. (2008). Impact Study of Farm radio Program produced by Agriculture information and Communication Centre: A case Study from the farmers of Phalebas Kannigian V.D.C. of Parvat District, Unpublished Master's Thesis, T.U.

Sharma, G. (2010). Agriculture Extension Service and Knowledge Dissemination: Past Experiences, Present Status and Strategies for Effective Research to Farmers in Changed Context. Proceedings of the sixth National Horticulture Conference held at Kirtipur, Kathmandu, March 11-12, 2010, Nepal Horticulture Society.

Sher, M. (2001). Agricultural extension, strategies & skills. Faisalabad: *Uni-Tech Communication.*

Singh, S. (2006). *Selected Success Stories on Agricultural Information Systems*. Asia-Pacific Association of Agricultural Research Institutions, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, September 2006, Bangkok 10200, Thailand.

Singh, A. K. (2001). Agricultural Extension: Impact and Assessment. *Agro bios*, Jodhpur, India. Retrieved from www.bd.undp.org/content/bangladesh/.../access-to-information--ll-.html.

Singh, R. (2012). Women entrepreneurship issues, challenges and empowerment through self help groups: an overview of Himachal Pradesh. *International Journal of Democratic and Development Studies*, 1(1) 45-58.

Siraj, M. (2011). A model for ICT based services for agriculture extension in Pakistan. Retrieved from http://www.cabi.org date 4, 12 2013.

Stewart, D. W., & Shamdasani, P. N. (1990). Focus Groups: Theory and Practice, Sage Publications, Newbury Park, California.

Sterling, S. O'Brien, J., & Bennett, J. (2007). Advancement through Interactive Radio. *Information Systems Frontiers*, *11*(2), April 2009.

Stigter, K., Baier, W., Barrie, I., Brunini, O., Dommermuth, H., Gat, Z., Gommes, R., & Keane, T. (2010) Chan Ah General. Chapter 1 inGuide to Agricultural Meteorological Practices (GAMP), WMO 134 (3rd Ed.), WMO, Geneva.

Stigter, K. (Ed.). (2010a). Applied agro-meteorology. *Springer*, Heidelberg etc., xxxviii + 1101 pp. *International Maize and Wheat Improvement Center (CIMMYT)*, New Delhi, India

Tahir, M., Javaid, N., Iqbal, A., Khan, Z. A., & Alrajeh. (2013). On adaptive energy efficient transmission

Talbot, C., & Newman, D. R. (1998). Beyond Access and Awareness: Evaluating Electronic Community Networks, London: British Library, British Library Research and Innovation *Report* 149. Retrieved from http://www.qub.ac.uk/mgt/cicn/beyond/.

Tajdar, M. Q., Khan, M. M. A., & Alam, S. (2011). International Journal of Trade, Economics and Finance, *2(*4), August 2011.

Taragola, N. M., & Van Lierde, D. F. (2010). Factors affecting the internet behaviour of horticultural growers in Flanders, Belgium. *Computers and Electronics in Agriculture*, 70, 369–379.

Tawari, D. (2006). Methods of Teaching Communication. *Cresent Public. Corp*. New Delhi, India.

Terry, Jr., R. (1994). Understanding and perceptions about agriculture of television news reporters. Proceedings of the Western Region Agricultural Education Research Meeting, 13, 54-65.

Tiwari, S. P. (2008). Information and communication technology initiatives for knowledge sharing in agriculture. *Indian Journal of Agricultural Sciences, 78*(9), 737 – 747.

Tortermvasana, K. (2011). ZTE petitions court to block 3G auction. *Bangkok Post.* Retrieved March 22, 2011. Retrieved from http://www.bangkokpost.com/business/telecom/218201/zte-petitions-court-to-block-3g-auction for Development, Bangalore.

Tunis Commitment. (2005). The World Summit on the Information Society. Tunis, November 16-18, 2005.

Uddin, Md. H. (2002). *Assessment of information needs for the agricultural scientists and researchers in Bangladesh*. Unpublished PhD Dissertation, University of Dhaka, Bangladesh.

Van den Ban, A. W., & Hawkins, F. A. (1992). *Agricultural Extension.* England, Longman Social Technical p. 128.

Veeraraghavan, R., Yasodhar, N., & Toyama, K. (2007). *Warana unwired: Replacing PCs with mobile phones in a rural sugarcane cooperative*. Paper presented at the International Conference on Information & Communication Technologies.

Verlaeten, M. P. (2002). Policy frameworks for the knowledge Based Economy: ICTs, Innovation and human Resources- An OECD Global Forum, Brazil, September 2002.

Waters, D., James, R., & Darby, J. (2011). Health Promoting Community Radio in Rural Bali: an Impact Evaluation. Rural and Remote Health 11 (online), 2011: 1555. Retrieved from http://www.rrh.org.au

Warren, M. F. (2002). Adoption of ICT in agricultural management in the United Kingdom: The inter-rural digital divide. *Agricultural Economics*, *48*(1) 1–8.

