USE OF ICT BY THE FISHERMEN FOR FISH FARM MANAGEMENT IN SELECTED AREAS OF DAUDKANDI UPAZILLA UNDER CUMILLA DISTRICT

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DECEMBER, 2020

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REG. NO: 18-09205

Submitted to the faculty of Agriculture,
Sher-e-Bangla Agricultural University, Dhaka
In partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE

IN

AGRICULTURAL EXTENSION AND INFORMATION SYSTEM

Semester: July-December, 2020

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CERTIFICATE

This is to certify that the thesis entitled **"Use of ICT by the Fishermen for Fish Farm Management in Selected Areas of Daudkandi Upazilla under Cumilla District"** submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **Master of Science in Agricultural Extension and information system**, embodies the result of a piece of bona fide research work carried out by **Md. Habibur Rahman**, Registration **No. 18-09205** under my supervision and guidance. To the best of my knowledge, no part of the thesis has been submitted for any other degree or diploma.

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

Dated: December, 2020
Dhaka, Bangladesh

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“Dedicated to My
Beloved Wife,
Respected Parents
And
Affectionate
Daughter “Mashkura”

ACKNOWLEDGEMENTS

All praises are to the ‘Almighty Allah, Omnipresent and Omniscient, who enabled to me accomplish of this research work.

The author reckons at first a great pleasure and honor to express his heartfelt gratitude, deepest sense of appreciation, best regards and profound indebtedness to his research supervisor, Prof. Md. Mahbubul Alam, PhD, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka for his scholastic guidance, continuous supervision, valuable suggestions and instructions, in completion of the research work as well as in preparing this manuscript.

The author is highly indebted and grateful to his respective teacher and co-supervisor, Prof. Md. Abul Bashar, Department of Agricultural Extension & Information System, Sher-e-Bangla Agricultural University, Dhaka for his helpful comments and suggestions, sincere encouragement, heartfelt and generous cooperation in improving the manuscript.

The researcher reckons special thanks to Mst. Nazma Akter Upazilla Fisheries Officer of Daudkandi upazilla for her cordial support and also deems his heartfelt gratitude to Md. Abdullah al Mamun, Assistant Upazilla Fisheries Officer of Daudkandi upzaila. The researcher is grateful to Mawlana Ebrahim, Hafez Mawlana Farid, Md. Aziz Ullah, and Md. Zamil Hossain for their cordial help during the data collection of the study.

The author likes to extend cordial thanks to his elder brother Razeul Islam Razu and thanks to his friends especially Shohel, for their kind co-operation, valuable advice during his study.

Finally, the researcher expresses his thanks gratefulness to all of his well-wishers and parents.

The Author

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ABBREVIATIONS

UFO Upazilla Fisheries Officer
AUFO Assistant Upazilla Fisheries Officer
UFEO Upazilla Fisheries Extension Officer
BBS Bangladesh Bureau of Statistics
FAO Food and Agriculture Organization
GO Governmental Organisation
GDP Gross Domestic Product
GPS Global Positioning Systems
IT Information Technology
ICT Information and Communication Technology
MEAS Modernizing Extension and Advisory Services
NGO Non-Governmental Organisation
SPSS Statistical Package for Social Science
TAM Technology Acceptance Model

USE OF ICT BY THE FISHERMEN FOR FISH FARM MANAGEMENT IN SELECTED AREAS OF DAUDKANDI UPAZILLA UNDER CUMILLA DISTRICT

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ABSTRACT

The study was conducted to determine the extent of use of ICT by the fishermen for fish farm management, to determine the extent to which the selected factors influence fish farmer's use of ICT for fish farm management and to identify the barriers are faced by the fish farmers in using ICT tools for fish farm management in selected areas of Daudkandi upazilla under Cumilla district. Two unions namely Baro para and Gouripur of Daudkandi upazilla were randomly selected as research area under Cumilla district. Data were collected from 103 randomly selected fish farmers from the study areas, through personal interview by the researcher himself during October 25 to November 25, 2020. Data were analyzed by Multiple Regression analysis using SPSS 25.0. Age, education, fish farm size, fish farming experience, communication exposure, fisheries training received, ICT possession, usefulness of use ICT tools were the selected variables for the study. Data indicates that that majority of the respondents' (38.8%) use of various ICT were found less while one-third of them 33% use moderately. A little more than one-fourth of the respondents (28.2%) use ICT tools for fish farm management. Majority (86.4%) of the fish farmers in the study area were of middle to young aged This study found that middle to young aged fish farmers is more interested and engaged in fish farming and their high use of ICT in fish farming. (63.1%) of the fish farmers' education level varied from primary to secondary levels. Thus, it can be said that the high education level, more interested and used of ICT for fish farming. Concerning the barrier, 'high cost of ICT tools' was most frequently reported by fish farmers followed by 'lack of ICT training and ICT infrastructure. Findings revealed that, level of education, communication exposure and ICT possession had positive and significant contribution to the use of ICT for fish farm management which constitutes 67.4% (R^2 = 0.674) of the variances. Thus, the study concludes with the recommendation to enable favorable environment to promote use of ICT tools in receiving fish farming information.

CHAPTER-I

INTRODUCTION

1.1 Background of the Study

Information and communications technology (ICT) is an extensional term for information technology (IT) that stresses the use of communications and the integration of telecommunications (telephone lines and wireless signals) and computers, as well as necessary enterprise software, storage and audiovisual, that enable users to access, store, transmit, and manipulate information. (Benard and Dulle 2017). This can also be referred to as the digital infrastructures like mobile, computers, laptops, internet, you tube, face book, twitter etc. which generate information to others (Kuhlmann, 2005). Digital and other electronic technologies are transforming our economies, societies and people's lives. Technology has had an especially profound impact on the information and communications activities that have always been central to sustainable development. Information communication technology (ICT) facilitate communication and information processing by electronic means that includes radio, television telephone, mobile phone, computers and the Internet. (Ajani, 2014)

New ICT are being used across the sector in fisheries, from resource assessment, capture or culture to processing and commercialization. (Jensen, 2007). Some are specialist applications such as sonar for locating fish. Others are general purpose applications such as Global Positioning Systems (GPS) used for navigation and location finding, mobile phones for trading, information exchange and emergencies, radio programming with fishing communities and Web-based information and networking resources. (Donner, 2009). A wide range of technologies can be adapted and introduced in all but the most remote communities and once appropriated by users, can have positive impacts on their lives. Food and livelihoods security issues and the lack of extension support for fishers and fish farmers can be addressed through information networks. New opportunities can emerge from combining mobile and newer networking technologies (Mlozi, *et al.,* 2012). Programmers and policies supporting further development of ICT in fishing communities and across the sector more broadly must link effectively between relevant stakeholders

from local to international, levels, be designed to cater truly for the needs of the poor and lead towards more responsible fisheries. Information and communications technologies are a fundamental development tool to support information sharing, collaboration and dialogue leading to increased participation and ownership (Donner, 2009).

ICT in the fisheries sector are emerging fields focusing on enhancing fisheries and rural development. It involves applications of innovative ways to use ICT in the rural domain. The advancement in ICT can provide accurate, timely, relevant information and services to the fish farmers, thereby facilitating an environment for a more remunerative fisheries sector. However, all the ICT initiatives are not uniform with disparities between regions in the level and quality of telecommunications, information and the effort of individuals, public and private organizations, and differentiated nature of demand of the fish farmers in different areas. As a result, there have been many successes, failures, lessons learned and experiences gained, so far. While these initiatives are intended to address the needs of the farmers through ICT, their actual usage and their ability to bring significant impact on the fish farm productivity and socio-economic development of the intended beneficiaries use the facilities provided for them meaningfully to meet their needs (MEAS Project January 2013).

The common problems in the use of ICT in rural segments are ICT illiteracy, availability of relevant and localize contents in their languages, easy and affordable access and other issues as awareness and willingness for use of new technologies among the rural peoples etc. (Sofia Reino, *et al*., 2011). Most of the fish farmers of Bangladesh are still lack of information and modern fisheries knowledge. Most fish farmers need easy access to information like elements, availability and access, of information like element, availability, access and utilization. ICT that creates opportunities for rural fish farmers to obtain information and knowledge about market, fisheries issues, problems and suggest how to develop the fisheries market. Mobile services in the fisheries sector provide more information on the market, weather, transport service and fisheries techniques that help to contact the agencies and department (Aker, 2011).

Being located in South Asia, Bangladesh has a young and rapidly growing population of 164 million (BBS January 2014). With more than 30 percent of the citizens living below

the poverty line, the country's GDP per capita ranks among the lowest in the world. The economy mainly depends on agriculture and the production of apparel and garments with little development of other industries. However, favorable demographic and macro-economic trends, high economic growth rates (6.3 percent in 2012) and a relatively liberal investment climate have convinced (Goldman Sachs and JP Morgan) to identify Bangladesh as one of the most attractive emerging economies. Despite having 50 years of history the government has only from 1997 officially recognized the potential of the Bangladeshi ICT industry and its impact on the economy That is why; it is considered as one of the most serious threats to fisheries production with its potential negative aspects on human health, food security, agriculture, fisheries, biodiversity, water, economic activities and other natural resources (NCSA, 2007). The impacts of climate variability, change and extreme events will lead to severe stress on overall development, environment and human well-being.

1.2 Statement of the Research Problem

The major constraints to fish farming were identified as those of environmental impacts of aquaculture operations: water pollution (Olagunju, *et al.*, 2007), inadequate supply of fingerlings, inadequate information, and feeds supply (Olagunju *et al.*, 2007). Information and communication technology (ICT) is enhancing the capacity building of different communities. As one of the big community farmers in Bangladesh, the fishermen are facing different problems and hindrances to enhance their income. Fisheries productivity can be increased in Bangladesh through the usage of ICT among fishermen. It could bring changes in economic development and enhance the quality of life especially in fishermen communities. Fish farmers face many financial and economic problems in the use of ICT. Similarly, many fishermen do not take an interest in using ICT (Hosseini *et al*., 2012). There are many other factors observed such as lack of interest of ICT service providers in rural areas and low quality of service as major causes of not using ICT tools among fishermen community. The fishermen community does not have proper access to connect directly with the market due to a lack of proper usage of computers and mobile phones (Odada *et al*., 2004) and (Omar, *et al*., 2011) indicated that fishermen are facing many problems 4 and hindrances in ICT usage including the

expensive cost particularly computer and sonar. Fishermen still depend on the traditional way having no exposure towards ICT usage and ICT benefits. They cannot judge the status of the trade and could decide whether to sale cannot judge the status of the trade and decide whether to sale cannot judge the status of the trade and decide whether to sell their product or to remain at sea to continue fishing. The fishermen hesitate to learn about ICT from experts. (Fowler & Etchegary, 2001) revealed that mobile phones were still relatively expensive for poor farmers and fishermen. In addition to the cost of the phone itself, maintenance factors such as recharging the phones are also important considerations in developing country's regions (Fowler & Etchegary, 2001). (Munyua, 2007) indicated in the Bangladesh context that uncoordinated ICT initiatives have created several problems including the high cost of the technology, poor ICT connectivity, skills and lack of local contents. Furthermore, there is a lack of information sharing culture and low awareness of ICT use in development at all levels. These issues raise the questions of finding out the appropriate ICT tools. While mobile phones may be suitable for certain aspects of improving the lives of the community, similarly other technologies such as radio or internet could play an equally important complementary use in significant changes of the recent world. We could say that media strongly presented important use in human development. Unfortunately, in most fishing communities, empowerment projects are not habit of think about ICT tools as a pivotal component toward this change.

