USE OF MODERN IRRIGATION TECHNIQUES BY THE FARMERS

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CERTIFICATE

*This is to certify that the thesis entitled "**USE OF MODERN IRRIGATION TECHNIQUES BY THE FARMERS**" submitted to the department of Agricultural Extension and Information System, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka in partial fulfillment of the requirements for the degree of Master of Science (M.S.) in Agricultural Extension, embodies the result of a piece of bona fide research work carried out by **MD. RASEL AL MAMUN, Registration No. 19-10240** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

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

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DEDICATED
TO
MY BELOVED
PARENTS

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The Author

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABBREVIATIONS

BBS	Bangladesh Bureau of Statistics
GDP	Gross Domestic Product
DAE	Department of Agricultural Extension
USA	United States of America
FAO	Food and Agriculture Organization of the United Nations
HYV	High Yielding Varieties
GoB	Government of Bangladesh
MoA	Ministry of Agriculture
UN	United Nations
UNO	Upazila Nirbahi Officer
MoYS	Ministry of Youth and Sports
MoP	Muriate of Potash
TSP	Triple Super Phosphate
IPM	Integrated Pest Management
BINA	Bangladesh Institute of Nuclear Agriculture
BADC	Bangladesh Agricultural Development Corporation
SAAO	Sub-Assistant Agriculture Officer
SAU	Sher-e-Bangla Agricultural University
SPSS	Statistical Package for Social Sciences

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ABSTRACT

The purposes of the study were to describe the selected characteristics of the farmers; to determine the extent of farmers' use of modern irrigation technique and to explore the contribution among each of the selected characteristics of farmers with their use of modern irrigation techniques. The study was undertaken purposively in Kishoreganj Upazila under Nilphamari District. Validated and well-structured interview schedule was used to collect data from 101 respondents during 1st July, 2021 and completed in 30 July, 2021. Descriptive statistics, multiple regressions were used for analysis. The majority (65.34 percent) of the farmers had medium use of modern irrigation techniques compared to having 26.23 percent high and 7.92 percent had low use of modern irrigation techniques. Among 11 selected characteristics of the farmers three characteristics namely- education, training received and knowledge on agricultural irrigation of the respondents had significant positive contribution with their use of modern irrigation techniques but problem faced by the farmers in using modern irrigation techniques of the respondents had significant negative contribution with their use of modern irrigation techniques. The rest 7 characteristics namely, age, family size, farm size, annual family income, farming experience, agricultural extension media contact and attitude towards using modern irrigation techniques had no significant contribution with their use of modern irrigation techniques. Almost half of the farmers (48.51%) were illiterate to primary level education. Finding leads to conclude that, if suitable steps are taken to improve education level of the farmers, an appreciable proportion of the farmers will be encouraged to use of modern irrigation techniques. Increase in training facilities to develop modern irrigation techniques will minimize farmer's problems. If the farmers gain more knowledge on modern irrigation, they will face less problems in use of modern irrigation techniques.

CHAPTER-I
INTRODUCTION

1.1 General Background

Water is an essential component of every living being on earth, and its significant and vital role in agricultural development has been fully realized in the various developmental plans of Bangladesh. The water resources of Bangladesh are viewed as the most important cornerstones for their potential role to realize developments in agriculture sector and ensure food security for the future. The average total amount of water available in the field to grow one kilogram of rice was 1,606 L (L) in 2015−16 and 1605 L in 2016−17. The Average irrigation water supplied to the field was 1402 L kg^{-1} in 2015−16 and 1086 L kg^{-1} in 2016−17 (Mainuddin *et al*., 2020)

However, the volume of available water resources remains the most essential determinants of agricultural expansion both in terms of horizontal and vertical expansion. Different irrigation methods result in different levels of productions and are known to play an important role in water conservation to further agricultural expansion. The water sources in Bangladesh include surface water, groundwater, seawater desalination, and sewers. Surface water comes from rainfall, and its storage is low due to low and irregular rainfall, especially in the northern and central regions (Ministry of Planning, 1990; Al-zahrani *et al*., 2011).

Bangladesh enjoys the wealth of ground water due to the geology of water bearing rocks. The water production capacity of these rocks varies depending on the type of layer and the thickness of the configuration and their inherent characteristics (Al-zahrani *et al*., 2011). Waste water treatment plants

also supplies water to irrigate some crops. Presently it is used on a limited scale, but still reduces the consumption of groundwater in some areas. Agriculture sector consumes maximum water compared to other sectors. Estimates show that consumption of water in Bangladesh has been increased by 5.50% by household use, 11.5% by industrial activities, and 83% for agricultural operations (Abdel-Aziz, 1986; Al-zahrani and Baig, 2011). Increased groundwater accessibility resulting from the expansion of deep and shallow tube wells helped Bangladesh attain near self-sufficiency in rice, with national output increasing over 15 million tons in the last two decades. In addition to increasing supplies, water demand also needed to be curtailed by increasing water use efficiency through the adoption of water conserving practices such as reduced tillage, raised bed planting, and the right choices of crops. Decreasing water availability both in terms of quantity and quality suggest that the unchecked expansion of dry season boro rice cultivation may not be a long-term option for Bangladesh (Qureshi *et al*., 2015).

It is essential to reconsider economical ways of water consumption by agricultural sector. In these regards, the Bangladesh has developed national plan for water, especially after the emergence of evidence indicating the total consumption of water has reached to the critical levels. The sixth and seventh development plans, launched in the years of 1978–1979; 2016–2020 stressed on the collection of comprehensive and accurate data to overcome the issues related to water in order to make effective planning for water resources management. The most important measures enlisted in water resources policy focus on maintaining non-renewable groundwater reserves. National Water Plan is in place to achieve the optimum utilization of water and agricultural policies that would lead to reducing water consumption in the agricultural sector and application of modern irrigation methods, and the rational use of water for domestic, recreational and industrial sectors. The plan also focused on the reconsideration of the tariff of water consumption. The plan calls for the

re-evaluation of the regulatory framework for managing its water resources and making it in line with the emerging needs of the community (Ministry of Planning, 1990).

Groundwater has become the prime source of drinking and irrigation use in drought-prone Barind Tract (BT) of Bangladesh as the surface water sources are minimal. Continuous groundwater withdrawals for irrigation, drinking, domestics, industries and other uses deplete groundwater levels (GWL). Over 97% of accessible freshwater comes from groundwater, half of which is for drinking water and approximately half for irrigation water worldwide (Hossain *et al*., 2022).

Bangladesh is determined to practice agriculture by employing its water resources sustainably and it remains the basic and key element to future agricultural development plans. Many researchers (Atta *et al*., 2011) believe that sound and appropriate agricultural technologies can help improving agricultural production both in quality and volume, and limit the depletion of water resources. Similarly, Nwachukwu and Egwuonwu (2012) also believe that development and application of modern and appropriate irrigation technologies can certainly improve water use efficiency, ensure sustainability of water resources and their utilization, elevate crop yields and empower farming communities. Realizing the importance of water situation, the MEP (2010) stresses to bridge the gap between the rates groundwater extraction and their natural replenishment rates. Keeping in view the situation of water resources, Bangladesh has also launched a program to employ new sources of water, efficient utilization of irrigation systems, and modern irrigation methods to save water and lessen the stress on groundwater resources (MEP 2010; Atta *et al*., 2011; KACST, 2012). About 66% irrigators adopt modern irrigation methods like irrigation in the Bangladesh whereas only 74% farmers apply irrigations by employing surface irrigation systems (MEP, 2010).

The situation calls for finding all the alternatives and techniques to rationalize water consumption. All those involved in scientific research are required to maintain the presently available water resources in good conditions and at the same time make efforts to explore the new water saving irrigation technologies. To combat the situation, Bangladesh has started employing new modern irrigation methods to reduce the extraction pressures on groundwater resources as reported by Atta *et al*. (2011). Al-Zahrani *et al*. (2012) maintain that if improved irrigation methods used effectively, they would enhance yields, quality of crops and the water-use-efficiency as well. The researchers reported encouraging response on the adoption of new irrigation technologies that are proved to be cheap, reliableand simple to use. Therefore, it is imperative and seems justified to create awareness on the water saving modern irrigation methods among the farmers. However, before diffusing innovation in the farming community and taking any new technology to the farmers, it is extremely important to study the attitudesof the farmers.

Present study is an endeavor to gather information on the use of the modern irrigation techniques both traditional and modern irrigation methods. Agricultural Extension Service aims to educate the people of farming community in order to improve their quality of life through dissemination of knowledge. technologies, techniques, methods, ideas and useful information through extension system (Uddin, 2008). Therefore, at this juncture, it seems appropriate to take into account the role of agriculture extension in the present initiative.

1.2 Statement of the Problem

Water resources management in Bangladesh faces immense challenge for resolving many diverse problems and issues. The most critical is water scarcity during the wet and the dry seasons, ever-expanding water needs of a growing economy and population, and massive river sedimentation and bank erosion.

There is a growing need for providing total water quality management, and maintenance of the eco-system (NWPo, 2019).

The application of advanced irrigation technologies to agriculture could be the key driving force for enhancing crop productivity and promoting agricultural development. However, efforts have been made to introduce new advanced irrigation technology to stimulate more precision to Bangladesh agriculture such as drip irrigation, sprinkler irrigation and water conservation techniques but widespread adoption of these modern irrigation techniques are still to be achieved (iDE, 2012).

A systematic evaluation study on use of modern irrigation techniques by the farmers is not satisfactory which demands further research on this topic specially in drought prone areas of Bangladesh. Also, very little information is available on knowledge and actual use of modern irrigation techniques by the farmers in Bangladesh. Therefore, the researcher has undertaken the study titled "farmers' use of modern irrigation techniques". In order to make the study manageable the following research questions were taken into consideration:

1. What are the extents of use of modern irrigation techniques?
2. What are the selected characteristics of the farmers that influence their use of modern irrigation techniques?
3. Is there any contribution of the farmers' selected characteristics on their use of modern irrigation techniques?

1.3 Objectives of the Study

Considering the importance of use of modern irrigation techniques, the following objectives were taken in order to give proper direction in the study:

I. To determine the extent of farmers' use of modern irrigation techniques;

II. To describe the selected characteristics of the farmers; and

III. To explore the contribution of the selected characteristics of farmers' with their use of modern irrigation techniques.

1.4 Justification of the Study

To sum up, agricultural irrigation techniques studies have shown that farm mechanization led to increase in inputs, increased agricultural productivity and profitability on account of timeliness of operations, better quality of work and more efficient utilization of crop inputs. Undoubtedly, farm irrigation techniques mechanization displaced animal labour from 60-100%, but resulted in less time for farm work. Also, use of modern irrigation techniques led to increase in the human labour employment for the on-farm and off-farm activities as a result of manufacture, repair, servicing and sales of tractors and improved farm equipments. Several studies have been conducted on the impact of use of modern irrigation techniques on production, productivity, cropping intensity, human labour employment, as well as, income generation. Different researchers have concluded that use of modern irrigation techniques enhances the production and productivity of different crops due to timeliness of operations, better quality of operations and precision in the application of the inputs (Faruk et al., 2019).

Equipment for various operations like sowing, irrigation, plant protection, harvesting, threshing and other operations are generally being used by farming community. The fact, however, are those even small farmers utilize selected irrigation techniques for efficient farm operations, through custom hiring. In Bangladesh though, this has been in the most uneven manner. Government efforts have mostly been confined to the promotion of manual and animal drawn tools and implements. Power drawn implements have also gained momentum due to the concerted efforts of the Government, credit institutions and industries (Negrete, 2019).