Weiss, A., Van Crowder, L., & Bernardi, M. (2000). Communicating agrometeorological information to farming communities. *Agricultural and forest Meteorology*, *103*(1), 185-196.

Williamson, R. D., & Smoak, E. P. (2005). Embracing edutainment with interactive e-learning tools. *J. Ext. 43* (5).

World Bank (2007). Agriculture for Development, *World Development Report*, 2008 386. Faisalabad. (Unpublished Masters Dissertation) University of Faisalabad, Punjab, Pakistan.

World Bank (2008). Agriculture for Development, *World Development Report*, 2008. Retrieved from http://siteresources.worldbank.org/INTWDR2008/Resources/2795087-1192111580172/ WDROver2008-ENG.pdf

Zia, A. (2007). *Effects of cable television on women in Pakistan: A comparative study of heavy and light viewers in Lahore. Unpublished* Doctoral Dissertation, University of Punjab, Pakistan.

Appendix- A
Questionnaire for Beneficiary Group (English Version)

Service Area

☐ AICC ☐ Non AICC ☐ Others (Please Specify)

Basic Information:
Name of the farmer: ..... Age: .....
Educational Qualification: ☐ M.A ☐ B.A ☐ H.S.C ☐ S.S.C ☐ JSC ☐ PSC ☐ Illiterate.

Address of the Farmers - Village: ..... Union: ..... Upazilla: .....
Zilla: ..... Phone No: .....

Section A: Demographic Data (Question No. 1-4)
1. Information of the family members dependent on the interviewee:

Name	Age	Gender (Male/Female)	Education	Occupation	Relation
1.					
2.					
3.					
4.					
5.					

2. Total Area of Land:

Description of Land	**Total (Decimal)**	**Description of Land**	**Total (Decimal)**
Household land area(Except Pond)		Own Land (Except household)	
Obtaining Borga (getting leased)		Providing Borga	
Obtaining Lease		Providing Lease	
Household pond (Number)		Garden	
Land area of household pond		Fish pond/ Fish Gher	
Fallow Land		Others	

3. Household and other assests:

Description	Please give tick mark
House	Tent/Tinshed /tinshed with brickbuilt /brickbuilt
Cowshed	Yes /No
Electricity	Yes /No - National Greed /Solar Panel
Tubewell	Owned /Combined /Others/ Not at all
Agricultural Machinary	Irrigation Pump/Power tiller/Theser/Plough/Spear /Weeder/Net/Boat
Livestock (Nos)	Cows---- Goats----------Sheep---Buffaloes--Duck-----Poultry----Pigeon
Others	Tractor/Rickshaw/Van/ Nasimon/Karimon/Easybike

4. Do you have the following assests?

1. Radio- ☐ Yes ☐ No
2. Mobile- ☐ Yes ☐ No
3. Television - ☐ Yes ☐ No
4. Computer -- ☐ Yes ☐ No
5. Bicycle-- ☐ Yes ☐ No
6. Motor Cycle ☐ Yes ☐ No

Section B: Financial Data (Question No. 5-7)

5. Annual Income:

Serial No.	**Source of Income**	**Total earning**	**Total product cost**	**Neat Profit**
a) Agricultural Sector	Crops			
	Domestic animals (Poultry)			
	Fishery			
	Total taka (Agricultural Sector)			
b) Non - agricultural sector:	Daylabour			
	Service			
	Bussiness			
	Foreign Income			
	Others			
	Total taka (Non Agricultural Sector)			
Total Income (Agri. +Non Agri. Sector) (A+B)				

6. Information regarding loan**:**

Yes	**No**	**Reasons of taking loan**	**Sources of loan**	**Amount of loan (Yearly)**
			NGO / Bank/ Money lender /Relatives	

7. How do you accomplish marketing agricultural products?

☐ Self marketing ☐ through salesman ☐ other ways (please mention)

Section C: Sources of information using ICT tools (Question No: 8-25)

8. Do you watch television regularly?

☐ Yes ☐ No

9. Which T.V programmes do you prefer?

☐ News ☐ Agricultural programmes ☐ Movies ☐ Others (please mention)

10. If you watch programmes related to agriculture, tick the channel (Answer could be more than one)

No	Name of the channels	Name of Agricultural Programs
1	Bangladesh Television	Mati O Manush
2	Bangladesh Television	Krishi Dibanishi
3	Channel I	Hridoye Mati o Manus
4	Channel I	Hridoye Mati o Manuser Dak
5	Channel I	Krishi News
6	ATN Bangla	Matir Subas
7	Bangla vision	Shymal Bangla
8	RTV	Amar Desh
9	Dighonto TV	Sufola Bangladesh
10	Baishakhi TV	Krishi O jibon
11	ETV(India)	Annadata

