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Irrigation Practice in Rice Cultivation and Its Sustainability in Bangladesh: Issues and Challenges

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PhD Dissertation

Researcher

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Session: 2009-2010**

**Institute of Bangladesh Studies (IBS)
University of Rajshahi
Rajshahi**

October, 2013

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PhD Dissertation

A Dissertation submitted to the Institute of Bangladesh Studies (IBS),
University of Rajshahi, Bangladesh in Partial fulfillment of the
Requirements for the Degree of

Doctor of Philosophy In Environmental Studies

Researcher

Md. Nazrul Islam

**Institute of Bangladesh Studies (IBS)
University of Rajshahi
Rajshahi**

October, 2013

Certificate

This is to certify that the dissertation entitled “**Irrigation Practice in Rice Cultivation and Its sustainability in Bangladesh: Issues and Challenges**” is an original work accomplished by Md. Nazrul Islam, Ph.D. Fellow in Environmental Studies of the session 2009-2010 at the Institute of Bangladesh Studies (IBS), University of Rajshahi, Bangladesh. The findings and views expressed in the dissertation are originated from both primary and secondary data and entirely his contribution. He has prepared this dissertation under my supervision and guidance. As far as I know the dissertation has not been submitted anywhere else for any purposes e.g. any degree, diploma or publication. I have gone through the draft of dissertation thoroughly and found it satisfactory for submission. The dissertation is therefore recommended and forwarded to the University of Rajshahi through Institute of Bangladesh Studies (IBS) for necessary formalities leading to its acceptance in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Environmental Studies.

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Declaration

I hereby declare that the dissertation entitled “**Irrigation Practice in Rice Cultivation and Its sustainability in Bangladesh: Issues and Challenges**” has been prepared by me. It is an original work carried out by me taking advice and suggestions from my honorable supervisor. I myself take all the responsibilities for all comments, statements and opinions articulated in the dissertation. The dissertation or any part of it has not been submitted partially or fully to any academic institution or university in pursuing any degree or diploma.

Md. Nazrul Islam

PhD Fellow in Environmental Studies

Session: 2009-2010

Institute of Bangladesh Studies (IBS)

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Acknowledgements

This dissertation is the outcome of my three years laborious efforts as a PhD fellow at the Institute of Bangladesh Studies (IBS), University of Rajshahi, Bangladesh. I am indebted to all those who are related directly or indirectly in completion of this research. At the beginning of this dissertation, I glory the name of Almighty Allah who blessed me with nice opportunities to complete this research work successfully in a sound health and peaceful environment.

In expressing acknowledgements at first, I would like to express my heartiest gratitude to my honorable research supervisor Dr. M. Mostafa Kamal. I am greatly indebted to him for his guidance, keen supervision and encouragement that helped me to start and complete this research. His insightful comments have enriched the research significantly. I strongly feel that the accomplishment of this research work would not have been come out as a reality without his constant encouragement and caring attitudes towards me.

I owe to Dr. M. Shahidullah, Director and Professor of the Institute of Bangladesh Studies (IBS), and Dr. M. Mahbubor Rahman, former Director of the Institute of Bangladesh Studies (IBS), University of Rajshahi, for their continuous inspiration and cooperation all along. I must note my unbounded appreciation to the faculty members of the Institute of Bangladesh Studies (IBS), Dr. M. Zainul Abedin, Professor of Economics and former Director, Dr. Swarochish Sarker, Dr. Jakir Hossain, Dr. Md. Nazimul Haque, and Md. Kamruzzaman for their guidance and cooperation.

I am ever grateful to my father Md. Nawab Ali Mian, mother Mrs. Noorjahan Begum, mother in law Murshid Jahan, brother and sisters who constantly helped me at different stages of this research.

I am expressing my sincere thanks and gratitude to the Ex-Vice Principal of Abdulpur Govt. College, Natore, for his inspiration to do PhD and former Executive Director Mr. Mannan of BMDA, Rajshahi, Assistant Engineer specially Shah Mohammad Monjurul Islam and officials of BMDA, Godagari Upazila for their kind cooperation.

In undertaking this study I have received help from wide range of organizations and persons. The empirical part of the research has been completed with the kind support and help of the residents of Saluabhita, Char Khoksabari villages of Sirajganj and Sheikhpur, Raninagar and Banduria villages of Godagari, specially my study respondents, who being patient interviewees provided necessary information for the study. I shall never forget their sincere cooperation. I have no hesitation to point out that it would have been impossible for me to complete this research without direct support and sincere cooperation of Md. Nazmul Hogue (Zumma) and Md. Rashedur Rahman. They made all the arrangements for data collection and FGD in the two study areas.

I am thankful to the fellows specially Md. Mahfil Khan, A.K.M. Mahmudul Haque and staffs of the IBS for their well wishes and cooperation.

I would like to extent my special thanks to the Govt. of Bangladesh for providing me three years deputation to conduct this research. Without this opportunity, the thesis would not have been come out the reality. I would also offer my thanks to the authority of DAE, BMDA for giving the opportunity to use their books and articles.

I would like to thank my wife Sohely Parvin for her continuous inspiration and kind help. My affectionate daughter Nishat Tasnim Arpita deserves special thanks for her unbound curiosity and cooperation during the whole research process and accomplishing my daily family affairs.

Finally, I thank all my friends and well wishers who directly and indirectly contributed to the completion of this research work.

Rajshah

October, 2013.

Md. Nazrul Islam

Abstract

The goal of the research is to examine the present irrigation practices in rice field and its sustainability to prevent water scarcity for future generation. The research objectives are intended to examine the irrigation policy, methods and manuals, present practices, adverse impacts on society and environment, measuring the ground water table, legal and ethical issues etc; in respect of the level of sustainability.

Two villages of Sirajganj Sadar Upazilla under Sirajganj district and three villages of Godagari Upazila under Rajshahi district are selected as the study areas to collect required primary data for addressing the study objectives. Total number of samples is 180. After conducting a preliminary visit and observation researcher prepares a complete list of 340 numbers of households of the study villages from which 180 respondents are selected through simple randomization. Households of study villages are stratified into three groups in accordance of land ownership and amount of land cultivate for rice production in Kharif-1 season. Both qualitative and quantitative data have been used for the research work. Both the data come from primary and secondary sources are used for this research. Data from secondary sources has been collected through deskwork and content analysis. Primary Data has been collected through questionnaire survey, in-depth and in-formal Interview, focus group discussion, ground water table measurement and KAP model study.

Socioeconomic situation of both the study areas is not so good because there are still landless farmers who cultivate land with share crop or taking lease from other farmers. Moreover, seasonal unemployment is one of main problems faced by small and marginal farmers that show the poverty features of the study areas. Laws and policies associated with irrigation are not properly implements by the government that needs to enforce immediately to conserve and sustainable use of water resources for future generation. In both the study areas, though there are some rivers, canals, small ponds and other water bodies but

water is not found during irrigation in dry season. Farmers depend on groundwater for irrigation though some land stands beside the river or canal. Most of the farmers prefer cultivation of rice though they state that it does not increase income and is not profitable but rice fulfills food requirements. Excessive irrigation has adverse impacts on other crops, environment, human health, and fresh water fishes etc. Surface water bodies dry up due to excessive groundwater harvesting. Chemical fertilizer and pesticides pollute local water bodies along with irrigation water decreasing fishes and aquatic animals and due to excessive groundwater extracting for irrigation the water soluble metals like iron, arsenic, lead, cadmium etc., found in tube wells' water are harmful for the humans as well as other animals. People have not much knowledge about water use from traditional and religious point of view but they agree that by following traditional and religious beliefs irrigation water misuse can be minimized. Economic sustainability is seen quite balanced in the study areas. Social sustainability is not well enough because there is safe drinking water scarcity in dry season. People state that groundwater level is decreasing day by day. Data of static groundwater level collected from both the study areas shows that day by day and every year gradually groundwater level is decreasing disturbingly, which is not good sign for future availability of groundwater resources. 24 years data of groundwater table collected from Barind Multipurpose Development Authority of Godagari Upazila shows that decreasing level of groundwater is around 36 to 46 feet. Therefore, it can be assumed that environmental sustainability is in danger at present. Government should take immediate steps for conserving water resources. An in-depth investigation is required further to measure the level of sustainability of present irrigation practice in rice cultivation.

Abbreviation and Acronyms

AEZ	-	Agro Ecological Zone
As	-	Arsenic
B	-	Boron
B.A.	-	Bachelor of Arts
BADC	-	Bangladesh Agricultural Development Corporation
BARI	-	Bangladesh Agricultural Research Institute
BARC	-	Bangladesh Agricultural Research Corporation
BAU	-	Bangladesh Agriculture University
BBS	-	Bangladesh Bureau of Statistics
BC	-	Block Supervisor
B.C	-	Before Christ
Beel	-	Bengali word meaning Marshland or swamp
Bigha	-	Bengali word meaning measure of land
BMDA	-	Barind Multipurpose Development Authority
BRRRI	-	Bangladesh Rice Research Institute
BWDB	-	Bangladesh Water Development Board
Ca	-	Calcium
Cd	-	Cadmium
CEC	-	Cation Exchange Capacity
Cm	-	Centimeter
CNG	-	Combined Natural Gas
Cusec	-	Cubic feet per second
DoAE	-	Department of Agriculture Extension
Dighi	-	Bengali word meaning large pond or lake
DOE	-	Department of Environment
DTWs	-	Deep Tube Wells
DW	-	Deep Water
ECNWRC	-	Executive Committee of the National Water Resources Council

EIA	-	Environmental Impact Assessment
FAO	-	Food and Agriculture Organization
FC	-	Field Capacity
FCD	-	Flood Control and Drainage
FCDI	-	Flood Control Drainage and Irrigation
FGD	-	Focus Group Discussion
g	-	Gram
GIS	-	Geographical Information System
ha	-	Hectare
H.S.C	-	Higher Secondary Certificate
HYV	-	High Yielding Variety
ICID	-	International Commission on Irrigation and Drainage
IMP	-	Irrigation Management Program
IPM	-	Integrated Pest Management
IRRI	-	International Rice Research Institute
IWMI	-	International Water Management Institute
K	-	Potassium
Kaccha	-	Bengali word meaning made of mud or earth
KAP	-	Knowledge Attitude Practice
Kg	-	Kilogram
Kharif	-	Bengali word meaning the autumnal harvest crop
Khal	-	Bengali word meaning a canal or channel
L	-	Low
l	-	Liter
LLP	-	Low Lift Pump
M	-	Medium
M.A	-	Master of Arts
Mg	-	Magnesium
mm	-	Millimeter
Mo	-	Molybdenum
Mound	-	Bengali word meaning a measure of unit
MV	-	Modern Variety
Nala	-	Bengali word meaning drain or channel

NEMAP	-	National Environmental Management Action Plan
NWMP	-	National Water Management Plan
N	-	Nitrogen
NGOs	-	Non Government Organizations
OFWM	-	On-Farm Water Management
OM	-	Organic Matter
Opt	-	Optimum
P	-	Phosphorus
PANASI	-	Pabna Natore Sirajganj Irrigation Project
Pb	-	Lead
pH	-	Hydrogen potential
Rabi	-	Bengali word meaning spring harvest
S	-	Sulphur
Santal	-	Bengali word meaning name of an aboriginal tribe of Bangladesh
SRDI	-	Soil Resources Development Institute
S.S.C	-	Secondary School Certificate
STWs	-	Shallow Tube Wells
T. Aman	-	Transplanted Aman rice
Tempu	-	Bengali word meaning vehicle operating by shallow tube well engine
UP	-	Union Parishad
V-L	-	Very Low
WARPO	-	Water Resources Planning Organization
Zn	-	Zinc

Contents

Certificate	i
Declaration	ii
Acknowledgements	iii
Abstract	v
Abbreviation and Acronyms.....	vii
Contents	x
List of Tables	xx
List of Figures.....	xxvi
List of Maps	xxvii
Chapter-1 Introduction.....	1
1.1 Prelude	1
1.2 Statement of the Problem	2
1.3 Literature Review.....	4
1.4 Conceptual Framework.....	5
1.5 The Research Questions	6
1.6 Objectives.....	6
1.6.1 General OBJECTIVES	6
1.6.2 Specific Objectives.....	6
1.7 Hypothesis.....	6
1.7.1 Indicators to Measure Sustainability	6
1.7.2 Indicators for Environmental Sustainability	6
1.7.3 Indicators for Economic Sustainability.....	7
1.7.4 Indicators of Social Sustainability.....	7
1.8 Research Approach.....	7
1.8.1 Data Used and Sources	7
1.8.1.1 Primary data sources	7
1.8.1.2 Secondary sources of data.....	7
1.9 Study Area Selection	7
1.10 Sample Size and Sample Techniques.....	8
1.11 Data Collection Techniques.....	8
1.11.1 Secondary data Collection Techniques.....	8
1.11.2 Primary Data Collection Techniques.....	8
1.11.2.1 Questionnaire survey	8

1.11.2.2	In-depth and in-formal interview.....	9
1.11.2.3	Focus group discussion.....	9
1.11.2.4	Ground water table measurement.....	10
1.11.2.5	KAP model study.....	10
1.11.2.6	Data collection to measure sustainability.....	11
1.11.2.7	Data analysis.....	11
1.12	Presentation of Findings.....	11
1.13	Justification of the Study.....	11
1.14	Scope and Limitation of Research.....	12
1.15	Research Matrix.....	12
1.16	Conclusion.....	13

Chapter-2 Environmental and Socioeconomic Settings of the Study

	Area	14
2.1	Introduction.....	14
2.2	Location of the Study Area	14
2.3	Communication of Study Areas from Upazila Headquarters.....	16
2.4	Road and Transport of Study Area	17
2.5	Agro Ecological Features of the Study Area	17
2.5.1	Wetland.....	19
2.5.2	Forestry.....	20
2.5.3	Biodiversity	20
2.5.4	Animal Biodiversity.....	20
2.5.4.1	Terrestrial animals.....	20
2.5.4.2	Aquatic animals	20
2.5.5	Plant Biodiversity: Terrestrial and Aquatic.....	21
2.5.6	Agro-biodiversity	21
2.6	Physiography.....	21
2.7	Climate	21
2.8	Land Type and Soil Type.....	22
2.9	Water Resources.....	22
2.10	Present Land Use.....	23
2.11	Major Cropping Pattern.....	23
2.12	Environmental Constrains for Development	23
2.12.1	Study Villages of Sirajganj Sadar Upazila.....	23
2.12.2	Study Areas of Godagari.....	23
2.13	Soil Fertility Status in Sirajganj	24
2.14	Socio Economic Condition and Demographic Factor of the Study Area	25
2.14.1	Age Group Distribution.....	25

2.14.2	Sex Group.....	26
2.14.3	Marital Status	26
2.14.4	Family Size	27
2.14.4.1	Children	27
2.14.5	Religion	28
2.14.6	Educational Status.....	28
2.14.7	Occupation.....	29
2.14.7.1	Main Occupation.....	29
2.14.7.2	Other Occupation	29
2.14.8	Skillness.....	30
2.14.8.1	Skillness on farming.....	30
2.14.8.2	Skillness on others	30
2.14.9	Family Types	30
2.14.10	Housing.....	31
2.14.11	Housing Types	31
2.14.12	Drinking Water Source	32
2.14.13	Toilet Facilities.....	32
2.14.13.1	Types of toilet.....	33
2.14.14	Land Ownership.....	33
2.14.14.1	Homestead land	34
2.14.14.2	Agricultural land.....	34
2.14.14.3	Horticulture land	35
2.14.14.4	Pond	35
2.14.14.5	Fallow land.....	35
2.14.15	Cultivated Land	36
2.14.15.1	Cultivable land owned.....	36
2.14.15.2	Share cropping land.....	37
2.14.15.3	Land of leased in	37
2.14.15.4	Land of leased out.....	37
2.14.16	Value of Leased in	38
2.14.17	Value of Leased out.....	38
2.14.18	Value of Share Cropping.....	39
2.14.19	Land Cultivated in Kharif-1 Season.....	39
2.14.20	Land Cultivated in Kharif-2 Season.....	39
2.14.21	Own Land for Rice Cultivation	40
2.14.22	Leased or Share Crop Land for Rice Cultivation	40
2.14.23	Land Irrigate for Rice Cultivation	41
2.14.24	Use Land for Commercial Farming	41
2.14.25	Total Commercial Farming Land.....	42

2.14.26	Annual Income	42
2.14.27	Annual Expenditure	42
2.14.28	Annual Savings	43
2.14.29	Annual Deficit	43
2.14.30	Annual Income from Rice.....	44
2.14.31	Annual Income from other Crops	44
2.14.32	Annual Income from other Sources.....	45
2.15	Findings.....	45
2.16	Conclusion.....	47
Chapter-3	Examining Irrigation Laws and Policies in Bangladesh	48
3.1	Introduction.....	48
3.2	Laws for Irrigation Activities.....	49
3.2.1	The Canals Act, 1864 (Bengal Act No. V of 1864).....	49
3.2.1.1	Findings.....	49
3.2.2	The Irrigation Act, 1876.....	50
3.2.2.1	Findings.....	55
3.2.3	The Embankment And Drainage Act, 1952.....	56
3.2.3.1	Findings.....	64
3.2.4	The Bangladesh Irrigation Water Rate Ordinance, 1983.....	64
3.2.4.1	Findings.....	67
3.2.5	The Ground Water Management Ordinance, 1985.....	68
3.2.5.1	Findings.....	70
3.2.6	evsjv`k cvwb AvBb, 2013.....	70
3.2.6.1	Findings.....	90
3.2.7	National Water Policy, 1999.....	91
3.2.7.1	River basin management.....	91
3.2.7.2	Planning and management of water resources.....	92
3.2.7.3	Water rights and allocation.....	95
3.2.7.4	Public and private involvement	96
3.2.7.5	Public water investment.....	97
3.2.7.6	Water supply and sanitation.....	98
3.2.7.7	Water and agriculture.....	99
3.2.7.8	Water and industry	99
3.2.7.9	Water and fisheries and wildlife	100
3.2.7.10	Water and navigation	100
3.2.7.11	Water for hydropower and recreation.....	100
3.2.7.12	Water for the environment.....	101
3.2.7.13	Water for preservation of haors, baors, and beels.....	102

3.2.7.14	Economic and financial management	103
3.2.7.15	Findings.....	104
3.2.8	RvZxq K...wl bxwZ 2013.....	105
3.2.8.1	Findings.....	122
3.2.9	Evaluation of Public and Private Sector Involvement in.....	122
3.2.10	Minor Irrigation Management.....	122
3.2.10.1	A move toward public sector control: 1984-87	122
3.2.10.2	More private sector liberalization and expansion.....	123
3.2.10.3	Findings.....	124
3.3	Major Findings	124
3.4	Conclusion.....	126