1.3 The Research Questions

Based on the above approach, this study was conducted on the basis of the following research questions:

i. What are the selected factors that influence fish farmers to use ICT in fish farm management?
ii. What extent do fish farmers use ICT tools for fish farm management?
iii. What is the significant influence of the selected factors on fish farmer’s use of ICT for fish farm management?
iv. Which barriers are faced by the fish farmers in using ICT tools for fish farm management?

1.4 Objectives of the Study

In view of the aforesaid research questions, the following objectives were formulated:

i. To determine and describe the socio-economic characteristics of the respondent fish farmers
ii. To determine the extent of use of ICT by the fish farmers for fish farm management
iii. To determine the extent to which the selected factors influence fish farmer's use of ICT for fish farm management.
iv. To identify the barriers faced by the fish farmers in using ICT tools for fish farm management.

1.5 Scope and Significance of the Study

This research will especially help the fish farmers to know how to use the different ICT tools for fish farm management. It will planners, policymakers, and concerned people learn about the use practices of ICT taken by various level fish farmers against conventional cultivation method. This will help the policy-planners planners prepare a plan to increase the farmers' income, food security, and well-being in response to modern technology in the field level. It will also make the concerned people aware of thinking about various alternatives to adapt ICT tools with the problems faced by traditional tools.

1.6 Assumptions of the Study

Assumption is the supposition that an apparent fact or principle is true in the light of available evidences (Goodman, 2005). An assumption is taken as a fact or belief to be true without proof. The following assumptions have been taken into consideration for the present following study. The respondents are involved in furnishing proper responses to the questions contained in the interview schedule.

i. The interviewers have to be well adjusted to the social and cultural environment of the study area.
ii. Opinions furnished by the respondents are representative of the whole population of the study.
iii. The respondents should have given accurate and current information.
iv. The interviewers should be able to rate the responses of the fish farmers with adequate precision.
v. The data are normally and independently being distributed.

1.7 Limitations of the Study

This study fulfills the requirement of the Masters of Science (MS) in Agricultural Extension & Information System. It is exploratory and the study covered only one upazilla (i.e., Daudkandi) due to limited resources, time and financial constraints. The findings will show the impact of ICT tools use in Daudkandi upazilla. It is held that the result generated from this study is relevant to many areas of the county and other countries that have similar information and communication technology and adaptation pattern. Other limitations are as follows:

i. The study is confined to flood plain land area of Daudkandi upazilla under Cumilla district.
ii. Several data collecting methods, scales and statistical tests have been utilized to measure the use of ICT over a relatively short period of time.
iii. For information about the study, the researcher has to depend on the data furnished by the selected respondents during the interview with them.
iv. Level of knowledge of the respondents is also a barrier to the study.
v. The conceptual framework of the study emphasizes the use of ICT in the locality. It may not be applicable in all other areas of Bangladesh.

1.8 Definition of Important Terms

For clarity of comprehension certain the accompanying terms frequently used all through the study are characterized and defined in alphabetical order:

Information and Communication Technologies (ICT)

ICT refer to communication technologies that include computers, the Internet, geographical information systems, mobile phones, and the traditional electronic media like radio, television and e-newspaper. In this study, any computer-mediated communication media and applications such as mobile phones, Internet, social media, digital information repositories, ICT-assisted call centers, digital photography, web or mobile apps, and blogs are considered. (Ajani, 2014; Balaji, *et al.*, 2007)

Internet

The Internet is interconnected between of thousands of networks and millions of computers using standardized communication protocol (TCP/IP). It is a network of a computer networks that connects billion of webpages. The Internet carries many

information resources and services, such as e-mail, apps, shopping, instant messaging, music, videos, and news. (Mohanty & Mishra, 2020)

Computer

Computer is a programmable electronic device that processes data and convert data into useful information. It performs high-speed processing of numbers. (Norton, 2008)

ICT ownership

ICT ownership refers to a respondent's possession of ICT devices like mobile phones, computers, laptops, the Internet.

Age

Age of the respondent was characterized as the timeframe from his birth to the time of interview.

Level of education: Level of education of an individual farmer was defined as the formal education received up to a certain level from an educational institute (e.g. school, college and university) at the time of interview.

Communication

Communication is a process in which participants create and share information with one another in order to reach a mutual understanding. This definition implies that Communication is a process of convergence (or divergence) as two or more individuals exchange information in order to move toward each other (or apart) in the meanings that they ascribe to certain events (Valente & Rogers, 1995)

Group Media

Group media defines as the recurrence of exposure of the respondents to various group of information, for example, group discussion meetings, farm demonstration meeting, method demonstration meetings and result demonstration meetings.

Individual Media

Individual media defines the recurrence of respondents' presentation to various individual information sources, for example, neighbors, companions, relatives, extension workers, local leader, and so on.

Information Sources

The term information sources define the media or channels through which different data are diffused among the farmers on various aspects including crops, livestock, fisheries, education and other similar matters.

Mass Media

The mass media are the mean of communication or instrument or device through which messages are transmitted towards a generally extensive, heterogeneous, and mysterious crowd inside a moderately shorter coordinated structure the source of people's gathering. Mass media incorporated into the study were radio, TV, internet, face book/tweeter, you tube etc.

Organizational Participation

Is characterizes as a relationship of two or more persons which have no less than one face to face meeting per year. Cooperation in an association defines to his participating in the association as general member, executive member or executive officer.

Social Media

Social media is defined by (Kaplan & Heinlein, 2009) as a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and allow the “creation and exchange of user-generated content.

Mobile phone

A portable telephone that sends and receives radio signals through a network of short-range transmitters located in overlapping cells throughout a region, with a central station making connections to regular telephone lines. Also called cellular telephone, mobile phone. A small telephone that people can take with them and use outside their homes called also mobile phone, (chiefly US) cellular phone, (US, informal) cell, (British) mobile.

Technology

The branch of knowledge that deals with the creation and use of technical means and their interrelation with life, society, and the environment, drawing upon such subjects as industrial arts, engineering, applied science, and pure science. The application of this knowledge for practical ends. Scientific or industrial process, invention, method, or the like. The sum of the ways in which social groups provide themselves with the material

objects of their civilization. The purposeful application of information in the design, production, and utilization of goods and services, and in the organization of human activities

ICT Perceived usefulness

ICT perceived usefulness is one of the independent constructs in the Technology Acceptance Model (TAM). This was defined by Fred Davis defined this "the degree to which a person believes that using a particular system would enhance his or her job performance". It means whether or not someone perceives that technology to be useful for what they want to do.

CHAPTER-II

REVIEW OF LITERATURE

An attempt was made in this Chapter to represent a brief review of related research information to evaluate the extent of use of ICT in Baro para and Gouripur union under Daudkandi upazilla of Cumilla district in Bangladesh. Since, the literature review forms a linkage between past and present research works related to problem that helps an investigator to draw a satisfactory conclusion. A few research works on the use of ICT in farming practices by the farmers of studied area have been reviewed according to the following sequences:

2.1 Concept of Information and Communication Technology (ICT)

Murray, *et al., (*2011) conducted investigation on Information and communications technology (ICT) is an another/extensional term for information technology (IT) which stresses the use of unified communications and the integration of telecommunications.

Alam & Uddin (2018) investigated on 'Use of information and communication technologies by the farmers in receiving agricultural information'. The purposes of the study were to determine the extent of use of Information and Communication Technologies (ICT) by the farmers in receiving agricultural information in Homna upazilla under Cumilla district and to explore the contribution of selected characteristics of respondents with their ICT use in receiving agricultural information

Achora, Mwije & Masabo (2019) conducted an investigation on Use of information communication technologies in conservation agriculture knowledge pathways among smallholder farmers in Machakos and Laikipia countries, Kenya. The main objective of this study was to analyse the use of ICT for Conservation Agriculture knowledge among smallholder farmers in Machakos and Laikipia counties, Kenya.

Alkhaldi & A. N. (2016) conducted a study on the broadness of ICT covers any product that will store, retrieve, manipulate, transmit or receive information electronically in a digital form, e.g., personal computers, digital television, email, robots. For clarity, Zippo provided an ICT hierarchy where all levels of the hierarchy "contain some degree of

commonality in that they are related to technologies that facilitate the transfer of information and various types of electronically mediated communications.

Alam (2015) showed that 89.7 percent of the respondents had no use to low use of Cell Phone for receiving agricultural information and 10.3 percent of the respondents had medium use to high use of Cell Phone for receiving agricultural information at Singair upazilla of Manikganj district in Bangladesh.

Uddin (2015) revealed that about two third (64.5%) of the respondents had medium use of ICT in receiving agricultural information compared to 13.6 % and 21.8 % having low and high use of ICT in receiving agricultural information respectively at Homna upazilla of comilla district in Bangladesh.

Ahmed (2012) conducted a study on Utilization and effectiveness of ICT for disseminating agricultural technologies among the farmers

Gakuru, *et al.,* (2009) noted that in Tanzania, building on the utility of mobile phones as recording tools, listening devices, money-makers, and catalysts for dialogue, community radio stations are incorporating mobile technology into programming and it is being used for advisory services in agriculture.

Ajani (2014**)** conducted a study on Promoting the use of information and communication technologies (ICT) for agricultural transformation in Sub-Saharan Africa: Implications for policy. Information and communication technologies (ICT) have the potential to reach many farmers with timely and accessible content.

2.2 Use of ICT in Fisheries Sector

Fisheries are a branch of agricultural science. E-agriculture (sometimes written e-agriculture or referred to as ICT in agriculture) is a relatively recent term in the field of agriculture and rural development practices. Consistency in the use of this term began to materialize with the dissemination of results from a global survey carried out by the United Nations (UN). Food and Agriculture Organization (FAO, (2006**)** conducted in late by the of the United Nations found that half of those who replied identified "e agriculture" with information dissemination, access and exchange, communication and

participation processes improvements around rural development. In contrast, less than a third highlighted the importance of technical hardware and technological tools.

Benard, Dulle & Lamtane (2018) conducted a study on the influence of ICT usage in sharing information on fish farming productivity in the southern highlands of Tanzania.in the southern highlands of Tanzania Benard. The use of ICT in sharing information is very important in enhancing fish farming productivity among fish farmers. However, little is known on the between the use of ICT and fish farming productivity in the southern highlands of Tanzania.

Benard and Dulle (2017) conducted a study on application of ICT tools in communicating information and Knowledge to artisanal fishermen communities in Zanzibar. Results showed that artisanal fishermen need information on weather conditions, modern fish capturing methods, market and marketing and fish preservation and processing. The study also found that mobile phones and radio are the most ICT tools used by the artisanal fishermen. The findings also revealed that communicating information and knowledge through ICT tools was limited by lack of funds, poor network connectivity, lack of training and seminars on the use of ICT in accessing information and poor coverage on radio and television transmission.

Mangstl (2008) conducted a study on emerging issues, priorities and commitments in e-agriculture. Here E-agriculture, therefore, describes an emerging field focused on the enhancement of agricultural and rural development through improved information and communication processes. More specifically, e-agriculture involves the conceptualization, design, development, evaluation and application of innovative ways to use information and communication technologies (ICT) in the rural domain, with a primary focus on agriculture (e-Agriculture Community of Practice) In 2008, the United Nations referred to e-agriculture as "an emerging field" with the expectation that its scope would change and evolve as our understanding of the area grows.