11. Which technology do you learn by watching these T.V programmes? (Answer could be more than one)

☐ Modern production techniques
☐ Seed production and storage management
☐ Integrated crop management techniques
☐ Hervesting and storage management
☐ Technique of prawn production
☐ Fertilizer and soil management
☐ Irrigation management and weed
☐ Use of agricultural machinery
☐ Production technique of pond prawn
☐ Health care of cattle

12. Do you use mobile phone?

Yes ☐ No ☐

13. How many members of your family use mobile phones?

1. One (self) ☐
2. Two (self and wife) ☐
3. Three or above (other members) ☐

14. Reasons of using mobile phone. (Answer may be more than one)

☐ Family communication ☐ Agricultural information ☐ Entertainment ☐ Others

15. Which service do you choose to obtain agricultural information?

A. 7676 (Banglalink) B. Agri help line 27676 C. Agri. Call centre (09633123123) D. Others

16. Do you listen to the radio? If yes, are you regular in listenting to radio?

☐ Yes ☐ No ☐ Regularly ☐ Irregularly

17. Which programmes do you listen most? (Answer may be more than one)

☐ News ☐ Music ☐ Programmes related to agriculture ☐ Others (please mention)

18. Which radio station do you prefer listening to agricultural programmes?

- ☐ Bangladesh Betar
- ☐ F.M Radio (ABC, TODAY, FURTI ----------)
- ☐ Regional Radio
- ☐ Community Radio

19. Mention some important agricultural programmes that you get informed by listening to radio.

1.....
2.....
3.....
4.....
5 …….

20. How long have you been listenting to those programmes?

21. How do you get information regularly about weather forecast like humidity, cloud, rainfall drought, fog, heat etc.? (Give tick mark)

☐ Radio ☐ Television ☐ Mobile ☐ Extension worker ☐ others

22. How many varieties of crop did you cultivate in the last season?

Name of the Crops	**Variety**	**Sources of ICT (Give tick mark)**				
1. Rabi Season		Radio	TV	Mobile	Extension worker	Others (Please mention)
Rice (Boro)						
Wheat						
Potato						
Maize						
Mustard						
Pulse						
Vegetables						
Sugarcane						
Onion						
Others (Please mention)						
2. Kharif-1						
Rice (Broadcasted Aman)						
Rice (Aus)						
Jute						
Vegetables						
Maize						

Others (Please mention)						
3.Kharif -2						
Rice (Transp lanted Aman)						
Maize						
Onion						
Vegetables						
Others (Plez. mention)						

23. What kinds of fertilizer do you use in growing rice and other crops?

Crops & land area	**Chemical fertilizer**	**Quantity (Kg)**	**Which of the following sources influences you in using fertilizer? (Give tick mark)**				
			Radio	TV	Mobile	Extension worker	Others (Printed materials, Call centre, Website etc.)
Rice (Boro)	Urea (Nitrogen)						
	TSP (Phosphet)						
	DAP (Diamoneium Phosphate)						
	Potash						
	Others(Boron, Salpher, Zinc)						
	Organic Fertilizer						
	Cowdung						
	Varmicompost						
	Others						
Rice (Aus)	Urea (Nitrogen)						
	TSP (Phosphet)						
	DAP (Diamoneium)						

Crops & land area	**Chemical fertilizer**	**Quantity (Kg)**	**Which of the following sources influences you in using fertilizer? (Give tick mark)**				
			Radio	TV	Mobile	Extension worker	Others (Printed materials, Call centre, Website etc.)
	Phosphate						
	Potash						
	Others(boron Salpher Zink)						
	Organic Fertilizer						
	Cowdung						
	Varmicompost						
	Others						
Rice (Aman)	Urea (Nitrogen)						
	TSP (Phosphet)						
	DAP (Dyamoneiums Phosphet)						
	Potas						
	Others(boron Salpher Zinc)						
	Organic Fertilizer						
	Cowdung						
	Varmicompost						
	Others						
Wheat	Urea (Nitrogen)						
	TSP (Phosphet)						
	DAP (Di-amoneium Phosphet)						
	Potas						
	Others(boron Salpher Zink)						

Crops & land area	Chemical fertilizer	Quantity (Kg)	Which of the following sources influences you in using fertilizer? (Give tick mark)				
			Radio	TV	Mobile	Extension worker	Others (Printed materials, Call centre, Website etc.)
	Organic Fertilizer						
	Cowdung						
	Varmicompost						
	Others						
Jute	Urea (Nitrogen)						
	TSP (Phosphet)						
	DAP (Di-amoneium Phosphate)						
	Potas						
	Others(boron Salpher Zink)						
	Organic Fertilizer						
	Cowdung						
	Varmicompost						
	Others						
Potato	Urea (Nitrogen)						
	TSP (Phosphate)						
	DAP (Di-amoneium) Phosphet)						
	Potas						
	Other(boron, Salpher Zinc)						
	Organic Fertilizer						
	Cowdung						