Chapter-4	State of Water Source, Irrigation Methods and Present Irrigation Practices	127
4.1	Background	127
4.2	Water Sources in the Study Areas.....	127
4.3	Irrigation System.....	128
4.4	Water Needs During Different Stages of Rice Cultivation is Given as Follows:	128
4.5	Manuals of Irrigation	130
4.5.1	Soil Preparation.....	130
4.5.2	Irrigation and Drainage.....	130
4.5.3	The Relationship Between Soil and Water.....	131
4.5.4	Determine the time of Irrigation	131
4.5.5	Easy Procedure for Measurement of Soil Moisture by Hand-feel Method	131
4.5.6	Stages of Rice Crops to Reduce Water Scarcity Condition.....	133
4.5.7	Determine the Area of Land or Basin for Irrigation.....	134
4.5.8	Various Methods of IRRIGATION	135
4.5.9	Basin Method	135
4.6	Sources of Irrigation Water	136
4.6.1	Sources of Water and Irrigation Water use	137
4.6.2	Ownership of Shallow Pumps.....	137
4.7	Manuals and Methods of Irrigation.....	138
4.7.1	Manuals of Irrigation and to Status of Follow Ness.....	138
4.7.2	Methods of Irrigation used.....	138
4.7.3	Types of Irrigation Method Followed.....	138
4.7.4	Interval of Irrigation (day after)	139
4.7.5	Frequencies of Irrigation.....	139
4.7.6	Maintaining Optimal Water Level	140

4.8	Present Irrigation Practices in Rice Cultivation	140
4.8.1	Knowledge about Irrigation in Bangladesh.....	140
4.8.1.1	Starting time of irrigation.....	140
4.8.2	Laws and Policies of Irrigation Practice.....	141
4.8.2.1	Laws, policies, and Government Agencies provide irrigation Facilities.....	141
4.8.2.2	Implementing agency of laws and policies	141
4.8.2.3	Laws to install a tube well for irrigation	142
4.8.2.4	Permission for tube wells installation	142
4.8.2.5	Getting or avoiding permission to install shallow or deep tube wells.....	143
4.8.3	Training Activities.....	143
4.8.3.1	Training and their types	143
4.8.3.2	Training on irrigation and their types.....	145
4.8.4	Cropping Pattern and Cultivation Method.....	146
4.8.4.1	Cropping pattern.....	146
4.8.4.2	Cultivation method.....	146
4.8.4.3	Types of commercial farming	146
4.8.5	Reasons of Rice Cultivation.....	146
4.8.5.1	Cultivating rice more than other crops.....	146
4.8.5.2	Increasing Income through rice cultivation	147
4.8.5.3	Rice cultivation profitable than other crops.....	148
4.8.6	Government Initiatives of Irrigation	149
4.8.6.1	Government initiatives taken.....	149
4.8.6.2	Willingly participate and pay per bigha.....	150
4.8.7	Irrigation drainage systems.....	150
4.8.7.1	Misuse occurred and types of drainage system.....	150
4.8.7.2	Construct concrete drain.....	151
4.8.8	Excessive Irrigation Practice.....	151
4.8.8.1	Excessive irrigation and the causes	151
4.8.8.2	Variation of rice production through excessive irrigation....	152
4.8.9	Groundwater Extraction.....	152
4.8.9.1	Status of groundwater withdrawn	152
4.8.9.2	Uses surface water bodies	153
4.8.10	Cultivation of Alternative Crops	153
4.8.10.1	Thinking or accepting alternative crops.....	153
4.8.10.2	Accepting or denying alternative crops	154
4.8.11	Irrigation Water Scarcity and Necessary Steps	155
4.8.11.1	Future irrigation water scarcity and the causes.....	155

4.8.11.2	Necessary steps of the government.....	156
4.9	Findings.....	156
4.10	Conclusion.....	158

Chapter-5	Farmers' Knowledge, Attitude and Practice towards Irrigation in Rice Cultivation.....	159
5.1	Introduction.....	159
5.2	Procedure of KAP Study.....	159
5.3	Steps in Preparation of a KAP Questionnaire.....	160
5.3.1	Area Identification.....	160
5.3.2	Question Preparation.....	160
5.3.3	Validation of Questions.....	162
5.4	Conducting a KAP Study.....	162
5.5	Farmers' KAP about Irrigation Laws and Policies Towards Irrigation..	163
5.5.1	Knowledge.....	163
5.5.2	Attitude.....	164
5.5.3	Practice.....	166
5.6	Farmers' KAP about Government Initiatives Regarding Irrigation..	167
5.6.1	Knowledge.....	167
5.6.2	Attitude.....	167
5.6.3	Practice.....	168
5.7	Farmers' KAP about Irrigation Methods and Manuals.....	169
5.7.1	Knowledge.....	169
5.7.2	Attitude.....	169
5.7.3	Practice Question.....	171
5.8	Farmers' KAP about Irrigation Training.....	172
5.8.1	Knowledge.....	172
5.8.2	Attitude Question.....	172
5.8.3	Practice Question.....	173
5.9	Farmers' KAP about Sources of Irrigation Water.....	173
5.9.1	Knowledge.....	173
5.9.2	Attitude.....	174
5.9.3	Practice.....	175
5.10	Farmers' KAP about Interval and Level of Irrigation.....	175
5.10.1	Knowledge.....	175
5.10.2	Attitude.....	176
5.10.3	Practice.....	178
5.11	Farmers' KAP about Drainage System and Misuse of Water.....	179
5.11.1	Knowledge.....	179
5.11.2	Attitude.....	180

5.11.3	Practice Question.....	181
5.12	Farmers' KAP about Groundwater Table.....	182
5.12.1	Knowledge.....	182
5.12.2	Attitude Question.....	183
5.12.3	Practice Question.....	184
5.13	Farmers' KAP about Adverse Impact due to Irrigation Practices .	184
5.13.1	Knowledge.....	184
5.13.2	Attitude.....	185
5.13.3	Practice.....	187
5.14	Farmers' KAP about Ethical Issues of Irrigation Practices.....	187
5.14.1	Knowledge.....	187
5.14.2	Attitude.....	188
5.14.3	Practice.....	190
5.15	Findings.....	191
5.16	Conclusion.....	192
Chapter-6	Adverse Externalities of Irrigation Practice in Rice Cultivation..	193
6.1	Introduction.....	193
6.2	Excessive Irrigation and Its Impact.....	194
6.2.1	Variation of Rice Production and Types of Variation.....	194
6.2.2	Impacts of Irrigation and their Types.....	194
6.2.3	Adverse Impacts on other Crops and Employment Status.....	195
6.3	Future Water Scarcity.....	196
6.3.1	Future Severe Water Scarcity and their Reasons.....	196
6.4	Groundwater Table and the Level.....	196
6.4.1	Decreasing Ground Water Table and its Causes.....	198
6.5	Negative Impact of Over-exploitation of Groundwater.....	199
6.6	Condition of Water Bodies.....	200
6.7	Declining Fishes.....	200
6.8	Adverse Effect of Irrigation Water.....	201
6.9	Condition of Environmental Health.....	202
6.10	Water Scarcity in dry Season and Scarcity of Safe Drinking Water ...	203
6.11	Human Health Problems.....	203
6.12	Pesticides to Kill the Crabs or other Animals.....	204
6.13	Government Prohibited Pesticides.....	205
6.14	Pollution of Local Water Bodies.....	205
6.15	Harmful Effects of Metal Pollutants.....	206
6.16	Reasons of Irrigation Water Scarcity.....	206
6.17	Findings.....	207
6.18	Conclusion.....	208

Chapter-7	Ethical Issues about Present Irrigation Practices.....	209
7.1	Introduction.....	209
7.2	Water in Islam.....	209
7.3	Water in the Quran	210
7.4	Water in the Sunnah.....	210
7.5	Water and the Shariah.....	211
7.6	Ethical Issues.....	211
7.6.1	Equity of Water.....	211
7.6.2	Ethics of Throwing Waste Products	211
7.6.2.1	Throwing waste products.....	211
7.6.2.2	Throwing Household waste water.....	212
7.6.3	Use Banned Pesticides	212
7.6.3.1	Govt. banned pesticides	212
7.6.4	Water as Valuable and Limited Resources	213
7.6.4.1	Water as limited resource in earth.....	213
7.6.5	Religious and Traditional Beliefs.....	213
7.6.5.1	Water use in Islam religion	213
7.6.5.2	Traditional beliefs regarding water use	214
7.6.5.3	Traditional and religious beliefs	215
7.6.5.4	Prevention of water misuse	216
7.6.6	Groundwater Deposition and Abstraction.....	216
7.6.6.1	Underground recharge process	216
7.6.6.2	Recharge and withdrawal ratio of groundwater.....	217
7.6.6.3	Opinion regarding recharge and withdrawal ratio	217
7.7	Findings.....	218
7.8	Conclusion.....	219
Chapter-8	State of Sustainability and Further Challenges.....	220
8.1	Introduction.....	220
8.2	Indicators for Economic Sustainability	220
8.2.1	Purchasing Fertilizer and Manures, Pesticides and Herbicides... 220	
8.2.2	Purchasing Water for Irrigation.....	221
8.2.3	Cost, Production and Selling Price of Different Rice.....	221
8.2.4	Annual Income	222
8.2.5	Annual Income from Rice.....	222
8.2.6	Annual Savings from Rice Cultivation.....	222
8.2.7	Annual Deficit for Rice Cultivation.....	222
8.2.8	Annual Income from other Crops	222
8.2.9	Employment Status.....	223
8.3	Indicators of Social Sustainability	223

8.3.1	Equity of Water.....	223
8.3.2	Scarcity of Safe Drinking Water.....	223
8.3.3	Condition of Human Health.....	224
8.4	Indicators for Environmental Sustainability.....	224
8.4.1	Condition of Water Bodies.....	224
8.4.2	Condition of Fishes.....	225
8.4.3	Adverse Effect of Irrigation Water.....	225
8.4.4	Condition of Environmental Health.....	225
8.4.5	Impacts on other Crops.....	226
8.4.6	Groundwater Table and the Level.....	226
8.4.6.1	Decreasing water level and the causes.....	226
8.4.7	Groundwater Table of Deep Tube Wells in 2011 and 2012 in Godagari.....	227
8.4.8	Groundwater Level in 2011 and 2012 in Sirajganj.....	228
8.4.9	Static Water Level in 2008, 2009 and 2010 in Godagari.....	228
8.4.10	Static Water Level in 2008, 2009 and 2010 in Godagari.....	229
8.5	Findings.....	230
8.6	Conclusion.....	231
Chapter-9	Findings, Policy Implications, Conclusion.....	232
9.1	Findings.....	232
9.2	Policy Implication.....	234
9.3	Conclusion.....	236
	Bibliography.....	238
	Appendices:.....	245

List of Tables

Table 1.1	: Sample size distribution.....	8
Table 2.1	: Land Type of the study villages in Sirajganj.....	24
Table 2.2	: Land Type of the study villages in Godagari.....	25
Table 2.3	: Other occupation of the respondents.....	29
Table 2.4	: Other Skillness of the respondents.....	30
Table 2.5	: Number of houses of the respondents.....	31
Table 2.6	: Housing types of the respondents.....	31
Table 2.7	: Land Ownership of the Study Respondents.....	33
Table 2.8	: Homestead land of the respondents.....	34
Table 2.9	: Agricultural Land Ownership of the respondents.....	34
Table 2.10	: Horticulture Land Ownership of the Respondents.....	35
Table 2.11	: Pond of the respondents.....	35
Table 2.12	: Fallow land of the respondents.....	35
Table 2.13	: Total amount land Cultivated.....	36
Table 2.14	: Amount of cultivable land owned.....	36
Table 2.15	: Land for share cropping by the HH.....	37
Table 2.16	: Land of leased in.....	37
Table 2.17	: Land of leased out.....	37
Table 2.18	: Value of leased in taka.....	38
Table 2.19	: Value of leased out in taka.....	38
Table 2.20	: Value of share cropping of the respondents.....	39
Table 2.21	: Amount of land cultivated in kharif-1 season.....	39
Table 2.22	: Amount of land cultivated in kharif-2 season.....	39
Table 2.23	: Amount of own land for rice cultivation.....	40
Table 2.24	: Amount of leased or share crop land for rice cultivation.....	40
Table 2.25	: Amount of land irrigate for rice cultivation.....	41
Table 2.26	: Amount of land for commercial farming.....	42
Table 2.27	: Annual income of the respondents.....	42
Table 2.28	: Annual Expenditure of the Respondents.....	42
Table 2.29	: Annual Savings of the respondents.....	43
Table 2.30	: Annual Deficit of the respondents.....	43
Table 2.31	: Annual income from rice of the respondents.....	44
Table 2.32	: Annual income from other crops of the respondents.....	44
Table 2.33	: Annual income from other sources of the respondents.....	45
Table 4.1	: Stages of rice crops according to its water needs.....	128
Table 4.2	: Procedure of determine wetness of soil by hand's feeling.....	133

Table 4.3	: Depth of crop roots in different types of soil.....	134
Table 4.4	: Measurement of basin for proposed irrigation (in decimal)	135
Table 4.5	: Statement about sources of water and irrigation water use	137
Table 4.6	: Statement about ownership of shallow pumps.....	137
Table 4.7	: Manuals of irrigation provided by DoAE.....	138
Table 4.8	: Statement about methods of irrigation	138
Table 4.9	: Maintain optimum water level in rice field	140
Table 4.10	: Starting time of irrigation in Bangladesh	140
Table 4.11	: Laws, policies, and Government Agencies provide irrigation Facilities.....	141
Table 4.12	: Implementing agency of laws and policies in study areas.....	141
Table 4.13	: Getting or avoiding permission to install tube wells	143
Table 4.14	: Types of Training by DoAE	144
Table 4.15	: Types of Training on Irrigation	145
Table 4.16	: Preference of rice cultivation and the causes	146
Table 4.17	: Increasing Income through rice cultivation and their positive and negative statement.....	147
Table 4.18	: Profit in rice cultivation and their positive and negative causes .	148
Table 4.19	: Types of government initiatives about irrigation.....	149
Table 4.20	: Willingly participating government's initiatives for irrigation and payment per bigha	150
Table 4.21	: Misuse or leakage of water during irrigation and Types of drainage system	150
Table 4.22	: Construct concrete drain and misuse through kuccha drain	151
Table 4.23	: Give excessive irrigation in the rice field and the causes.....	151
Table 4.24	: Variation of rice production due to excessive irrigation and types of variation	152
Table 4.25	: Causes of avoiding surface water bodies	153
Table 4.26	: Accept any alternative crops that consume less water	153
Table 4.27	: Accepting alternative crops or causes for denying.....	154
Table 4.28	: Reasons of Irrigation Water Scarcity.....	155
Table 4.29	: Types of steps needed for government regarding irrigation.....	156
Table 5.1	: Respondent's Level of knowledge about Irrigation laws and policies	163
Table 5.2	: Taking permission to install Irrigation Tube wells and the awareness level	164
Table 5.3	: Necessities of Laws and Policies regarding irrigation and their Level of necessities.....	164
Table 5.4	: Level of attitude for implementation of laws and policies in study area.....	165

Table 5.5	: Requirements of enforcing laws and policies appropriately and Level of acceptance to enforce laws and policies	165
Table 5.6	: Statement about appropriateness to take permission for installing tube wells for Irrigation and level of appropriateness.....	166
Table 5.7	: Compliance with the laws and policies of irrigation and Level of compliance.....	166
Table 5.8	: Knowledge about government initiatives regarding irrigation in study area.....	167
Table 5.9	: Level of requirement of government initiatives regarding irrigation..	167
Table 5.10	: Statement about betterment of Govt. controlled irrigation system than private system and level of necessities for govt. control irrigation system.....	167
Table 5.11	: Statement about necessities of govt. control irrigation system for sustainable rice production and level of necessities	168
Table 5.12	: Government initiatives about irrigation in study areas and explanation of respondents.....	168
Table 5.13	: Knowledge about irrigation manuals.....	169
Table 5.14	: Knowledge Level about irrigation manuals for usefulness of irrigation	169
Table 5.15	: Level of attitude for achieving optimum production by following irrigation manuals	169
Table 5.16	: Preferring modern and traditional irrigation methods	170
Table 5.17	: Level of preferring systematic irrigation method	170
Table 5.18	: Following irrigation manuals	171
Table 5.19	: Using present irrigation method	171
Table 5.20	: Following the methods of irrigation manuals and its level.....	171
Table 5.21	: Level of knowledge about irrigation training program of DoAE ..	172
Table 5.22	: Necessities of irrigation training and level of requirements	172
Table 5.23	: Having any training on irrigation and sources of taking training on irrigation.....	173
Table 5.24	: Knowledge about sources of water better for irrigation.....	173
Table 5.25	: Preferring sources of irrigation water	174
Table 5.26	: Appropriate sources of water for irrigation in study area.....	174
Table 5.27	: Opinion about using surface water in case of availability instead of groundwater for irrigation.....	174
Table 5.28	: Level of knowledge about four stages of interval in irrigation in rice field	175
Table 5.29	: Level of knowledge about prescribed method of maintain water level in different stages	175

Table 5.30 : Knowledge regarding level of water maintain in four different stages and the level of knowledge.....	176
Table 5.31 : Knowledge about better rice production following interval of irrigation in different stages and their level of acceptance	176
Table 5.32 : Appropriateness of present interval method of irrigation and the level of appropriateness.....	177
Table 5.33 : Requirements to maintain optimal level of water in the rice field	177
Table 5.34 : Practice about following interval of irrigation and its level.....	178
Table 5.35 : Learning sources of interval method used for irrigation	178
Table 5.36 : Maintaining optimal level of water in the rice field.....	178
Table 5.37 : Learning sources of maintaining water level method	179
Table 5.38 : Knowledge about drainage system for irrigation in the study area and its level of knowledge.....	179
Table 5.39 : Causes of misuse of large volume of water through present drainage system and the level of acceptance	180
Table 5.40 : Statement about reducing misuse of water by concrete drainage and the level of acceptance	180
Table 5.41 : Statement about systematic irrigation to reduce misuse of irrigation water and the level of acceptance	180
Table 5.42 : Perception about irrigation water misused by farmers' carelessness and the level of acceptance	181
Table 5.43 : Statement about constructing concrete drain to save water and type of misuse through kuccha drain	181
Table 5.44 : Knowledge about causes of ground water table downward and the level of knowledge	182
Table 5.45 : Knowledge about groundwater recharge process and the level of knowledge.....	182
Table 5.46 : Perception of decreasing groundwater table caused by over extracting and its level	183
Table 5.47 : Statement about extracting and recharging ratio must be similar for sustainable irrigation and the level of attitude.....	183
Table 5.48 : Statement about observing groundwater table practically decreasing day by day and the level of acceptance.....	184
Table 5.49 : Knowledge about adverse impact for cultivation of rice round the year and the level of knowledge	184
Table 5.50 : Statement about adverse impact of irrigation in dry season on other crops and the level of acceptance	185
Table 5.51 : Statement about negative impacts of excessive irrigation on plants and animal and the level of acceptance.....	185