Akinbile & Alabi (2010) conducted a study on use of ICT among fish farmers in Oyo state. This is through improving capacity of fish farmers with the use of Information Communication Technologies (ICT). In determining the use of ICT among

fish farmers in Oyo State, one hundred and twenty respondents were interviewed for the study.

Gakuru, *et al.,* (2009) conducted a study on innovative farmer advisory services using ICT. Many ICT in agriculture or e-agriculture interventions have been developed and tested around the world, with varied degrees of success, to help agriculturists improve their livelihoods through increased agricultural productivity and incomes, and reduction in risks. Agriculture Network Information Centre has to be formed for providing internet access to quality, authoritative agriculture information, and specialized reference services. Seamless integration of GIS, SRS and GPS etc. holds the key for effective utilization of spatial technologies to solve agriculture problem. Unlike most science and technology disciplines, agriculture has a mechanism for distilling and distributing research to those who need it.

Aphunu & Atoma (2011**)** conducted a study on extent of use of ICT by fish farmers in Isoko Agricultural Zone of Delta State, Nigeria. The study examined the extent of use of ICT by fish farmers in Isoko agricultural zone of Delta State. The respondents were well aware of and used the telephone (GSM), television and radio for their contacts and enquiries, report preparation and information search. However, use of ICT facilities was constrained by the problem of maintenance, low level of production and rural poverty. Training to increase technical efficiency of farmers on ICT use and maintenance, and establishing appropriate policies to reduce rural poverty remain instrumental towards ICT use by fish farmers.

Akinbile & Alabi (2010) conducted a study on use of ICT among fish farmers in Oyo state. The need to reduce the import bill on fish through improved fish farming in order to meet its increasing demand led to enhancement of local production. This is through improving capacity of fish farmers with the use of Information Communication Technologies (ICT).

Jensen (2007**)** conducted a study on the digital provide: information (technology), market performance and welfare in the South Indian fisheries sector'. When information is limited or costly, agents are unable to engage in optimal arbitrage. Excess price dispersion across markets can arise, and goods may not be allocated efficiently. In this setting, information technologies may improve market performance and increase welfare.

Between 1997 and 2001, mobile phone service was introduced throughout Kerala, a state in India with a large fishing industry. Using micro level survey data, we show that the adoption of mobile phones by fishermen and wholesalers was associated with a dramatic reduction in price dispersion, the complete elimination of waste, and near-perfect adherence to the Law of One Price. Both consumer and producer welfare increased. The importance of ICT is also recognized in the 8th Millennium Development Goal, with the target to "make available the benefits of new technologies, especially information and communications technologies (ICT) to the fight against poverty (World Bank, 2019).

2.3 ICT use Constraints

Van Wart, *et al.,* (2017) conducted a study on integrating ICT adoption issues into (e-) leadership theory. Telematics and Informatics. Constraints are the element which hinders in doing some activities or operations in a certain field. It is the negative factor which not only reduces production but also hinders the way of adaptation.

Benard, Dulle & Lamtane (2019) conducted a study on challenges associated with the use of information and communication technologies in information sharing by fish farmers in the Southern highlands of Tanzania. It was found that the most frequently used ICT by fish farmers in sharing agricultural information were mobile phones, radio and television. Also, the study revealed that major challenges facing fish farmers in sharing information include unfavorable radio or television broadcasting time, high cost of acquiring and maintenance of ICT facilities, lack of training on ICT, poor network connectivity and low level of literacy. Moreover, it was further found that there was negative significant relationship ($P < 0.05$) between challenges associated with the use and degree of ICT usage by fish farmers.

Asif, Farouque, Rahman, & Rana (2018) conducted a study on constraints of using information and communication technologies by young entrepreneurs for farm management. The main purpose of the study was to investigate the constraints of using information and communication technologies (ICT) by the young entrepreneurs in farm management. The study was conducted in four randomly selected villages of Trishal and Fulbaria upazilla under Mymensingh district.

Gelb, *et al.,* (2008) conducted a study on adoption of ICT enabled information systems for agricultural development and rural viability. In ICT adoption workshop at the IAALD-AFITA-WCCA conference. There were continued references to the multitude of barriers to ICT use throughout the workshop discussions. The following lists several – not necessarily specific to fisheries sector or rural communities they include-

a. The lack of physical and human resource infrastructure which was repeatedly cited as a major impediment. Comments identifying wireless connectivity as an alleviating factor for example did not contribute to the understanding of this issue since wireless facilities need infrastructure as well. Infrastructure was related to technology in general.

b. Too much innovation can be an obstacle by blocking the use of older technologies which can often be more effective and/or by imposing an unacceptable cost.

c. ICT use based on working within communities takes longer in many cases because of the lack of understanding and awareness of the needs and challenges of small-scale fish farmers, lack of understanding what ICT can do including unexpected deviations from initials fish farmer and community expectations.

d. Ensuring leadership within the political and governmental environment.

e. Developing leadership and agents of change at all levels including communities.

f. Sharing ICT use funding including public/private partnership.

g. Sharing details of successful projects including business opportunities and their benefits.

2.4 Factors Influencing the Use of ICT

2.4.1 Age and the use of ICT tools

Abraham (2006) revealed that age had significant contribution to the impact of using ICT tools by the fish farmers for fish farm management.

Ajani (2014) reported that there was negative significant relationship between the age of the fish farmers and the level of use of different ICT tools for fish farming purposes by them.

Ogutu, *et al*., (2014) who reported that there was significant positive correlation between the age of the farmers and their participation in ICT based market information service projects for accessing to agricultural market information.

Ahmed (2012) it was observed that there was no significant relationship between age of the farmers and ICT utilization in agriculture by them.

Aker (2011)) noticed that the age of the farmers was a significant factor inversely influencing the use of ICT tools by them. It was observed in the study that the use of ICT tools for agricultural transactions was greater among the younger farmers.

Ali (2011) noticed that age of the farmers had no significant relationship with adoption of mass media-based information for decision-making in vegetable cultivation.

Duncombe (2011) it was revealed that age of the farmers had no contribution to the adoption of ICT by the farmers.

Goodman (2005) observed that at least two types of ICT media were used by most of the respondents aged between 21 to 60 than respondents of other ages.

Mlozi, *et al.,* (2012) reported that the younger farmers had more exposure to ICT usage and courses than the older farmers.

Pandian (2002) found that farmers‟ age had direct positive effect between age of the farmers and effect of use of video education on knowledge retention

2.4.2 Education and the use of ICT tools

Alam (2015) found that education showed significant and positive relationship with their use of cell phone.

Uddin (2015) found that education had significant contribution on their use of ICT media.

Abraham (2006) revealed that level of education had significant contribution to the impact of using ICT by the farmers.

Mollah (2006) observed in his study that education of the farmers had significant positive relationship with the rice production technologies.

Anisuzzaman (2003) concluded that the education of the farmers had significant positive relationship with their use of information and communication media.

Nuruzzaman (2003) in his study observed that education of the farmers had significant positive relationship with their use of mass media.

Pandian (2002) found that education of the farmers had direct positive effect on the effect of video education on knowledge retention.

2.4.3 ICT use experience and the use of ICT tools

While the author did not find any direct study of the relationship between mobile phone use experience and extent of ICT use in agriculture extension discipline, anecdotal evidence suggests, users skill increases over time with using of a particularly technology. He becomes more familiar with the technology. Therefore, their extent of use is expected to be higher with times. Considering this analogy, this study formulates the hypothesis that past experiences positively influence users to use ICT more for their work.

2.4.4 ICT ownership and the use of ICT tools

A microwave-radio telephone system installed in the remote region of Tumaca, Columbia, along with community access points resulted in better trade and market opportunities (Lio and Liu, 2006). Rural telephone and community radio services initiated in India and Sri Lanka had received a positive response from farmer communities (James, 2004).

The International Institute of Communication Development (IICD) at Manobi, an African telecom company have initiated a collaborative program to help the farmers of Burkina Faso, Ghana, Mali, Uganda and Zambia gain access to market price information via text messages. Wireless Application Protocol (WAP), or the mobile internet as well as personal computers and personal digital assistants (PDA). Also, Village Phone Program (VPP) of Grameen Bank of Bangladesh successfully converted telephones into production goods by lowering transaction costs (Bayes, 2001).

Use of mobile phones help farmers to make decisions much more easily than without mobile phone and farmers got, exchanged, and manipulated information quickly by using mobile phone. The ownership of mobile phones by agricultural stakeholders had widely

spread and increasingly assist to overcome isolation and made communication among rural people easier. Mobile phones are, therefore, becoming increasingly important to agro-based entrepreneurs as an infrastructural device for improving efficiency of agriculture markets and contributing to empowerment (Mlozi, *et al.*, 2012).

Mobile phones are becoming increasingly important to agro-based entrepreneurs as an infrastructure service for improving efficiency of agriculture markets, hence contributing to female farmers empowerment. Mobile phones helped them to easily obtain agricultural information when they needed. Moreover, other evidence found that farmers having mobile phone can decide the best time to sell crops and livestock as they could get instant information on prices at different market places (Ashraf, *et al*., 2005).

It can be assumed that smart phone users are most interested in communicating with extension agent than the farmers who have featured phone. Most of the farmers use internet in their phones. It also can be assumed that the people who have their own device are more fluent to communicate with the extension workers and for other activities.

2.4.5 Usefulness of using ICT tools

Many studies showed that the access of communication technologies have impact on the economic, poverty reduction as well as agriculture development. The use of mobile phones could increase the efficiency of farmers by affordable access of communication technologies in rural areas of developing countries. The study was conducted in Bangladesh indicated that use of mobile phones increased access of information among men and women and improved their living standard (Abraham, 2006; Aker, 2008; Galperin & Mariscal, 2007; Jensen, 2007, Bhavnani, *et al*., 2008).

Role of ICT in agricultural production on Africa reported that ICT played a significant role in a country's development. (Horestone, 2012). The main objective of that paper was to assess if at all on the proliferation of ICT of the African continent had any significant impact on agricultural production. The results found that ICT played significant role in enhancing agricultural production while mobile phones remain a significant contributor to agricultural growth. The result also found that certain socio-economic characteristics such as higher education level and skills were prerequisites for effective improvement in agricultural production due to the adoption and utilization of new technologies. Other

evidence suggested that there was a strong relationship between usefulness of ICT and influence of using ICT in agriculture (Dixon, 2009).

Farmers had the real need to access about market information, land records and services, accounting and farm management information, management of pests and diseases, rural development programs and hence ICT could help accessing those services. ICT projects dealing such services are extremely limited. ICT help farmers to get timely information yet availability of ICT is remained limited (Meera, *et al*., 2004).

Research conducted in Ghana reported that mobile phones stimulate the development of agricultural information and advisory services which positively impact farmers' income and agricultural production (Kora, 2010).

Result from India shows that ICT helped farmers in receiving clear and focused services, simple and user friendly, accurate and timely information, well organized and easy to find agricultural information (Kataria, 2015). Furthermore, ICT would enable extension workers to gather, store, retrieve and disseminate a broad range of information needed by small producers such as information on best practices, new technology, better prices of inputs and outputs, better storage facilities, improved transportation links, collective negotiations with buyers, information on weather. Emergence of new agricultural development paradigms challenge the conventional methods of delivering important services to citizens. ICT had been developed as a tool for achieving meaningful societal transformation, which was believed to provide a reliable network in agricultural sector. ICT had been utilized as an extension tool, which has enhanced the information flow between agricultural extension services and their clients (D' Silva, *et al*., 2010). Therefore, it may be concluded that with the increase of perceived usefulness of using ICT, respondents' use of ICT will increase.