Crops & land area	Chemical fertilizer	Quantity (Kg)	Which of the following sources influences you in using fertilizer? (Give tick mark)				
			Radio	TV	Mobile	Extension worker	Others (Printed materials, Call centre, Website etc.)
	Varmicompost						
	Others						
Maize	Urea (Nitrogen)						
	TSP (Phosphate)						
	DAP (Di-amoneium Phosphate)						
	Potash						
	Others(boron Salpher , Zinc)						
	Organic Fertilizer						
	Cowdung						
	Varmicompost						
	Others						
Pulse	Urea (Nitrogen)						
	TSP (Phosphate)						
	DAP (Diamoneium Phosphate)						
	Potash						
	Other (boron, Salpher , Zink)						
	Organic Fertilizer						
	Cowdung						
	Varmicompost						
	Others						
Mustard	Urea (Nitrogen)						
	TSP (Phosphet)						

Crops & land area	**Chemical fertilizer**	**Quantity (Kg)**	**Which of the following sources influences you in using fertilizer? (Give tick mark)**				
			Radio	TV	Mobile	Extension worker	Others (Printed materials, Call centre, Website etc.)
	DAP (Dyamoneiums Phosphet)						
	Potas						
	Others(boron Salpher Zink)						
	Organic Fertilizer						
	Cowdung						
	Varmicompost						
	Others						

24. Is there any call centre in your locality? If yes, mention the name.
☐ Yes ☐ No Other (name) ----------

25. Mention whether you get any kind of agricultural information from call centre?

Section D: Responses related to crops (Question No. 26-37)

26. Land and production under cultivation.

Name of Crops	**Area of land-Decimal**	**Total Production**	
1. Rabi Season		Present	Previous (2/3year before)
Rice (Boro)			
Wheat			
Potato			
Maize			
Mustard			
Pulse			
Vegetables			
Sugarcane			
Onion			
Others (Plez. mention)			
2. Kharif-1			
Rice (Broadcast)			
Rice (Aus)			
Jute			
Vegetables			

Maize		
Others		
3.Kharif -2		
Rice (Transplanted aman)		
Maize		
Onion		
Vegetables		
Others (Plez. mention)		
Total cultivated land		

Mond = KG Bigha = decimal Kani = Decimal

27. Number of plots and of variety of crops under your farming.

Plots	**Area of plots**	**Rabi**	**Kharif-1**	**Kharif-2**
Plot 1				
Plot 2				
Plot 3				
Plot 4				
Plot 5				
Plot 6				

(A separate sheet may be attached herewith for additional plots)

28. **Cropping Intensity**

Mention the crops that you have cultivated on your land. (Including Lease & Borga)

Crop	**Land area (decimal)**	**Total production (Mond/ M.ton/Bale)**
1 Single crop		
2. Double crops		
3. Triple Crops		
Total land		

29**.** Adaptation of developed technologies for irrigation management system:
Have you any idea about modern irrigation system like AWD, irrigation scheduling etc.?

Season	Crops	Yes	No	Information/ Knowledge/ Technologies
1.Rabi season				
2. Kharif-1				
3. Kharif-2				

30**.** Sourec of irrigation water:

River or Canal water	Pond Water	Collected rain water	Tubewell	Others
			Deep/Shallow	

31. **Distribution System of Irrigation Water:**
Processes of irrigation; which system do you apply? (Give tick mark)

Irrigation System		Irrigation System	
1. Kacha Irrigation Canal		5.Pacca Irrigation Canal	
2.Adha Pacca Irrigation Canal		6. Ferocement Irrigation Canal	
3.Polythene made Irrigation Canal		7. Plastic/ Polythene Hose pipe	
4. Underground Irrigation Canal		8. Others	

32. Do you cultivate "Sesbania "(Dhanchia)" as green mannure? If yes, please mention the land area and time of showing.
☐ Yes ☐ No Land Area ---------- Time of Showing and hervesting ----------

33. Do you cultivate vegetables?
☐ Yes ☐ No

34. Do you think that the cultivation of vegetables has comparatively increased from that of last five years?
If yes, please explain the reasons.

☐ Yes ☐ No
Explanation:

35. Have you ever tested soil of the land you cultivate?
☐ Yes ☐ No

36. Which institution has tested your soil?
☐ SRDI ☐ NGO

37. What type of pest management do you apply in your crops?

Integrated pest management (Non pesticide pest management)	**Please give tick**
1.Parching (Rice)	
2. Light tape	
3. Hand net	
4.Feromon tape (vegetables)	
5.Spray Mehogoni seed water	
6. Seletion of disease defending variety	
7. Use of pesticide	

Section E: Farmers related to Fisheries (Question No. 38-53)

38. How long have you been cultivating fish?
39. Have you any training on fish cultivation? If yes, mention the name of the training authority.
40. Which category does your pond/gher belong to?
☐ Seasonal ☐ Annual
41. Mention the ownership of the pond/Gher.
☐ Individual ☐ Jointly
42. Mention the variety of fish you rare**.**

43. From where do you collect better fingerling?
☐ Govt. Hachary
☐ Neighbour
☐ NGO
☐ Others
44. From where do you collect information about quality fingerling?
☐ Radio ☐ Television ☐ Mobile ☐ Extension worker ☐ others (Please specify)