1.5 Assumptions of the Study

An assumption has been defined as “the supposition that an apparent fact or

principle is true in light of the available evidence" (Goode, 1945). An assumption is taken as a fact or belief to be true without proof. So the following assumptions were in mind of the researcher while carrying out this study:

i) The respondents included in the sample were capable of furnishing proper responses to the questions of the interview schedule.
ii) Views and opinions furnished by the respondents were the representative views and opinions of the whole population of the study.
iii) The responses furnished by the respondents were reliable and they truly expressed their opinions on use of modern irrigation techniques.
iv) The data collected by the researcher were free from bias.
v) The researcher who acted as the interviewer was well adjusted to the social and cultural environment of the study area. Hence, the respondents furnished their correct opinions without any hesitation.
vi) The information sought by the researcher revealed the real situation to satisfy the objectives of the study.
vii) The findings were useful in choosing the clients as well as for planning execution and evaluation the extension programme.

1.6 Limitations of the Study

The present study was undertaken to have an understanding of the farmers' use of modern irrigation techniques and to determine the contribution factors with selected characteristics of the farmers. Considering the time, money and other necessary resources available to the researcher and to make the study manageable and meaningful from the point of view of research, it becomes necessary to impose certain limitations. The limitations were as follows:

i. The study was confined in two unions of Kishoreganj Upazila under Nilphamari District.
ii. The study was restricted within the farmers who had some cultivable land under their own cultivation.
iii. The population for the study was kept confined to the heads of the family who regularly cultivated their land.

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

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

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

1.1 Definition of Related Terms

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

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

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

Family size: It refers to the total number of individuals in the beneficiary's family.

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

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

Agricultural extension media contact: Agricultural extension media contact referred to an individual exposure to different information sources and personalities relate to agriculture for dissemination of new technologies.

Knowledge: knowledge referred to the extent of facts or information about an idea, object or persons knows. Regarding knowledge aspects knowledge occurs when an individual is exposed to technologies existence and gain some understanding of how it functions (Rogers, 1995).

Problem faced: Problem faced in using modern irrigation techniques meant any difficult situation which require some actions to minimize. The term problem faced referred to different problem faced by the farmers during using modern irrigation techniques.

Respondents: Randomly selected people considered to be representative of the population are known as respondents. They are the people from whom a social research worker usually gets most data required for her research. In this study the respondents were the village level farmers.

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

CHAPTER II
REVIEW OF LITERATURE

The researcher made an intensive search for available literature on the present study. The review was conveniently presented on the major objectives of the study. This chapter is divided into three major sections. The first section deals with use of different irrigation technology. The second and third section deals with contribution of farmer's characteristics on their use of different modern techniques and the conceptual framework of the study. Therefore, available literatures' on studied related to use of modern irrigation technology was only presented in this chapter.

2.1 Use of Different Modern Irrigation Technology

Moursy *et al*. (2022) conducted a research aims at evaluating the comparison between drip and surface irrigation systems in old lands of medium salinity in the Northern Nile Delta of Egypt, determining the best irrigation method to achieve the highest water productivityand optimum water consumption. A field experiment is performed in summer and winter seasons of 2020/2021. Soil and water characteristics are determined through representative sampling. The results show the differences in total cost of producing different summer and winter crops under tested irrigation systems. Surface irrigation system total cost was increased, while drip irrigation system total cost was decreased under all treatments with 29% to 54% based on the crop type. Also, drip irrigation gave more efficient water uses and water saving under different summer and winter crops. Hence, Drip irrigation system increased the value of water use efficiency, while surface irrigation system gave high value of productivity compared with drip irrigation system, due to higher salinity, additional leaching water used to control soil salinity.

Jaafar *et al*. (2021) in his study revealed that 90% of farmers agree that

better irrigation management can improve the economic productivity of their farms, and a similar percentage agreed that they are willing to use free smart mobile applications to assist them in managing (scheduling) irrigation for their crops. Results also indicated that among all socio-demographic characteristics considered in this study, age, nationality, and region were significantly associated with the use of a paid smart irrigation app. Willingness to pay was 57%, with younger farmers and those using energy or electricity, and those paying more for energy and water, more willing to pay. Farmers planting citrus and banana trees were more likely to use smart irrigation apps than those planting other crops such as potatoes and vegetables. The findings help to identify the factors influencing the adoption of smart irrigation applications in agriculture, which will provide insights into the inter linkages between irrigation management and infrastructure and socio-demographic variables.

Kuli and Degefa (2021) showed that farmers have developed several indigenous knowledge of irrigation water management practices. Among these knowledge, frequent maintenance of river side diversion weir, main line, sub main and in field furrow to avoid flow obstruction, cutting back water flow in the furrow when water reached at furrow end to decide amounts of irrigation water to be applied, giving priority for drought sensitive crop type and crop growth stage that cause significant yield when there is shortage of water, irrigate their crops after 5:00 pm to reduce evaporation water loss during irrigation, applying the next irrigation when the soil is dry (soil crack) and/or crop start wiling, application of farm yard manure and frequent weeding to increase soil water holding capacity and to avoid soil moisture competition among the crop and weed are the best one.

Murtiningrum *et al*. (2019) conducted a study on irrigation from system approach and cycle of knowledge management implementation. The cases were

Clean Irrigation Movement in Yogyakarta Province, Operation and Maintenance of Irrigation system of Lodoyo Irrigation System in East Java, and Irrigation Management Unit in Colo Irrigation System Central Java and East Java Provinces. From the cases, it was learnt that knowledge of individual in irrigation management determines the advancement of irrigation system and its sustainability. The success of institution is in management of its knowledge that influences the success of irrigation management.

Ding (2018) stated on the General Report of Question 61 of the 23rd Congress of the International Commission on Irrigation and Drainage (ICID). The Question was entitled "State of Knowledge of Irrigation Techniques and Practicalities within Given Socio-Economic Settings", covering three sub-questions: adopting precision irrigation and improving surface irrigation to combat water scarcity; using ICT, remote sensing, control systems and modeling for improved performance of irrigation systems; and adaptability and affordability of new technologies under different socio-economic scenarios. Under the Question, 64 accepted papers covering a wide range of topics of irrigation techniques and practicalities were summarized and reviewed with valuable views and state-of-the-art information/knowledge on the topics concerned. It was concluded that improving surface irrigation and precision irrigation are still the major areas in which to achieve objectives of higher agricultural water use efficiency and productivity; that new technologies and their applications in the irrigation sector can help to achieve the objectives; and that to address "adaptability and affordability" would ensure the real value achieved in practice.

Huang *et al*. (2017) investigated which factors may influence producers' use of irrigation technologies and/or water management practices (WMPs). One major finding was that Arkansas producers are more likely to rely on WMPs instead of sprinkler irrigation as a response to changes in depth to water and drought

occurrences. This finding highlighted the importance of expanding the existing literature that focuses mostly on more efficient irrigation technologies, especially in areas where WMPs are more prevalent. Climate factors also play a role. Sprinkler systems are more prevalent in regions with lower average temperature. WMPs were used to mitigate the impact of more frequent droughts.

Matović *et al*. (2016) conducted a research which was during the dry and warm growing seasons of 2011, 2012 and 2013 at Guča, which is a well-known potato-growing region of Serbia. Potato was grown under both rainfed conditions and with irrigation, applying two methods: sprinkler and subsurface drip irrigation. The objective of the research was to conduct a comparative analysis and assess the profitability of potato production under rainfed conditions and with irrigation by these two methods. The main outcome of the research showed that higher yields and more profitable production are achievable with irrigation, compared to rainfed conditions. Subsurface drip irrigation was found to be more profitable than sprinkler irrigation. The results provided insight into the structure and distribution of income and expenses, the income and expense growth trend, the percentage profit growth in the case of sprinkler and subsurface drip irrigation, as well as potential income losses at the national level if the irrigation methods considered are not used. A detailed analysis of the production costs provided insight into the feasibility of optimizing potato-growing approaches for all three types of production. The higher profitability of irrigated potato production opens the question of the need to increase irrigation coverage in Serbia.

Al-Zaidi *et al*. (2014) in his study found that farmers have the positive attitudes towards the use of modern irrigation methods. Therefore, sufficient quantity of water can be saved by the farmers by replacing the old traditional irrigation methods with the modern ones. The study suggests the need for awareness

campaigns among the farmers. Launching of agricultural extension education programs on efficient and water saving irrigation methods could be very suitable and viable option for conserving and maintaining water resources of the kingdom.

Psarras *et al*. (2014) studied the effects of different irrigation techniques and water qualities on tomato (*Solanum lycopersicum* L., hybrid 'Verdoun') yield, fruit quality and health risks were investigated under field conditions in Crete, Greece. Nine irrigation treatments were applied, including combinations of 3 water quantities: full irrigation (FI), regulated deficit irrigation (RDI) and partial root drying (PRD), 2 water qualities: fresh water (FW) and secondary treated municipal wastewater (WW), and 2 depths of application: surface (S) and subsurface (SS). WW was used after an onsite treatment which included: a) heavy metal (As, Cd, Cr, Cu, Pb) addition, b) a sand filter, c) a special filter for heavy metal removal (HMR), and d) a UV treatment for reducing bacterial populations. The marketable, non-marketable and defective fruit yield was measured and fruit samples were analyzed for total soluble solids (TSS) and titratable acidity (TA). Samples of irrigation water, soil and fruit were analyzed for heavy metals, *E. coli*, total coliform and total bacterial populations. Commercial fruit yield was not significantly affected by the deficit irrigation regimes applied, although in absolute values it was 5-7% lower compared to the fully-irrigated treatment. This was mainly due to an increase of the non-commercial fruit (small-sized). Irrigation water use was reduced by 23% in RDI and PRD treatments, while water use efficiency for harvested yield was increased by 20%. Marketable yield was not affected by the quality of the irrigation water used. The UV treatment was efficient in removing E. coli from the WW, with no sample through the growing season detected as E. coli-positive. No E. coli populations were detected in the harvested fruit, while in soil, the percentage of E. coli-positive samples was similar in both FW and WW treatments, indicating soil contamination by exogenous factors. The

combination of sand filter and HMR was efficient in removing heavy metals, resulting in no differentiation of soil heavy metal content between FW and WW treatments. In conclusion, the application of deficit irrigation practices can efficiently reduce water use with no significant effects on yield and quality of tomato plants, under the local conditions of Crete. Moreover, the possibility for the safe use of municipal wastewater for irrigating vegetable crops may further enhance the potential for fresh water saving in an area where fresh water availability for irrigation is limited.

Ortuno *et al*. (2010) reviewed the use of trunk diameter fluctuations and their derived parameters for irrigation scheduling in woody crops. The strengths and weaknesses of these continuously measured plant-based water stress indicators compared with other discretely measured indicators for diagnosing plant water status in young and mature trees are discussed. Aspects such as sensor reading variability, signal intensity and the relationship between trunk diameter fluctuations and plant water status are analyzed in order to assess their usefulness as water stress indicators. The physiological significance of maximum and minimum daily trunk diameter and maximum daily trunk shrinkage (MDS) are also considered. Current knowledge of irrigation protocols and baselines for obtaining maximum daily trunk shrinkage reference values is discussed and new research objectives are proposed. We analyze the response of woody crops to continuous deficit irrigation scheduled by maintaining MDS signal intensity at threshold values to generate mild, moderate and severe water stress and assess the possibility of using linear variable displacement transducer (LVDT) sensors in trunk as a precision tool for regulated deficit irrigation scheduling. Finally, the possibility of using MDS signal intensity as a tool to match the irrigation regime to tree water requirements is also reviewed.