2.4.6 Use of ICT by the Farmers'

Aminuzzaman, *et al*., (2003) observed a study on induction of ICT as a strategic tool for agricultural development and reported that ICT helped farmers in crops production by using clear and focused services but the main limitations to the adoption of ICT in agriculture appeared to lie in the education levels and cultural backgrounds of rural communities, as well as a lack of motivation stemming from the farmers' perception of

the scant usefulness of ICT and their limited digital skills. Connectivity was another important obstacle, despite regional advances.

The overall goal or expected outcome of this research is to see the potential of modern ICT to improve yields and income, and to disseminate knowledge to farmers to help them manage risk in an informed manner. Modern ICT can play a role in bridging the information gap, and in reducing the information asymmetry that exists between farmers and between regions. The delivery of information through mobile phones has the potential to deliver localized content rapidly, and can thus enhance the dissemination of knowledge and information on technologies, inputs, markets and prices, and help in better risk management. This can act as a catalyst to enable better adoption of improved technologies, seed varieties, and farming practices (Mittal, 2009).

Action Aid (2011) defines the list of basic conditions for successful farming: land, water, farming inputs (seeds, breeds, farm tools and equipment, sustainable fertilizers and pesticides), extension services and training, credit and financial services, etc. If these three observations are taken as facts, modern ICT can be used as an efficient tool to enable non-progressive farmers to connect to extension information and to make them adopt technology faster. ICT can play an important role in the adoption of technologies that are in an early stage of development like no tillage and the genetically modification technology revolution (Fischer, *et al.,* 2009).

Meera, *et al.,* (2004) reported that farmers had the real need to access about market information, land records and services, accounting and farm management information, management of pests and diseases, rural development programmers and ICT could help accessing these services. They found that ICT helped farmers to get timely information however sufficient availability of ICT facilities was limited. ICT can help to exchange market information, weather report and business information. By the blessings of technology, the farmers can directly contact with the brokers or agent to sell their products. One of the perceived benefits of modern ICT is greater access to information about marketing prices. It is expected that price information will have a beneficial impact by improving the bargaining power of farmers with traders. Thus, enabling them to realize better prices and by reducing arbitrage, wastage or spoilage (Mittal, *et al*., 2010).

Jensen (2007) found that the introduction of mobile phones decreased price dispersion and wastage by facilitating the spread of information for fishermen in Kerala. Both consumer and producer can be benefitted by using ICT. A produce may find the most profitable channel of selling products and consumers can compare the products' price across markets and decide about their shopping. The farmers who had no mobile phone were facing many problems in selling their products and getting market related information in comparison to mobile phone users. In rural areas most of the farmers cannot contact with the agricultural experts due to lack of communication. These people mostly depend on conventional methods of communication like personal contact, bulletin boards, price charts. Often, they failed to obtain necessary information when needed. Thus, accurate and timely information remains as one of the main problems especially for the smallholder farmers (Duncombe, 2011).

2.5 Conceptual Framework of the Study

Conceptual framework is the foundation for understanding the research issues and linkage among different variables. It helps as guiding principles for analyzing the research issues. It also helps easy visualization of the relationship between the dependent and independent variables. The study tried to focus towards use of ICT by the fish farmers for fish farm management. A dependent variable may be influenced and affected through interacting forces of many characteristics in his surroundings.

The conceptual framework of Rogers and Schoemaker (1971) were kept in mind while fish framing the structural arrangement for the dependent and independent variables. This study expected use of ICT by the fish farmers for fish farm management as dependent variable, which was influenced by selected socio-economic characteristics of the fish farmers as independent variables viz. age, level of education, annual family income, farm size, farming experience, fisheries training received, communication exposure, ICT possession, usefulness of uses ICT and barrier in adopting ICT tools for fish farm management. Now the conceptual model of the study has been presented in the Figure 2.1.

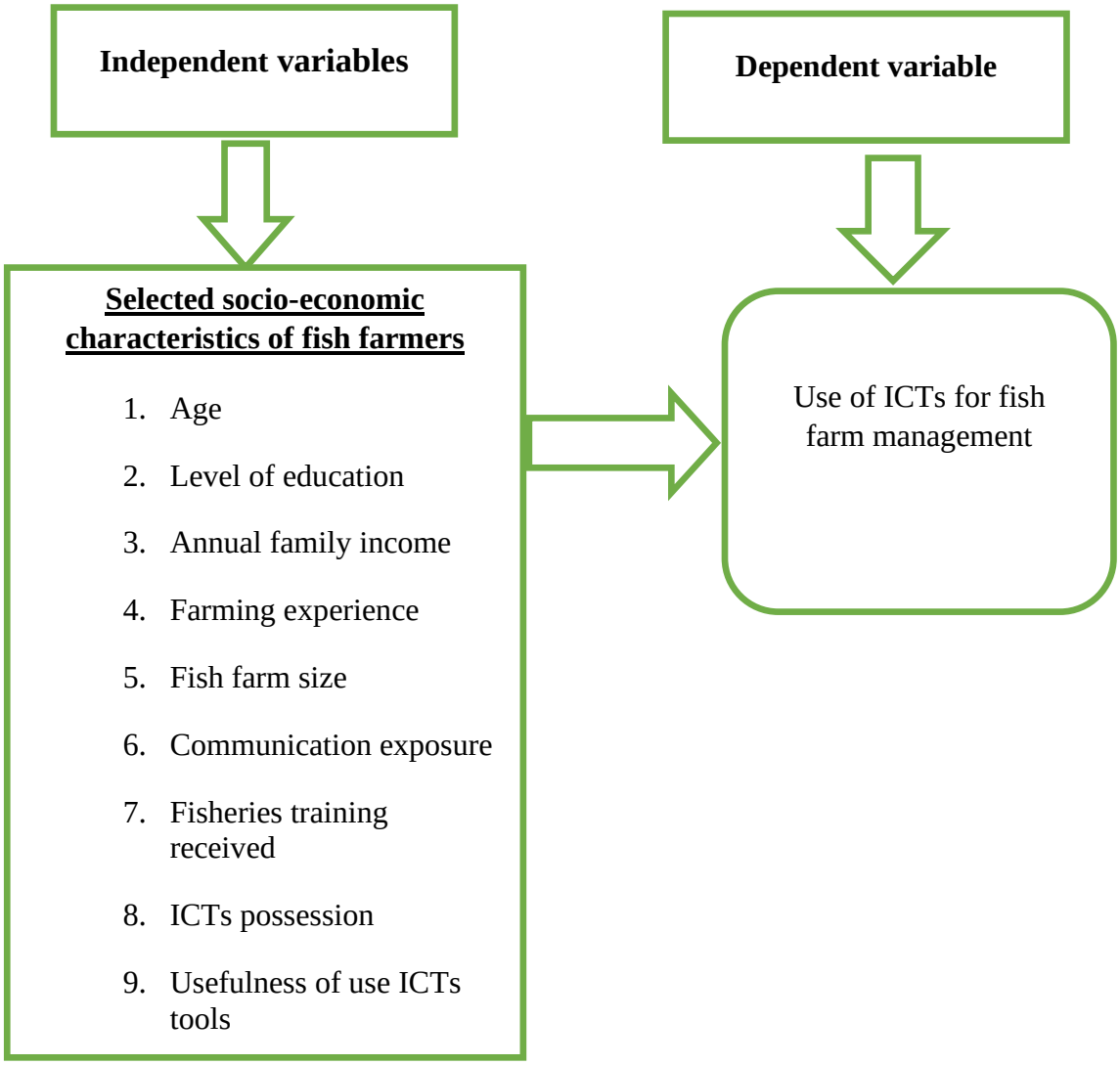

Figure 2.1 Conceptual framework of the study

CHAPTER-III

METHODOLOGY

This chapter describes the procedures and methods used in this study. This chapter is divided into three sections. The first section describes the overview of research design. The second section describes the measurement of variables. Finally, the third section describes the methods applied in data analysis.

3.1 Research Design

3.1.1 Locale of the study

Cumilla district is selected purposively as it is potential district of Bangladesh for fisheries practices. There are twelve upazillas in Cumilla district, among Daudkandi upazilla were selected purposively. The study was conducted in two unions namely Baro para and Gouripur. These unions were selected purposively because farmers of these areas are comparatively conventional method followers. Prior to selecting these unions, a thorough discussion with the concerned GOs and NGOs personnel and local elites was conducted by the researcher to contact targeted farmers. (Figure 3.1 and 3.2 show the map of the locale of the study).

Figure: 3.1 Map of Cumilla district showing Daudkandi upazilla

Figure: 3.2 Map of Daudkandi upazilla showing study area

3.1.2 Population and sampling frame

Fishermen using ICT for fish farm management in Daudkandi upazilla under Cumilla district constituted the population of the study. The list of all the fish farmers in Daudkandi upazilla was collected. Thus, a total of 235 fish farmers were constituted the population of this study. Data were collected from the sample rather than whole population due to time and fund constraints. Fish farmers were selected randomly and proportionately from the villages as the sample by using a random number table. Thus, 103 fish farmers were selected as the sample for this study using an online sample determination application. Data collection was conducted only once they willingly agreed to participate in the survey voluntary. Distribution of population, sample size and pre-test sample are shown in the Table 3.1.

Table 3.1 Population and sample of this study

Union	Population	Sample size	Pre-test sample
Baropara	135	65	4
Gouripur	100	38	3
Total	235	103	7

3.1.3 Instrument for data collection

Since the reasons for study were to test the hypotheses and measure the variances, a cross-sectional survey strategy was operationalized for this study. Henceforth, data was gathered utilizing an organized meeting plan. Remembering the targets, the study adjusted approved estimation things from earlier investigations, at whatever point conceivable. The beforehand prepared interview schedule was prettied and vital adjustments were completed. In most instances, closed form questions were used. Approved estimation of each construct with their literature sources was exhibited in an English version of the interview schedule as joined in Appendix-A.

3.1.4 Collection of data

Data for this study were collected through personal interview by the researcher himself period from 25th October to 25th November, 2020. The interview schedule prepared earlier by the researcher was used to gather information. All possible efforts were made to explain the purpose of the study to the respondents to get valid and pertinent information from them. Interviews were conducted with the respondents at their fish farm. While starting the interview with any respondent, the researcher took all possible care to establish rapport with them so that they did not feel uneasy or hesitant to furnish proper responses to the questions and statements in the schedule. The questions were explained and clarified whenever any respondent felt difficulty in understanding properly. None of the fish farmers was interviewed from the reserve list during final collection of data.

3.1.5 Variables of the study

Two variables were used for this study:

1. Dependent variable: It is a variable that is the result or outcome or effect of other variables. This variable is often known as criterion or outcome variable. The dependent variable's value depends on the other variables' value, that is, independent variable. In this study, use of ICT tools for fish farm management by the fish farmers was considered as the dependent variable.

2. Independent variable: It is a variable that the researcher can control over or manipulate to predict another variable (i.e., dependent variable). Therefore, this variable is often called as predictor variable or causal variable. In an experimental setting, a researcher wants to manipulate the variable or introduce new variable to see

its effect on the dependent variable. In this study age, level of education, annual family income, farming experience, farm size, communication exposure, fisheries training received, ICT device ownership, usefulness of using ICT tools barrier in adopting ICT tools were considered as independent variables.

3.2 Measurement of Variables

Variables are two types. These are discussing in the below:

3.2.1 Measurement of independent variables

3.2.1.1 Age

Age of the fish farmers refers to the period of time from his birth to the time of interview. It was measured in terms of actual years on the basis of his response to item No. 1 of the interview schedule (Appendix A).