45. Which method do you use to cultivate fish?
☐ Single ☐ combined ☐ Cage ☐ Pan System ☐ Integrated system

46. What kind of fish feed do you use?
☐ Rice bran
☐ Wheat dust
☐ Oil cake
☐ Packet food
47. From where do you collect information about quality feed? (Please give tick)
☐ Radio ☐ Television ☐ Mobile ☐ Extension worker ☐ Others (Please mention)

48. The amount of fertilizer used in the pond/gher.

Name of Fertilizers	**Amount**
Lime	
Potash	
Phosphate	
Urea	

49. Which is the source of information in using fertilizer in proper way in your pond/gher? (Please give tick)
☐ Radio ☐ Television ☐ Mobile ☐ Extension worker ☐ others (Please mention)

50. Do you follow any measure to maintain the quality of water?
☐ Yes ☐ No

51. What measure do you follow to maintain the quality of water?

52. What is the source of information to maintain the quality of pond water? (Please mark tick)
☐ Radio ☐ Television ☐ Mobile ☐ Extension worker ☐ Others (Please mention)

53. Fish cultivation and its annual production.

Variety of fish	**Production (K.G)**	**Production (Own Use)**	**Production (Sale)**	**Production cost**	**Net profit**

Section F: Responses related to livestock (Question No. 54-62)

54. How long have you been rearing cattle?

55. Do you vaccinate your cattle regularly?
☐ Yes ☐ No

56. What is the source of information regarding vaccination?

57. From where do you get PPR, FRD and other vaccines?

58. Do you deworm your cattle?
☐ Yes ☐ No

59. If yes, from where do you know about vaccination? (Please mark tick)
☐ Radio ☐ Television ☐ Mobile ☐ Extension worker ☐ Others (Please mention)

60. Have your cattle under Artificial Insemination (AI)?
☐ Yes ☐ No

61. Which food do you give to your cattle and where do you collect them from?
---

62. What is the source of information regarding health care?
☐ Radio ☐ Television ☐ Mobile ☐ Extension worker ☐ Others (Please mention)

Section G: Responses related to gender involvement in agriculture (Question No. 63-67)

63**.** What types of agricultural works are the women of your family involved in? (Answer may be more than one)

☐ In preserving seed…….. what kinds of seeds ----------
☐ In processing crops ……. what kind of crops ----------
☐ In sowing crops…… what kind of crops ----------
☐ In rearing poultry …….
☐ In rearing livestock ……

64. What is the percentage of woman's participation in the following agricultural activities?

Activities	Percentage
Use of fertilizer at the right time	
Choice of variety in fish cultivation	
Selection of nutritional vegetables	
Decision of selling products	
Selection of crops' variety	
Health care of livestock	

65. Mention the organizations from where they (women) have been given training on agriculture.

66. What kind of ICT tools do the women of your family use?

☐ Radio ☐ Television ☐ Mobile ☐ Others (Please mention)

67. Which problems do the woman of your family face in doing agricultural work?

Section H: Responses related to the impact of ICT (Question No. 68-72)

68. Do you think that the information you have got from agricultural programmes has made positive impact on the production of agricutre in comparison with the past? If so, what are those? (You may give the tick mark more than one)

1. Increase of average production
2. Production of high value crops
3. Reducing expenses of production
4. Increase of selling price
5. Production of vegetables free from chemical
6. Pesticide free vegetables
7. Increase of the use of effective agricultural technology
8. Others

69. What kind of information /technology do you need to increase agricultural production? (You may give the tick mark more than one)

☐ Technologies related to pest management like IPM, ICM, etc
☐ Weather forecast (rainfall, humidity, cloud, rainfall, drought, fog, etc.)
☐ Proper use of fertilizer
☐ Use of agricultural machinery (weeder, thresher, guti urea applicator)
☐ Irrigation system
☐ Market price
☐ Soil health
☐ Others

70. Which media influence you more in growing vegetables?

☐ Radio ☐ Television ☐ Mobile ☐ Extension worker ☐ Others (Please mention)

71. Where from do you know the market price of your crops?

☐ Radio ☐ Television ☐ Mobile ☐ Extension worker ☐ Others (Please mention)

72. How do you get the information related to pest management?
☐ Radio ☐ Television ☐ Mobile ☐ Extension worker ☐ Others (Please mention)

Section I: Responses related to ICT oriented Farmers (AICC, FIAC, Practical Action, Winincoporate etc.) (Question No. 73-92)

73. How long have you been engaged in Agriculture and Information Communication Centre (AICC/FIAC)?

☐ Intitiation to three months
☐ Three to six months
☐ Six month to one year
☐ One to two years

74. How often do you visit the AICC?
☐ Not at all ☐ every day ☐ once a week ☐ once a forthnight ☐ more than twice a month