Farahani *et al*. (2006) observed present water balance in Syria as a whole is

negative, with key basins suffering overdraft. That is mostly attributed to rapid increases in irrigated land and inadequacies in agricultural water use and management practices causing over–exploitation of groundwater. Syria has already begun taking encouraging steps towards full–scale modernization of irrigation systemsby improving irrigation networks and upgrading irrigation systems with the goal of increased irrigation and network system efficiency and reduced field water use. This article discusses the importance of on–farm irrigation water management considerations in current and future irrigation technology upgrades and modernization policies and practices. Policy deficiencies in this area could lead to the continuation of the existing inadequate, improper, and wasteful on–farm irrigation water management practices, irrespective of the technological level of the irrigation system. This article additionally discusses water management strategies for improved water productivity. At present, on– farm water management strategies are most unanimously geared towards maximizing production per unit of land for increased profit. In light of water scarcity and the alarming decline in water tables in Syria, advocating fullirrigation in basins with a negative water balance is unwise and unsustainable. In the latter basins, the practice of deficit irrigation represents a better strategy as it tends to maximize production per unit water used, a win–win scenario for improving both productivity and sustainability of water.

According to a study led by the Bangladesh Agricultural Development Corporation (BADC), Department of Agricultural Extension (DAE), (2019) around 55.87 lakh hectares of land was irrigated in 2018-19. Of this amount, about 40.83 lakh hectares, or 73 per cent, of the land was irrigated through the use of ground water while the remaining 15.03 lakh hectares, or 27 per cent, was irrigated with surface water. Five profoundly powerful techniques for irrigation are sprinkler irrigation, drip irrigation, surface irrigation, basin irrigation, and furrow irrigation. Among them, the drip irrigation system is the most proficient and suitable water system framework.

According to Saha and Mollah, (2019) in Bangladesh, use of groundwater in a massive scale for Boro rice is the main cause of declining groundwater tables, especially in the Rangpur Division-now a burning issue at the national level. The system of Alternate Wetting and Drying (AWD) is one, and can be introduced in saving water and energy, where both farmers and pump-owners are able to save around 30 to 35 per cent of their irrigation water requirements.

Carey and Zilberman, (2002) developed a stochastic dynamic model of irrigation technology adoption. It predicts that farms will not invest in modern technologies unless the expected present value of investment exceeds the cost by a potentially large hurdle rate. The article also demonstrates that, contrary to common belief, water markets can delay adoption. This article was motivated by evidence that, contrary to NPV predictions, farms wait until random events such as drought drive returns significantly above costs before investing in modern irrigation technologies.

2.2 Review of Literature Related to Contribution of Farmer's Characteristics on their Use of Different Modern Techniques

2.2.1 Age

Pandict *et al*. (2013) have found no significant contribution of age of farmers and use of surface irrigation techniques.

Rahman (2006) found that a positive and significant contribution of age of the bean farmers of Pabna District had significant contribution on their use of different modern irrigation techniques.

2.2.2 Education

Pandict *et al*. (2013) found a significant contribution of education of vegetable farmers of Northwest Region of Bangladesh and use of surface irrigation techniques.

Rahman (2006) found that education of the farmers of mymensingh had significant contribution of their use of different modern irrigation techniques.

2.2.3 Family size

Noman (2012) found that there was a negative contribution of family size and constraints of sandbar cropping technology.

2.2.4 Annual family income

Pandict et al. (2013) have found no significant contribution of the annual family income of farmers and use of surface irrigation techniques.

Parvez (2009) observed that annual family income had negative contribution of constraints faced by the farmers in small scale aquaculture.

Rahman (2006) found that income of the farmers had no contribution of their use of different modern irrigation techniques.

2.2.5 Farm size

Pandict et al. (2013) have found no significant contribution of the farm size of farmers and use of surface irrigation techniques.

Rahman (2006) found that farm size of the farmers had no significant contribution of their use of different modern irrigation techniques.

2.2.6 Farming Experience

Islam (2008) found that farming experience of vegetable cultivation had a negative and substantial significant contribution of knowledge on vegetables production by woman members in homestead area under world vision project.

2.2.7 Training exposure

Pandict et al. (2013) have found significant contribution of the training received by farmers and use of surface irrigation techniques.

Rahman (2006) found that training received by the farmers had significant contribution of their use of different modern irrigation techniques.

2.2.8 Contact with extension media

Parvez (2009) found in his research work that there was negative significant contribution of extension media contact and constraints faced by the farmers in small scale aquaculture.

Rahman (2006) found that extension media contact of the farmers had no significant contribution of their constraints faced in Banana cultivation of

Sunargaon Upazila under Narayangonj District.

2.2.9 Knowledge

Pandict et al. (2013) have found significant contribution of the knowledge of farmers and use of surface irrigation techniques.

2.2.10 Problems faced on modern irrigation techniques

Nahid (2005) conducted a study and found that there was no significant contribution of cotton cultivation knowledge of the cotton growers and their problem confrontation in cotton production.

2.2.11 Use of modern irrigation techniques

BMDA (2021) found that different types of modern and cost-effective irrigation technologies are being promoted in the region including its vast Barind tract, in order to reduce gradual mounting of cost for irrigation besides boosting soil productivity.

Rahman and Luo (2010) conducted a study and found that groundwater has covered 77 percent of total irrigated area and about 80 percent of groundwater has been utilized for crop production. More importantly, 75 percent of the total irrigation water has been used for paddy (rice) production.

According to International Maize and Wheat Improvement Center (CIMMYT) research (2017), in Barisal District the axial flow pump can reduce costs up to 50 percent at low lifts – areas where the water source is close to the field surface, and therefore is easy to pump up to irrigate fields.

2.3 Conceptual Framework of the Study

In scientific research, conceptual framework is selection and measurement of variables. Properly constructed hypothesis of a research contains “dependent variable” and “independent variable”. This study is concerned with the farmers’ use of modern irrigation techniques. So, the use of modern irrigation techniques was the dependent variables of the study. Use of modern irrigation techniques and affected through interacting forces of many independent variables. It is not possible to deal with all the variables in a single study. After consulting with

the relevant experts and reviewing of past related literatures, eleven selected characteristics of the farmers' were considered for the study as the independent variables, which might have contribution on use of modern irrigation techniques. Based on this discussion the conceptual framework of this study has been formulated as shown in figure 2.1.

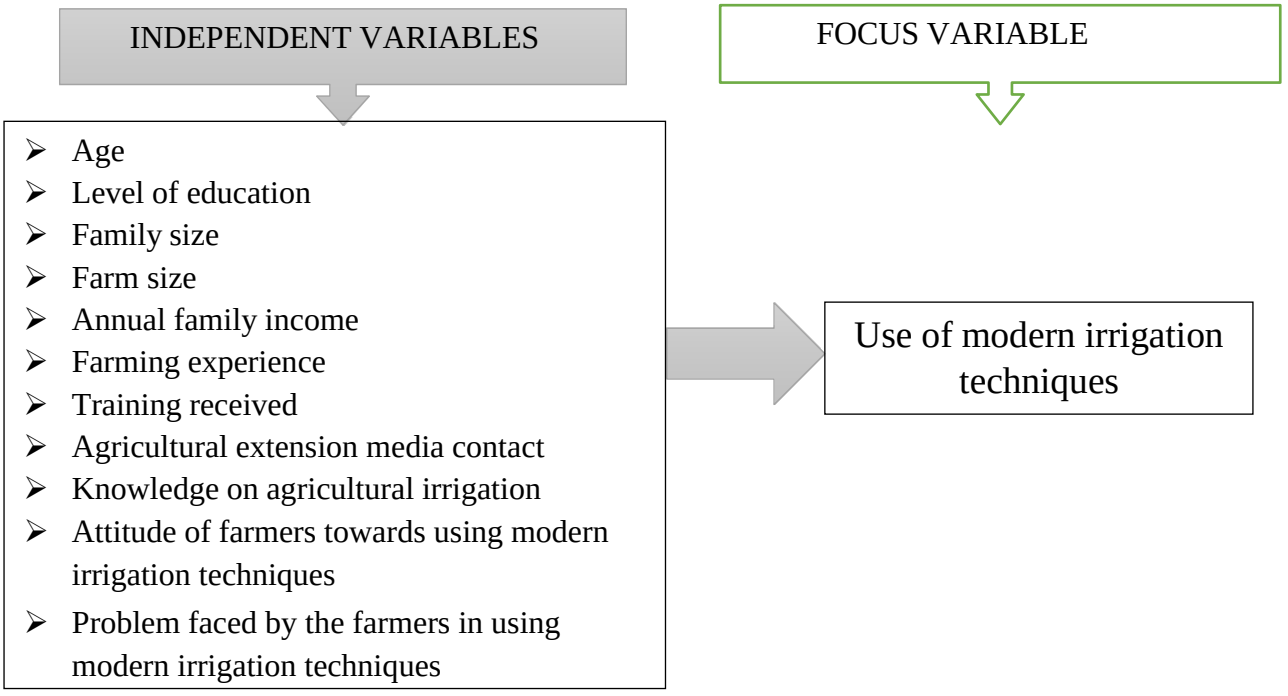

Figure 2.1: The conceptual framework of the study

CHAPTER III
METHODOLOGY

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

3.1 Locale of the Study

The study was conducted in Kishoreganj Upazila under Nilphamari District. Kishoreganj Upazila has nine unions and out of the nine unions, two were selected randomly as the locale of the study. Kishoreganj Upazila (Nilphamari District) area 204.90 sq km, located in between 25°49' and 25°59' north latitudes and in between 88°57' and 89°07' east longitudes. It is bounded by Jaldhaka Upazila on the north, Taraganj Upazila on the south, Gangachara Upazila on the east, Nilphamari sadar and Saidpur Upazilas on the west. Population Total 253192; male 130781, female 122411; Muslim 213285, Hindu 39411, Buddhist 57 and others 439. Map of Nilphamari District and Kishoreganj Upazila are presented in Figure 3.1 and 3.2.

3.2 Population and Sampling Procedure

The study location was in Kishoreganj Upazila. Separate lists of farmers of the study villages were prepared by the researcher with the help of Sub-Assistant Agriculture Officer (SAAO) of Kishoreganj Upazila Agricultural Office.

The farmers of Kishoreganj Upazila were the target population of the study. Kishoreganj Upazila was purposively selected due to investigator’s familiarity

of the area, language, and culture of the people. There are nine unions of Kishoreganj Upazila. Among them Nitai and Magura union were selected by random sampling procedure. Two villages (Nitai Koranipara, Musrut Panialpukur) of Nitai union and two villages (Singer Gari, Dolapara) were selected by randomly. The selection of respondents is shown in figure 3.3.

Total farmers of this area who are completely or partly involve in use of modern irrigation techniques were 1012, which constituted the population of this study. Out of these 1012 respondent about 10 % were selected randomly as the sample of the study. Thus, one hundred one (101) farmers were selected as the sampleof the study. Proportionate random sampling technique was used in order to select the respondents. An appropriate sample reserve list was determined to avoid the uncertainty related with the availability of sample during data collection.

A reserve list of 10 (10% of total sample size) farmers was also prepared. Farmers in the reserve list were used only when a respondent in the original list was not available. The distribution of the sample farmers and those in the reserved list from the villages is shown in the table 3.1.