Table 5.52 : Statement about negative impacts of excessive irrigation on human and social health and the level of acceptance	186
Table 5.53 : Statement about alternatives instead of rice in kharif-1 season to save water	186
Table 5.54 : Perception about future water scarcity due to excessive groundwater extraction and the level of acceptance.....	186
Table 5.55 : Statement about cultivating rice round the round.....	187
Table 5.56 : Statement about knowledge of water use in Islam.....	187
Table 5.57 : Knowledge about traditional/religious value system regarding water use and the level of knowledge.....	187
Table 5.58 : Statement about believing water as a god gifted resources and the level of trust	188
Table 5.59 : Statement about necessities of obeying social/religious ethics to conserve water and the level of necessity	188
Table 5.60 : Statement about groundwater as a limited resource and the level of acceptance	189
Table 5.61 : Statement about not extracting groundwater unwisely and the level of acceptance	189
Table 5.62 : Using water in such a manner that next generation can get at least same water and the level of acceptance.....	189
Table 5.63 : Statement about by following traditional ethics to save water misuse and the level of acceptance.....	190
Table 5.64 : Learning sources to follow traditional/religious value system.....	190
Table 5.65 : Statement to follow traditional/religious value system of water use and the level of acceptance	191
Table 6.1 : Variation of rice production due to excessive irrigation.....	194
Table 6.2 : Types of impacts due to excessive irrigation	195
Table 6.3 : Appropriate irrigation without creating adverse impacts.....	195
Table 6.4 : Reasons of Irrigation Water Scarcity.....	196
Table 6.5 : Causes of decreasing ground water table.....	198
Table 6.6 : Statement about adverse effect of irrigation water.....	201
Table 6.7 : Types of changes in Environment.....	202
Table 6.8 : Irrigation water scarcity and safe drinking water in dry season..	203
Table 6.9 : Types of impacts of irrigation water	204
Table 6.10 : Using government prohibited pesticides and their adverse effects	205
Table 6.11 : Types of pollution by chemical fertilizers and pesticides.....	205
Table 6.12 : Minerals present in tube wells water and their harmful effects on health.....	206

Table 6.13 : Statement about reasons of irrigation water Scarcity.....	206
Table 7.1 : Causes of throwing waste products.....	212
Table 7.2 : Fallen household waste water into nearby water bodies and its pollution	212
Table 7.3 : Using Govt. banned pesticides and their adverse effects	212
Table 7.4 : Water use according to Islam	214
Table 7.5 : Water use according to traditional beliefs	215
Table 7.6 : Positive and Negative opinion about recharge and withdrawal ratio of groundwater.....	217
Table 8.1 : Purchasing fertilizer, manures, pesticides and herbicides/bigha for rice.....	220
Table 8.2 : Purchasing water for the amount of taka/bigha for irrigation.....	221
Table 8.3 : Cost, production and selling price of different rice	221
Table 8.4 : Hampering environmental health by excessive irrigation.....	225
Table 8.5 : The causes decreasing water level.....	226
Table 8.6 : Static Water Level of Deep Tube wells in 2011 and 2012 under Godagari Upazila	227
Table 8.7 : Static Water Level of Deep Tube wells in 2011 and 2012 under Sirajganj Sadar Upazila	228
Table 8.8 : Static Water Level of Deep Tube wells in 2008, 2009 and 2010 under Godagari Upazila.....	228
Table 8.9 : Static Water Level of Deep Tube wells in 2008, 2009 and 2010 under Godagari Upazila.....	229

List of Figures

Figure 1.1 : Sustainability Matrix	5
Figure 2.1 : Age of the respondents	25
Figure 2.2 : Sex of the respondents	26
Figure 2.3 : Marital Status of the respondents	26
Figure 2.4 : Distribution of Family Size	27
Figure 2.5 : Number of Children	27
Figure 2.6 : Religion of the respondents.....	28
Figure 2.7 : Educational Status of the HH.....	28
Figure 2.8 : Main Occupation of the respondents.....	29
Figure 2.9 : Family Types of Study Households	30
Figure 2.10 : Drinking water source in the study areas.....	32
Figure 2.11 : Sanitation and Toilet of Study Households	32
Figure 2.12 : Status of the toilet.....	33
Figure 2.13 : Used of land for commercial farming.....	41
Figure 4.1 : Level of Irrigation water in different stages of rice cultivation	129
Figure 4.2 : Measurement of soil moisture condition by hand's feel method.....	132
Figure 4.3 : Determine the area of land or basin for irrigation.....	134
Figure 4.4 : Basin Method of Irrigation in the Rice Field	136
Figure 4.5 : Statement about intervals of irrigation	139
Figure 4.6 : Frequencies of irrigation in a season (days).....	139
Figure 4.7 : Laws to install a tube well for irrigation.....	142
Figure 4.8 : Seeking permission of Tube wells installation.....	142
Figure 4.9 : Statement about training on Agriculture	143
Figure 4.10 : Training on irrigation from agricultural department	145
Figure 4.11 : Cropping pattern in the study area	146
Figure 4.12 : Government initiatives about irrigation	149
Figure 4.13 : Increase or decrease water withdrawn from under ground for rice cultivation.....	152
Figure 4.14 : Any water bodies near the rice field and avoid using.....	153
Figure 4.15 : Knowledge about future irrigation water scarcity.....	155
Figure 6.1 : Impacts of excessive irrigation on other crops except rice	194
Figure 6.2 : Facing water scarcity in future	196
Figure 6.3 : Groundwater Table	198
Figure 6.4 : Drying water bodies earlier due to excessive ground water harvesting.....	200

Figure 6.5	: Decreasing fishes due to irrigation water.....	200
Figure 6.6	: Hampering environmental health by excessive irrigation and the changes	202
Figure 6.7	: Impact of irrigation water on human health and the difficulties	203
Figure 6.8	: Statement about using pesticides to kill the crabs or any other animals in rice field.....	204
Figure 6.9	: Pollution of local water bodies by Chemical fertilizer and pesticides and types of pollution	205
Figure 7.1	: Throwing waste products into the pond/dishes and the causes.....	211
Figure 7.2	: Statement about water is limited resource in earth	213
Figure 7.3	: Water use in Islam and their description	213
Figure 7.4	: Traditional beliefs regarding water use	214
Figure 7.5	: Following the traditional and religious beliefs regarding water use and causes of rejection.....	215
Figure 7.6	: Preventing water misuse by obeying religious and other traditional beliefs	216
Figure 7.7	: Underground is recharged by rain and flood water.....	216
Figure 7.8	: Thinking the recharge and withdrawal ratio of ground water for irrigation.....	217
Figure 8.1	: Employment status due to irrigation.....	223
Figure 8.2	: Scarcity of safe drinking water for irrigation in dry season.....	223
Figure 8.3	: Drying water bodies earlier due to excessive ground water harvesting.....	224
Figure 8.4	: Decreasing fishes due to irrigation water.....	225

List of Maps

Map 2.1	: Upazila Map of Sirajganj Sadar.....	15
Map 2.2	: Upazila Map of Godagari.....	16
Map 2.3	: Agro ecological Zons of Bangladesh.....	18

Chapter-1

Introduction

1.1 Prelude

The idea of irrigation was originated and recognized by the Egyptians. Around in 5000 B.C., the Egyptians used water of the Nile River to create the first irrigation system for crop production. Gradually, they made development and progress to the irrigation system, eventually creating a fairly elaborated one. In fact, by 2100 B.C. the Egyptians had developed an irrigation system that used a channel to divert water to its ultimate target.¹ In our subcontinent, irrigation practice was started around in 2600 B.C.²

However, in Bangladesh modern systematic irrigation started in the early 1960s with the introduction of “GREEN REVOLUTION”. At that time government introduced deep tube wells and low-lift pumps through Bangladesh Agricultural Development Corporation (BADC). Before that, farmers used to grow crops under rain fed conditions. Shallow tube wells came into operation after 1980.³ Bangladesh has a land area of about 14.845 million *ha* of which 8.44 million *ha* (57%) are under cultivation.⁴ Irrigation is currently available to less than 50% of the land that can be irrigated in the Rabi season. At present, about 77.6% of the cultivable land (6.55 million *ha*) has irrigation facilities.⁵ This amounts to about 45% of the total cropped area.⁶

Irrigation has revolutionized rice production in Bangladesh. However, limited irrigation is used for other crops. The rice crop alone occupies 90-95% of the irrigated area and only 5-10% is left for other crops. Cultivation of High Yield Variety (HYV) of rice during the Boro season (substitute crop of wheat) is almost entirely dependent on irrigation water. Both small and minor scale irrigation systems play dominant role in High Yield Variety (HYV) Boro rice cultivation. On the other hand, irrigation in Aus and T. Aman has also an important impact on increasing rice production. The early part of Aus and the later part of T. Aman crops sometimes suffer from water stress. Supplementary irrigation in these two

¹ www.homefurnish.com/homeimprovement/plumbing/historyofirrigation.aspx accessed on 19/07/110.

² www.en.wikipedia.org/wiki/Irrigation accessed on 19/07/10.

³ M. Mainuddin, “Poverty alleviation versus mass poisoning: the dilemma of groundwater irrigation in Bangladesh.” *Groundwater Intensive Use*, ed. by A. Sahaquillo, et.al. (London: Taylor & Francis plc., 2005) pp. 221-222.

⁴ Bangladesh Bureau of Statistics (BBS), *Yearbook of Agricultural Statistics of Bangladesh* (Dhaka: Reproduction, Documentation & Publishing Wing, BBS, 2010), p. 312.

⁵ *Ibid.* p. 253.

⁶ *Ibid.* p. 312.

stages promotes HYV rice adoption and ensures stable and better crop yields as well. Some selected crops such as wheat, millet and potatoes can be produced with residual soil moisture. Application of one or two irrigations can substantially increase the yield of these crops.⁷

Irrigation is started enormously all over the country with the introduction of **Green Revolution** in Bangladesh in mid-1970s. At first traditional irrigation is introduced among the farmers in Bangladesh. Farmers irrigated their vegetable garden, fruit garden, and seedbed manually. They also irrigated boro rice seedbed using nearby surface water. They did not depend on ground water. Surface water was the main source of irrigation water to growing crops. However, after green revolution the use of ground water to irrigate crop fields has increased. During 1980s, the government had withdrawn the tax on importing shallow pumps so that farmer can buy shallow pumps on cheap price to irrigate their rice fields using ground water throughout the country for enhancing the rice production. In the meantime, cultivation of high yield variety of rice increased that needed large volume of irrigation water for the better production and without irrigation; optimal production of rice cannot be achieved. Therefore, dependency on ground water for irrigation is increased day by day. Now a day's farmers irrigate their crops using ground water rather than surface water. Around 70% of irrigation water comes from ground water and only 20-30% from surface water. In recent past irrigation practice was community based because government organization such as Bangladesh Agriculture Development Corporation (BADC) and other organizations managed irrigation for the farmers but recent times farmers irrigate their crop fields individually with the introduction of shallow pumps. They withdraw water from the ground easily by the shallow pumps. Therefore, the use of ground water for irrigation purposes is increasing continuously.⁸

1.2 Statement of the Problem

Groundwater irrigation has been the second most dramatic episode in Bangladesh agriculture like other Asian countries. It is introduced in 1960 by a government Agency called Bangladesh Agricultural Development Corporation (BADC). BADC ran heavily subsidized program on Deep Tube wells (DTWs) and Shallow Tube wells (STWs). In the late 1970's, there was a continuous effort to decrease public sector involvement and a gathering momentum in private sector. Import duties were reduced and in some case exempted and private sector was allowed to import the equipment. Since then import of STWs picked up sharply.

⁷ M. Mainuddin, "Poverty alleviation versus mass poisoning: the dilemma of groundwater irrigation in Bangladesh." *Groundwater Intensive Use*, ed. by A. Sahuquillo, et.al. (London: Taylor & Francis plc., 2005) pp. 221-222.

⁸ Ibid.

The contribution of groundwater to total irrigated area has increased from 4% in 1971 to 70% from 1999 to till.⁹

At present irrigation as like as use of chemical fertilizers and pesticides is inevitable for agricultural production in Bangladesh like any other countries. With the increase of chemical fertilizers and pesticides, irrigation is increased multiple times since the introduction of high yield variety of rice in Bangladesh. It has been experiencing since the introduction of irrigation and agro technology that irrigation is the most important supply factor for high yield variety of rice production. Different experimental research shows that around three thousand liters water is required for one kg rice production.¹⁰ Certainly, farmers have to depend on both surface and ground water for watering their rice field. However, the irrigation feature of Bangladesh is not suitable for development progress as well as for environment. Unexpectedly contribution of groundwater to total irrigation is 70% while the contribution of surface water is around 20-30%. No country is as dependent upon groundwater as Bangladesh that results the gradual increasing of ground water exploitation. As a result, ground water table has already been lowered alarmingly due to excessive and unwise withdrawal of ground water. At present, it is difficult to harvest ground water through STWs as well as hand tube wells in many parts of Bangladesh especially in the northwest regions.

It is observed that the use of surface water from rivers, ponds, canals, beels, ditches etc; is decreasing day by day because of degradation of wetlands and other surface water reservoir, siltation, water divert and up lift in the upper stream by India, human intervention and so on. Due to shortage of surface water, the use of ground water for irrigation purposes is increasing and thus ground water table declines alarmingly. Thus, it causes very difficulties to withdraw water from the ground in different places of Bangladesh.

As a major cereal crop, farmers are used to cultivate rice throughout the year, which is also creating more pressure on ground water. Moreover, farmers are not much aware about the irrigation methods and techniques provide through manuals by department of agriculture extension, consequently large volume of irrigation water misuses and sometimes pollutes. They irrigate their rice field until it is over flooded.

Some water-soluble minerals containing arsenic (As), lead (Pb), cadmium (Cd) etc; are also found in soil along with ground water in many areas of Bangladesh due to excessive and unplanned withdrawing of huge volume of ground water. These metallic elements are treated as toxic, which cause decrease of soil fertility, contaminate of surrounding surface water bodies etc. It

⁹ Ibid.

¹⁰ *International Rice Research Institute*, Manila, Philippine.

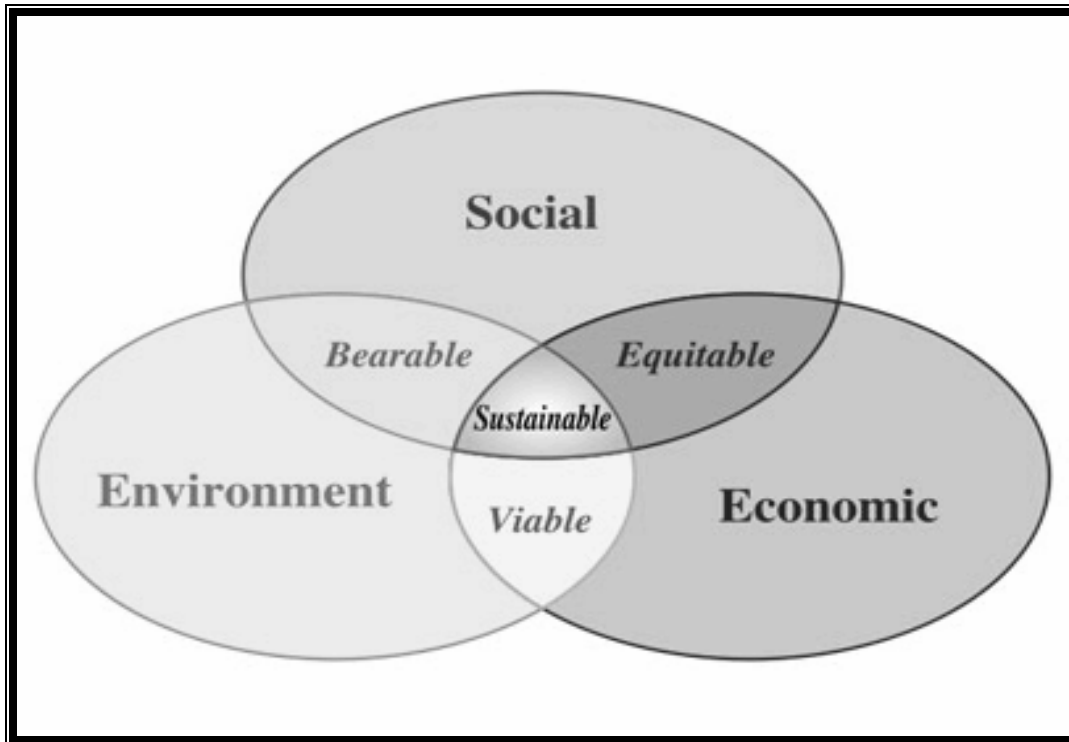
is assumed that the water containing such elements is also harmful for the human as well as for environmental health and in dry season environment becomes pale and gloomy that shows the adverse affects creating from excessive irrigation using ground water. Gradually this scenario is becoming more acute in most parts of the country.

In addition, it is observed that many parts of the country especially northwest region is experiencing water scarcity in dry season and at that time maximum hand and shallow tube wells do not get required level of ground water to up lift the water. It is creating water scarcity for drinking and household use as well as irrigation. Sometimes it costs low rice production that happened in recent past years. Therefore, it is an alarming situation for the country. Necessary steps should be taken immediately to proper use of water so that it is possible to avoid the future scarcity of fresh water. But questions has been arising that in what extent the country is experiencing water scarcity; how much ground water table is decreased and what is the ratio of withdrawal and recharge. In addition, what are the social and environmental impacts creating from present irrigation systems and practices, what are the causes of excessive use of ground water and misuse of water, what are the factors of violation of manuals and traditional ethos as well as religious value systems regarding water use? Moreover, it is very important to measure the sustainability of present irrigation systems in rice production. Therefore, an in-depth investigation is required to know evidently about the above-mentioned questions and to measure the level of sustainability of present irrigation systems. This research is intended to examine the irrigation policy, methods and manuals, present practices, adverse impacts on society and environment, measuring the ground water table, legal and ethical issues etc; in respect of the level of sustainability.