75. Have you got any training from AICC?
☐ Yes ☐ No

76. Mention the name of the trainings you got.

77. What type of services do you get from AICC? Rank your services in order of priorty.

☐ Agricultural information through internet
☐ Local and international market position
☐ Agricultural programmes of radio and T.V.
☐ Agricultural print matarials (book let, leaf let, poster etc.)
☐ Electronic media and materials
☐ Agricultural documentary films
☐ Exchange agricultural information through E-mail.
☐ Remedies during natural calamities

78. How much time do you spend at AICC for getting your desired information?

Frequency	5 minutes	15 minutes	30 minutes	45 minutes	1 hour
every day					
once in a week					
once in a forthnight					
once in a month					

79. What is the positive impact you have got from AICC services?

- ☐ Average increase of crop production
- ☐ Crop production of high price
- ☐ Reducing the production cost
- ☐ Higher selling price
- ☐ Others

80. Which technologies have you learnt from AICC?

- ☐ Method of making quick compost and other natural manure
- ☐ Irrigation management (efficient use of water like AWD)
- ☐ Different types of pest management (IPM, ICM). Ex- Light trap, purching, etc.
- ☐ Accurate doze of chemical fertilizer
- ☐ Making seed bed and maintenance
- ☐ Proper fertilizer management
- ☐ Use of agricultural machinery (weeder, thesher, gutiurea applicator)
- ☐ Iirrigation system
- ☐ Leaf colour Chart

81. Which problems do you face in getting information from AICC?

- ☐ Shortage of ICT tools like Computer, Fax, Internet, Mobile, TV etc.
- ☐ Inefficiency of using ICT tools
- ☐ Lack of exact capability
- ☐ Shortage of time

82. Is there any advantage of using internet in the AICC?

☐ Yes ☐ No

83. If there is, how will you evaluate the time of using internet?

☐ too little ☐ little ☐ sufficient ☐ very satisfactory

84. Do you think that the services rendered by AICC are up to the mark?

☐ Yes ☐ No

85. If not, what measures are to be taken to upgrade the AICC?

86. How do you rate your computer literacy?

☐ Beginner ☐ medium ☐ expert ☐ well expert

87. How can you grade ICT tools like TV for agricultural programmes, documentary films, E-mail and other electronic media for exchanging agricultural information?

☐ Very useful ☐ useful ☐ average ☐ unuseful

88. If the services mentioned above are not useful, what are the reasons you think behind?

☐ Complexity of information ☐ language problem ☐ having no knowledge in using ICT ☐ electricity problem ☐ presentation of ICT knowledge in a complex way ☐ irregular follow-up

89. How fruitful is the ICT knowledge provided by AICC for your agricultural work?

☐ Relevant ☐ irrelevant ☐ average

90. If it is irrelevant, what are the reasons behind it?

91. How do you evaluate the services rendered by AICC at present?

- ☐ Very good, this meets all of my problems related to agriculture.
- ☐ Good. It meets up al most all necessities related to agriculture.
- ☐ Somehow, it meets up most of our problems related to agriculture.
- ☐ Not goodat all. It does not meet up any necessity related to agriculture.

92. What is your expectation about the distribution of agricultural information through ICT tools in your area?

Signature :
Name of the Interveiwer :
Date :
Cell No. :

Appendix- B

Reference Tables

Table No. 1 (6.10): Frequency distribution of ICT respondents by age

Age (in years)	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
A (20-30)	260	22.22	15	1.83	275	13.82
B (30-40)	310	26.50	270	32.93	580	29.15
C (40-50)	360	30.77	150	18.29	510	25.63
D (50-60)	170	14.53	295	35.98	465	23.37
E (60-70)	70	5.98	90	10.98	160	8.04
Total	**1170**	**100.00**	**820**	**100.00**	**1990**	**100.00**

Table No. 2 (6.11) Frequency distribution of respondents by education

Level of Education	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
A (Illiterate)	170	45.21	206	54.79	376	18.89
B (Primary)	369	58.85	258	41.15	627	31.51
C (Junior High School)	309	62.68	184	37.32	493	24.77
D (SSC)	184	64.11	103	35.89	287	14.42
E (College)	105	63.25	61	36.75	166	8.34
F (University)	33	80.49	8	19.51	41	2.06
Total	**1,170**	**100.00**	**820**	**100.00**	**1,990**	**100.00**

Table No. 3 (6.12) Frequency distribution of farm category by service area

Farm Category	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Landless	38	3.25	39	4.76	77	3.87
Marginal	444	37.95	375	45.73	819	41.16
Small	542	46.32	330	40.24	872	43.82
Medium	132	11.28	68	8.29	200	10.05
Large	14	1.20	8	0.98	22	1.11
Total	**1170**	**100.00**	**820**	**100.00**	**1990**	**100.00**

Table No. 4 (6.15): Frequency distribution of pond/gher ownership by service area

Ownership	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Individual	490	89.09	360	96	850	91.89
Jointly	60	10.91	15	4	75	8.11
Total	**550**	**100.00**	**375**	**100**	**925**	**100.00**