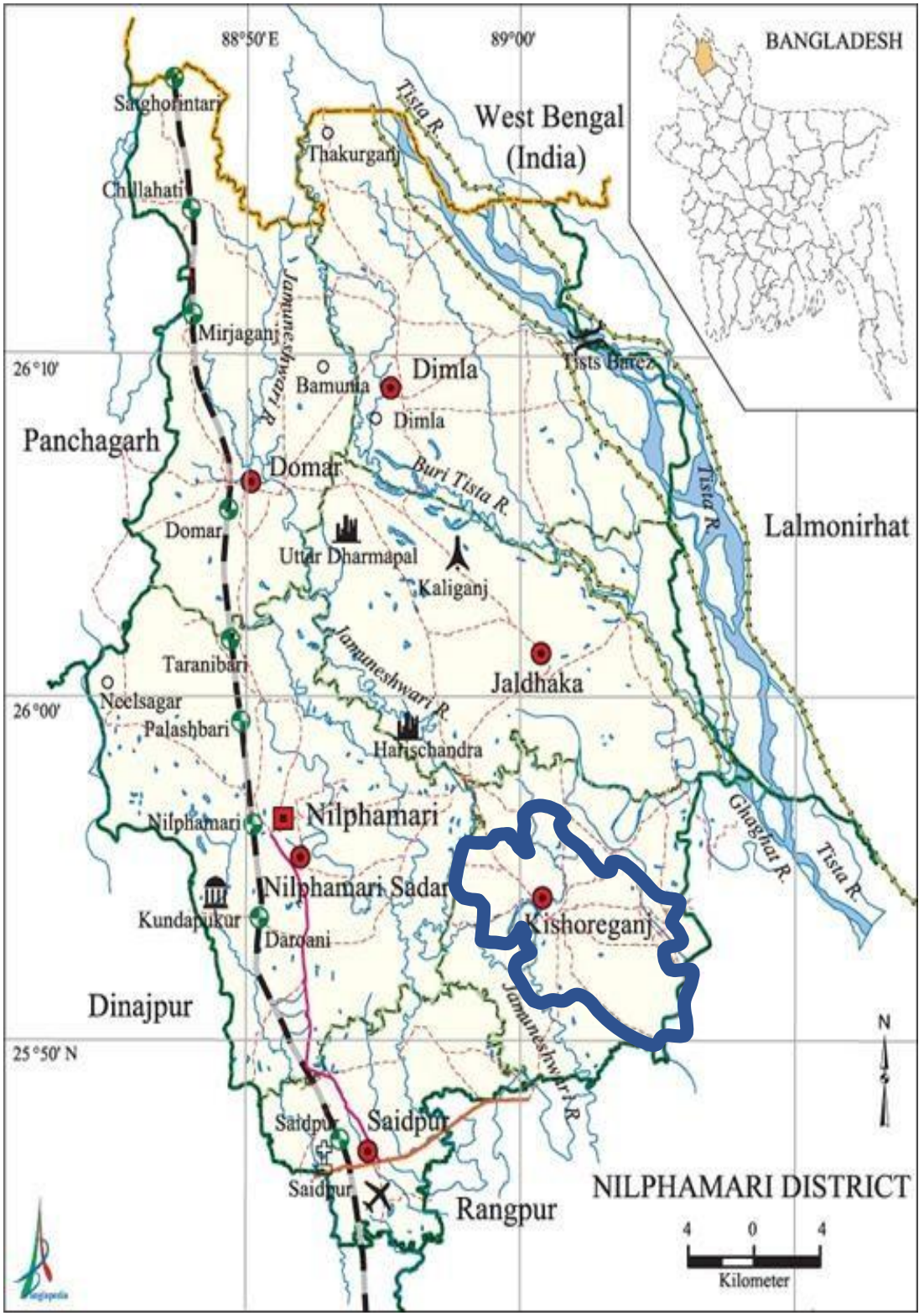

Figure 3.1: A map of Nilphamari District showing Kishoreganj Upazila

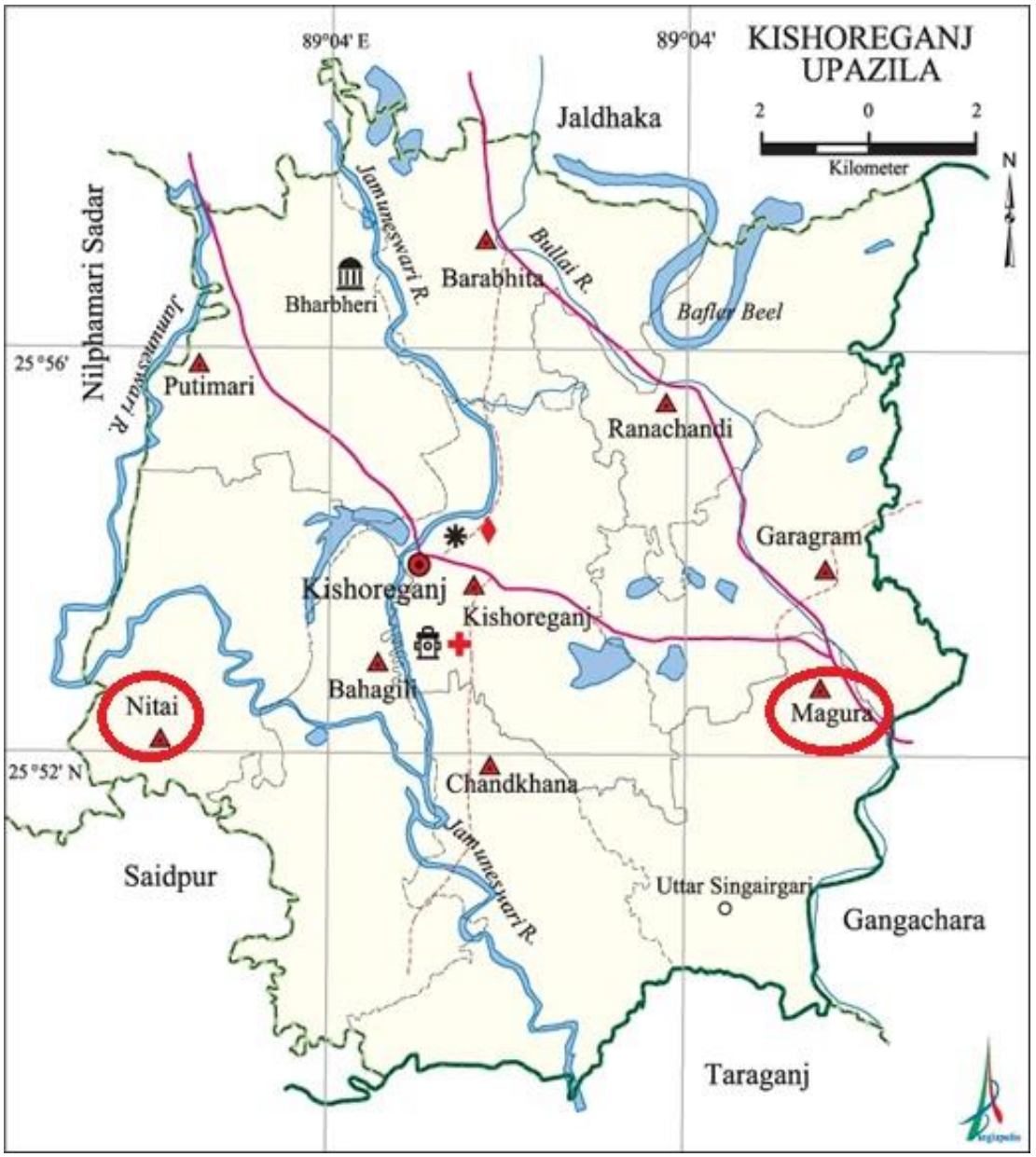

Figure 3.2: A map of Kishoreganj Upazila showing the study area

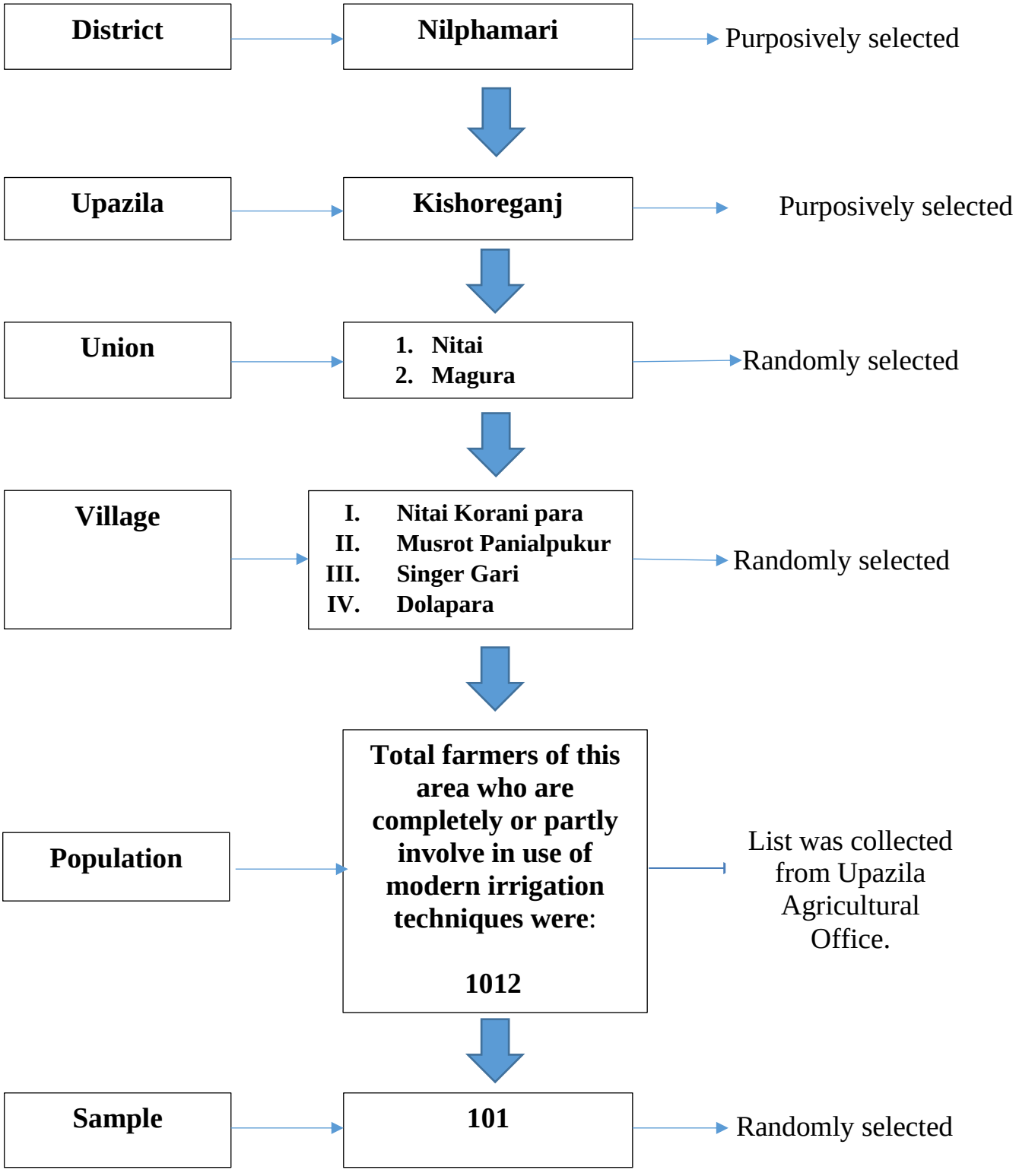

Figure 3.3: Flowchart of sample selection

Table 3.1 Distribution of population and sample of the study

Name of the unions	Name of the villages	Population	Sample size	Reserve list
Nitai	Nitai Korani para	219	22	2
	Musrut Panialpukur	266	27	3
Magura	Singer Gari	318	32	3
	Dolapara	209	20	2
Total		**1012**	**101**	**10**

3.3 Research Instruments

A well-structured interview schedule was developed based on objectives of the study. Direct and simple questions were exerted in open form and close form keeping in view the dependent and independent variables. Appropriate scales were developed to measure both independent and dependent variables.

The questionnaire was pre-tested with 15 farmers in actual situation before preparing the final draft. Necessary corrections, additions, alternations, rearrangements and adjustments were made in the interview schedule based on pretest experience. The questionnaire was then multiplied by printing in its final form. A copy of the interview schedule is presented into Appendix I.