1.3 Literature Review

Review of literature offers relevant information regarding the topic. To acquire knowledge about irrigation practices and sustainability, the researcher reviewed relevant literature. While reviewing, the researcher has gone through chapters/objectives, articles of few books, Internet, reports, journals, newspapers etc. according to his research title and objectives, but it is found that specific focus on these topics is not sufficient. After reviewing literature the researcher observes as per his acquired knowledge that less stress has been paid to irrigation practice in rice cultivation and sustainability issues, though some water related research works have been conducted in our country. Nevertheless, some relevant researches have been carried out elsewhere in the world. So literature review suggests that there is huge knowledge gap in the field of present research that is why it is the main justification for undertaking this research.

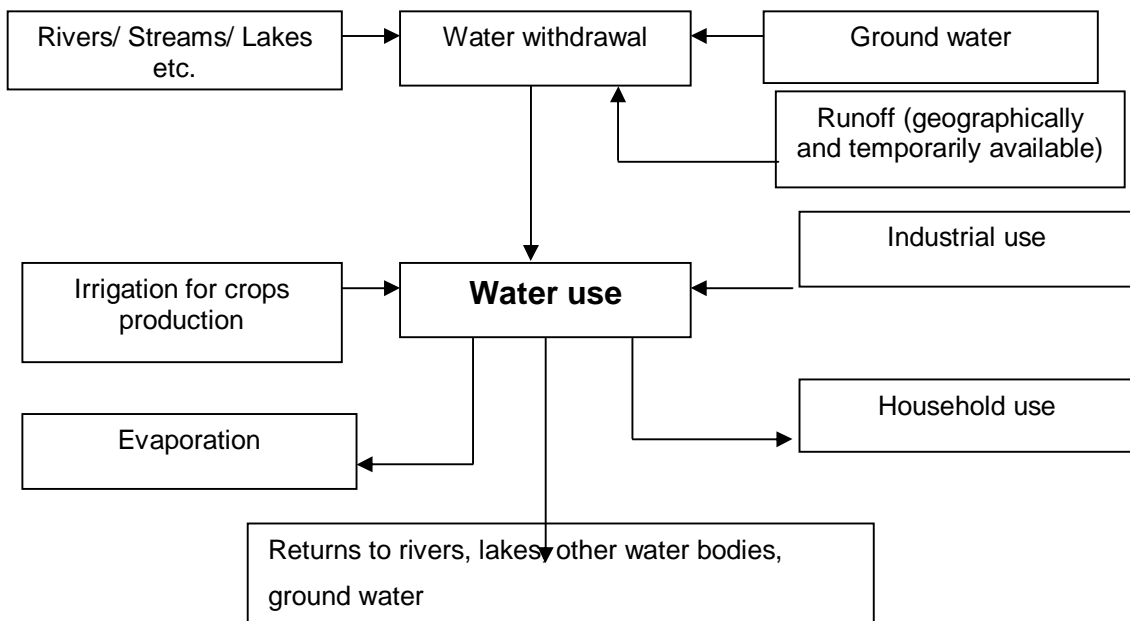
Figure 1.1
Sustainability Matrix



Adopted from: [www.sustainability.umd.edu/img/content_pages/..](http://www.sustainability.umd.edu/img/content_pages/)
Accessed on July 13, 2010.

1.4 Conceptual Framework

Water withdrawal and consumption



Adopted from: the Doctoral thesis produced by Joseph Xercavins i Valls.

1.5 The Research Questions

- ❖ What is the level of appropriateness of irrigation policies and manuals in our country?
- ❖ What are the sources of water and practices of present irrigation in Rice cultivation?
- ❖ What are the levels of farmer's knowledge, attitude and practice about irrigation?
- ❖ What are the adverse externalities of present irrigation practices?
- ❖ What are the ethical issues about present irrigation practices?
- ❖ What is the present state of sustainability and challenges?

1.6 Objectives

1.6.1 General OBJECTIVES

To examine the present water use practices in irrigation purposes and finally to find out the sustainable irrigation practices for preventing water scarcity for future generation.

1.6.2 Specific Objectives

- 1) To review the present irrigation policies in Bangladesh;
- 2) To see the state of water sources and methods of irrigation;
- 3) To examine the present irrigation manuals and practices in rice cultivation.
- 4) To assess the farmers' knowledge; attitude; and practice about irrigation.
- 5) To apprehend the adverse externalities of present irrigation practices regarding sustainability;
- 6) To find out ethical issues about present irrigation practices;
- 7) To measure the present state of sustainability and challenges;

1.7 Hypothesis

Present Irrigation Practice does not ensure Sustainability of Rice Cultivation.

1.7.1 Indicators to Measure Sustainability

Sustainability comprises of three factors, environmental, economic and social.

1.7.2 Indicators for Environmental Sustainability

Environmental Health, Land Degradation, Soil Fertility, Biodiversity and Ecology, Other Crop Production, etc.

1.7.3 Indicators for Economic Sustainability

Production of rice and other crops per unit of land, farmer's income, employment, profitability, etc.

1.7.4 Indicators of Social Sustainability

Equity of water, Poverty, Household and Drinking water, sanitation, Human health, Level of knowledge, etc.

1.8 Research Approach

The research approach is mixed method for the present research. Both qualitative and quantitative data are used to address the research objectives and both the results are integrated and synthesized through cross-sectional description and interpretation.

1.8.1 Data Used and Sources

Both qualitative and quantitative data have been used for the research work. Both the data come from primary and secondary sources are used for this research.

1.8.1.1 Primary data sources

Primary data was the study field and population.

1.8.1.2 Secondary sources of data

Secondary data includes official records and documents regarding irrigation laws and policies, irrigation methods and manuals, records about surface water reservoir and ground water table use for irrigation, their changes, relevant research articles and books, newspapers, dissertations, thesis, websites etc.

1.9 Study Area Selection

Two villages of Sirajganj Sadar Upazilla under Sirajganj district and three villages of Godagari Upazilla under Rajshahi district are selected purposively as the study area. While selecting the study area, attention is given to examine the use of water for irrigation purposes in rice cultivation. Most of the areas of Sirajganj Sadar Upazilla are Jamuna flood plain alluvium land situated on west side of the river Jamuna. As the research is cross-sectional descriptive, two villages named Charkhoksabari and Shaluabhita of khokshabari union are selected as study areas for this research to collect required primary data for addressing the study objectives. On the other hand, three villages named Sheikhpur, Raninagar and Banduria of Gogram union under Godagari Upazila of Rajshahi district are also selected as study field. This is comparatively high plain land area than that of Sirajganj Sadar Upazilla.

It is assumed that selected villages of Sirajganj Sadar and Godagari Upazilla are as same as plain land areas of Bangladesh. The farmers irrigate their land with shallow and deep tube wells that is why level of groundwater is decreasing day by day and it is observed that wetland and reservoir like ponds, beels and canals are completely dried up during summer season. Therefore, farmers have to depend on ground water for irrigation purposes. Researcher practically observes that the study areas are suitable for him to perform his study.

1.10 Sample Size and Sample Techniques

Total number of sample is 180. After conducting a preliminary visit and observation in study field, we prepare a complete list of 340 numbers of households of the study villages from which 180 respondents are selected through simple randomization. Before selection of respondents, households of study villages are stratified into three groups in accordance of land ownership and amount of land cultivate for rice production in Kharif-1 season. 15 or 10 households are selected from each stratum. Each household is considered as a unit of analysis. In the study area of Sirajganj, total respondents are 90(45+45), and in the study area of Gadagari, total respondents are also 90(32+29+29). Respondents for in-depth interview, informal discussion and FGD are selected purposively from the selected respondents as above.

Table 1.1
Sample size distribution

Study Respondents	Number of Sample	Sampling Techniques
Questionnaire survey	180	Stratified Random
FGD	12x4= 48	Purposive
In-depth and informal interview	6	Purposive

1.11 Data Collection Techniques

1.11.1 Secondary data Collection Techniques

Data from secondary sources has been collected through desk work and content analysis from official records and documents regarding irrigation laws and policies, irrigation methods and manuals, records about surface water reservoir and ground water table use for irrigation, their changes, relevant research articles and books, newspapers, dissertations, thesis, websites etc.

1.11.2 Primary Data Collection Techniques

1.11.2.1 Questionnaire survey

Questionnaire survey has been conducted through face-to-face interview for collecting primary data from study population regarding demographic and socioeconomic data and information of selected respondents; total land

ownership; amount of cultivated land; amount of cultivated land for rice production in Kharif-1 season (Kharif-1 season consisting from March to June). In addition, data collected regarding irrigation methods; sources of irrigation water; mono crop or multiple crop; interval of irrigation; level of irrigation; misuse and leakage of water, present state of ground water table, adverse impacts of present irrigation practice (impacts on soil fertility, biodiversity, soil and water pollution, other crop production, environmental health, human health etc.), level of violation of manuals provided by the Department of Agriculture Extension; traditional as well as religious values and ethics, degree of sustainability of irrigation practice etc. The questionnaire was developed with open, close-ended and multiple-choice questions.

1.11.2.2 In-depth and in-formal interview

In depth and informal interview has been done to collect the further in detail information about present irrigation practices as mentioned above for rice cultivation. Village mentors, officials of Department of Agriculture Extension, Bangladesh Agricultural Development Corporation (BADC) and Water Development Board were selected for in-depth interview. Qualitative data was come through in-depth and in-formal interview.

1.11.2.3 Focus group discussion

Focus group discussion method is used to build up picture of the local situation and crosscheck the information, which is collected through questionnaire survey by face-to-face interview and observation methods. Memory based quantitative data which are collected through different procedure needs more accuracy and to explore hidden data. Generally, peoples are tended to hide their own cultivable land, level and misuse of irrigation. The researcher arranged four different sessions of FGD in two study areas. The duration of these sessions was one and half an hour. Twelve members were selected through purposive sampling procedure. Among them seven members were the respondents selected as study population and other five members were village leaders, NGO workers, Agricultural Extension Officers, a school teacher and a village mentor. Researcher himself was the moderator. He selected the list of topics for elaborate discussion and to learn about the topics from village community members, which were used to detect the obstacle of sustainability by present irrigation practices that the researcher assumed.

1.11.2.4 Ground water table measurement

Firstly, data regarding ground water table were collected from different official documents such as Water Development Board, Department of Agriculture Extension, Bangladesh Agricultural Development Corporation (BADC), Barind Multipurpose Development Authority (BMDA), other available sources etc. Secondly, data were collected from three villages of Godagari by using measuring meter due to depth of water table and data were collected from two villages of Sirajganj using measuring tape through linear method. 10 deep and shallow tube wells operated by diesel and electric power were selected purposively from two study areas to collect data of ground water table within 15th October to 15th November and from 15th March to 15th April to estimate the ratio between harvest and recharge of ground water. Again, in same time of the second year of data collection regarding ground water table was collected from same places to estimate the seasonal and annual variation.

1.11.2.5 KAP model study

“KAP” model study was conducted to know the level of knowledge, attitude and practices of study population selected for the present research. It served as a diagnosis of the respondents about their knowledge, accordingly their attitude and practice regarding same matter. The main purpose of KAP model study was to explore the level of knowledge and measure the attitude so that it could be easily understand their practice about irrigation to know what study population knew about irrigation, how they felt and how they behaved or acted with irrigation.

The knowledge referred to the following topics in present research: 1) Introduction to irrigation in our country; 2) Government initiatives about irrigation; 3) Manuals and Methods of irrigation; 4) Level of irrigation water; 5) Interval of irrigation; 6) Source of irrigation water used; 7) Misuse of irrigation water; 8) State of ground water table; 9) Season of irrigation; 10) Irrigation in relation to climate change; 11) Impacts of irrigation etc. Attitude referred to their feelings towards the same feature as well as any preconceived ideas that they might have towards it. Practice referred to the ways in which they demonstrated their knowledge and attitude through their actions regarding irrigation.

Appropriate questions and statements were developed to measure and tested the KAP model for the present research. Statement and questions to measure level of Knowledge were designed in accordance of the topics as mentioned above. Statements and questions were open-ended as well as multiple-choice questions, and in some cases without multiple-choice answers by which false answer and statement were identified. Questions included in the Attitude section were designed to gauge the prevailing attitudes, beliefs and misconceptions

of the study population about the different features of irrigation that they actually maintained in the field. KAP study was done efficiently using different strategies. Statements were provided, and respondents were asked to indicate the extent to which they agreed with those statements, on a pre-determined scale (strongly disagree, moderately disagree, not so agree, not agree etc.). Questions included in the practice section were designed to assess the practices of the study population regarding irrigation. Questions and statements were open-ended questions, multiple choice questions and answers as like as those of the Knowledge section to prevent false information as a result of guessing.

1.11.2.6 Data collection to measure sustainability

Sustainability comprises of three factors; environmental, economic and social. Required data regarding the indicators of sustainability were come through different tools as discussed above.

1.11.2.7 Data analysis

At first collected data are edited, classified, categorized, coded and listed for analysis and interpretation. Quantitative data are analyzed through frequency distribution for age, marital status, occupation, literacy rate, land ownership, total agricultural land, amount of land cultivate for rice production, etc. Irrigation practice and sustainability oriented qualitative data collected through questionnaire survey, observation, FGD and in-depth interview are analyzed through inductive reasoning processes to analyze and interpret the irrigation practice and sustainability issues to draw an inference, which are supplementary to the findings come from quantitative analysis. Both the results and findings are also interpreted through inductive reasoning process to measure the state of sustainability and to formulate the suggestions.

1.12 Presentation of Findings

The results and findings have been presented in table, graph, diagram, flow chart and in narrative form.

1.13 Justification of the Study

In the review of literature it is clearly suggested that there is research gap in the field of this research. To best of researcher's knowledge, no significant research work is carried out about irrigation practice in rice cultivation and its sustainability in Bangladesh. So present research will fulfill existing knowledge gap and will be helpful for the policy makers in preparing appropriate water use policy for Bangladesh as well as academicians and other future research personnel will be benefited from this research. Therefore, it is expected that existing study will be beneficial for the people of Bangladesh.

1.14 Scope and Limitation of Research

The research work is a new field of study. The findings that are found in this research will help the policy makers, academicians, knowledge seekers and researchers to get some new knowledge in this field. Though the study is conducted in two villages in Sirajganj and three villages in Rajshahi district, it will represent almost the whole country. On the other hand considering the time constraint, money and other necessary resources available to the researcher, the following limitations were imposed in conducting this research;

- 1) The study was confined in two villages of Sirajganj Sadar and three villages of Godagari Upazilla only.
- 2) Though the research was done mainly on the field based primary data; so some errors might occur.

1.15 Research Matrix

General Objective		Assumed Result		
To examine the present water use practices in irrigation purposes and finally to find out the solution of sustainable irrigation practices for preventing water scarcity for future generation.		So the ultimate goal of my thesis is to find out the way for proper using of water in irrigation purposes attaining sustainability of present water condition that exists and to ensure the way of developing water availability for the future generation so that scarcity of water in future could be reduced and make the fresh water available for everyone.		
Specific Objectives	Verifiable Indicators	Data sources	Data Collection Tools	Analysis Tools
To see the state of water sources and prescribed methods as provided by the Department of Agriculture Extension, BADC.	Water sources, prescribed methods of irrigation	Books Articles Journals Thesis Websites	Documents or contents analysis	Inductive reasoning process.
To observe the present irrigation manuals and practices in rice cultivation.	Irrigation practices	Manuals and Field Survey	Questionnaire survey, Observation, FGD.	Frequency distribution
To assess the farmer's knowledge, attitude and practice about irrigation.	Farmer's knowledge, Attitude, Practice	Field Survey	Questionnaire survey, Observation, FGD. Scaling method	Frequency distribution and inductive reasoning process
To apprehend the adverse externalities of present irrigation practices regarding sustainability	Water scarcity, water inequity, biodiversity, ecology	Field Survey	Questionnaire survey, Observation, FGD.	Frequency distribution, inductive reasoning
To find out ethical issues about present irrigation practices.	Ethical Issues	Field Survey	Questionnaire survey and informal discussion	Description in respect of code of conduct
To measure the present state of sustainability and further challenges.	Sustainability, Challenges	Field Survey	Questionnaire survey, Observation, FGD.	Mean, inductive reasoning process

1.16 Conclusion

Water crisis of Bangladesh affects both rural and urban areas, and is a matter of both water scarcity and water quality. About 97% of water on the Earth is saline water, leaving only 3% as fresh water of which slightly over two thirds is frozen in glaciers and polar ice caps. The remaining unfrozen fresh water is mainly found as groundwater, with only a small fraction present above ground or in the air. Fresh water is a renewable resource, yet the world's supply of clean, fresh water is steadily decreasing. Water demand already exceeds in respect of supply in many parts of the world and as the world's population continues to increasing. Importance of awareness at the global level to preserving water for ecosystem services has only recently emerged as during the 20th century, more than half the world's wetlands have been lost along with their valuable environmental services. Biodiversity including rich freshwater ecosystems are currently declining faster than marine and terrestrial ecosystems. Water resources are sources of water that are useful or potentially useful to humans. Water is used for irrigational, industrial, household, recreational and environmental activities. Among them use of water for irrigation in rice production plays dominant role in Bangladesh. In addition, for this we exploit or misuse huge volume of surface and ground water. Therefore, time has come to check misuse of water and to find out possible solution to achieve water sustainability by sustainable irrigation practices in rice cultivation.

Chapter-2

Environmental and Socioeconomic Settings of the Study Area

Aim of this chapter is to describe about environmental and socioeconomic settings of the study areas. Environmental features include location, communication, road and transport, physiography, weather and climate, land and soil type, soil fertility, water resources, present land usages, major cropping pattern, environmental constraints for development etc., of both the study areas. On the other hand, socioeconomic and demographic features include age, sex, marital status, family size, religion, literacy status, occupation, skillness, family types, house types, drinking water source and sanitation etc; of the study areas. It also describes the total amount of land, total amount of cultivable land, annual income, annual expenditure, annual savings and deficit, annual income from rice and from other crops, annual income from other sources etc., of the study population in both the areas.