Table No. 5 (6.26): Frequency distribution of television programs by service area

Television Program	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
News	870	74.36	580	70.73	1450	72.86
Movies	80	6.84	135	16.46	215	10.80
Agricultural Programmes	200	17.09	75	9.15	275	13.82
Others	20	1.71	30	3.66	50	2.51
Total	**1170**	**100.00**	**820**	**100.00**	**1990**	**100.00**

Table No. 6 (6.27): Frequency distribution of television watching by service area

Status of TV watching	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Yes	1110	94.87	610	74.39	1720	86.43
No	60	5.13	210	25.61	270	13.57
Total	**1170**	**100.00**	**820**	**100.00**	**1990**	**100.00**

Table No. 7 (6.28) Frequency distribution of radio listening by service area

Listening Period	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
01-10 years	273	49.64	137	83.03	410	57.34
10-20 years	251	45.64	28	16.97	279	39.02
20-30 years	26	4.73	0	-	26	3.64
Total	**550**	**100.00**	**165**	**100.00**	**715**	**100.00**

Table No. 8 (6.29): Frequency distribution of radio station by service area

Different Stations	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Bangladesh Betar	380	69.09	135	81.82	515	73.57
FM Radio	70	12.73	8	4.85	78	11.14
Regional Radio	30	5.45	15	9.09	45	6.43
Community Radio	70	12.73	7	4.24	77	11.00
Total	**550**	**100.00**	**165**	**100.00**	**700**	**100.00**

Table No. 9 (6.30): Frequency distribution of mobile phone use by service area

Status of Mobile	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Yes	1135	97.01	615	75	1750	87.94
No	35	2.99	205	25	240	12.06
Total	**1170**	**100.00**	**820**	**100**	**1990**	**100**

Table No. 10 (6.31): Frequency distribution of mobile user by service area

Number of Mobile Users	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
One (self)	1135	94.98	615	98.4	1750	99.7151
Two (self and wife)	40	3.35	10	1.6	50	2.85
Three or above	20	1.67	0	0	20	1.14
Total	**1195**	**100.00**	**625**	**100**	**1755**	**100.00**

Table No. 11 (6.32): Frequency distribution of the means for weather forecast by service area

Means of Information	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Radio	330	28.21	177	21.59	465	23.37
Television	645	55.13	410	50.00	1035	52.01
Mobile	160	13.68	120	14.63	240	12.06
Ext. worker	25	2.14	105	12.80	155	7.79
Call centre	10	0.85	8	0.98	28	1.41
Total	1170	100.00	820	100.00	1990	100.00

Table No. 12 (6.33): Frequency distribution of information source for crop variety by service area

Information Source	Service Area					
	ICT		Non-ICT		Total	
	No	%	No	%	No	%
Radio	15	1.28	18	2.20	33	1.66
Television	211	18.03	78	9.51	289	14.52
Mobile	299	25.56	98	11.95	397	19.95
ICT based Service Centre	239	20.43	0	-	239	12.01
SAAO	325	27.78	519	63.29	844	42.41
Progressive Farmer	35	2.99	66	8.05	101	5.08
Website	11	0.94	0	-	11	0.55
Print media (krishi katha)	35	2.99	41	5.00	76	3.82
Total	**1170**	**100.00**	**820**	**100.00**	**1990**	**100.00**

Table No. 13 (6.34): Frequency distribution of source of irrigation by service area

Source of Irrigation	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No	%
River/Canal	179	15.30	131	15.98	310	15.58
Pond	111	9.49	54	6.59	165	8.29
Rain	60	5.13	65	7.93	125	6.28
Tubewell	820	70.09	570	69.51	1390	69.85
Total	**1170**	**100.00**	**820**	**100.00**	**1990**	**100.00**

Table No. 14 (6.35): Frequency distribution of irrigation system by service area

Irrigation System	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Kacha Irrigation Canal	470	40.17	670	81.71	1140	57.29
Semi Pacca Irrigation Canal	320	27.35	92	11.22	412	20.70
Polythene made Irrigation Canal	119	10.17	17	2.07	136	6.83
Pacca Irrigation Canal	145	12.39	24	2.93	169	8.49
Fero-cement Canal	116	9.91	17	2.07	133	6.68
Total	**1170**	**100.00**	**820**	**100.00**	**1990**	**100.00**

Table No. 15 (6.36): Information source of quality figureling

Information Source	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.		No.	%
Radio	20	3.64	25	6.67	45	4.86
Television	37	6.73	35	9.33	72	7.78
Mobile	158	28.73	99	26.40	257	27.78
Extension	75	13.64	105	28.00	180	19.46
Call centre	54	9.82	10	2.67	64	6.92
ICT based Information Centre	119	21.64	0	-	119	12.86
Others	87	15.82	101	26.93	188	20.32
Total	**550**	**100.00**	**375**	**100.00**	**925**	**100.00**