3.4 Measurement of Variables

The variable is a characteristic, which can assume varying, or different values in successive individual cases. A research work usually contains at least two important variables viz. independent and dependent variables. An independent variable is that factor which is manipulated by the researcher in his attempt to ascertain its relationship to an observed phenomenon. A dependent variable is that factor which appears, disappears or varies as the researcher introduces, removes or varies the independent variable (Townsend, 1953). In the scientific research, the selection and measurement of variable constitute a significant

task. Following this conception, the researcher reviewed literature to widen this understanding about the natures and scopes of the variables relevant to this research. At last, 11 independent variables (selected characteristics) and one dependent variable were selected for the study. The independent variables were: age, education, family size, farm size, annual family income, farming experience, training received, agricultural extension media contact, knowledge on agricultural irrigation, attitude of farmers towards using modern irrigation techniques and problem faced by the farmers in using modern irrigation techniques. The dependent variable of this study was the use of modern irrigation techniques by the farmers. The methods and procedures in measuring these variables are presented below:

3.5 Measurement of the Independent Variables

The eleven characteristics of the farmers mentioned above constitute the independent variables of this study. The following procedures were followed for measuring the independent variables.

3.5.1 Age

Age of a respondent was measured by the period of time from his/her birth to the interview and it was measured in terms of complete years on the basis of their response. A score of one (1) was assigned for each year age.

3.5.2 Education

Level of education was measured in terms of class passed by respondent. If a respondent received education from the school, their education was assessed in terms of year of schooling, i.e., one (1) score was given for one year of schooling. For example, if the respondent passed the final examination of class V, his/her education score was taken as 5. If the respondent had education outside school and the level of education was equivalent to class V of the school than his education score was taken as 5. Each illiterate person was given a score of zero.

3.5.3 Family size

The family size of a respondent was measured in terms of total number of members in his family including himself, spouse, children, brothers, sisters, parents and other person who jointly live and ate together.

3.5.4 Farm Size

The total farm size of a respondent referred to the total area of land, on which his family carried out farming operations, the area being estimated in terms of full benefit to the farmers. A farm was considered to have full benefit from the cultivated area either owned by him or obtained on lease from others and half benefit from the area which was either cultivated by him on borga or given others for cultivation on borga basis. The land possession was measured for each respondent in terms of hectare by using the following formula:

$$FS=A+B+ 1/2 (C+D) +E+F$$

Where,

FS = Farm size

A = Homestead area

B = Own land under own cultivation

C = Land given to others as borga

D = Land taken from others as borga

E = Land taken from others on lease/mortgage

F = Others (pond, poultry yard etc.)

3.5.5 Annual family income

The term annual income refers to the annual gross income of a respondent himself and the members of his family from different sources. It was expressed in taka. In measuring this variable, total earning in taka of an individual respondent was converted into score. A score of one was given for every one thousand takas. The total annual income was determined by summing up of incomes from all the sources such as agriculture, business & labor wage etc.

3.5.6 Farming experience

Assigning score of one (1) farming experience was determined by each year of working experience of a respondent either in his own farm or to that of his parents. This variable appears in item number 6 in the interview schedule as presented in Appendix-A.

3.5.7 Training received

Training received of the respondents was determined by the total number of days a respondent received training in his/her entire life on different production technology from different organizations. Measuring score of 1 was assigned for each day of training. This variable appears in item number 7 in the interview schedule as presented in Appendix-A.

3.5.8 Agricultural extension media contact

Extension contact of a respondent was measured by respondent's extent of contact with communication channels used by extension services. The degrees of contact were 'regularly', 'occasionally', 'rarely', 'not at all' against suitable scores are assigned as 3, 2, 1 and 0 respectively.

Degree of contact	Score
Regularly	3
Occasionally	2
Rarely	1
Not at all	0

The number of communication channels are ten (10), then an individual respondent can obtain highest score 30 and minimum score 0 (zero).

3.5.9 Knowledge on agricultural irrigation

Knowledge refers to the ability of a respondent to recall or recognize items of

information related to anything. It was measured based on knowledge on agricultural irrigation. The knowledge on agricultural irrigation was determined by computing a knowledge score based on the responses against 16 questions regarding knowledge on agricultural irrigation. These statements were collected after thorough consulting with relevant experts reviewing of existing literatures and searching websites. Each of the statements carried a full weight of 2 (two). For correct answer respondents was given full marks. If, the respondents are unable to give answer then he or she gets zero mark. Thus, knowledge score of a farmer could range from 0 to 32, where '0' indicated no knowledge and 32 indicated highest level of knowledge on agricultural irrigation. This variable appears in item number 9 in the interview schedule as presented in Appendix-I.

3.5.10 Attitude towards using modern irrigation techniques

Attitude towards using modern irrigation techniques was measured by developing an attitude scale through Puttaswamy (1977) given scale that developed a scale to measure the attitude of village extension workers towards training and visit system in Indian context. Here five-point Likert method of summated ratings was used to find out the attitude towards using modern irrigation techniques.

Twelve statements expressing attitude towards using modern irrigation techniques were constructed. Out of these 12 statements six were positive and six were negative. Scoring was done by assigning 4, 3, 2, 1 and 0 scores to the five alternative responses as "strongly agreed", "agreed", "undecided", "disagreed", and "strongly disagreed", respectively in case of a statement. However, attitude towards using modern irrigation techniques of a farmer was obtained by summing up his/her scores for all the ten statements in item no. 10 in the interview schedule. Attitude score, thus, obtained for a respondent could range from zero (0) to 48, where zero (0) indicated unfavorable and 48, indicated highest level of favorable attitude.

3.5.11 Problem faced by the farmers in using modern irrigation techniques

After thorough consultation with relevant experts, farmers and relevant variable literature, 12 problems were selected related to use of modern irrigation techniques for the study. A list of 12 probable problems that farmers could face in different aspects were listed and asked the farmers to indicate the extent of their problem faced in using of modern irrigation techniques. It was measured by using a five-point rating scale. For each problem score of 4, 3, 2, 1 and 0 were assigned to indicate extent of problems as very high, high, medium, low and not at all respectively. The problems score was computed for each respondent by adding his/her scores for all 12 problems. The possible range of problem scores thus could be 0 to 48. A total score of 48 indicated highest problems in respect to use of modern irrigation techniques, while a score of 0 indicated no problems faced by the farmers in use of modern irrigation techniques.

3.6 Measurement of the Dependent Variable

Use of modern irrigation techniques of the farmers referred to the knowledge gained by the respondent in agricultural irrigation activities.

Twenty-one statements expressing use of modern irrigation techniques were constructed. Scoring was done by assigning 3, 2, 1 and 0 scores to the four alternative responses as "regularly", "occasionally", "rarely" and "not at all", respectively in case of a statement. However, use of modern irrigation techniques of a farmer was obtained by summing up his/her scores for all the 21 statements in item no. 12 in the interview schedule. Use of modern irrigation techniques score, thus, obtained for a respondent could range from zero (0) to 63, where zero (0) indicated no use and 63 indicated highest use.

3.7 Statement of Hypothesis

As defined by Goode and Hatt (1952), “A hypothesis is a proposition which can be put to a test to determine its validity. It was seemed to be contrary to, or in accord with common sense. It may prove to be correct or incorrect. In any event, however, it leads to an empirical test”. A hypothesis simply means a mere assumption or some supposition to be proved or disproved. But for a researcher, hypothesis is a formal question that he intends to resolve. According to Kerlinger (1973), “A hypothesis is a conjectural statement of the relation between two or more variables. Hypothesis is always in declarative sentence form, and they relate either generally or specifically variables to variables”. Hypothesis may be broadly divided into two categories, namely, research hypothesis and null hypothesis. In studying relationships between variables, an investigator first formulates research hypothesis which states anticipated relationships between the variables. However, for statistical test it becomes necessary to formulate null hypothesis. A null hypothesis states that there is no relationship between concerned variables.

The null hypothesis was developed in this study to explore the relationships between dependent and independent variables. There are 11 independent variables and a single depended variable. The null hypotheses were formulated to explore the contribution each of the characteristics of farmers and their use of modern irrigation techniques. Then null hypotheses were developed in the following manner:

“There is no contribution of the selected characteristics of the farmers with their use of modern irrigation techniques”. Which are age, education, family size, farm size, annual income, farming experience, training received, agricultural extension media contact, knowledge on agricultural irrigation, attitude of farmers towards using modern irrigation techniques and problems faced by the farmers in using modern irrigation techniques and use of modern

irrigation techniques by farmers.

3.8 Data Collection Procedure

The researcher himself collected the data from the sample respondents through face-to-face contact with the help a pre-tested interview schedule. Whenever any respondent faced difficulty in understanding questions, more attention was taken to explain the same with a view to enabling the respondent's local opinion leaders to answer properly. No serious problem was faced by the investigator during data collection but obtained cooperation from the respondents. Data collection was started in 1st July, 2021 and completed in 30 July, 2021.

3.9 Data processing

For data processing and analysis, the following steps were followed:

3.9.1 Compilation of data

After completion of field survey all the interview schedule were compiled, tabulated and analyzed according to the objectives of the study. In this process all the responses in the interview schedule were given numerical coded values. The responses to the question in the interview schedule were transferred to a master sheet to facilitate tabulation. Tabulation was done on the basis of categories developed by the investigator himself.

3.9.2 Categorization of the respondents

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

3.10 Statistical analysis

Data collected from the respondents were complied, coded, tabulated and analyzed in accordance with the objectives of the study. Various statistical measures such as frequency counts, percentage distribution, average, and standard deviation were used in describing data. SPSS (version 20.0) computer program were used for analyzing the data. The categories and tables were used in describing data. The categories and tables were also used in presenting data for better understanding.

3.10.1 Statistical model

Regression analysis examine the contribution between dependent and independent variables. In regression analysis, there are at least two variables: the criterion (dependent) variable and the predictor (independent) variable. The dependent variable is a variable of interest, or variable that we want to examine, explain, and predict. Independent variable attempts to explain the dependent variable. When there is only one independent variable, then we are talking about a simple regression, and when there are several independent variables, then we are talking about multiple regression. The goal of regression analysis is to estimate the regression model that minimizes the total distances of the dependent variable from the regression line (Horvat and Mijoc, 2012).

Name of multiple linear regression means:

1. Multiple –there are more independent variables X;

2. Linear –the regression function is linear by the coefficients B_1, B_2, ... B_n;

3. Regression –the regression function as the best prediction of Y based on X_i, i = 1,.., n is used. The goal of multiple regressions is to determine the intensity of the relationships as more independent variables and the dependent variable.

One of the assumptions for the use of multiple regression analysis is the existence of a linear dependence between the variables. Multiple regression has the form $Y = A + B_1X_1 + B_3X_3 + b_2x_2 + ... + B_nX_n$, where Y is the dependent

variable, and the X_1, X_2, X_3, X_n independent variables.

Multiple regressions provide answers to the following questions:

i. How well the independent variables can explain the dependent variable (R^2)?

ii. What is the relative importance of each independent variable in explaining the change in the dependent variables (beta coefficients), under the condition that there is no significant multi co linearity?

iii. What change of the dependent variable is expected for each unit change of each independent variable (which shows the simple correlation coefficients)? If X_1 increases by one unit, what is the expected change in Y (response gives B_1) assuming that does not change the impact of other explanatory variables X_2, X_3, ..., X_n?

An important goal while creating a regression model is to explain the largest possible percentage of the dependent variable. In simple multiple regression, the percentage of the explained dependent variable is labelled as R^2 (R – squared) and it tells what percentage of the dependent variable is explained by the included independent variables. A good model exists when the difference between the sums of squares model and the residual sum of squares (F test) is higher possible (Gegaj, 2011).