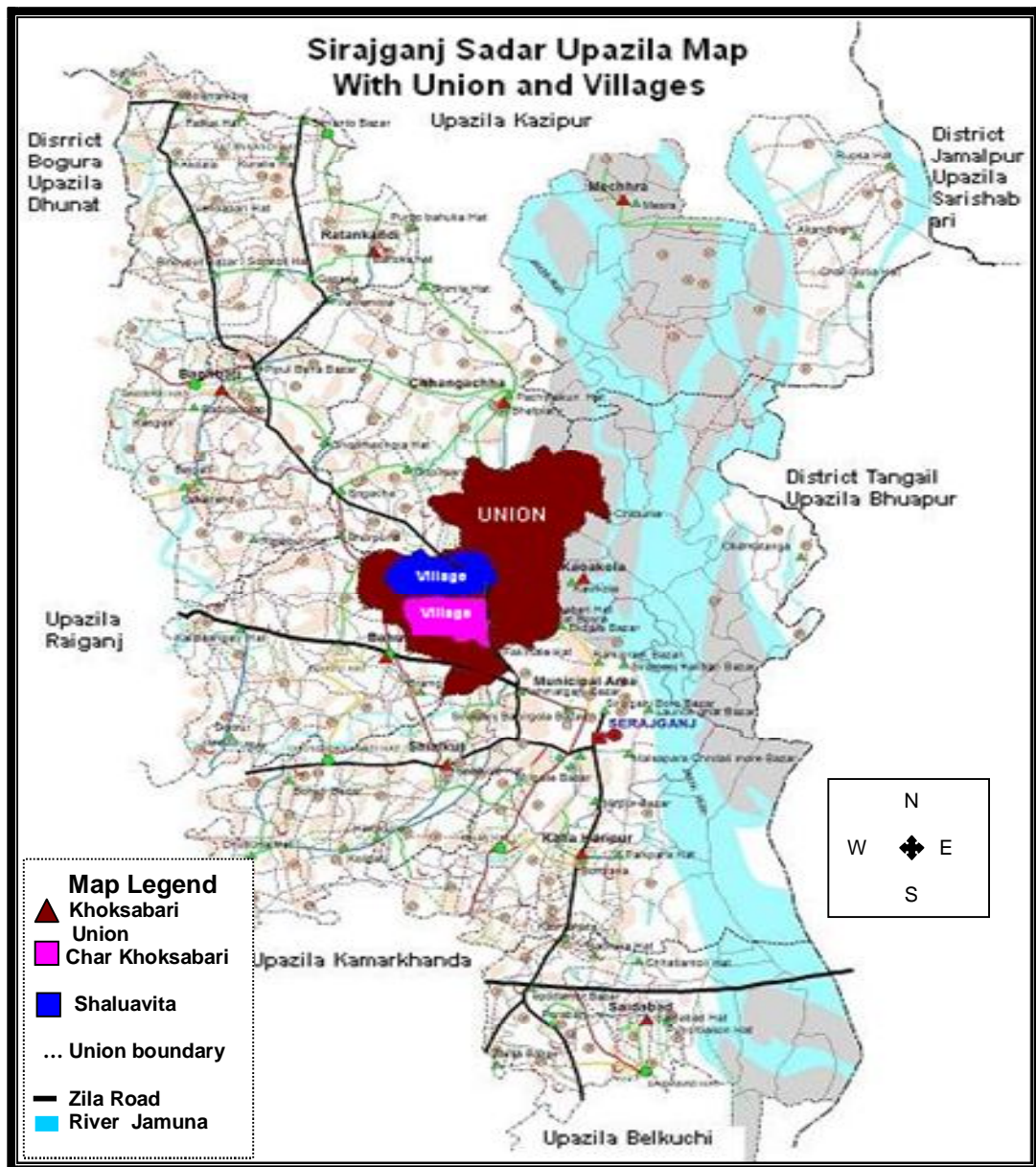
2.1 Introduction

Socioeconomic condition of study areas varies due to their geographical and climatic conditions along with other factors. Khoksabari union as study area under Sirajganj sadar upazila of Sirajganj district is situated on the bank of the River Jamuna as known Jamuna flood plain areas. On the other hand, Gogram union under Godagari upazila of Rajshai district selected as study locale is situated on the bank of River Padma known as High Ganges River Floodplain areas. In Sirajganj areas, all type of crops are grown while in Godagari areas, all types of crops are not grown because of the soil type and availability of ground and surface water sources. Housing pattern and population density are also different in both the areas. In Gadagari, population is less than those areas of Sirajganj. Environmental, weather and climatic features are quite different in both the areas according to rainfall, temperature, drought, river flow, wetland, water sources etc.

2.2 Location of the Study Area

The two villages named Char Khoksabari and Saluabhita, selected as study areas, are situated in Sirajganj Sadar Upazila of Sirajganj district and three villages named Raninagar, Sheikhpur and Banduria are situated in Godagari Upazila of Rajshahi district. These five villages are selected as the study areas for present research. Study villages selected from Sirajganj sadar upazial are shown in below map.

Map 2.1
Upazila Map of Sirajganj Sadar



Adopted from: http://en.wikipedia.org/wiki/Sirajganj_Sadar_Upazila

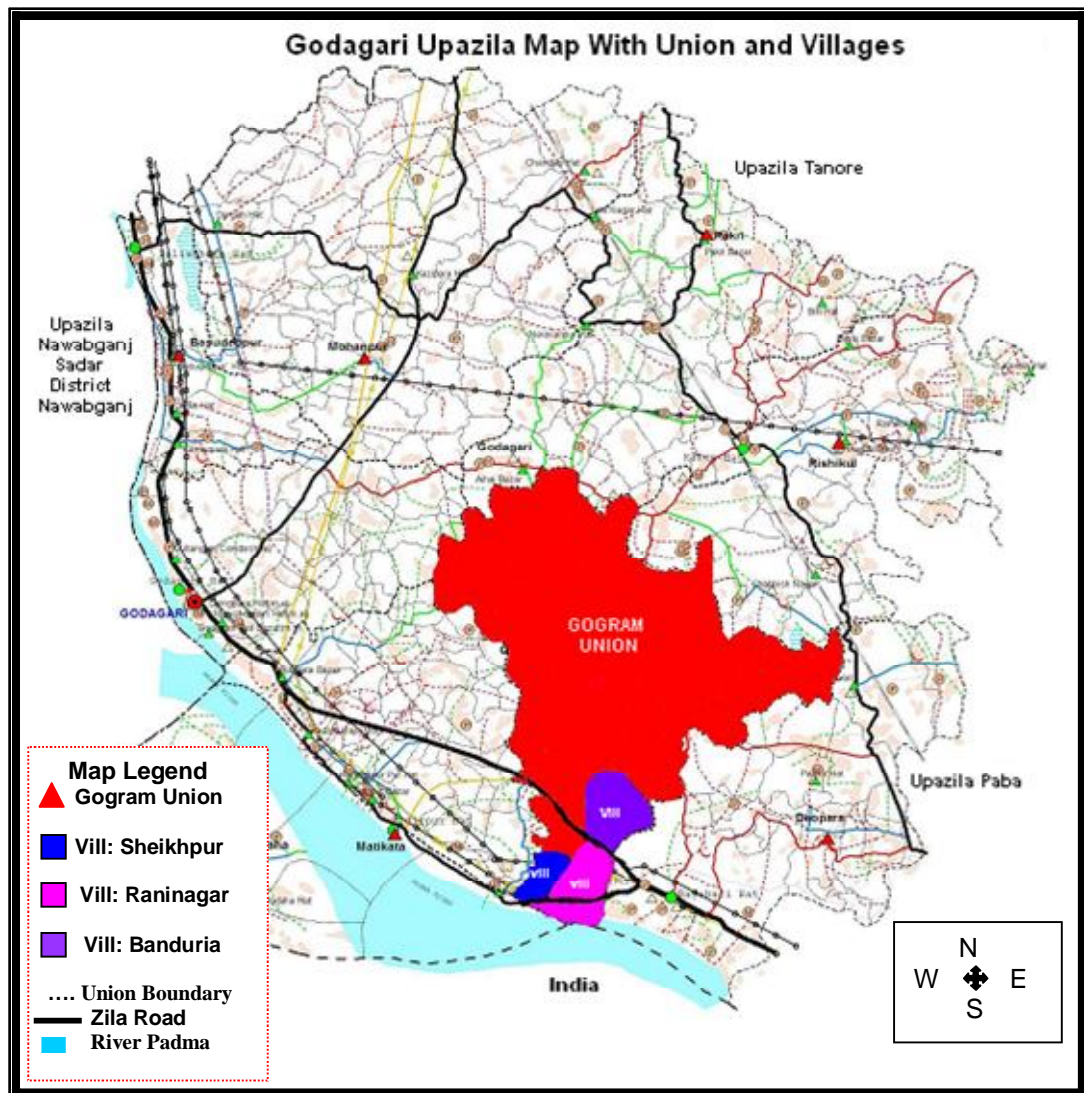
Sirajganj Sadar Upazila is located at 24° 27' 30" N, 89° 42' 0" E and 24° 27' 29.88" N and 89° 42' 0" E. This Upazila under Siarjganj district with an area of 325.77 sq km is surrounded by Kazipur Upazila on the north, Kamarkhanda and Belkuchi Upazilas on the south, Kalihati and Bhuapur Upazilas under Tangail district on the east, Kamarkhanda, Raiganj and Dhunat Upazilas on the west. Main rivers flowing in this upazila are Jamuna, Ichamati and Hurasagar.¹¹

On the other hand, Godagari Upazila is located at 24° 28' 0.12" N, 88° 19' 50.16" E and 24° 28' 0" N, 88° 19' 48" E.

¹¹ *Banglapedia*, National Encyclopedia of Bangladesh.

Study Villages selected from Godagari Upazila are shown in the below map.

Map 2.2
Upazila Map of Godagari



Adopted from: http://en.wikipedia.org/wiki/Godagari_Upazila

Godagari Upazila under Rajshahi district with an area of 472.13 sq km is bounded by Nawabganj Sadar and Tanore Upazilas on the north, West Bengal of India and the Ganges on the south, Paba and Tanore Upazilas on the east and Nawabganj Sadar Upazila on the west. Main rivers flowing in this upazial are Ganges and Mahananda.¹²

2.3 Communication of Study Areas from Upazila Headquarters

The communication systems of both the study villages from Upazila headquarters are better than any other Upazilas of Bangladesh. Rajshahi-Sonamasjid high way crosses the study villages of Gogram union under Godagari upazila. Rajshahi-Chapainawabganj old road also has gone through on

¹² Ibid.

the south side of the study villages. In addition, there are small and narrow roads constructed by Barind Multi-purpose Development Authority (BMDA) to develop local communication with surrounding villages including hats and bazaars. On the other hand, Sirajganj-Kazipur upazila road crosses the study villages selected from Sirajganj sadar upazila. However, there are sufficient pacca and earthen road, which connected the study villages with surrounding roadways and villages but it is not developed as like as Godagari upazila.

2.4 Road and Transport of Study Area

Both the villages of Sirajganj is situated just near by the Sirajganj Sadar-Kazipur Upazila main road. It is around 5 kilometers from the Sirajganj district town. The road inside the villages is earthen and muddy. People usually use rickshaw van, mini truck, tempu, auto rickshaw etc. to carry their goods. People travel from their villages to Upazilla headquarters by rickshaw, rickshaw van, minibus, CNG Tricle, tempu, auto rickshaw etc. It is observed during field visit and survey that communication and transport are quite good for the people of both the villages.

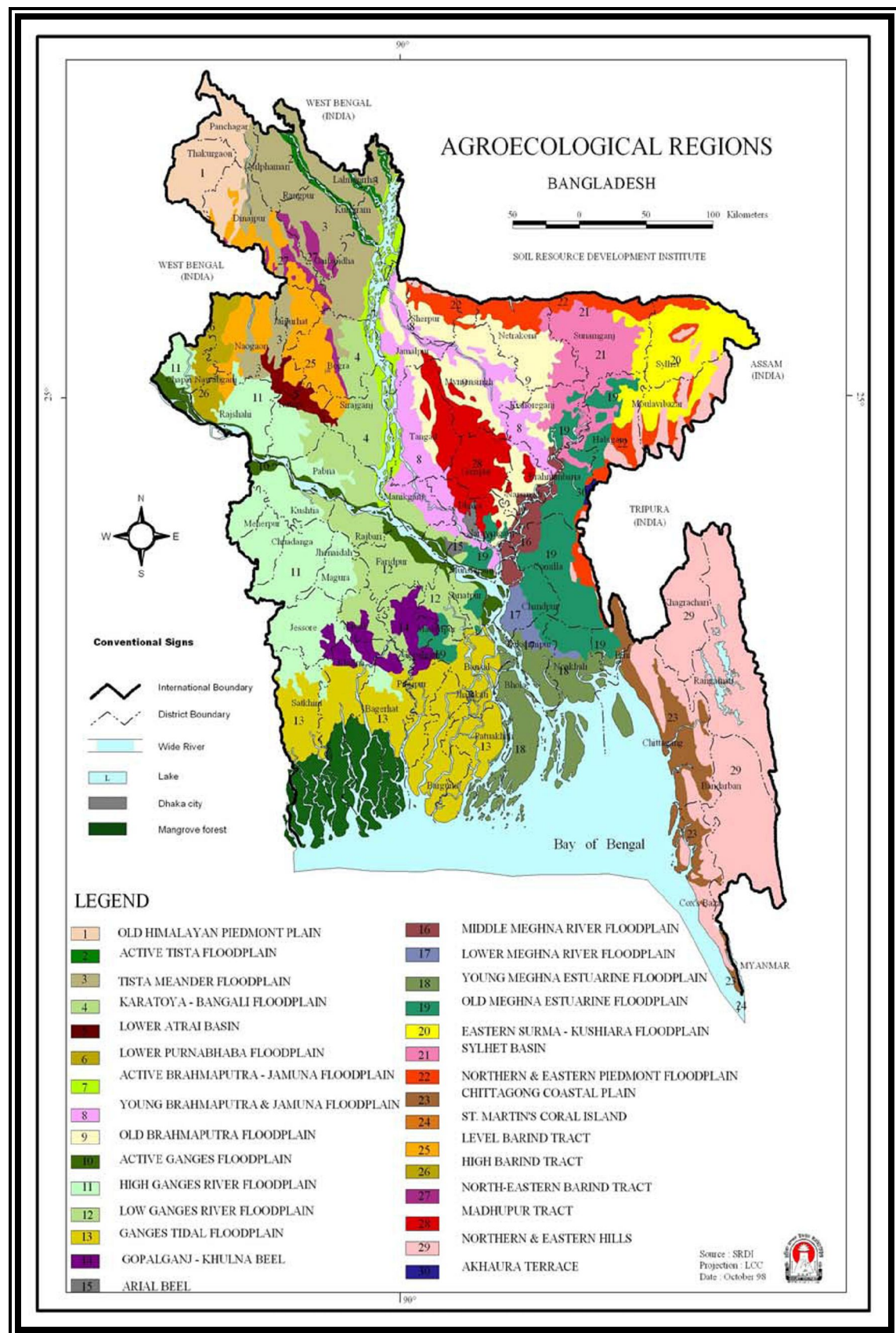
On the other hand, among the three villages of Godagari Upazila, Raninagar and Sheikhpur villages are situated at the south side of Rajshahi-Chapainawabganj-Sonamasjid highway and at the north side of Rajshahi-Chapainawabganj old road way. However, Banduria village is situated near about one kilometer in the north side of Rajshahi-Sonamasjid high way. The roadways inside the villages are pitch road. People use rickshaw van, buffalo cart, mini truck, tempu to carry their local goods and travel. People travel by rickshaw van and on foot. The communication and transport of villages are quite satisfactory than villages of Sirajganj district.

2.5 Agro Ecological Features of the Study Area

An Agro-ecological zone recognizes which is based on hydrology, physiographic, soil types, tidal activity, cropping patterns, seasons, weather and climate. In fact, an agro-ecological zone indicates an area characterized by homogeneous agricultural and ecological characteristics. This homogeneity is more prominent in the sub region and unit levels. The agro-ecological zones of Bangladesh have been identified based on four elements such as physiography, soils, and land levels in relation to flooding and agro climatology. Bangladesh has been tentatively divided into 30 agro-ecological zones. These 30 zones have been subdivided into 88 agro-ecological sub-regions, which have been further subdivided into 535 agro-ecological units.¹³ Below Map shows the agro-ecological zones of Bangladesh.

¹³ Ibid.

Map 2.3
Agro ecological Zones of Bangladesh



Source: Yearbook of Agricultural Statistics of Bangladesh, 2010.

The study villages of Sirajganj district are characterized as the Karatoya-Bangali Floodplains areas. It covers eastern half of Bogra district and most of the Sirajganj district covering 2572 km² areas. It is situated in fourth agro-ecological zone. This region is very similar to the Tista Meander Floodplain in physiography and soil, and comprises a mixture of Tista and Brahmaputra sediments. Most areas have smooth, broad, floodplain ridges and almost level basins. The soils are grey silt loams and silty clay loams on ridges and grey or dark grey clays in basins. Five general soil types occur in the region, of which non-calcareous grey floodplain and non-calcareous dark grey floodplain soils predominate. The soil is moderately acidic throughout. Organic matter contents are generally low in the cultivated layer of ridge soils and moderate in basins. General fertility is medium.¹⁴

The study areas of Godagari are situated in High Ganges River Floodplain areas. It is found in 11th agro-ecological zone. It covers the Nowabgonj, Rajshahi, southern Pabna, Kushtia, Meherpur, Chuadanga, Jhenaida, Magura, Jessore, and Northern part of Satkhira and Khulna districts, together with minor rare in Noagaon and Narail districts covering 13205 km² areas. Most of the areas have a complex relief of broad and narrow ridges and inter-ridge depressions. The upper parts of high ridges stand above normal flood level. Lower parts of ridges and basin margins are seasonally shallowly flooded. General soil types predominantly include calcareous dark grey floodplain soils and calcareous brown floodplain soils. Organic matter content in the brown ridge soils is low but higher in the dark grey soils. Soils are slightly alkaline in reaction. General fertility level is low.¹⁵

2.5.1 Wetland

Sirajganj sadar upazila is rich in wetland and waterbodies than Godagari upazila. There are many rivers such as Jamuna, Korotoya, Ichamoti, Hurasagar, Fhuljhor some small canals etc. There are some beels as the part of great Chalan beel areas, numerous small ditches, ponds, dighis etc in these study areas. On the other, only the great Padma River is flowing just near by the villages at the south side of the study villages of Godagari upazila under Rajshahi district. Thus, main water source of the Godagari upazila is ground water while both the ground and surface water is available in Sirajganj though ground water extraction in Goadagari is expensive due to lower level of ground water table.

¹⁴ Ibid.

¹⁵ Ibid.

2.5.2 Forestry

There is no reserve or planned forest either in the study villages of Godagari or in the study villages of Sirajganj. However, there are significant changes and development in strip plantation, dyke plantation, social and on-farm forestation, homestead gardening, community forestation etc., which we observed during field survey. Traditional small forest consisting with various creepers to fruits and timbers are not available, which is the safe home of different biodiversity. A noteworthy afforestation is increased with number of alien plants species planted instead of indigenous species that does not friendly to local biodiversity. It is observed that even for these alien species creeper like plants, grass; other linear vegetation has decreased very much, and some of these species are vulnerable, endangered or going to extinct. However, vegetation intensity is much better in Sirajganj than Godagari of Rajshahi district.