3.2.1.2 Education

The education of a respondent was measured by the number of years of successful schooling. A score of one (1) was assigned for each year of schooling completed. For example, if a respondent completed study up to class five, his education score was assigned as 5.

The knowledge status of a respondent who could sign only was assigned a score of 0.5 while illiterate fish farmers were assigned a score of 0. Besides, if a respondent did not go to school but studied at home and if his knowledge status was equivalent to a formal school education.

3.2.1.3 Fish farm size

Farm size of a respondent referred to the total area of land on which he carried out the fish farming operation, the area being in terms of full benefit to him. The term refers to the fish farm area either owned by the respondent or culture fish on share-farming lease or taking from other including homestead pond. It was measured in hectares for each respondent using the following formula:

$$FS = A + B + \frac{1}{2}(C + D) + E$$

Where, FS = Fish farm size,

A = Homestead Pond,

B = Own Pond under own cultivation,

C = Pond taken from others as borga

D = Pond given to other as borga,

E =Pond taken from others on lease,

The data was first recorded in terms of local measurement unit i.e., decimal and then converted into a hectare. The total area, thus, obtained is considered as his fish farm size score (assigning a score of one for each hectare of land). This variable appears in item number three (3) in the interview schedule as presented in Appendix -A.

3.2.1.4 Fisheries training received

Training of a respondent was measured by the total number of days for which a respondent attended in different training programs on fish farming. If a respondent takes training for 7 days, he will get 7 scores. This variable appears in item number ten (10) in the interview schedule as presented in Appendix -A.

3.2.1.5 Communication exposure in fish firming

Communication exposure was measured as one's extent of contact to different information sources. Each respondent was asked to indicate his nature of contact for each of 14 selected media with five alternative responses was prepared for the respondents. Following scores were assigned for each of 14 media.

Extent of exposure	**Score Assigned**
Never	0
Rarely	1
Occasionally	2
Often	3
Regularly	4

Thus, the communication exposure scores of fish farmers could range from 0 to 56. Where '0' indicated no exposure and 56 indicated very high media contact. This variable appears in item eight (8) in the interview schedule as presented in Appendix-A.

3.2.1.6 ICT possession

The ICT possession score of a respondent was computed on the basis of his possession of the number and type of ICT devices. This considered both self and shared access. Scores for ICT possession were assigned as follow:

Nature of possession	Score Assigned
Self	2
Shared	1
No possession	0

ICT possession score was determined by summing the scores of all the four ICT devices. Thus, the score could range from 0 to 2, where 0 indicated no possession and 2 indicated the self-possession of ICT tools.

3.2.1.7 Usefulness of using ICT tools

Usefulness of using ICT tools score of a respondent was computed on the basis of his belief on how they are benefitted by using ICT tools in their fish farming activities. Respondents' responses were captured by using a five-point rating scale (0-4) ranging from 'Not at all' to 'Most use full against six statements.

Assigned items	Score
Not at all	0
Not use full	1
Less use full	2
Moderately use full	3
Most use full	4

Usefulness of using ICT tools score was determined by summing the scores of all 6 items. Thus, the score could range from 0 to 4, where '0' indicates Not at all and '4' indicates Most use full agreement.

3.2.2 Measurement of Dependent Variable

3.2.2.1 Use of ICT tools for fish farm management

The use of ICT tools for fish farm management is measured by measuring the ICT tools of use of an ICT tool by respondent's fish farmer. The use of ICT tools of a fish farmers was measured in his/her nature to use different ICT tools in his/her own fish farm management system. Respondent's fish farmers were asked to mention his/her nature of use of ICT tools for fish farm management and scores were assigned as follows:

Use of ICT tools	Score
Never	0
Rarely	1
Occasionally	2
Often	3
Frequently	4

Use of ICT tools use score was determined by summing the scores of all six items. Thus, the score could range from 0 to 4, where '0' indicates no and '4' indicates highest use of ICT tools.

3.3 Data Analysis

3.3.1 Editing

Raw data were properly reviewed for omitting errors. The researcher made a careful scrutiny when he completed an interview so that all data were included to facilitate coding and tabulation.

3.3.2 Coding and tabulation

The researcher consulted with the research supervisor and co-supervisor, to make a detailed coding plan. All responses were given in the numerical score. The respondent responses were transferred to a spread sheet of SPSS to facilitate tabulation. In accordance with the objectives of the research, all of the data were tabulated.

3.3.3 Categorization of data

For coding operation, the collected data were classified into various categories. These categories were developed for each of the variables. The procedures and categorization of a particular variable were further discussed in the chapter 4 in detail.

3.3.4 Method of data analysis

The data were analyzed in accordance with the objectives of the research work. The statistical measures such as range, means, standard deviation, number and percentage distribution were used to describe the variables. The analysis of data was performed using statistical treatment with SPSS (Statistical Package for Social Sciences) computer program, version 25. In order to estimate the contribution of the selected factors that might influence fish farmers in the use of ICT tools in receiving farm-related information, linear regression analysis was used. Throughout the study the 0.05 level of probability was used as the basis of rejection or accepting a null hypothesis. If the computed value of was equal to or greater than the designated level of significance (p), the null hypothesis was rejected and it was concluded that there was a significant contribution of the concerned variable to the used ICT. Whenever the computed value was rejected. It was concluded that there was no contribution of the concerned variables to the use of ICT tools for fish farm management.

CHAPTER-IV

RESULT AND DISCUSSION

In this chapter, the findings of the study and interpretation of the results have been presented. Data obtained from respondents through interview were measured, analyzed, tabulated and statistically treated according to the objectives of the study. These are presented in four sections. In the first section, independent variables have been discussed. The second section dealt with factors which influences using ICT tools of fish farmers for their fish farm management, in third section discuss with dependent variables, and finally, find out the barriers faced by the fish farmers during ICT tools use in fish farm management have been discussed in the third section.

4.1 Respondents Characteristics and Descriptive Statistics

In this section the descriptive statistics are presented in Table 4.1

Selected Characteristics of the fish farmers

Nine characteristics of the fish farmer were selected for the study. These selected characteristics were age, level of education, annual family income, farming experience, fish farm size, communication exposure, fisheries training received, ICT possession and usefulness of use ICT tools. The salient features of the selected characteristics of the fish farmers have been presented in the table 4.1.

Table 4. 1 The salient features of the selected characteristics of the fish farmers

Sl. No.	Characteristics	Measuring unit	Range		Mean	SD
			Possible	Observed		
1.	Age	Year	-	19-68	40.02	9.879
2.	Level of education	Year of schooling	-	0-16	6.704	4.318
3.	Annual income	000’ taka	-	68-2010	351.16	271.88
4.	Fish farming experience	No. of year	-	1-37	7.20	5.413
5.	Fish farm size	Ha.	-	.101-12.14	.645	1.301
6.	Communication exposure	Score	-	0.29-2.21	1.088	.403
7.	Use ICT tools	Score	0-4	0.5-4	1.736	.802
8.	Fisheries training receive	No. of days	-	0-14	1.301	.124
9.	ICT possession	Score	0-15	1-9	.932	.343
10.	ICT usefulness	Score	0-4	3-4	3.695	.238

4.1.1 Age

The range of age of the fish farmers was found between 19 to 68 years and the average of age was 40.02 years with the standard deviation of 9.879. Age classification was done according to the People's Republic of Bangladesh; the fish farmers were classified into three categories based on their age: young aged (up to 35 years), middle aged (36 to 50 years) and old aged (above 51 years). The categories and the distribution of the fish farmers according to their age are shown in Table 4.2.

Table 4.2: Distribution of the fish farmers according to their age

Category	**Number of Farmers**	**%**
Young Aged (up to 35 years)	40	38.8
Middle Aged (36 to 50 years)	49	47.6
Old Aged (Above 51 years)	14	13.6
Total	**103**	**100**

Categorization was done based on youth classification of Bangladesh. Data presented in Table 4.2 indicates that the highest proportion (47.6%) of the fish farmers were in middle aged category, 38.8% of fish farmers were of young aged and rest 13.6% of fish farmers are of old aged category. However, data also revealed that (86.4%) of the fish farmers in the study area were of middle to young aged. This study found that middle to young aged fish farmers is more interested and engaged in fish farming and their high use of ICT in fish farming.

4.1.2 Level of education

The range of education of the fish farmers was found between 0 to 16 and the average of education was 6.704 years with the standard deviation of 4.32. Fish farmers were classified into five categories based on their education: cannot read and write (0), can sign only (0.5), primary level (1-5), secondary level (6-10) and above secondary level (above 10). The categories and the distribution of the fish farmers according to their education are shown in Table 4.3.

Table 4.3: Distribution of the farmers according to their education

Category	Number of Farmers	%
Can't Read and Write (0)	4	3.9
Can Sign Only (0.5)	13	12.6
Primary Level (1-5)	32	31.1
Secondary Level (6-10)	33	32.0
Above Secondary	21	20.4
Total	**103**	**100**

Categorization was done based on schooling in educational institutions calculated from the collected data. Data presented in Table 4.3 indicates that the highest proportion (32.0%) of the fish farmers fall under the category of secondary level of education whereas 31.1% of the fish farmers fall under the category of primary level, 20.4% fall under above secondary category, 12.6% fall under can sign only and only 3.9% of the fish farmer fall under the can't read and write category. The findings indicate that (63.1%) of the fish farmers' education level varied from primary to secondary levels. Thus, it can be said that the high education level, more interested and used of ICT for fish farming.

4.1.3 Annual family income

The range of fish farmers income of the farmers was found between 68 to 2010 TK (in thousands of TK) and the average of income was 351.16 TK (in thousands of TK) with the standard deviation of 271.888. Fish farmers were classified into three categories based on their income both agricultural and non-agricultural income source: low income (up to 80 thousand of TK), medium income (81 to 623 thousand of TK) and high income (above 623 thousand of TK). The categorization and the distribution of the fish farmers done according to their income both agricultural and non-agricultural income source are shown in Table 4.4.

Table 4.4: Distribution of the fish farmers according to their annual income

Category	Number of Farmers	%
Low income (Up to 80)	1	1.0
Medium income (81 to 623)	94	91.2
High income (Above 623)	8	7.8
Total	**103**	**100**

Categorization was based on standard deviation calculated from the collected data. Data presented in Table 4.4 indicates that the highest proportion (91.2%) of the fish

farmers had medium income, 7.8% of the fish farmers had higher income and there are 1% of the farmers who had lower income. Respondent's income comes from both agricultural and non-agricultural income source but most incomes come from fisheries source. 91.2% of the fish farmers had medium income by fish farming activities. But prior to fish farming they were engaged with other business and after hearing from friends or relatives or neighbor or taking training from different NGOs or GOs about fish farming, they started fish farming and their income increased noticeably.

4.1.4 Farming experience

Fish farming experience of the respondent farmers was ranged from 1 to 37 years. The average score was 7.20 years. On the basis of their fish farming experience, the respondent fish farmers were classified into three categories as shown in Table 4.5.