For determining the contributions of the selected characteristics of the respondents “use of modern irrigation techniques”, Multiple regressions analysis was used. Standardized Coefficients which are expressed in a. One percent (0.01) level of probability and b. Five percent (0.05) level of probability were used as the basis for rejecting any null hypothesis.

CHAPTER IV
RESULTS AND DISCUSSION

This chapter deals with the result and discussion of present research work. Necessary explanations and appropriate interpretations have also been made showing possible and logical basis of the findings. However, for convenience of the discussions, the findings are systematically presented in the following sections.

4.1 Characteristics of the Farmers

This section deals with the selected characteristics of farmers which were assumed to be associated with the use of agricultural modern irrigation techniques. Different farmers possess different characteristics which are focused by his/her behavior. In this section, eleven characteristics have been discussed. The selected characteristics of the farmers were; age, education, family size, farm size, annual family income, farming experience, training received, agricultural extension media contact, knowledge on agricultural irrigation, attitude of farmers towards using modern irrigation techniques and problem faced by the farmers in using modern irrigation techniques. Measuring unit, range, mean and standard deviations of those characteristics of farmers were described in this section. Table 4.1 provides a summary profile of farmers' characteristics.

Table 4.1 Characteristics profile of the respondents

Sl. No.	Characteristics (with measuring unit)	Range		Mean	Standard deviation
		Possible	Observed		
01	Age (years)	Unknown	18–70	43.63	13.15
02	Education (schooling years)	Unknown	0.0 – 16	5.92	4.27
03	Family size (number of members)	Unknown	2-12	5.70	1.61
04	Farm size (hectare)	Unknown	0.17-2.45	1.10	0.59
05	Annual family income (‘000’BDT)	Unknown	20–700	234.12	147.71
06	Farming experience (Score)	Unknown	2–50	21.41	11.18
07	Training received (Days)	Unknown	0–12	2.69	2.80
08	Agricultural extension media contact (Score)	0 - 30	8–25	14.54	4.12
09	Knowledge on agricultural irrigation (Score)	0-32	12-29	20.43	4.51
10	Attitude of farmers towards Using modern irrigation techniques (Score)	0-48	10-45	19.60	9.35
11	Problem faced by the farmers in using modern irrigationTechniques (Score)	0-48	11-45	27.93	9.55

4.1.1 Age

Age of the respondents varied from 18 to 70 years, the average being 43.63 years with the standard deviation of 13.15. Regarding age, the farmers were classified into three categories according to Ministry of Youth and Sports, Bangladesh, 2008, such as “young aged” (up to 35), “middle aged” (36-50) and “old aged” (above 50). The distribution of the farmers according to their age is shown in Table 4.2.

Table 4.2 Distribution of the farmers according to their age

Basis of categorization(year)	Respondents	
	Numbers	Percent
Young aged (Up to 35)	30	29.70
Middle aged (36-50)	43	42.58
Old aged (Above 50)	28	27.72
Total	101	100

Data represented in Table 4.2 indicate that the middle-aged farmers comprised the majority proportion (42.58 percent) of the farmers followed by young old aged category (29.70 percent) and the lowest proportion were made by the old category (27.72 percent). Data also indicate that the young to middle aged respondents constitute almost 72.28 percent of total respondents. Pandict et al. (2013) found almost similar findings.

4.1.2 Education

Education level of the respondents ranged from 0-16 in accordance with year of schooling. The average education score of the respondents was 5.92 with a standard deviation of 4.27. Based on their level of education, the respondents were grouped into five categories according to Hoque, 2016 and Masud, 2007 such as-, “Illiterate” (0.0.5), "Primary education" (1-5), "Secondary education" (6-10), “Higher secondary” (11-12) and “above higher secondary” (>12) as shown in Table 4.3.

Table 4.3 Distribution of the farmers according to their education

Basis of Categorization (schooling years)	Respondents	
	Number	Percent
Illiterate (0-0.5)	22	21.78
Primary (1-5)	27	26.73
Secondary (6-10)	40	39.60
Higher secondary (11 -12)	8	7.92
Above higher secondary (Above 12)	4	3.96
Total	101	100

Data shown in the Table 4.3 indicates that the highest proportion (39.60 percent) of the respondent was secondary level of education followed by primary education category (26.73 percent). On the other hand, the lowest proportion (3.96 percent) of the farmers was above higher secondary education category followed by higher secondary education category (7.92 percent) and 21.78 percent of the farmers was illiterate. Parvez (2009) found almost similar findings.

4.1.3 Family size

The number of family members of the respondents ranged from 2 to 12 with an average of 5.70 and standard deviation of 1.61. Based on the family size the respondents were classified into three categories as small, medium and large family as shown in Table 4.4.

Table 4.4 Distribution of the farmers according to their family size

Basis of categorization (No. of family member)	Respondents	
	Numbers	Percent
Small family (Up to 4)	23	22.77
Medium family (5-7)	63	62.38
Large family (Above 7)	15	14.85
Total	101	100

Data furnished in the Table 4.4 indicated that the highest proportion (62.38 percent) of the respondents had medium family size consisting up to 5-7 members, while 22.77 percent of the respondents belonged to the category of small family compared to 14.85 percent of them having large family size. Hossain (2016) found almost similar findings. Such findings are quite normal as per the situation of Bangladesh (BBS, 2020). The trend of nuclear family has been rising in the study area and subsequent the family member becoming smaller than the extended family.

4.1.4 Farm size

Farm size of the respondents ranged from 0.17 hectare to 2.45 hectares with the mean of 1.10 and standard deviation of 0.59. On the basis of their farm size, the farmers were classified into three categories followed by DAE (1999) as shown in Table 4.5.

Table 4.5 Distribution of the farmers according to their farm size

Basis of categorization (ha)	Respondents	
	Number	Percent
Marginal farm (Up to 0.2)	4	3.96
Small farm (0.21 – 1.0)	48	47.52
Medium farm (1.01 – 3.0)	49	48.52
Total	101	100

Data presented in the Table 4.5 demonstrated that highest proportion (47.52 percent) of the farmers had small farm compared to 3.67 percent having marginal farm and 48.52 percent of the farmers had medium farm. The findings indicated that overwhelming majority (96.04 percent) of the farmers had small to medium farm size. According to Bangladesh Economic Review (2017), Most of the farmers live on below a subsistence level in Bangladesh. This in one of the vital reasons for not adopting improved farming practices in their farm as well as having lower skill on marketing practices.

4.1.5 Annual family income

Annual family income of the respondents ranged from 20 to 700 thousand taka. The mean was 234.12 thousand taka and standard deviation was 147.71. On the basis of annual family income, the respondents were categorized into three groups as shown in Table 4.6.

Table 4.6 Distribution of the farmers regarding annual family income

Basis of categorization ('000' BDT)	Respondents	
	Number	Percent
Low income (Up to 87)	15	14.85
Medium income (88-381)	68	67.33
High income (Above 381)	18	17.82
Total	101	100

Data shown in Table 4.6 presented that the highest proportion (67.33 percent) of the respondents had medium family income while 14.85 and 17.82 percent of the respondents had low and high annual family income respectively. The gross annual family income of a farmer is an important indicator of how much he/she can invest in his/her farming. Generally higher income encourages one's integrity to achieve better performance and to show his/her individual better status in the society. The higher income increases the risk-taking capacity of the farmers' use of agricultural irrigation technologies. Farmers with low income generally invest less in their farms.

4.1.6 Farming experience

The observed experience of the farmers ranged from 2-50, the mean being 21.41 and standard deviation of 11.18. According to their observed ranged of using irrigation techniques experience scores, the farmers were classified into three categories (Mean±SD) as shown in Table 4.7.

Table 4.7 Distribution of the farmers according to their experience

Basis of categorization (Score)	Respondents	
	Number	Percent
Low experience (Up to 10)	17	16.83
Medium experience (12-32)	69	68.32
High experience (Above 32)	15	14.85
Total	101	100

Similar result was observed Sadekuzzaman (2007) where highest respondents were medium experience. Data presented in the Table 4.7 indicated that 68.32 percent of the farmers had medium farming experience compared to having 16.83 percent low and 14.85 percent high farming experience. Findings again revealed that almost all (85.15 percent) of the farmers had low to medium farming experience.

4.1.7 Training received

The observed training exposure of the farmers ranged from 0-12 days, the mean being 2.69 and standard deviation of 2.80. According to their observed ranged of training exposure scores, the farmers were classified into four categories as shown in Table 4.8.

Table 4.8 Distribution of the farmers according to their training

Basis of categorization (Score)	Respondents	
	Number	Percent
No training (0)	21	20.79
Low training (Up to 4)	61	60.40
Medium training (5-8)	13	12.87
High training (Above 8)	6	5.94
Total	101	100

Data presented in the Table 4.8 indicated that 60.40 percent of the farmers had low training received compared to 20.79 percent had no training and 12.87 percent had medium training received and only 5.94 percent of the farmers had high training received. Findings again revealed that almost all (81.19 percent) of the farmers had low to no training received.

4.1.8 Agricultural extension media contact

The observed extension contact scores of the farmers ranged from 8 to 25 against the possible range from 0 to 30, the mean and standard deviation were 14.54 and 4.12 respectively. Based on this score, the farmers were classified into three categories according to agricultural extension contact which is presented in Table 4.9.

Table 4.9 Distribution of the farmers according to their extension contact

Basis of categorization (Score)	Respondents	
	Number	Percent
Low extension contact (Up to 10)	18	17.82
Medium extension contact (11-18)	67	66.34
High extension contact (Above 18)	16	15.84
Total	101	100

Data presented in the Table 4.9 showed that a proportion of 66.34 percent of the farmers had medium extension contact compared to 17.82 percent of them having low extension contact. Only 15.84 percent of the farmers had high contact. Thus, overwhelming majority (84.16 percent) of farmers had low to medium extension contact. Extension contact is a very effective and powerful source of receiving information about various new and modern irrigation technologies. The status of no or having low and medium contacts might have significant impacts on use of agricultural modern irrigation technologies.

4.1.9 Knowledge on agricultural irrigation

Knowledge on agricultural irrigation score of the respondents ranged from 12 to 29 against the possible range of 0–32 having an average of 20.43 and standard deviation of 4.51. Based on the theoretical scores, the farmers were classified into three categories according to Vinod *et al.*, 2011 such as 'low knowledge', 'medium knowledge' and 'high knowledge'. The distribution of the respondents according to their knowledge on agricultural equipment's is given in Table 4.10.

Table 4.10 Distribution of the farmers according to their knowledge

Basis of categorization (Score)	Respondents	
	Number	Percent
Low knowledge (Up to 16)	25	24.75
Medium knowledge (17-25)	60	59.41
High knowledge (Above 25)	16	15.84
Total	101	100.0

Data of Table 4.10 shows that majority (59.41 percent) of the respondents had medium knowledge followed by 24.75 percent of the farmers had low knowledge and 15.84 percent of the farmers had high knowledge. Among the farmers, majority of them (84.16 percent) of the farmers had low to medium knowledge on agricultural modern irrigation technologies. Pandict et al (2013) found almost similar findings. Knowledge is to be considered as vision of an explanation in any aspect of the situation regarding use of agricultural modern irrigation technologies. It is act or state of understanding; clear perception of fact or truth, that helps an individual to foresee the consequence he may have to face in future. It makes individuals to become rational and conscious about related field. To perform optimum production and marketing, farmers should have adequate knowledge and skill on different aspects of cultivation.

4.1.0 Attitude towards modern irrigation technologies

The score of attitude towards modern irrigation technologies of the farmers ranged from 10 to 45 against the possible score of 0 to 48, the mean being 28.84 and standard deviation of 4.59. Based on attitude towards modern irrigation technologies score, the farmers were classified into three categories as shownin Table 4.11.