2.5.3 Biodiversity

Biodiversity includes plant, animal, agro-biodiversity, terrestrial and aquatic plants and animals.

2.5.4 Animal Biodiversity

2.5.4.1 Terrestrial animals

In both the study area of Sirajganj and Godagari, wild animals like fox, dog, cat, snake, house wizzard, wizzard, bat, crane, crow, owl, dove, eagle, vulture, king fisher, weaver bird, wood pecker, flies, ant, butterfly, bee, dragonfly, frog and toad, mongoose, mosquitoes, spider, earthworm, rat etc., are seen but not available. Perhaps, due to deforestation and population increase, number of wild animals has decreased because they have lost their shelter with the decreasing of forest and other habitat. Moreover, domestic animals like cow, goat, sheep, buffalo, fowl, duck, and pigeon are found. However, number and composition of wild and domestic animals are higher in Sirajganj than Godagari.

2.5.4.2 Aquatic animals

As the part of Chalan Beel, study villages of Sirajganj are rich in aquatic fauna and flora especially fresh water fishes. Sirajganj is also habitation of several reptiles, moluscs, aquatic birds etc such as snake, frog, crab, water strider, and fish like mola, cat fish, kajuli, bailla, koi, puti, tengra, bou mach, carp, taki, shol, African cat fish, darkina, chapila, bata, tara bayim, boal etc; are found. While in Godagari, turtle, snake, frog, crab, and fish like, catfish, bailla, koi, puti, tengra, carp, African catfish, bata, tara bayim, etc., are found. In addition, significant

numbers of aquatic plants are seen in Sirajganj. It is rich in fish biodiversity as well as reptiles and other biodiversity than Godagari because Sirajganj is rich in wetlands including open and close water bodies.

2.5.5 Plant Biodiversity: Terrestrial and Aquatic

In both the study areas, timber plants like mehakani, segun. Koroi, neem, shimul, khair, babla, chatim, kadam, fruit trees like mango, lemon, papaya, black berry, jackfruit, melon, palm (local Tal), coconut, tetul (tamarind), banana, litchi, guava, hog plum (local amra), olive, etc., are found. Medicinal plants like thankuni, bohera, fern, ada, dutura, bahera, akand, tulsi, gritakumari, halud, mehedi are found.

In the study areas of Sirajganj, water hyacinth, lotus, algae, blue green algae, water lily, mosses, ferns, lichen, actinomycetes, fungi, waterweed etc; are found. In Godagari, mosses, ferns, actinomycetes, fungi, waterweed etc., are found. However, as we observed during field survey, Sirajganj is also rich in terrestrial and aquatic flora than Godagari.

2.5.6 Agro-biodiversity

Bangladesh is rich in agro-biodiversity. Selected study villages of Sirajganj and Godagari are not exceptional from this. There are various cereal crops such as different rices and wheat, jute, pulses, mustard, sugarcane, kaun, chille, vegetables, brinjal, zinger, garlic, tomato, potato etc., are cultivated. On the other hand, rice, wheat, mustard, tomato, chille, potato etc., are cultivated in Godagari. However, intensity of agro-biodiversity in Sirajganj is higher than Godagari.

2.6 Physiography

As the study villages of Sirajganj is situated in Karatoya-Bangali Flood Plain, most of the areas have smooth, broad, floodplain ridges and almost level basins. Relief is more irregular. In addition, the study villages of Godagari are situated in High Ganges River Floodplain; most of the areas have a complex relief of broad and narrow ridges and inter-ridge depressions. Upper parts of high ridges remain above flood level. Lower parts are seasonally swallowing flooded.

2.7 Climate

Climatic condition of Godagari is depended on the climatic data of Rajshahi. As like Rajshahi, Godagari is generally marked with monsoons, high temperature, considerable humidity and moderate rainfall. The hot season commences early in March and continues until the middle of July. The maximum mean

temperature observed is about 32 to 36 °C (90 to 97 °F) during the months of April, May, June and July and the minimum temperature recorded in January is about 7 to 16 °C (45 to 61 °F). The highest rainfall is observed during the months of monsoon. The annual rainfall in the district is about 1,448 mm (57.0 in).

Sirajganj District of Rajshahi division has an area of about 2497.92 km². The main rivers are Jamuna, Baral, Ichamati, Karatoya and Phuljhor. The annual average temperature reaches a maximum of 34.6 °C, and a minimum of 11.9 °C. The annual rainfall is about 1610 mm (63.4 in).

2.8 Land Type and Soil Type

The study areas of Sirajganj in Karatoya-Bangali Flood Plain include high land 23%, medium high land 44%, medium low land 14%, lowland 4%, very low land 1%, homestead and water bodies 14%. On the other hand, the study areas of Godagari in High Ganges River Floodplain include highland 43%, medium highland 32% medium lowland 12%, lowland 2%, homestead and water bodies 11%.

Soils of Sirajganj are silt loam and silty clay loam in ridges and dark grey clay soils in basins. In Godagari, most ridge soils are calcareous and basin soils are non-calcareous. Organic matter content in ridges are low (<1.5%) and high (2-5%) in dark grey soil. Soil reaction is strongly acidic.¹⁶

2.9 Water Resources

In the study area of Sirajganj, sufficient ground water is present for irrigating in the rice fields. It is very much easy to withdraw groundwater for irrigation. However, the river Jamuna is flowed beside Sirajganj Sadar Upazila and surface water sources are found available in the study villages because the Karatoya and Bangali canals are flowing through the study villages but water of these surface sources is hardly seen to use for irrigation.

In the Godagari, water pumped from the Ganges River to irrigate kharif crops to the southern part of the region through irrigation canal dag for this purpose. At present, surface water are not available in this study area to irrigate boro paddy. Therefore, for irrigation in rice fields farmers totally depend on ground water in Godagari as like as other parts of Barind Tract.

¹⁶ *Characterization of the Agro ecological zones*, available at www.fangrasia.org/admin/admin_content/files/38843.pdf

2.10 Present Land Use

Aus, Aman and jute are widely cultivated in the study areas of Sirajganj. Robi crops are extensively cultivated in dry season such as wheat, potato, mustard, chilli in northern areas and banana in southern parts. High yielding boro rice is also cultivated in the basins.

On the other hand, in Godagari on high flood plain ridges, Aus, jute, pulses, oilseeds, wheat, sugarcane, tobacco, potato, turmeric, cotton, banana and mango are grown. On lower parts of flood plain ridges, which seasonally flooded, mixed Aus, broadcast Aman and rain fed T.aman are also grown.

2.11 Major Cropping Pattern

Annual cropping patterns of Sirajganj study area are:

Wheat	→	Jute	→	T.aman
Potato	→	Jute	→	T.aman
Mustard	→	Jute	→	T.aman
Boro	→	Fallow	→	T.aman
Fallow	→	T. aus	→	T.aman
Boro	→	Fallow	→	Fallow

Annual cropping patterns of Godagari study area are

Wheat	→	B. aus/Jute	→	Fallow
Wheat	→	B. aus/Jute	→	T.aman
Mustard	→	Jute	→	T.aman
Lentil	→	Sesame	→	T.aman
Sugarcane	→	Boro	→	DW T.aman

2.12 Environmental Constrains for Development

2.12.1 Study Villages of Sirajganj Sadar Upazila

- 1) Uncertain depth and extent of rainwater flood the basin.
- 2) Irregular relief and complex soil patterns near river channels create problems for irrigation layouts and water management.
- 3) Shortage of surface water for rotting jute is found when rainfall is bellow average.¹⁷

2.12.2 Study Areas of Godagari

- 4) Rainfall variability, sometimes dry, sometimes wet, sometimes a false early start to the rains followed by drought.
- 5) Due to heavy and cracking basin clays, it is difficult to plough in both the dry and rainy seasons. There is too much scarcity of surface water.
- 6) Excavate/re-excavate channels, tanks, roadside ditches are needed to improve jute-rotting facilities. There is provision of shallow tube well.¹⁸

¹⁷ Ibid.

2.13 Soil Fertility Status in Sirajganj

The study area of Sirajganj apparently comprises a mixture of the Tista and Brahmaputra sediments. Most areas have smooth, broad, floodplain ridges and almost level basins. The soils are grey silt loams and silty clay loams on ridges and grey or dark grey clays in basins.

Five General soil types occur in the region of which, non-calcareous grey floodplain and non-calcareous dark grey floodplain soils predominate. They are moderately acidic throughout. Organic matter content is low in ridge soils and moderate in basins. General fertility level is medium.

Table 2.1
Land Type of the study villages in Sirajganj

Major land type	Soil pH	Soil OM	Nutrient status								
			N	P	K	S	Ca	Mg	Zn	B	Mo
Highland (23 %)	4.7-7.8	L	VL-L	L-M	L	L-M	Opt	Opt	L-M	L-M	Opt
Medium Highland (44%)	5.4-7.9	L	VL-L	L-M	L	L-M	Opt	Opt	L-M	L-M	Opt
Medium Lowland (14%)	6.2-7.7	L	VL-L	L-M	L	L-M	Opt	Opt	L-M	L-M	Opt

Source: Fertilizer Recommendation Guide-2005, Bangladesh Agricultural Research Council, Dhaka.

The study area of Godagari includes the western part of the Ganges River Floodplain, which is predominantly high land and medium highland. Most areas have a complex relief of broad and narrow ridges and inter ridge depressions, separated by areas with smooth, broad ridges and basins. There is an overall pattern of olive-brown silt loams and silt clay loams on the upper parts of floodplain ridges and dark grey mottled brown, mainly clay soils on ridge sites and in basins. Most ridge soils are calcareous throughout. General Soil types predominantly include calcareous dark grey floodplain soils and calcareous brown floodplain soils. Organic matter content in the brown ridge soils is low but higher in the dark grey soils. Soils are slightly alkaline in reaction. General fertility level is low although CEC is medium and K-bearing minerals are medium to high but the Zn and B status are low to medium.¹⁹

¹⁸ Ibid.

¹⁹ *Fertilizer Recommendation Guide-2005*, Bangladesh Agricultural Research Council, and Dhaka: Soils Publication No. 45, 2005. Available at www.moa.gov.bd/fertilizer/FRG_2005.pdf

Table 2.2
Land Type of the study villages in Godagari

Major land type	Soil pH	Soil OM	Nutrient status								
			N	P	K	S	Ca	Mg	Zn	B	Mo
Highland (43 %)	5.9-8.1	L	VL-L	L-M	M	L-M	Opt-H	Opt-H	L-M	L-M	M
Medium Highland (32 %)	6.0-8.1	L-M	VL-L	L-M	M	L-M	Opt-H	Opt-H	L-M	L-M	M
Medium Lowland (12 %)	6.5-8.3	L-M	L	L-M	M	L-M	Opt-H	Opt-H	L-M	L-M	M

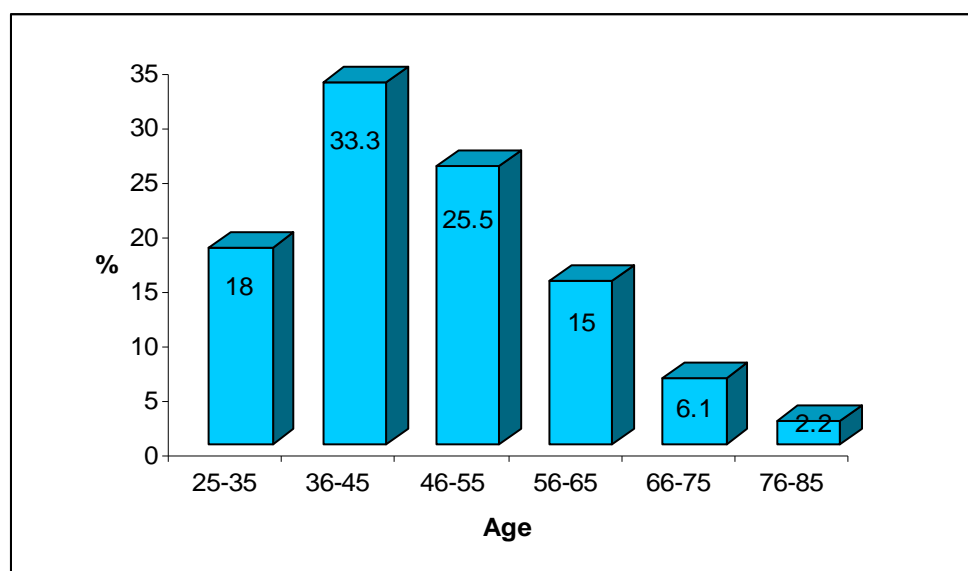
Source: Fertilizer Recommendation Guide-2005, Bangladesh Agricultural Research Council, Dhaka.

2.14 Socio Economic Condition and Demographic Factor of the Study Area

The study was conducted in five villages. Among them two villages named Char Khokshabari and Shaluabhita of Khokshabari Union under Sirajganj Sadar Upazila of Sirajganj district and three villages named Sheikhhpur, Raninagar and Banduria of Gogram Union under Godagari Upazila of Rajshahi district. The 90 respondents from each Upazila were selected for the present research.

2.14.1 Age Group Distribution

Figure 2.1
Age of the respondents



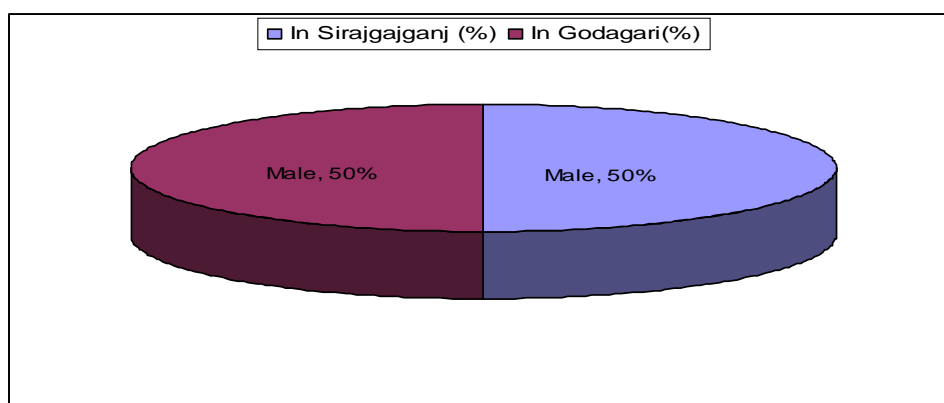
Source: Field Survey

The age of the respondents as head of the household shows that 33.3% belong to the age of 36 to 45, which is the highest frequency age group. 25.5% respondents belong to the age of 46 to 55. Only 2.2% respondents belong to the

age of 76 to 85. It is significant that number of elderly people is less in both that study villages. On the other hand, 18% belong to the age group of 25-35, which is also significant that there is sufficient young workforce in the study village. Highest percentage (58.8%) of age is found in both the study areas of Sirajganj and Godagari within age range 36 to 55 years.

2.14.2 Sex Group

Figure 2.2
Sex of the respondents

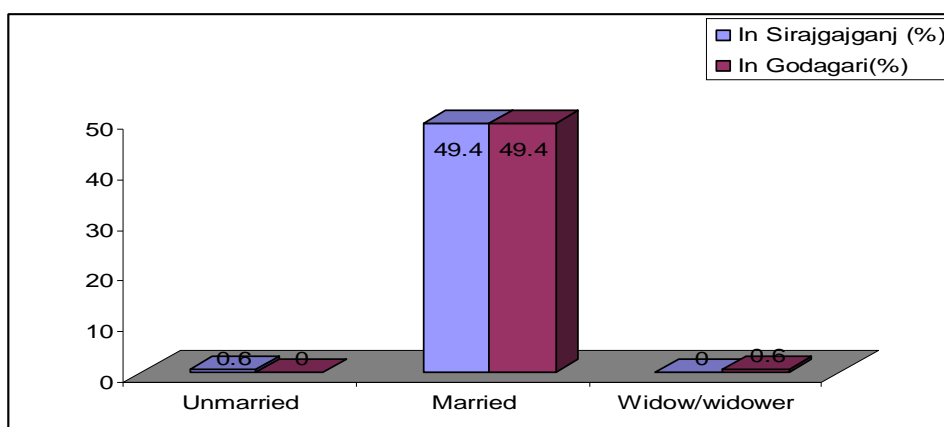


Source: Field Survey

The sex distribution of study areas shows that 100% head of the households of the study population are male and none of them is female. However, as we know in our traditional society there is too much insignificant number female as head of the household in Bangladesh. The study villages are not exceptional from this. Also in both the study areas, percentage of male respondents as head of the households is equal.

2.14.3 Marital Status

Figure 2.3
Marital Status of the respondents

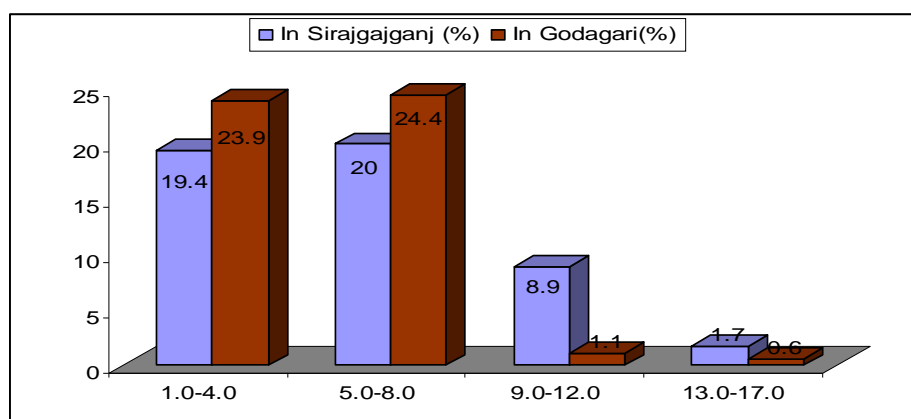


Source: Field Survey

Marital status shows that 98.8% household heads are married while 0.6% household head of Sirajganj is unmarried and 0.6% household head is widow in Godagari. This result reveals the low divorce rate in study areas as well as in our society that is a noteworthy indicator of a peaceful society. In addition, it is assumed that female does not expect any separation with husband due to socioeconomic dependency on husband.