Table No. 16 (6.37): Frequency distribution of information source for quality water by service area

Source of Information	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Radio	17	3.09	10	2.67	27	2.92
Television	67	12.18	45	12.00	112	12.11
Mobile	142	25.82	98	26.13	240	25.95
Extension worker	89	16.18	131	34.93	220	23.78
Call centre	23	4.18	0	-	23	2.49
ICT Centre	137	24.91	0	-	137	14.81
Others	75	13.64	91	24.27	166	17.95
Total	**550**	**100.00**	**375**	**100.00**	**925**	**100.00**

Table No. 17 (6.38): Frequency distribution of measurement for quality water by service area

Measurement	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Lime	310	56.36	290	77.33	600	64.86
Zeolite	168	30.55	50	13.33	218	23.57
Nitrogen	39	7.09	18	4.80	57	6.16
Phosphate	33	6.00	17	4.53	50	5.41
Total	**550**	**100.00**	**375**	**100.00**	**925**	**100**

Table No. 18 (6.39): Frequency distribution of information source for quality fish feed by service area

Information Source	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No	%
Radio	25	4.55	11	2.93	36	3.89
Television	39	7.09	35	9.33	74	8.00
Mobile	219	39.82	131	34.93	350	37.84
Extension worker	89	16.18	81	21.60	170	18.38
Call centre	21	3.82	0	-	21	2.27
ICT Centre	97	17.64	0	-	97	10.49
Others (Neigbor)	60	10.91	117	31.20	177	19.14
Total	**550**	**100.00**	**375**	**40.54**	**925**	**100.00**

Table No. 19 (6.40):Frequency distribution of information source for animal healthcare by service area

Source of Information	Service Area					
	ICT		Non ICT		Total	
	Frequency	%	Frequency	%	No	%
Radio	80	6.84	54	6.59	134	11.26
Television	145	12.39	99	12.07	244	20.50
Mobile	268	22.91	111	13.54	379	31.85
Extension	176	15.04	458	55.85	634	53.28
Call centre (Krishi call centre)	148	12.65	0	-	148	12.44
ICT based service centre (AICC, FIAC, CR,KR)	301	25.73	0	-	301	25.29
Others (Pharmacy, Input dealer, Progressive Farmer)	52	4.44	98	11.95	150	12.61
Total	**1,170**	**100.00**	**820**	**100.00**	**1,190**	**100.00**

Table No. 20 (6.41): Frequency distribution of information source for fish cultivation by service area

Method	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Single	65	11.82	45	12.00	110	11.89
Combined (poly culture)	395	71.82	315	84.00	710	76.76
Cage	10	1.82	0	-	10	1.08
Integrated system	80	14.55	15	4.00	95	10.27
Total	**550**	**100.00**	**375**	**100.00**	**925**	**100.00**

Table No. 21 (6.42): Frequency distribution of fish variety by service area

Variety of Fish	Service Area					
	ICT		Non-ICT		Total	
	No.	%	No.	%	No.	%
Telapia	73	13.27	53	14.13	126	13.62
Carp	135	24.55	91	24.27	226	24.43
Prawn	57	10.36	36	9.60	93	10.05
Mrigel	10	1.82	7	1.87	17	1.84
Mixed	201	36.55	145	38.67	346	37.41
Grass carp	25	4.55	15	4.00	40	4.32
Galda	30	5.45	17	4.53	47	5.08
Others	19	3.45	10	2.67	29	3.14
Total	**550**	**100.00**	**375**	**100.00**	**925**	**100.00**

Table No. 22 (6.43): Frequency distribution of information source for plant nutrition by service area

Source of Information	Service Area					
	ICT		Non-ICT		Total	
	Frequency	%	Frequency	%	No	%
Radio	51	4.36	26	3.17	77	3.87
Television	124	10.60	86	43.65	210	10.55
Mobile	161	13.76	76	31.67	237	11.91
Extension	302	25.81	571	72.19	873	43.87
Call centre (Krishi Call Centre)	171	14.62	-	-	171	8.59
ICT based Information Centre	337	28.80	-	-	337	16.93
Others	24	2.05	61	76.25	85	4.27
Total	**1170**	**100.00**	**820**	**41.21**	**1990**	**100.00**

Table No. 23 (6.44): Frequency distribution of media for growing vegetables by service area

Media	Service Area					
	ICT		Non-ICT		Total	
	Frequency	%	Frequency	%	N0	%
Radio	40	3.42	29	3.54	69	3.47
Television	201	17.18	92	11.22	293	14.72
Mobile	150	12.82	83	10.12	233	11.71
Extension Worker	245	20.94	490	59.76	735	36.93
Call centre(Krishi)	179	15.30	0	-	179	8.99
ICT Centre	288	24.62	0	-	288	14.47
Others	67	5.73	126	15.37	193	9.70
Total	**1170**	**100.00**	**820**	**100.00**	**1990**	**100.00**

Appendix C

Pictorials from Field Visit

Appendix D

AEZ Map