Table 4.11 Distribution of the respondents according to their attitude towards modern irrigation technologies

Basis of categorization (Score)	Respondents	
	Number	Percent
Unfavorable attitude (≤23)	22	21.78
Neutral attitude (24)	1	0.99
Favorable attitude (25-36)	73	72.27
Highly favorable attitude (37-48)	5	4.95
Total	101	100.0

Data contained in Table 4.13 indicates that 72.27 percent of the farmers had favorable attitude towards modern irrigation technologies; while 21.78 percent of the farmer's had unfavorable attitude towards modern irrigation technologies and 4.95 percent had highly favorable attitude towards modern irrigation technologies.

4.1.11 Problem faced by the farmers in using modern irrigation techniques

The scores of problems faced by the respondents ranged from 11 to 45 against the possible range of 0–48 with an average of 27.93 and standard deviation of 9.55. Based on this score, the farmers were classified into three categories according to Shamabadi, 2012 which is presented in Table 4.12.

Table 4.12 Distribution of the farmers according to problems faced

Basis of categorization (Score)	Respondents	
	Number	Percent
Not at all (0)	0	0.00
Low problems (Up to 12)	05	4.95
Medium problems (13-24)	30	29.71
High problems (25-36)	43	42.57
Very High problems (Above 36)	23	22.77
Total	101	100.0

Data of Table 4.12 shows that among the respondents the highest (42.57 percent) proportion of the farmers belong to the group of high problems faced category and the lowest (4.95 percent) proportion of the farmers had belonged to low problems faced. Among the farmers, majority of them (72.28 percent) had medium to high problems faced in using modern irrigation techniques. Nahid (2005) also found similar findings.

4.2 Use of modern irrigation techniques

The observed farmers' use of modern irrigation techniques scores of the farmers ranged from 16-61 against the possible range of 0 to 63, the mean being 37.34 and standard deviation of 9.25. According to their observed ranged of farmers' use of modern irrigation techniques scores, the farmers were classified into three categories based on the possible scale score as shown in Table 4.13.

Table 4.13 Distribution of farmers according to their use of modern irrigation techniques

Basis of categorization (Score)	Respondents	
	Number	Percent
Low use (Up to 21)	08	7.92
Medium use (22-42)	66	65.34
High use (Above 42)	27	26.73
Total	101	100.0

Data presented in the Table 4.13 indicated that the majority 65.34 percent of the farmers had medium use of modern irrigation techniques compared to

having 26.73 percent high and 7.92 percent had low use of modern irrigation techniques.

4.3 Contribution of the Selected Characteristics of the Respondents to their use of Modern Irrigation Techniques

In order to estimate the use of modern irrigation techniques, the multiple regression analysis was used which is shown in the Table 4.14**.**

Table 4.14 Co-efficient of multiple regressions analysis showing contribution of the selected characteristics of the farmers with their use of modern irrigation techniques

Dependent variable	Independent variables	β	Sig.	R^2	Ad. R^2	F-ratio
Use of modern irrigation techniques	Age	.178	.291^{NS}	0.443	0.374	6.425
	Education	.250	.020*			
	Family size	.121	.166^{NS}			
	Farm size	-.070	.392^{NS}			
	Annual family income	.128	.151^{NS}			
	Farming experience	.064	.710^{NS}			
	Training received	.279	.003**			
	Agricultural extension medi a contact	.086	.389^{NS}			
	Knowledge on agricultural irrigation	.310	.001**			
	Attitude towards using moder nirrigation techniques	.021	.805^{NS}			
	Problem faced by the farmers in using modern irrigation Techniques	-.184	.035*			

NS Not significant; * Significant at 0.05 level of probability and ** Significant at 0.01 level of probability

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.665[a]	.443	.374	7.322
a. Predictors: (Constant), problem, edu, farm.size, income, attitude, family.size, knowledge, age, training, contact, expri				

Results presented in the Table 4.14 show that education, training received and knowledge on agricultural irrigation of the respondents had significant positive contribution with their use of modern irrigation techniques but problem faced by the farmers in using modern irrigation techniques of the respondents had significant negative contribution with their use of modern irrigation techniques. Of these, training received and knowledge on agricultural irrigation were the most important contributing factors (significant at the 1% level of significant) and education and problems faced by the farmer in use of modern irrigation techniques of the respondents were less important contributing factors (significant at 5% level of significant). Coefficients of other selected variables don't have any contribution on their use of modern irrigation techniques.

The value of R^2 is a measure of how of the variability in the dependent variable is accounted by the independent variables. So, the value of $R^2 = 0.443$ means that independent variables account for 44.3% of the variation with their modern irrigation techniques. The F ratio is 6.425 which is highly significant ($p<0$).

However, each predictor may explain some of the variance in respondents their modern irrigation techniques simply by chanced. The adjusted R^2 value penalizes the addition of extraneous predictors in the model, but value 0.374 is still show that variance in farmers using modern irrigation techniques can be attributed to the predictor variables rather than by chanced (Table 4.14).

In summary, the models suggest that the respective authority should consider the farmers' education, training received, knowledge on agricultural irrigation and problem faced by the farmers in using modern irrigation techniques for improving use of modern irrigation techniques and in this connection some predictive importance has been discussed below:

4.3.1 Contribution of training received of farmers to their use of modern irrigation techniques

From the multiple regression, it was concluded that the contribution of training received to their use of modern irrigation techniques was measured by the testing the following null hypothesis;

"There is no contribution of training received by the farmers to their use of modern irrigation techniques".

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 training was significant at 1% level (0.003)
b. So, the null hypothesis could be rejected.
c. The direction between training received and use of modern irrigation techniques was positive.

The β-value of training received was (0.279). So, it can be stated that as training received increased by one unit, farmers' use of modern irrigation techniques increased by 0.279 units.

Based on the above finding, it can be said that farmers had more training increased the use of modern irrigation techniques. So, training has high significantly contributed to the farmers‟ use of modern irrigation techniques. Training helps farmers to gather more knowledge on use of modern irrigation techniques which ultimately helps farmers to reduce their problems in irrigation

techniques.

4.3.2 Contribution of knowledge on agricultural irrigation of farmers to their use of modern irrigation techniques

From the multiple regression, it was concluded that the contribution of knowledge on agricultural irrigation to their use of modern irrigation techniques was measured by the testing the following null hypothesis;

"There is no contribution of knowledge by the farmers to their use of modern irrigation techniques".

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 knowledge was significant at 1% level (.001)
b. So, the null hypothesis could be rejected.
c. The direction between knowledge and use of modern irrigation techniques was positive.

The β-value of knowledge on agricultural irrigation was (0.310). So, it can be stated that as knowledge on agricultural irrigation increased by one unit, farmers' use of modern irrigation techniques increased by 0.310 units.

Based on the above finding, it can be said that farmers had more knowledge increased farmers‟ use of modern irrigation techniques. So, knowledge has high significantly contributed to the farmers‟ modern irrigation techniques.

4.3.3 Contribution of education of the farmers to their use of modern irrigation techniques

The contribution of education of the farmers to their use of modern irrigation techniques was measured by testing the following null hypothesis;

“There is no contribution of education of the farmers to their use of modern irrigation techniques”.

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

a. The contribution of the education was at 5% significance level (.020).
b. So, the null hypothesis could be rejected.

The direction between education and modern irrigation techniques was positive.

The β-value of level education is (0.250). So, it can be stated that as education increased by one unit, farmers‟ use of modern irrigation techniques increased by 0.250 units.

Based on the above finding, it can be said that farmers’ education increased the farmers’ use of modern irrigation techniques. So, education has significantly contributed to the farmers’ use of modern irrigation techniques. Education plays an important role to reduce problems in modern irrigation techniques in many cases. Education enhances knowledge on many aspects such as training, participation, extension contact and so on.

4.3.4 Contribution of problem faced by the farmers in using modern irrigation techniques to their use of modern irrigation techniques

From the multiple regression, it was concluded that the contribution of problem faced by the farmers in using modern irrigation techniques to their use of modern irrigation techniques was measured by the testing the following null hypothesis;

“There is no contribution of problem faced by the farmers in using modern irrigation techniques to their use of modern irrigation techniques”.

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 problems faced by the farmer was significant at 5% level (0.035)
b. So, the null hypothesis could be rejected.
c. The direction between problems faced by the farmer and use of modern irrigation techniques was negatives.

The β-value of problems faced by the farmer was (-0.184). So, it can be stated that as problems faced by the farmer increased by one unit, farmers‟ use of modern irrigation techniques decreased by 0.184 units.

Based on the above finding, it can be said that farmers had higher problem faced decreased their use of modern irrigation techniques. So, problems faced by the farmer in modern irrigation techniques have high significantly contributed to the farmers’ use of modern irrigation techniques.

CHAPTER V
SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the Findings

Findings different aspects of the study are summarized below:

5.1.1 Selected characteristics of the farmers

Age

The majority proportion (42.58 percent) of the farmers was middle young aged category and (29.70 percent) of them was young aged and the lowest proportion were made by the old category (27.72 percent).

Education

The highest proportion (39.60 percent) of the respondent was secondary level of education followed by primary education category (26.73 percent). On the other hand, the lowest proportion (3.96 percent) of the farmers was above higher secondary education category followed by higher secondary education category (7.92 percent) and 21.78 percent of the farmers was illiterate.

Family size

The highest proportion (62.38 percent) of the respondents had medium family size, while 22.77 percent of the respondents belonged to the category of small family compared to 14.85 percent of them having large family size.

Farm Size

The highest proportion (48.52 percent) of the farmers had medium farm compared to 3.96 percent having marginal farm and 47.52 percent of the farmers had farm.

Annual family income

The highest proportion (67.33 percent) of the respondents had medium family income while 14.85 and 17.82 percent of the respondents had low and high annual family income respectively.

Farming experience

The most 68.32 percent of the farmers had medium farming experience compared to having 16.83 percent low and 14.85 percent high farming experience.

Training received

The majority 60.40 percent of the farmers had low training received compared to 20.79 percent had no training and 12.87 percent had medium training received and only 5.94 percent of the farmers had high training received.

Agricultural extension media contact

A proportion of 66.34 percent of the farmers had medium extension contact compared to 17.82 percent of them having low extension contact. Only 15.84 percent of the farmers had high contact.

Knowledge on agricultural irrigation

The majority (59.41 percent) of the respondents had medium knowledge category followed by 24.75 percent of the farmers had low knowledge category and 15.84 percent of the farmers had high knowledge.

Attitude towards modern irrigation technologies

The majority 72.27 percent of the farmers had favorable attitude towards modern irrigation technologies; while 21.78 percent of the farmer's had unfavorable attitude towards modern irrigation technologies and 4.95 percent had highly favorable attitude towards modern irrigation technologies.

Problem faced by the farmers in using modern irrigation techniques

The highest 42.57 percent of the farmers belong to the group of high problems faced and the lowest 4.95 percent of the farmers had low problems faced followed by medium problems faced (29.71 percent) farmers.

5.1.2 Use of modern irrigation techniques

The observed farmers' use of modern irrigation techniques scores of the farmers ranged from 16-61 against the possible range of 0 to 63, the mean being 37.34 and standard deviation of 9.25. The majority (65.34 percent) of the farmers had medium use of modern irrigation techniques compared to having 26.73 percent high and 7.92 percent had low use of modern irrigation techniques.