2.14.4 Family Size

Figure 2.4
Distribution of Family Size

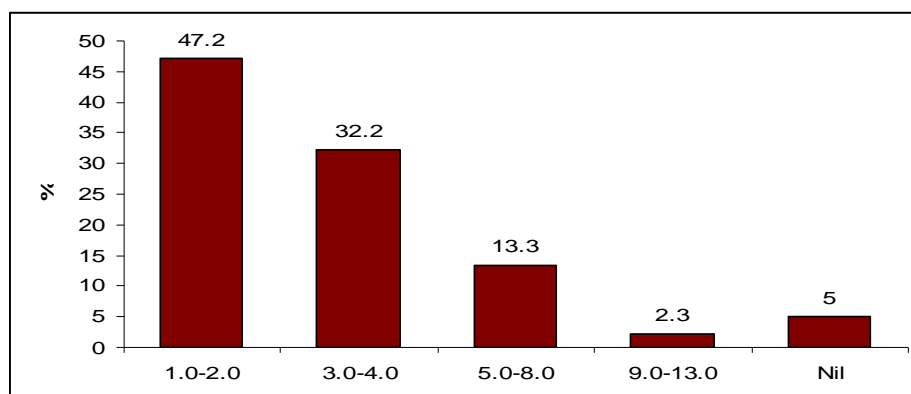


Source: Field Survey

Family size distribution shows that 44.4% households have 5 to 8 family members, which is highest frequency. Among them 20% households are found in Sirajganj and 24.4% are found in Godagari. 43.3% households have 1 to 4 members in their family means those are might be nuclear family. Only 2.2% households have big family members numbered 13 to 17 that means these households are the traditional family of Bangladesh. This result shows that highest number of population lives with joint family.

2.14.4.1 Children

Figure 2.5
Number of Children

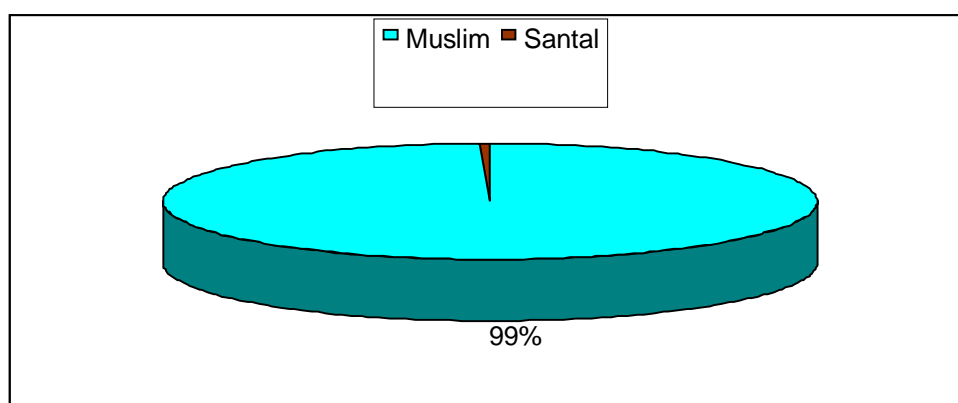


Source: Field Survey

Above chart shows, there are 1-2 children in 47.2% households, which is highest frequency, and 3-4 children in 32.2% households, 5-8 children in 13.3% households, 2.3% respondents have 9-13 children and 5% respondents do not have any children. This result reveals that low number of children becomes common phenomena among maximum respondents. On the other hand, there are some households either joint or separated have large number of children but this kind of households is less or it can be said that it is decreasing.

2.14.5 Religion

Figure 2.6
Religion of the respondents

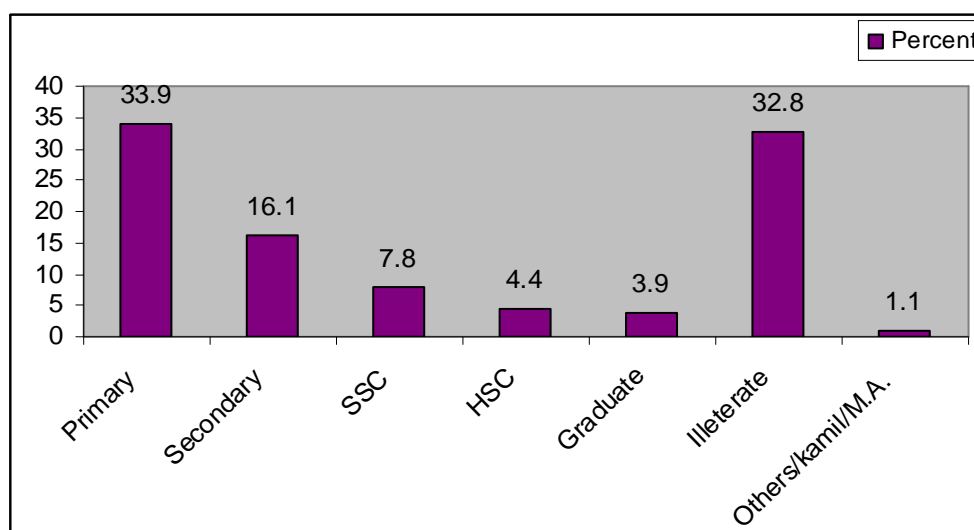


Source: Field Survey

Result shows that 99% household heads are Muslim and only 1% is Santal lived in Godagari. There is no Santal or tribal population in Sirajganj.

2.14.6 Educational Status

Figure 2.7
Educational Status of the HH



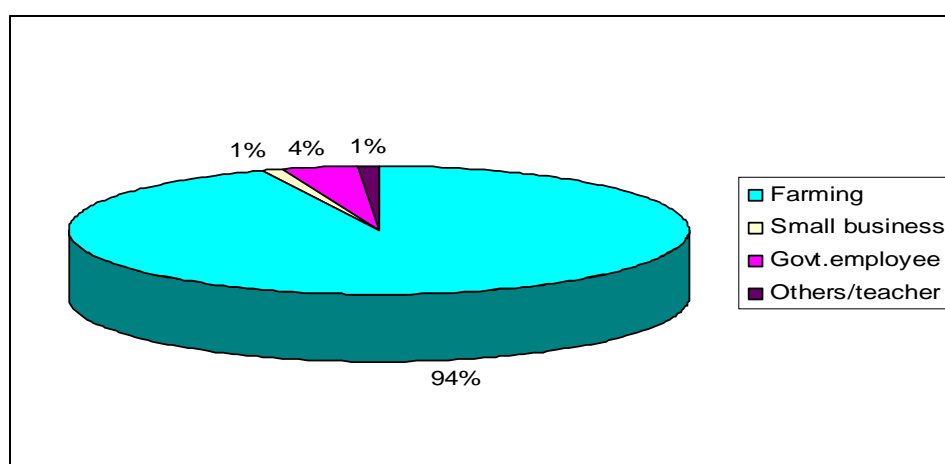
Source: Field Survey

The analysis in above chart shows the educational status of the study population. The chart shows that 32.8% respondents are illiterate and among them 22.2% respondents are found in Godagari. Literate persons are higher in Sirajganj than Godagari. However, 33.9% population have primary education, 16.1% have secondary, 4.4% have higher secondary, 3.9% have graduate and only 1.1% has post graduate education and this 1.1% is found in Godagari study villages.

2.14.7 Occupation

2.14.7.1 Main Occupation

Figure 2.8
Main Occupation of the respondents



Source: Field Survey

Above result regarding occupation shows that 94% respondents are engaged in farming and only 6% are engaged in small business, government employee and teacher. This result reveals that maximum study populations as well as population live in rural areas engage in farming as their main occupation though they engage in some alternative jobs for more income or for seasonal work.

2.14.7.2 Other Occupation

Table 2.3
Other occupation of the respondents

Other Occupation	In Sirajganj (%)	In Godagari (%)	Percent
Day labor	12.7	1.1	13.8
Small business	16.7	2.2	18.9
Deep tube wells operator	0	0.6	0.6
Total	29.4	3.9	33.3

Source: Field Survey

On the basis of other occupation like day labor, small business and deep tubewell operator 29.4% respondents are found in Sirajganj and only 3.9% are found in Godagari.

2.14.8 Skillness

2.14.8.1 Skillness on farming

Generally, respondents in both the study areas of Sirajganj and Godagari are skilled in farming though some respondents are skilled in others such as fishery, dairy and poultry, horticulture, pisciculture etc., as alternative opportunity to generate more income and sometimes for creating more jobs.

2.14.8.2 Skillness on others

Table 2.4
Other Skillness of the respondents

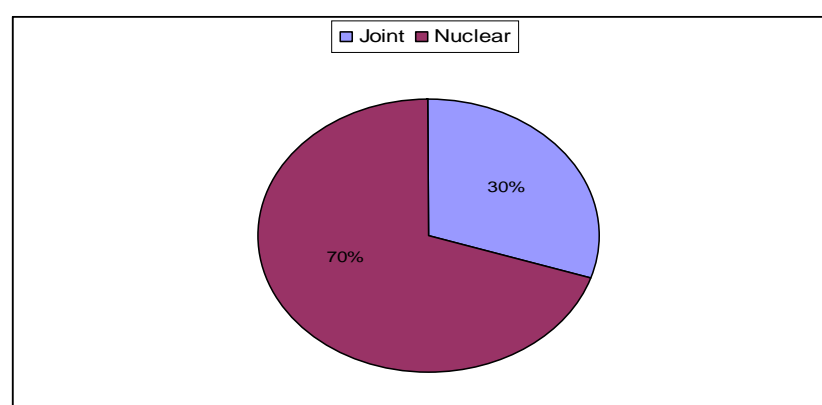
Other Skillness	In Sirajganj (%)	In Godagari (%)	Percent
Small business	9.9	2.2	12.1
Dairy/poultry	8.9	0	8.9
Horticulture	2.2	0	2.2
Pisciculture	5.4	0.6	6.0
others/teachers	0	0.6	0.6
Total	26.4	3.4	29.8

Source: Field Survey

Based on skillness in small business, dairy/poultry, horticulture, pisciculture and teachers, 26.4% respondents are found in Sirajganj whereas in Godagari only 3.4% respondents are found. However, respondents who have other skillness apart from farming have good opportunity for more income.

2.14.9 Family Types

Figure 2.9
Family Types of Study Households



Source: Field Survey

Distribution of family types shows that 30% households are joint family and it is similar in both the study areas of Sirajganj and Godagari. 70% are nuclear family, which are also similar in both study areas. Therefore, the number of nuclear family is highest in both the study areas indicate that society is changing toward nuclear family.

2.14.10 Housing

Table 2.5
Number of houses of the respondents

No. of Houses	In Sirajganj (%)	In Godagari (%)	Percent
1.00	9.4(17)	9.4(17)	18.9
2.00	13.9(25)	22.8(41)	36.7
3.00	15.0(27)	7.2(13)	22.2
4.00	6.7(12)	7.2(13)	13.9
5.00	3.3(6)	2.2(4)	5.5
6.00	1.1(2)	1.1(2)	2.2
8.00	0.6(1)	0	0.6
Total	50	50	100.0

Source: Field Survey

The above result shows that 36.7% respondents have 02 houses, 22.2% have 03 houses, 18.9% have 01 house and only 0.6% has 08 houses. In Sirajganj, highest numbers of respondents have three houses and in Godagari highest numbers of respondents have two houses.

2.14.11 Housing Types

Table 2.6
Housing types of the respondents

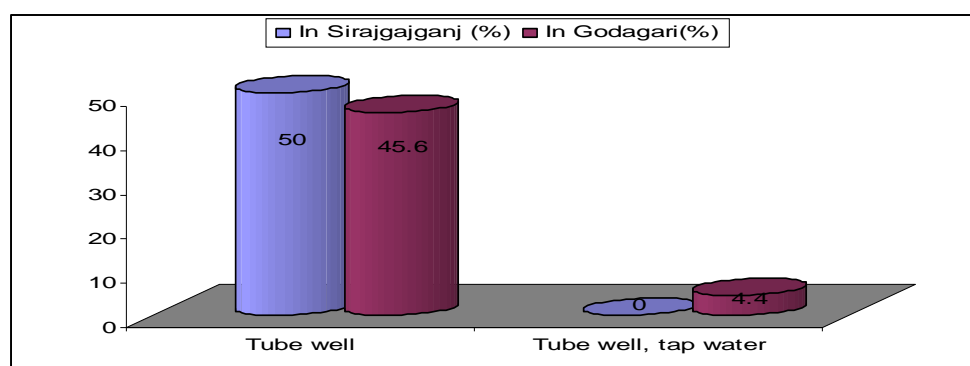
Houses types	In Sirajganj (%)	In Godagari (%)	Percent
Brick wall tin roofed	10(18)	8.9(16)	18.9
Mud wall tin roofed	1.7(3)	2.2(4)	3.9
Mud wall hay roofed	12.2(22)	28.3(51)	40.5
bamboo wall tin roofed	0.5(1)	3.9(7)	4.4
bamboo wall hay roofed	0.6(1)	0	.6
Tin wall tin roofed	20.5(37)	0	20.5
Pacca	0	6.1(11)	6.1
Brick wall tin roofed, Mud wall hay roofed	0	0.6(1)	0.6
Brick wall tin roofed, Tin wall tin roofed	2.2(4)	0	2.2
Mud wall hay roofed, Tin wall tin roofed	1.1(2)	0	1.1
Mud wall hay roofed, pacca	0.6(1)	0	0.6
Tin wall tin roofed, pacca	0.6(1)	0	0.6
Total	50	50	100.0

Source: Field Survey

Types of house of the respondents show that 42.2% respondents have mud wall with hay roofed, 21.7% have brick wall with tin roofed house, 21.1% have tin wall with tin roofed house, 4.4% have bamboo wall with tin roofed, 3.9% have mud wall with tin roofed and 6.1% residents have pacca houses. Among the respondents, 5% have different types of residence. In the study areas of Godagari, 28.3% respondents have mud wall hay roofed house, which is highest and in Sirajganj, 20.5% respondents have tin wall and tin roofed house, which is also highest. Therefore, it is found that there are some differences about the types of houses in both the study areas.

2.14.12 Drinking Water Source

Figure 2.10
Drinking water source in the study areas

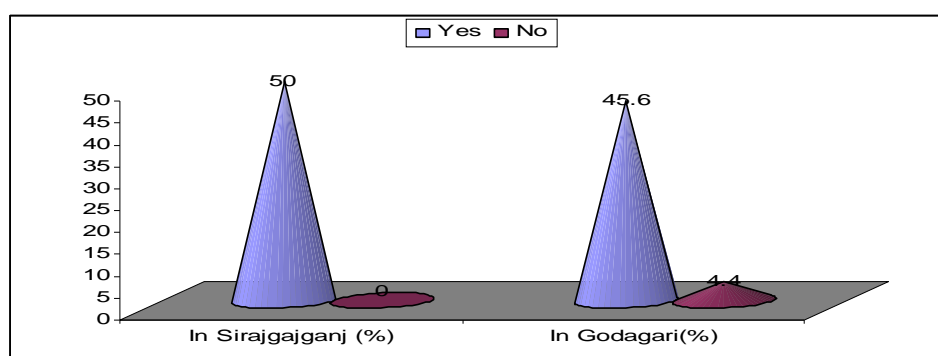


Source: Field Survey

Result in the above chart shows that source of drinking water is tubewell and thus 50% respondents of Sirajganj use tubewell as source of drinking water and 45.6% respondents use tubewells as source of drinking water in Godagari. Only 4.4% use supply water for drinking. As we know, Barind Multi-purpose Development Authority installs some water supply plants in Godagari and other part of Barind area to supply household use water because in some places in Barind areas normal hand tubewells does not work.

2.14.13 Toilet Facilities

Figure 2.11
Sanitation and Toilet of Study Households

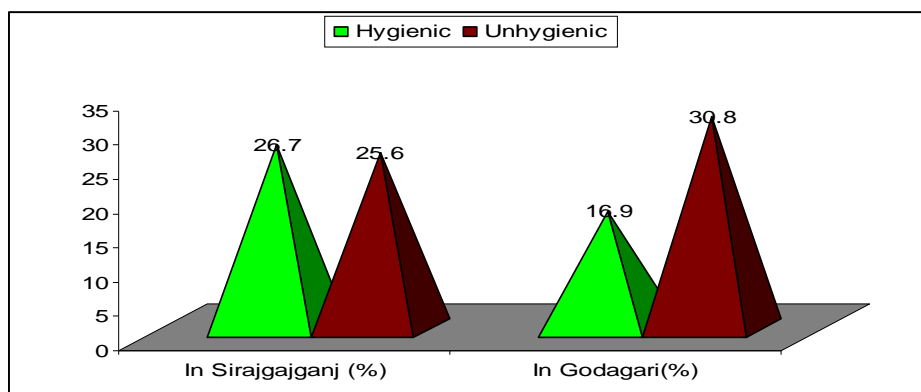


Source: Field Survey

In both the study areas, 95.6% respondents have toilet but 4.4% respondents in Godagari have no toilet. Among these, 26.7% toilet in Sirajganj and 16.9% toilets in Gadagari are hygienic and 25.6% and 30.8% toilets in Sirajganj and Godagari respectively are unhygienic. Therefore, toilet facilities are much better in Sirajganj than Godagari.

2.14.13.1 Types of toilet

Figure 2.12
Status of the toilet



Source: Field Survey

43.6% respondents in the study areas have hygienic toilet of which highest percentage is found in Sirajganj and 53.9% have unhygienic toilet of which highest percentage is found in Godagari. Therefore, the condition of hygienic toilet facilities in both the study areas is not satisfactory.

2.14.14 Land Ownership

Table 2.7
Land Ownership of the Study Respondents

Total amount of land (In acres)	In Sirajganj (%)	In Godagari (%)	Percent
0.36-0.99	21.7(39)	15(27)	36.7
1.00-1.99	16.1(29)	11.1(20)	27.2
2.00-2.99	8.9(16)	8.9(16)	17.8
3.00-3.99	1.1(2)	4.5(8)	5.6
4.00-4.99	1.1(2)	1.1(2)	2.2
5.00-5.99	1.1(2)	6.1(11)	7.2
6.00-11.00	0	3.3(6)	3.3
Total	50	50	100.0

Source: Field Survey

In both the study areas 36.7% respondents have 0.36-0.99 acre of land, 27.2% have 1.00-1.99 acre of land, 17.8% have 2.00-2.99 acres of land, 5.6% have 3.00-3.99 acres of land, 2.2% have 4.00-4.99 acres of land, 7.2% have 5.00-5.99 acres of land and 3.3% respondents have 6.00-11.00 acres of land. There is no landless respondent in the study villages but it is significant that 36.7%

respondents, the highest number of frequency have only 0.36-0.99 acre land that some of them have only homestead and some of them have homestead including some cultivable land that also shown in below table.

2.14.14.1 Homestead land

Table 2.8
Homestead land of the respondents

Homestead land(Acres)	In Sirajgaganj (%)	In Godagari (%)	Percent
0.03-0.10	15(27)	36.1(65)	51.1
0.11-0.18	9.4(17)	10.6(19)	20.0
0.19-0.26	11.1(20)	0.6(1)	11.7
0.27-0.34	7.8(14)	2.2(4)	10.0
0.35-0.42	6.7(12)	0	6.6
0.43-0.50	0	0.6(1)	0.6
Total	50	180	100.0

Source: Field Survey

According to above table about homestead land ownership, 51.1% respondents have 0.03 to 0.10 acre homestead land, 20% have 0.11 to 0.18 acre land, 11.7% have 0.19 to 0.26 acre land, 10% have 0.27 to 0.34 acre land, 6.6% have 0.35 to 0.42 acre land and 0.6% has 0.43 to 0.50 acre homestead land. Results show that small type of homestead land is found in Godagari compared to Sirajaganj.