Table 4.5: Distribution of the farmers according to their farming experience

Categories	Farmers	
	Number	Percent
Low experience (up to 5)	49	47.57
Medium experience (6-15)	50	48.54
High experience (above 15)	4	3.88
Total	**103**	**100**

The highest proportion (48.54%) of the fish farmers had medium experience of fish farming that means they are culture fish from 6 to 15 years. The lower experienced fish farmers (47.54%) and 3.88% had high experience about fish farming. As the average fish farming experience of the fish farmers in the studied area was 7.20 years and majority 96.12% of the respondents had low to medium experience that indicates young generation involved in fish farming. Their experience influences them to take or use new ICT tools and in this way use status is increased indirectly

4.1.5 Communication exposure

The observed extension media contact scores of the respondents ranged from .29 to 2.21. The average extension media contact score was 1.088 and the standard deviation was 0.403. Based on the possible range of extension media contact score (0 - 4). The categories and distribution of the respondents were shown in Table 4.6

Table 4.6: Distribution of the farmers according to Communication exposure

Sl. No	Sources of communication	Regularly (4)	Often (3)	Occasionally (2)	Rarely (1)	Never (0)	Index
Personal Media:							
1.	Neighbor fish farmers/progressive farmers	60 (58.3%)	35 (34.0%)	7 (6.8%)	1 (1.0%)	0	372
2.	Upazilla fisheries officer	0	0	22 (21.4%)	52 (50.5%)	29 (28.2%)	96
3.	Fisheries extension officer	0	4 (3.9%)	26 (25.2%)	45 (43.7%)	28 (27.2%)	109
4.	NGO worker(s)	2 (1.9%)	3 (2.9%)	17 (16.5%)	43 (41.7%)	38 36.9	94
5.	Fish fry or fingerlings/fish feed dealers	68 (66.0%)	25 (24.3%)	5 (4.9%)	5 (4.9%)	0	362
6.	Local leader	2 (1.9%)	3 (2.9%)	17 (16.5%)	59 (57.3%)	22 (21.4%)	110
Group Media:							
7.	Participation in group discussion	1 (1.0%)	5 (4.9%)	4 (3.9%)	37 (35.9%)	56 (54.4%)	71
8.	Participation in demonstration meeting	1 (1.0%)	1 (1.0%)	22 (21.4%)	9 (8.7%)	70 (68.0%)	60
9.	Participation in field day	0	1 (1.0%)	4 (3.9%)	15 (14.6%)	83 (80.6%)	26
10.	Participation in training course	0	1 (1.0%)	6 (5.8%)	10 (9.7%)	86 (83.5%)	25
Mass Media:							
11.	Listening fisheries programmed in Radio	0	0	0	1 (1.0%)	102 (99%)	1
12.	Watching fisheries programmed in TV	27 (26.2%)	9 (8.7%)	10 (9.7%)	55 (53.4%)	2 (1.9%)	210
13.	Reading fisheries books/magazines/leaflets	2 (1.9%)	0	4 (3.9%)	27 (26.2%)	70 (68.0%)	43
14.	Observing fisheries folksongs, fair, etc.	0	0	0	3 (2.9%)	100 (97.1%)	3

As in Table 4.6, in the case of personal media, 58.3% of the respondents regularly contacted neighbor fish farmers/progressive farmers while 50.5% of the respondents rarely contacted with upazilla fisheries officer for fish farm management. Majority (66.0%) of the respondents had regular contracted to fish fry or fingerlings/fish feed dealers for upcoming modern technologies related to fish farm management. On the contrary 4.9% of respondents often participated in group discussion for their farming in group contract. In case of participation in demonstration meeting, Participation in Field Day, participation in training course showed that majority percentage of

respondents (68.0%, 80.6%, and 83.5% respectively) never participated these forms of group media for fish farming. However, in case of mass media, 34.9% of the farmers response that they watching fisheries programmed in TV regularly too often, where 53.4% of the respondent that rarely watched program related to fish farming but other mass media related items (Listening fisheries programmed in Radio, Reading fisheries books/magazines/leaflets, Observing fisheries folksongs, fair, etc.) majority percentage of respondents (99%, 68.0%, and 97.1% respectively) never participated these forms of mass media for fish farming purpose.

Table 4.7: Distribution of the farmers according to Communication exposure

Category	Number of Farmers	%
No communication exposure	45	43.7
Low communication exposure	49	47.6
High communication exposure	9	8.7
Total	**103**	**100**

As in Table 4.7 in the case of communication exposure 43.7% of the respondents had no communication, 47.6% of the respondents had low communication, and only 8.7% of the respondents had high communication for their fish farm management activities.

4.1.6 Fisheries training received

The training exposure score of the fish farmers ranged from 0 to 14 days. The average score was 1.301 days and standard deviation was 0.124. According to the training exposure score, the fish farmers were classified into 4 categories such as, 'no training (0 days), short duration training exposure (1 -3 days), medium duration training exposure (4-7 days), and long duration training exposure (above 7 days) and presented in table 4.8.

Table 4.8: Distribution of the farmers according to their training exposure

Categories	No.	Percent
No training (0 days)	87	84.46
Short duration training exposure (1 -3 days)	2	1.94
Medium duration training exposure (4-7 days)	9	8.73
Long duration training exposure (above 7 days)	5	4.85
Total	**103**	**100.0**

The data of table 4.8 show that a majority (84.46%) of respondents received no training, while near 2% of the respondents received short duration training, 8.73% of respondents received medium duration training, while 4.85% received long training. This means that a

large portion of the respondents are away from training which keeps them away from ICT tools used in fish farm management.

4.1.7 ICT possession

The ICT possession of the fish farmers score ranged from 0.20 to 1.80 with an average of 0.932 and standard deviation 0.343. Depending on ICT possession status fish farmers are classified into three categories which are shown in Table 4.9.

Table 4. 9: Distribution of the farmers according to their ICT Possession

SL No.	ICT tools	Own By Myself (2)	Shared access (1)	No access (0)
A)	**Traditional Media**			
1	Television	**81 (78.6%)**	**8 (7.8%)**	**14 (13.6%)**
2	Radio	5 (4.9%)	26 (25.2%)	72 (69.9%)
B)	**New Media**			
3	Mobile phone	76 (73.8%)	25 (24.3%)	2 (1.9%)
4	Computer	4 (3.9%)	5 (4.9%)	94 (91.3%)
5	Internet	35 (34.0%)	14 (13.6%)	54 (52.4%)

From the Table 4.9 we found that new media like mobile phone, 76(73.8%) respondents have self-access, 25(24.3%) respondents have shared access and only 2(1.9%) respondents have no access in mobile phone. Thus, 81(78.6%) respondents have self-access, 8 respondents have shared access and 14 respondents have no access on television but in case of internet possession, 35% of the farmers have self-access, 14% respondents have shared access and 52.4% of the respondents have no access in internet services. Finally, 4 respondents have self-access, 5 respondents have shared access and most of the respondent's 91.3% respondents have no access in computer.

4.1.8 Usefulness of using ICT tools in fish farm management

The observed usefulness of use ICT tools scores of the respondents ranged from 3.00 to 4.00. The average usefulness of using ICT score was 3.695 and the standard deviation was 0.238. The categories and distribution of the respondents were shown in Table 4.10

Table 4. 10 Distribution of the fish farmers according to their usefulness of using ICT tools

Sl No	Statements	Extent of agreement					
		Most use full (4)	Use full (3)	Some What full (2)	Less use full (1)	Not use full at all (0)	Index
1.	I could save my productive time using ICT for communicating others	100 (97.1%)	3 (2.9%)	0	0	0	409
2.	Use of ICT provide me better access to farming information	44 (42.7%)	57 (55.3%)	2 (1.9%)	0	0	351
3.	ICT help me to know better about marketing information	85 (82.5%)	16 (15.5%)	2 (1.9%)	0	0	392
4.	ICT help me to reduce my transportation cost for farming	91 (88.3%)	12 (11.7%)	0	0	0	400
5.	I can upto date myself about my farming using ICT	35 (34.0%)	49 (47.6%)	18 (17.4%)	1 (1.0%)	0	324
6.	I can better communicate to the market actors (e.g., input dealers, suppliers) using ICT	99 (96.1%)	4 (3.9%)	0	0	0	408

The above Table 4.10 shows the opinion of the respondents about the usefulness, use of ICT tools where 97.1% respondents agreed it that they think ICT (e.g., mobile, internet, face book, you tube) can save productive time, in fish farm management. Furthermore, 55.3% respondents agreed that they think they will access farming information using ICT tools. Furthermore, 82.5% of respondents agreed that they will be updated with the latest farm-related information using ICT-based. Furthermore, 96.1% of respondents agreed that they will better communicate with market actors using ICT-based medium. Besides all of these 82.5% people agreed with the statement that the ICT (mobile phone, Internet) will be the effective media to get market information and also 88.3% respondents agreed to be reduced transportation cost using ICT for their farming.

Table 4. 11 Distribution of the fish farmers according to their usefulness of using ICT tools

Category	Number of Farmers	%
Now usefulness of using ICT tools	10	9.71
Less usefulness of using ICT tools	20	19.4
High usefulness of using ICT tools	73	70.9
Total	**103**	**100**

The above Table 4.11 shows the opinion of the respondents about the usefulness, use of ICT tools where 70.9% respondents highly agreed to that they think ICT (e.g., mobile, internet, face book, you tube) high useful in fish farm management and only 19.4% respondents having medium opinion and only 9.71% of the respondent usefulness of ICT tools for their fish farm management activities.

4.2 Use of ICT tools by the Fisherman in Fish Farm Management

The observed score of use of ICT tools in fish farming ranges from 3 to 24. The average and standard deviation were 1.737 and 0.802 respectively. The categories and distribution of the respondents were shown in Table 4.12

Table: 4. 12 Distribution of the farmers according to their Use of ICT tools in Fish farming system

SL No	ICT Tools	Frequently (4)	Often (3)	Occasionally (2)	Rarely (1)	Never (0)	Index
1.	Mobile phone	100 (97.1%)	3 (2.9%)	0	0	0	409
2.	Computer	2 (1.9%)	3 (2.9%)	2 (1.9%)	95 (92.2%)	0	116
3.	Internet	21 (20.4%)	21 (20.4%)	7 (6.8%)	54 (52.4%)	0	215
4.	Sensor	0	0	0	0	103 (100%)	0
5.	Social media (e.g., Facebook, Twitter etc.)	32 (31.1%)	20 (19.4%)	5 (4.9%)	1 (1.0%)	45 (43.7%)	199
6.	YouTube	40 (38.8%)	37 (35.9%)	3 (2.9%)	0	23 (22.3%)	277

The information gained from the field study Table 4.12 shows that 20.4% of fish farmers has frequent access to the internet service as the extent of use of ICT but about 52.4% fish farmers has rarely access at all to the internet. Similar responses can

be observed for the use of social media. On the other hand, 97.1% fish farmers use a mobile phone on daily basis. Despite of being new concept, uses of computers and sensors got extensive negative response as extent of use of ICT tools, all of the fish farmer (100%) has rarely access to the sensor and towards the computer also where only 52.4% fish farmers rarely use the computer for information access as extent of use of ICT tools. However, 31.1% of fish farmers use social media on a daily basis for receiving personal as well as farming related information.

Table 4.13: Distribution of the fish farmers according to their use of ICT tools in Fish farming system

Category	Number of Farmers	%
Less use	40	38.8
Moderate use	34	33.0
Frequent use	29	28.2
Total	**103**	**100**

The information gained from the field study Table 4.13 shows that majority of the respondents' (38.8%) use of various ICT were found less while one-third of them 33% use moderately. A little more than one-fourth of the respondents (28.2%) use ICT tools for fish farm management.

Contribution of Selected Factors of Fish Farmers in the Use of ICT for Fish Farm Management

In order to determine the relationship of socio-economic characteristics of fish farmers to their use of Information Communication Technologies (ICT), regression analysis was carried out which is presented in Table 4.14.