5.1.3 Contribution of the selected characteristics of the respondents to their use of modern irrigation techniques

Among 11 selected characteristics of the farmers four characteristics namely, education, training received and knowledge on agricultural irrigation of the respondents had significant positive contribution with their use of modern irrigation techniques but problem faced by the farmers in using modern irrigation techniques of the respondents had significant negative contribution with their use of modern irrigation techniques. and the rest seven characteristics namely, age, family size, farm size, annual family income, farming experience, training received, agricultural extension media contact and attitude of farmers towards using modern irrigation techniques of the farmers had no significant contribution with their use of modern irrigation techniques.

5.2 Conclusions

Following conclusions were drawn on the basis of findings, logical interpretation and other relevant facts of the study:

1. Among the farmers, the majority 65.34 percent of the respondents had belonged to medium use of modern irrigation techniques category

followed by 26.23 percent farmers had high use of modern irrigation techniques category and 7.92 percent of the farmers had low use of modern irrigation techniques category. Therefore, it may be concluded that there is scope to increase the extant of use of modern irrigation techniques by the farmers.

2. Almost half of the farmers (48.51%) were illiterate to primary level education. There existed a positive significant contribution with the education and their use of modern irrigation techniques. Therefore, it may be concluded that an appreciable proportion of the farmers will encouraged to use of modern irrigation techniques, if suitable steps are taken to remove illiteracy and improve education level of the farmers.
3. Most of the farmers had belongs to no training to medium training categories. Findings expressed that training received had significant positive contribution with their use of modern irrigation techniques. So, it may be concluded that any attempt to increase training received would ultimately increase their use of modern irrigation techniques.
4. Almost 75.25 percent of the farmers had medium to high knowledge on agricultural irrigation. Findings expressed that knowledge on agricultural irrigation of the farmers had significant positive contribution with their use of modern irrigation techniques. So, it may be concluded that if the farmers gain more knowledge on modern irrigation, though extension services provider, electronics, and printed media, they will face less problems in use of modern irrigation techniques.
5. Problem faced by the farmers in using modern irrigation techniques showed negative significant contribution with their use of modern irrigation techniques in the study area. Almost Three-fourth (72.28%) of the farmers had faced medium to high problem in use of modern irrigation techniques. This means the lower the problems faced by the farmers; the higher would be their use of modern irrigation techniques.

5.3 Recommendations

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

5.3.1 Recommendation for policy implication

1. The level of use of modern irrigation techniques was encouraging. However, there is a need of efforts for even wide knowledge on irrigation technologies by the farmers. So, it may be recommended that favorable initiative should be taken by the concerned authorities like DAE, BADC and other private service providers may lead to increase the use of modern irrigation techniques by farmers.

2. The findings of the study indicated that education had significant positive contribution with their use of modern irrigation techniques. Therefore, it may be recommended that the concerned authorities should take the special mass education program for the illiterate and low lettered farmers for solving their problems in use of modern irrigation techniques.

3. The findings revealed that the training received had a significant positive contribution with the use of modern irrigation techniques. So, it may be recommended that the concerned authority should increase training facilities to develop skills of the farmers technologically so that they can minimize their problems.

4. The findings showed knowledge on agricultural irrigation had a significant positive contribution with their use of modern irrigation techniques. So, it may be recommended that the extension workers of the concerned authority should increase the contact with farmers personally and motivate them to be connected with electronic and printed media that can help them to acquire related information and knowledge which will reduce their problems in use of agricultural irrigation techniques and thereby use of modern irrigation techniques will increased.

5. Problems faced by the farmers in using modern irrigation techniques had significant negative contribution with their use of modern irrigation techniques.

It is a fact that if problems faced by the farmers in using modern irrigation techniques is increased, farmers' use of modern irrigation techniques will be decreased. So, it may be recommended that concerned authorities should take necessary action to reduce problems regarding use of modern irrigation equipments' and also government can provide subsidy, so that farmers can afford the cost of modern irrigation equipments.

5.3.2 Recommendations for further study

1. The study was conducted on the farmers of only one selected area of Kishoreganj Upazila under Nilphamari District. Finding of the study need verification by similar research in other areas of the country including areas where use of modern irrigation techniques is yet to get popularity.

2. Contributions of eleven characteristics of farmers with their use of modern irrigation techniques have been investigated in this study. Further research should be conducted to find out contribution of the other personal characteristics of the farmers with their others problems.

3. In addition to use of modern irrigation techniques, those might have other factors relative to their social, economic, housing, sanitation, nutrition and domestic etc. Therefore, it may be recommended that research should be conducted relation to other factors of the farmers.

4. Research should also be undertaken to identify the factors causing hindrance use of modern irrigation techniques. Further research should be taken related to other issues.

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APPENDIX-A

Department of Agricultural Extension and Information System

Sher-e-Bangla Agricultural University

An interview schedule of the research study entitled

USE OF MODERN IRRIGATION TECHNIQUES BY THE FARMERS

Sl. No.: …… Date: ……...

Name of the respondent: ……

Father's name: ……

Village..... ;

Union: ……

Upazila ..... ;

District: ……...

(Please answer the following questions and put tick (√) whenever necessary. Your information will be kept confidential and will be used for research purpose only)

1. Age: What is your age? **…….....** Years

2. Education: Mention your educational qualification.

a) Can't read and write
b) Can sign name only
c) Passed class.....

3. Family size: Please mention your total number of family members (including yourself).

Male		Female		Total=	

4. Farm size: Please indicate the area of land according to tenure status.

Sl. No.	Types of land	Land area	
		Local unit(Decimal)	Hectare
A.	Homestead		
B.	Own land under own cultivation		
C.	Land given to others on *borga*		
D.	Land taken from others on *borga*		
E.	Land taken from others on lease/mortgage		
F.	Others (pond, poultry yard etc.)		
Total= A+B+ $\frac{1}{2}$(C+D) +E+F			

5. Annual income: Please state the income from following specific sources during the last year

Sl. No.	Source of income	Annual income(TK)
A. On farm income		

1	Agriculture	
2	Fisheries	
3	Livestock	
B. Off farm income		
1	Business	
2	Services	
3	Daily labor	
4	Remittance	
5	Others(if any)	
Total= (A+B)		

6. Farming experience ..... Years

7. Training received: Have you received any training on agricultural machineries**?**
Yes ☐ No ☐
If yes, how many days? Answer: ☐ Days

8. Agricultural extension media contact: Please indicate the extent of your contact with following extension media.

Sl. No.	**Extension media**	**Extent of contact**			
		Regularly (3)	**Occasionally (2)**	**Rarely (1)**	**Never(0)**
A. Individual Contact					
1	Meet with Agriculture Extension Officer (per year)	≥6 ( )	3-5 ( )	1-2 ( )	0 ( )
2	Meet with SAAO (per 3 month)	≥6 ( )	3-5 ( )	1-2 ( )	0 ( )
3	Meet with ideal farmers (per 3 month)	≥6 ( )	3-5 ( )	1-2 ( )	0 ( )
4	Meet with NGO or development worker (per 3 month)	≥6 ( )	3-5 ( )	1-2 ( )	0 ( )
5	Meet with agricultural input dealer (per 3 month)	≥6 ( )	3-5 ( )	1-2 ( )	0 ( )
B. Mass Media Contact					
1	Listening agricultural program on Radio	Daily ()	Weekly ( )	Monthly ( )	0 time/year ( )
2	Watching agricultural program on Television	Daily ( )	Weekly ( )	Monthly ( )	0 time/year ( )
3	Reading agricultural Publications like newspaper, poster, leaflet etc.	Daily ( )	Weekly ( )	Monthly ( )	0 time/year ( )
C. Group Contact					
1	Participation in farmer's field day (per year)	3 ( )	2 ( )	1 ( )	0 ( )
2	Participation in Focused Group Discussion (FGD) program	3 ( )	2 ( )	1 ( )	0 ( )

	(per year)				
Total= (A+B+C)					

09. Knowledge on agricultural irrigation:

Please answer the following questions

Sl. No.	Questions	Full marks	Obtained marks
1	What do you mean by agricultural irrigation?	2	
2	What are the modern methods of irrigation?	2	
3	Mention name of five irrigation equipment	2	
4	Mention two types of pumps name that is used in irrigation	2	
5	What are the tools used for irrigation?	2	
6	What are the causes of irrigation water losses?	2	
7	What are the sources of water used for irrigation?	2	
8	What type of energy is used to pump water?	2	
9	State the functions of water pump	2	
10	Describe the precautions of using electrical water pump	2	
11	Describe the functions of drip irrigation	2	
12	Describe the functions of furrow irrigation	2	
13	Describe the major functions of Sprinkler irrigation & sprinkler nozzle?	2	
14	Discuss about the importance of modern agricultural irrigation?	2	
15	Discuss about the major problems of modern agricultural irrigation?	2	
16	How do you consider the role of government towards modern agricultural irrigation systems?	2	
Total		32	

10. Attitude of farmers towards using modern irrigation techniques:

Please mention your degree of agreement with the following statements

Sl. No.	Statements	Extent of agreement/ disagreement				
		SA	**A**	**NO**	**D**	**SD**
1 (+)	The modern irrigation equipments and machineries are convenient for farming activities					
2 (-)	Modern irrigation techniques is harmful for environment					
3 (+)	Use of modern irrigation equipments and					

	machineries increases crop yield					
4 (-)	There is a lack of spare parts and service Facilities for using modern irrigation techniques					
5 (+)	Modern irrigation methods makes easy to do farming activities					
6 (-)	Using modern irrigation equipments and machineries is more risky compared to traditional machineries					
7 (+)	Introduction of modern irrigation is a blessing for farmers					
8 (-)	It causes human health hazard.					
9 (+)	Using modern irrigation techniques equipments and machineries reduces labor cost					
10 (-)	Maintenance and repairing cost of irrigation equipments and machineries is higher					
11 (+)	Modern irrigation techniques solve the problem of water shortage.					
12 (-)	Use of modern irrigation system is expensive					

(N.B: SA= Strongly Agreed; A= Agreed; NO= No Opinion; D= Disagreed; SD=Strongly Disagreed)

11. Problem faced by the farmers in using modern irrigation Techniques: Please mention the extent of the following problems faced in using modern irrigation Techniques

Sl. No.	**Problems**	**Extent of problem**				
		Very High (4)	**High (3)**	**Medium (2)**	**Low (1)**	**Not at all (0)**
1	Distance between irrigation source & land					
2	Lack of quality equipments					
3	High price of equipments					
4	Lack of spare parts					
5	Maintenance problems of irrigation Pumps					
6	Lack of knowledge and skill on using modern irrigation equipment					
7	Lack of awareness regarding modern irrigation methods					
8	Lack of training program on modern irrigation methods					
9	Lack of after sales service of equipment					
10	Mechanical troubles of locally					

	manufactured agri-irrigation pumps					
11	High price of fuel or energy source to run the pumps					
12	Lack of providing soft loan					

12. Use of modern irrigation techniques: Mention your level of use of modern irrigation techniques from land preparation to post-harvest operation-

Sl. No.	Type of methods	Name of the machinery	Extent of practice			
			Regularly (3)	Occasionally (2)	Rarely (1)	Never (0)
1	Water sources	Groundwater from wells				
		Surface water from Lake/River/Pond/Stream (Govt. irrigation project)				
		Rainwater				
2	Type of Pump use	Low lift pump				
		Deep tube well pump				
		Shallow tube well pump				
3	Micro Irrigation Devices	Drippers or emitters				
		Sprinkler nozzles				
		Rotor system sprinklers				
4	Techniques of irrigation	Flood irrigation				
		Furrow irrigation				
		Sprinkler irrigation				
		Drip irrigation				
		Basin irrigation				
5	Irrigation Canal	Canal with earthwork				
		Concrete canal				
		Concrete Aqueducts				
6	Use of Govt. irrigation project	BWDB				
		BADC/BMDA				
		Teesta Irrigation Project				
		LGED				

Thank you for nice co-operation

Signature of the Interviewer :…….

Date:…….