Table 4.14 Multiple Regression co-efficient of the selected characteristics of the fish farmers with their use of ICT for fish farm management

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	R^2	Adj. R^2	F
		B	Std. Error	Beta					
Use of ICT tools	(Constant)	-.214	.971		-.221	.826	.674	.642	21.36
	Age	-.025	.006	-.305	-4.150	.000^{NS}			
	Level of education	.077	.015	.412	5.228	.000**			
	Annual income	.000	.000	.124	1.477	.143			
	Fish farming experience	.000	.012	-.001	-.010	.992			
	Fish farm size	-.030	.050	-.049	-.597	.552			
	Communication exposure	.524	.171	.264	3.068	.003**			
	Fisheries training received	.005	.020	.018	.231	.818			
	ICT possession	.515	.154	.221	3.352	.001**			
	Usefulness use of ICT	.342	.252	.102	1.356	.179			

Dependent Variable: Use of ICT Tools
**Significant at 5%

Among the nine variables, three (3) variables namely level of education, communication exposure and ICT possession were found to contribute significantly to the use of ICT for fish farm management (Table 4.14) while the rest of the variables showed no significant contribution. All the factors jointly contribute 67.4% of the variances of the adoption (R^2 = 0.674). Each predictor may explain some of the variances in respondents' use of ICT by chance. The adjusted R^2 value (0.642) penalizes the addition of extraneous predictors in the model, but values of 0.642 still show that the variances in respondents' use of ICT can be attributed to the predictor variables rather than by chance and that both are suitable models (Table 4.14). In summary, the models suggest that the respective authority should consider the respondents level of education, communication exposure, ICT possession for fish farm management and knowledge on improved practices of fish farmers.

4.2.1 Significant relationship of level of education in use of ICT by the fishermen for fish farm management in Daudkandi upazilla under Cumilla district

The relationship of level of education in the use of ICT by the fishermen for fish farm management by testing the following null hypothesis; “there is no contribution of level of education in use of ICT by the fishermen for fish farm management in Daudkandi upazilla under Cumilla district”.

The p-value of the concerned variables was found .000. The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of level of education was at 5% significance level.
b. So, the null hypothesis could be rejected.

Fish farmer’s level of education had a positive influence on ICT user’s fish farmers’ for managing fish farm. It had the significant (significant at $p<0.000$) contribution on their fish farm management. It could be said that sometimes ICT tolls were not accepted by small educated farmers compared to highly educated farmers and they might face obstacles sometimes to take new decision for going outside from ICT practices considering benefit.

4.2.2 Significant relationship of communication exposure by the fishermen for fish farm management in Daudkandi upazilla under Cumilla district

From the multiple regression, it was concluded that the relationship of communication exposure by the fishermen for fish farm management by testing the following null hypothesis; “there is no contribution of communication exposure by the fishermen for fish farm management in Daudkandi upazilla under Cumilla district”

The p-value of the concerned variables was found .003. The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of the media exposure was at 5% significance level.
b. So, the null hypothesis could be rejected.

Fish farmer's communication exposure for ICT practices had positive influence on fish farm management. This implies that with the increased communication exposure, the fish farmers will increase with their use of ICT tools on fish farm management.

4.2.3 Significant relationship of ICT possession by the fishermen for fish farm management in Daudkandi upazilla under Cumilla district

From the multiple regression, it was concluded that the relationship of ICT possession by fish farmers for fish farm management by testing the following null hypothesis; "there is no contribution of ICT possession by the fishermen for fish farm management in Daudkandi upazilla under Cumilla district"

The p-value of the concerned variables was found .001. The following observations were made on the basis of the value of the concerned variable of the study under consideration.

c. The contribution of the ICT usefulness was at 5% significance level.
d. So, the null hypothesis could be rejected.

Fish farmers ICT possession had positive influence on fish farm management. This implies that with the increase of ICT possession, the fish farmers will increase with their use of ICT on fish farm management.

4.3 Barriers faced by the fish farmers in using ICT tools

Barrier faced by the fish farmer during use of ICT tools for fish farm management respondents was quantified by computing scores for their problems during use of ICT tools. The barrier faced by the farmers during use of ICT tools score ranged from 1.71 to 4 against the possible scores 0 to 4 with an average of 3.081 and a standard deviation of 0.336. Based on the barrier faced during towards fish farming scores, the respondents were classified into three categories as shown in Table 4.15.

Table 4. 15 Distribution of the fish farmers according to the barrier faced during used of ICT tools

Categories	No.	Percent
Low barrier faced	1	1
Medium barrier faced	29	28.2
High barrier faced	73	70.9
Total	**103**	**100.0**

The data presented in table 4.15 shows that the that majority of the respondents' (65.05%) faced high barrier of various ICT tools use while one-third of them 31.06% were faced medium barrier. A little only (1%) of respondents faced low barrier of ICT tools for fish farm management.

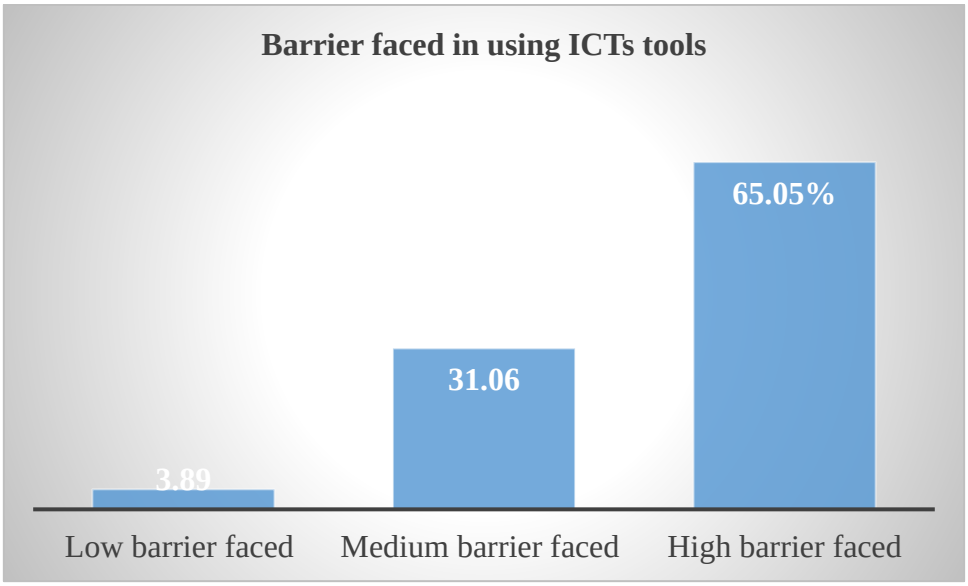

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Figure 4.1 Barrier faced in using ICT tools for fish farm management.

The findings also reveal that an overwhelming majority (96.11%) of the respondents faced medium to high level barrier faced during used of ICT tools for fish farm management.

CHAPTER-V

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents summary of findings, conclusions and recommendations of the study,

5.1 Summary of the Study

The title of the study was "Use of ICT by the Fishermen for Fish Farm Management in Selected Areas of Daudkandi upazilla under Cumilla District". The present study was undertaken with the objectives to determine and describe the socio-economic characteristics of the respondent fish farmers, to know the extent of use of ICT by fishermen for fish farm management, to explore the contribution of selected factors to the extent of use of ICT for fish farm management and to find out the barriers faced by fish farmers during ICT tools use. The selected characteristics of the fish farmers were age, education, annual income, farm size, training received, communication exposure and usefulness of use ICT tools. Two unions of Daudkandi upazilla under Cumilla district namely Baro para and Gouripur were selected as research area. The respondents of the study were the medium to smallholder fish farmers. The sample of fish farmers was drawn from a population of 235. Data were collected from 25th October to 25th November, 2020 using a questionnaire interview schedule.

The major findings of the study are summarized below.

5.1.1 Selected factors that influence farmers use of ICT tools in fish farm management

Findings in respect of the ten selected factors that influence fish farmer's use of ICT tools in fish farm management are summarized below:

Age

An overwhelming majority (47.6%) of the respondents was middle aged and 38.8% was young aged and 13.6% was old aged. The standard deviation was 9.879 and mean was 40.02.

Level of Education

Almost all of the farmers had different level of education. Among them highest proportion (32.0%) of the fish farmers fall under the category of secondary level of education whereas 31.1% of the fish farmers fall under the category of primary level, 20.4% fall under above secondary category, 12.6% fall under can sign only and only 3.9% of the fish farmer fall under the can't read and write category.

Annual Family Income

Fish farmers have both agricultural and non-agricultural income source. There the highest proportion (91.2%) of the fish farmers had medium income, 7.8% of the fish farmers had higher income and there are 1% of the farmers who had lower income

Farming Experience

Fish farming experience of the respondent fish farmers was ranged from 1 to 37 years. The average score was 7.20 years. The highest proportion (77.3%) of the fish farmers had medium experience of fish farming that means they are culture fish from 7 to 22 years. The lower experienced fish farmers 11.3 percent and 11.3 percent had high experience about fish farming. As the average fish farming experience of the farmers in the studied area was 14.98 years and majority 88.6% of the respondents had low to medium experience that indicates young generation involved in fish farming.

Communication Exposure

Extension media contact scores of the respondents ranged from .29 to 2.21. The average extension media contact score was 1.088 and the standard deviation was 0.403.

In case of personal media, 58.3% of the respondents regularly contacted with neighbor fish farmers/progressive farmers while 50.5% of the respondents rarely contact with upazilla fisheries officer for fish farm management. Majority (66.0%) of the respondents had regular contracted to fish fry or fingerlings/fish feed dealers for upcoming modern technologies related to fish farm management. On the contrary in group contract, 4.9% respondents often participated in group discussion for their farming. In case of Participation in demonstration meeting, Participation in field day, Participation in training course showed that majority percentage of respondents (68.0%, 80.6%, and 83.5% respectively) never participated these forms of group

media for fish farming. However, in case of mass media, 34.9% of the farmers response that they watching fisheries programmed in TV regularly too often, where 53.4% of the respondent that rarely watched program related to fish farming but other mass media related items (Listening fisheries programmed in Radio, reading fisheries books/magazines/leaflets, Observing fisheries Folksongs, fair, etc.) management majority percentage of respondents (99%, 68.0%, and 97.1% respectively) never participated these forms of mass media for fish farming purpose.

Fisheries Training Received

A majority (84.46%) of respondents received no training, while 2% of the respondents received short duration training, 8.73% of respondents received medium duration training, while only 4.85% received long training.

ICT Possession

The ICT possession of the fish farmers score ranged from 0.20 to 1.80 with an average of 0.932 and standard deviation 0.343.

The ICT ownership of the fish farmers found that new media like mobile phone, 76(73.8%) respondents have self-access, 25(24.3%) respondents have shared access and only 2(1.9%) respondents have no access in mobile phone. Thus, 81(78.6%) respondents have self-access 8 respondents have shared access and 14 respondents have no access on television but in case of internet possession, 35% of the farmers have self-access, 14% respondents have shared access and 52.4% of the respondents have no access in internet services. Finally, 4 respondents have self-access, 5 respondents have shared access, and most of the respondents (91.3%) have no computer access**.**

Usefulness of use ICT tools

The observed usefulness of use ICT tools scores of the respondents ranged from 3.00 to 4.00. The average usefulness of using ICT score was 1.736 and the standard deviation was .802. The opinion of the respondents about the usefulness, use of ICT tools where 97.1% respondents agreed it that they think ICT (e.g., mobile, Internet, face book, you tube) can save productive time, in fish farm management. Furthermore, 55.3% respondents agreed that they think they will access farming information using ICT tools. Furthermore, 82.5% of respondents agreed that they will be updated with the latest farm-related information using ICT-based. Furthermore,

96.1% of respondents agreed that they think they will better communicate with market actors using ICT-based medium. Besides all of these 82.5% of people agreed with the statement that the ICT (mobile phone, Internet) will be the effective media to get market information and also 88.3% respondents agreed to be reduced transportation cost using ICT for their farming.

5.1.2 Use of ICT tools by the fish farmers

The observed score of use of ICT tools in fish farming ranges from 0.50 to 4.00. The average and standard deviation were 1.737 and 0.802 respectively.

Use of ICT tools where it was agreed by 97.1% respondents that they think ICT (e.g. mobile, Internet, face book, you tube) can save productive time, in fish farm management. Furthermore, 55.3% respondents agreed that they think they will access farming information using ICT tools. Furthermore, 82.5% respondents agreed that they think they will be updated with latest farm related information using ICT-based. Furthermore, 96.1% respondents agreed that they think they will better communicate with market actors using ICT-based medium. Besides all of these 82.5% people agreed with the statement that the ICT (mobile phone, Internet) will be the effective media to get market information and also 88.3% respondents agreed to be reduce transportation cost reduced ICT for their farming.

5.2 Conclusions of the Study

Findings of the present study and the logical interpretation of other relevant facts interested the researchers to draw the following conclusions:

1. The Average use of ICT score was found 1.737 which is not so satisfactory, because the fish farmers in larger extents did not properly fulfill all aspects of use of ICT. Thus, it can be concluded that such low to medium use may not improve the fish farming profile of fish the farmers effectively and efficiently.
2. The study revealed that the education of the fish farmers had positive and significant relationship with the use of ICT. Thus, it may be said that high use of ICT was found in the case of educated fish farmers.
3. The study revealed that ICT possession of the fish farmers had a highly positive and significant relationship with the use of ICT in their activities. Thus, it may be concluded that high use of ICT was found in the

case of fish farmers having ownership of ICT tools in fish farm management.

4. The study revealed that communication exposure of the farmers had highly positive and significant relationship with the use of ICT in fish farming activities. Thus, it may be concluded that high use of ICT was found in the case of fish farmers having good communication.
5. Findings showed that the majority of the fish farmers had faced medium to high extent of barriers in using ICT tools in fish farming activities. Thus, it may be concluded that various obstacles hinder the way of using ICT in fish farming activities.

5.3 Recommendation of the Study

5.3.1 Recommendation for policy formulation

On the basis of the findings revealed from the study, the following recommendations are put forwarded that might guide the policy formulation:

1. The education of the fish farmers had positive and significant relationship with the use of ICT. Thus, it may be said that high use of ICT was found in the case of educated fish farmers
2. ICT possession had a significant contribution on their use of ICT tools and almost all the respondents either had direct or shared access to, particularly mobile phone, television and you-tube. Therefore, more mobile-phone enabled applications should be designed and implemented so that fish farmers can easily access to those applications and receive updated market information.
3. Since ICT possession is very important for a user to access the ICT application, the Ministry of Youth and Sports and ICT Division of Government of the People's Republic of Bangladesh along with private sectors should promote ICT self-efficacy training to the rural clienteles. Therefore, rural fish farmers may upgrade their skills and enable them to minimize their economic loss due to market related inequalities.

Fish farmers also should learn about the usefulness of ICT that they could easily look forward to using ICT devices as usefulness use also have positive relationship with the use of ICT tools.

5.3.2 Recommendation for further study

1. The study was conducted Daudkandi upazilla of Cumilla district. Similar studies should be conducted in other parts of the country to get a clear picture of the whole country which will be helpful for effective policy formulation.
2. The present study was undertaken to explore contribution of ten selected factors to fish farmer's use of ICT tools. Therefore, it could be recommended that further studies should be designed considering other agricultural and nonagricultural activities and including other characteristics of the fish farmers that might affect the use of ICT tools.
3. In the present study age, education, farm size, farming experience, fisheries training received, ICT possession, usefulness of use ICT tools had significantly contributed to fish farmer's use of ICT tools. In this connection, further verification is necessary for non-contributing characteristics.
4. It is difficult to determine actual use of ICT tools by the farmers. Measurement of use of ICT tools by the fish farmers is not free from questions. Therefore, more reliable measurement of concerned variable is necessary for further study.
5. Research should also be undertaken to identify to other factors causing hindrance to the use of ICT tools in fish farm management.

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APPENDIX- A

ENGLISH VERSION OF THE INTERVIEW SCHEDULE

Department of Agricultural Extension & Information System

Sher-e-Bangla Agricultural University

Dhaka-1207

An Interview Schedule for data collection for the Research on

"Use of ICT by the Fishermen for Fish Farm Management in Selected Areas of Daudkandi Upazilla under Cumilla District"

(This interview schedule is entitled to a research study. Collected data will only be used for research purpose and will be published aggregately)

Serial No.....

Name of the respondent : .....Father/Spouse name: .....

Village : .....Union : .....

Upazilla : .....District : .....

Please answer the following questions

A. Personal Information

1. Age……. years **2. Gender:** () Male () Female

3. Marital Status: Please mention your marital status.

a) Unmarried b) Married c) Divorced d) Separated e) Widowed

4. Level of education: Please mention your level of literacy

i. Cannot read and write ( )

ii. Can Sign only ( )

iii. I have passed class----------

5. Annual family income: Please mention your family income in taka from each of the following sources for last one year.

Income from agricultural sector: (A)				
Sl. No.	**Sources**	**Total Taka**		
		Production	**Unit price**	**Income ('000'Tk.)**
1.	Agriculture			
2.	Livestock			
3.	Fish			
Subtotal (A)				
Income from non-agricultural sector: (B)				
4	Service			
5	Business			
6	Labor			
7	Remittance			
8	Others (pl. specify_____)			
Subtotal (B)				
Total (A + B)				

6. **Farming Experience:** Please mention the following information about your farming Experience.

How long have you been engaged in fish farming? …….. Years.

7. **Fish farm size:** Please mention here about your farm size

Sl No	**Use of Land**	**Measuring unit**	
		Local Unit	**Hectare**
1	Homestead Pond (A1)		
2	Own pond under own farming (A2)		
3	Pond Given to others on Borga (A3)		
4	Pond Taken to others on Borga (A4)		
5	Pond Taken to others on Lease (A5)		

Total farm size= A1+A2+ 1/2(A3+A4) + A5 =

Farm Type: Please mention here about your farm type

Sl No	**Farm Type**	**Measuring unit**	
		Local Unit	**Hectare**
1	Integrated Fish Culture		
2	Mono Culture		
3	Composite Culture		

8. Communication exposure

Please mention your extent of information

Sl. N.	Sources of information	Extent of information				
		Regularly (4)	**Often (3)**	**Occasionally (2)**	**Rarely (1)**	**Never (0)**
Personal Media:						
1	Neighbor fish farmers/progressive farmers	7-8times/ month ()	5-6times/ month ()	3-4 times/ month ()	1-2 times / month ()	0()
2.	Upazilla Fisheries Officer	7-8 times/ year ()	5-6 times/ year ()	3-4 times/ year ()	1-2 times/ year ()	0()
3.	Fisheries Extension Officer	7-8 times/ year ()	5-6 times/ year ()	3-4 times/ year ()	1-2 times/ year ()	0()
4.	NGO worker(s)	4 time/ month ()	3 time/ month ()	2 time/ month ()	1 time/ month ()	0()
5.	Fish fry or Fingerlings/fish feed dealers	4 times/ month ()	3 time/ month ()	2 time/ month ()	1 time/ month ()	0()
6.	Local leader	7-8times/ month ()	5-6times/ month ()	3-4times/ month ()	1-2 times/ month ()	0()
Group Media:						
7.	Participation in group discussion	7-8 times/ year ()	5-6 times/ year ()	3-4 times/ year ()	1-2 times/ year ()	0()
8.	Participation in demonstration meeting	2 times/ year ()	1 times/ year ()	1 times/ 2 year ()	1 times/ 3 year ()	0()
9.	Participation in Field Day	4 times/ year ()	3 times/ year ()	2 times/ year ()	1 times/ year ()	0()
10.	Participation in training course	4-5 times/ life ()	3 times/ life ()	2 times/ life ()	1 times/ life ()	0()
Mass Media:						
11.	Listening fisheries programmed in Radio	Regularly ()	4-5 times/ week ()	2-3 times/ week ()	1 times/ week ()	0()
12.	Watching fisheries programmed in TV	Regularly ()	4-5 times/ week ()	2-3 times/ week ()	1 times/ week ()	0()
13.	Reading fisheries books/magazines/leaflets	7-8 times/ year ()	5-6 times/ year ()	3-4 times/ year ()	1-2 times/ year ()	0()
14.	Observing fisheries folksongs, fair, *etc.*	7-8 times/ year ()	5-6 times/ year ()	3-4 times/ year ()	1-2 times/ year ()	0()

9. Fisheries training received Have you received any Fisheries training, till today? If yes, please mention the following particulars

Sl. No.	Subject matter of training	Year of receiving training	Name of the sponsoring organization	Duration of training (Days)
1.				
2.				
3.				
4.				

10. Use of ICT tools in Fish farming system: Do you use any ICT tools in farming production?

Sl. No.	ICT Tools					
		Frequently (4)	**Often (3)**	**Occasionally (2)**	**Rarely (1)**	**Never (0)**
1.	Mobile phone	Everyday	Weekly	Monthly	Once in 2-3 months	
2.	Computer	Everyday	Weekly	Monthly	Once in 2-3 months	
3.	Internet	Everyday	Weekly	Monthly	Once in 2-3 months	
4.	Sensor	Everyday	Weekly	Monthly	Once in 2-3 months	
5.	Social media (e.g., Facebook, Twitter)	Everyday	Weekly	Monthly	Once in 2-3 months	
6.	YouTube	Everyday	Weekly	Monthly	Once in 2-3 months	

11. ICT Possession:

SL No.	ICT tools	Own By Myself (2)	Shared access (1)	No access (0)
C) Traditional Media				
1	Television			
2	Radio			
D) New Media				
3	Mobile phone			
4	Computer			
5	Internet			

12. Usefulness of using ICT in Fish Farm Management: Please give your opinion of the followings:

Sl No	Statements	Extent of agreement				
		Most use full (4)	**Use full (3)**	**Some What full (2)**	**Less use full (1)**	**Not use full at all (0)**
1.	I could save my productive time using ICT for communicating others					
2.	Use of ICT provide me better access to farming information					
3.	ICT help me to know better about marketing information					
4.	ICT help me to reduce my transportation cost for farming					
5.	I can up to date myself about my farming using ICT					
6.	I can better communicate to the market actors (e.g., input dealers, suppliers) using ICT					

13. Barriers faced by the farmers in adopting ICT tools

Please mention your opinion against the following problems

Sl. No.	Problems	Extent of Severity				
		High (4)	**Moderately High (3)**	**Medium (2)**	**Low (1)**	**Not at all (0)**
1.	Price of ICT devices is high					
2.	Use of ICT is costly					
3.	Use of ICT need technical knowledge					
4.	Unavailability of training on ICT					
5.	Unavailability of electricity					
6.	Low repairing facilities for ICT devices					
7.	Lack of credit facilities for buying ICT devices					

Respondent’s phone no. ----------

Thank you for your well cooperation

Dated.....

.....

Signature of interviewer