2.14.14.2 Agricultural land

Table 2.9
Agricultural Land Ownership of the respondents

Agricultural Land(In acres)	In Sirajgaganj (%)	In Godagari (%)	Percent
0.30-0.99	24.4(44)	18.3(33)	42.8
1.00-1.99	17.2(31)	9.4(17)	26.7
2.00-2.99	5.6(10)	8.3(15)	13.9
3.00-3.99	2.2(4)	4.4(8)	6.6
4.00-4.99	0.6(1)	2.2(4)	2.8
5.00-10.00	0	7.2(13)	7.2
Total	50	50	100.0

Source: Field Survey

Results of agricultural land ownership shows in above table that 42.8% respondents have 0.30 to 0.99 acre of agricultural land, 26.7% belongs to 1.00 to 1.99 acre of land, 13.9% have 2.00 to 2.99 acres of land, 6.6% have 3.00 to 3.99 acres of land, 2.8% have 4.00 to 4.99 acres of land. In addition, 7.2% respondents have 5.00 to 10.00 acres of agricultural land. In the study area of Sirajaganj, respondents have agriculture land within 0.30 to 4.99 acre of which 24.4% have 0.30 to 0.99 acre land while in Godagari respondents have 0.30 to 10.0 acre of agriculture land of which 7.2% have 5-10 acres land. So the big farmers are found in Godagari.

2.14.14.3 Horticulture land

Table 2.10
Horticulture Land Ownership of the Respondents

Horticulture land(In acres)	In Sirajgajanj (%)	In Godagari (%)	Percent
0.05-0.10	6.7(12)	2.2(4)	8.9
0.11-0.16	1.1(2)	0	1.2
0.17-0.22	2.2(4)	0	2.2
0.33-0.66	1.7(3)	3.9(7)	5.8
0.67-1.00	0.6(1)	0	0.6
0.00	37.8(68)	43.9(79)	81.7
Total	50	50	100.0

Source: Field Survey

Among the respondents, 8.9% have 0.05 to 0.10 acre of horticulture land, 1.2% has 0.11 to 0.16 acre, 2.2% have 0.17 to 0.22 acre, 5.8% have 0.33 to 0.66 acre, and 81.7% respondents have no horticulture land. Respondents of Sirajganj have more horticulture land than in Godagari.

2.14.14.4 Pond

Table 2.11
Pond of the respondents

Pond(In acres)	In Sirajgajanj (%)	In Godagari (%)	Percent
0.04-0.10	5.6(10)	1.1(2)	6.7
0.11-0.20	0.6(1)	1.1(2)	1.8
0.33-0.99	1.7(3)	3.9(7)	5.6
0.00	42.2(76)	43.9(79)	86.1
Total	50	50	100.0

Source: Field Survey

In the study areas, 6.7% respondents have 0.04-0.10 acre of pond, 5.6% have 0.33-0.99 acre of pond, 1.8% has 0.11-0.20 acre of pond and 86.1% respondents have no pond. In the study villages of Sirajganj, small size of ponds are found while in Godagari the size of ponds are bigger.

2.14.14.5 Fallow land

Table 2.12
Fallow land of the respondents

Fallow land(In acres)	In Sirajgajanj (%)	In Godagari (%)	Percent
0.03-0.10	5.6(10)	0	5.6
0.11-0.20	2.2(4)	0	2.2
0.21-.50	2.8(5)	0	2.8
00	39.4(71)	50(90)	89.4
Total	50	50	100.0

Source: Field Survey

Fallow land distribution shows that 5.6% respondents have 0.03-0.10 acre of fallow land, 2.3% have 0.11-0.20 acre of land, 2.8% have 0.21-0.50 acre of land and 89.4% have no fallow land. No fallow land is found in the study areas of Godagari but 11.6% respondents have fallow land in Sirajganj.

2.14.15 Cultivated Land

Table 2.13
Total amount land Cultivated

Total amount of land(In acres)	In Sirajganj (%)	In Godagari (%)	Percent
0.30-0.99	24.4(44)	17.8(32)	42.2
1.00-1.99	16.7(30)	10(18)	26.7
2.00-2.99	6.1(11)	8.3(15)	14.4
3.00-3.99	2.2(4)	4.4(8)	6.7
4.00-4.99	0.6(1)	2.2(4)	2.8
5.00-12.00	0	7.2(13)	7.2
Total	50	50	100.0

Source: Field Survey

According to results shown in above table about cultivable land ownership, 42.2% respondents have 0.30-0.99 acre of cultivable land, 26.7% have 1.00-1.99 acre of land, 14.4% have 2.00-2.99 acres of land, 6.7% have 3.00-3.99 acres of land, 2.8% have 4.00-4.99 acres of land and 7.2% have 5.00-12.00 acres of cultivable land. Big size of cultivable landowners is found in Godagari compared to Sirajganj.

2.14.15.1 Cultivable land owned

Table 2.14
Amount of cultivable land owned

cultivable land owned(In acres)	In Sirajganj (%)	In Godagari (%)	Percent
0.05-0.99	31.1(56)	16.1(29)	47.2
1.00-1.99	13.9(25)	6.7(12)	20.6
2.00-2.99	3.3(6)	2.2(4)	5.6
3.00-3.99	1.1(2)	2.2(4)	3.3
4.00-4.99	0	2.2(4)	2.2
5.00-5.99	0	3.9(7)	3.9
6.00-6.99	0	1.1(2)	1.1
0.00	0.6(1)	15.6(28)	16.1
Total	50	50	100.0

Source: Field Survey

Above chart shows that 47.2% respondents have 0.05-0.99 acre of cultivable land owned, 20.6% have 1.00-1.99 acre of land, 5.6% have 2.00-2.99 acres of cultivable land, 3.3% have 3.00-3.99 acres of land, 2.2% have 4.00-4.99 acres of land, 3.9% have 5.00-5.99 acres of land, 1.1% has 6.00-6.99 acres of land and 16.1% have no cultivable land owned. In the study area of Sirajganj, only 0.6% respondent has no cultivable land owned but in Godagari 15.6% have no

cultivable land owned. Therefore, percentage of landless farmer is so much higher in Godagari than that of Sirajganj.

2.14.15.2 Share cropping land

Table 2.15
Land for share cropping by the HH

Land for share cropping(In acres)	In Sirajganj (%)	In Godagari (%)	Percent
0.05-0.99	11.1(20)	11.7(21)	22.8
1.00-1.99	1.1(2)	3.9(7)	5.0
2.00-2.99	0	2.8(5)	2.8
3.00-3.99	0	1.1(2)	1.1
4.00-4.99	0	0.6(1)	0.5
5.00-5.99	0	1.1(2)	1.1
0.00	37.8(68)	28.9(52)	66.7
Total	50	50	100.0

Source: Field Survey

Share cropping land distribution shows that 22.8% respondents have 0.05-0.99 acre land, 5% have 1.00-1.99 acre of land, 2.8% have 2.00-2.99 acres of land, 1.1% has 3.00-3.99 acres and 5.00-5.99 acres of land, 0.5% has 4.00-4.99 acres of land and 66.7% have no land for share cropping.

2.14.15.3 Land of leased in

Table 2.16
Land of leased in

Land of leased in(In acres)	In Sirajganj (%)	In Godagari (%)	Percent
0.05-.99	15(27)	8.3(15)	23.6
1.00-1.99	1.1(2)	2.8(5)	4.0
2.00-2.99	0	1.1(2)	1.1
0.00	33.9(61)	37.8(68)	71.7
Total	50	50	100.0

Source: Field Survey

Among the respondents, 23.6% have 0.05-0.99 acre land of leased in, 4% have 1.00-1.99 acre of land, 1.1% has 2.00-2.99 acres of land and 71.7% have no land for leased in.

2.14.15.4 Land of leased out

Table 2.17
Land of leased out

Land of leased out(In acres)	In Sirajganj (%)	In Godagari (%)	Percent
0.05-0.99	6.1(11)	1.1(2)	7.2
1.00-4.95	3.3(6)	2.2(4)	5.6
0.00	40.6(73)	46.7(84)	87.2
Total	50	50	100.0

Source: Field Survey

In the study areas, 7.2% respondents have 0.05-0.99 acre land of leased out, 5.6% have 1.00-4.95 acres of land and 87.2% have no land for leased out.

2.14.16 Value of Leased in

Table 2.18
Value of leased in taka

Value of leased in (taka)	In Sirajgajganj (%)	In Godagari (%)	Percent
1000-20000	5.6(10)	8.3(15)	13.9
20001-40000	5.6(10)	1.7(3)	7.2
40001-60000	2.2(4)	1.1(2)	3.3
60001-80000	0.6(1)	1.1(2)	1.7
80001-100000	1.7(3)	0	1.7
100001-200000	1.1(2)	0	1.1
200001-300000	0.6(1)	0	0.5
00	32.8(59)	37.8(68)	70.6
Total	50	50	100.0

Source: Field Survey

Among the respondents, 13.9% have leased land in 1000-2000 taka, 7.2% have leased land in 2001-4000 taka, 3.3% have leased land in 4001-6000 taka, 1.7% has leased land in 6001-8000 taka, 1.7% has leased land in 8001-10000 taka, 1.1% has leased land in 10001-20000 taka, and 0.5% has leased land in 20001-30000 taka. 70.6% respondents have not spent taka for lease purposes.

2.14.17 Value of Leased out

Table 2.19
Value of leased out in taka

Value of leased out in taka	In Sirajgajganj (%)	In Godagari (%)	Percent
3000-50000	5(9)	1.7(3)	6.6
50001-100000	1.7(3)	0	1.8
100001-200000	1.1(2)	0.6(1)	1.7
200001-300000	0.6(1)	0	0.5
00	41.7(75)	47.8(86)	89.4
Total	50	50	100.0

Source: Field Survey

Above table states that 6.6% have leased out land in 3000-50000 taka per year, 1.8% has leased out land in 50001-100000 taka, 1.7% has leased out land in 100001-200000 taka, 0.5% has leased out land in 200001-300000 taka and 89.4% respondents have not leased out any land.

2.14.18 Value of Share Cropping

Table 2.20
Value of share cropping of the respondents

share cropping	In Sirajgajganj (%)	In Godagari (%)	Percent
0.50	10.6(19)	22.2(40)	32.8
00	39.4(71)	27.8(50)	67.2
Total	50	50	100.0

Source: Field Survey

According to the value of sharecropping, 32.8% respondents have shared crop by 0.50 and 67.2% have not shared any crop. The percentage of respondents in sharecropping is highest in Godagari than that of Sirajganj.

2.14.19 Land Cultivated in Kharif-1 Season

Table 2.21
Amount of land cultivated in kharif-1 season

Land cultivated in kharif-1 season(In acres)	In Sirajgajganj (%)	In Godagari (%)	Percent
0.30-0.99	30(54)	28.9(52)	58.9
1.00-1.99	15.6(28)	14.4(26)	30.0
2.00-2.99	3.3(6)	2.8(5)	6.1
3.00-3.99	1.1(2)	3.9(7)	5.0
Total	50	50	100.0

Source: Field Survey

In the study areas, 58.9% respondents have 0.30-0.99 acre land for cultivated in kharif-1 season, 30% have 1.00-1.99 acre of land, 6.1% have 2.00-2.99 acres of land and 5% have 3.00-3.99 acres of cultivable land in kharif-1 season.

2.14.20 Land Cultivated in Kharif-2 Season

Table 2.22
Amount of land cultivated in kharif-2 season

Land cultivated in kharif-2 season(In acres)	In Sirajgajganj (%)	In Godagari (%)	Percent
0.30-0.99	33.3(60)	27.8(50)	61.1
1.00-1.99	12.8(23)	9.4(17)	22.2
2.00-2.99	3.3(6)	3.9(7)	7.2
3.00-3.99	0.6(1)	3.3(6)	4.0
4.00-5.99	0	4.4(8)	4.4
6.00-9.00	0	1.1(2)	1.1
Total	50	50	100.0

Source: Field Survey

Among the farmers, 61.1% respondents have 0.30-0.99 acre land for cultivation in kharif-2 season, 22.2% have 1.00-1.99 acre of land, 7.2% have 2.00-2.99 acres of land, 4% have 3.00-3.99 acres of land, 4.4% have 4.00-5.99 acres of land and 1.1% has 6.00-9.00 acres of cultivable land in kharif-2 season.

2.14.21 Own Land for Rice Cultivation

Table 2.23
Amount of own land for rice cultivation

Own land for rice cultivation(In acres)	In Sirajgajganj (%)	In Godagari (%)	Percent
0.05-0.99	31.7(57)	16.1(29)	47.8
1.00-1.99	14.4(26)	7.2(13)	21.7
2.00-2.99	2.2(4)	2.2(4)	4.4
3.00-3.99	2	2.2(4)	3.3
4.00-4.99	0	2.2(4)	2.2
5.00-7.00	0	5(9)	5
00	0.6(1)	15(27)	15.6
Total	50	50	100.0

Source: Field Survey

Above chart shows that 47.8% respondents have 0.05-0.99 acre land for rice cultivation, 21.7% have 1.00-1.99 acre of land, 4.4% have 2.00-2.99 acres of land, 3.3% have 3.00-3.99 acres of land, 2.2% have 4.00-4.99 acres of land, 5% have 5.00-7.00 acres of land and 15.6% have not own land for rice cultivation. Percentages of own land for rice cultivation are highest in Sirajganj compared to Godagari.

2.14.22 Leased or Share Crop Land for Rice Cultivation

Table 2.24
Amount of leased or share crop land for rice cultivation

Leased or share crop land(In acres)	In Sirajgajganj (%)	In Godagari (%)	Percent
0.05-0.99	13.9(25)	18.3(33)	32.2
1.00-1.99	3.3(6)	6.6(12)	10.0
2.00-2.99	0	3.9(7)	3.9
3.00-5.99	0	2.8(5)	2.8
00	32.8(59)	18.3(33)	51.1
Total	50	50	100.0

Source: Field Survey

Results in above table shows the distribution of leased or share crop land for rice cultivation that 32.2% respondents have 0.05-0.99 acre land for rice cultivation, 10% have 1.00-1.99 acre of land, 3.9% have 2.00-2.99 acres of land, 2.8% have 3.00-5.99 acres of land and 51.1% have not any leased or share crop land for rice cultivation. Percentages of leased or share cropland for rice cultivation are highest in Godagari compared to Sirajganj.

2.14.23 Land Irrigate for Rice Cultivation

Table 2.25
Amount of land irrigate for rice cultivation

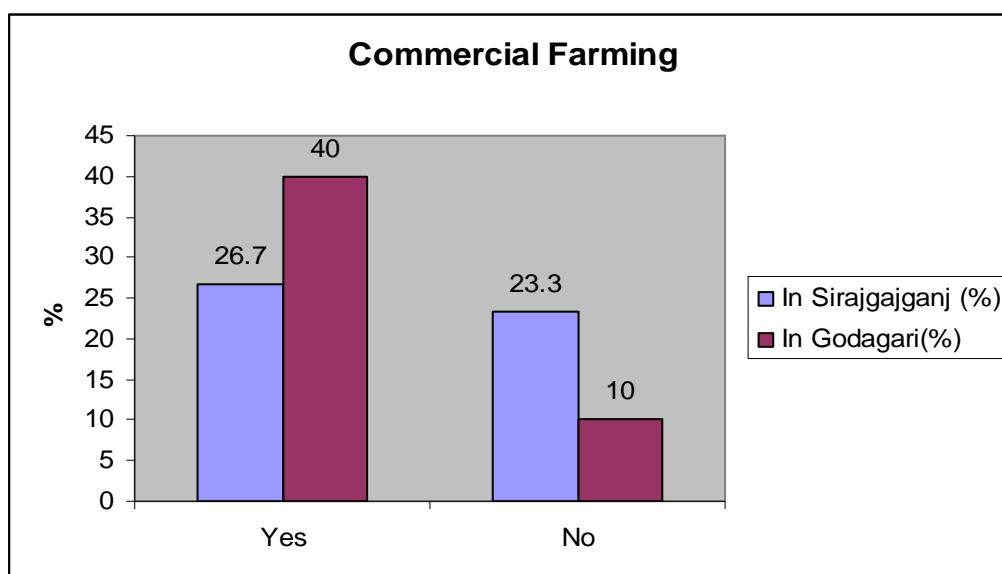
Amount of land(Acres)	In Sirajgajganj (%)	In Godagari (%)	Percent
0.05-0.99	31.7(57)	16.1(29)	48.3
1.00-1.99	14.4(26)	7.2(13)	25.6
2.00-2.99	2.2(4)	2.2(4)	12.2
3.00-3.99	1.1(2)	2.2(4)	5.0
4.00-6.60	0	7.2(13)	8.9
00	0.6(1)	15(27)	15.6
Total	50	50	100.0

Source: Field Survey

Result shows that 48.3% respondents have 0.30-0.99 acre of land for rice cultivation, 25.6% have 1.00-1.99 acre of land, 12.2% have 2.00-2.99 acres of land, 5% have 3.00-3.99 acres of land and 8.9% respondents have 4.00-8.25 acres of land for rice cultivation. Percentages of land irrigate for rice cultivation are highest in Sirajganj than that of Godagari.

2.14.24 Use Land for Commercial Farming

Figure 2.13
Used of land for commercial farming



Source: Field Survey

Among the farmers, 66.7% respondents use their lands for commercial farming in which 40% are found in Godagari and 33.3% respondents do not use their land for commercial farming. In the study area Godagari, more farmers are engaged in commercial farming than that of Sirajganj.

2.14.25 Total Commercial Farming Land

Table 2.26
Amount of land for commercial farming

land for commercial farming(In acres)	In Sirajgajganj (%)	In Godagari (%)	Percent
0.20-0.99	38.3(46)	58.3(70)	96.6
1.00-1.65	1.7(2)	1.7(2)	3.4
Total	50	50	100.0120

Source: Field Survey

In the study areas, 96.6% respondents have 0.20-0.99 acre of land and 3.4% respondents have 1.00-1.65 acre of land for commercial farming.

2.14.26 Annual Income

Table 2.27
Annual income of the respondents

Annual income(Taka)	In Sirajgajganj (%)	In Godagari (%)	Percent
20000-50000	1.1(2)	9.4(17)	10.6
50001-80000	12.8(23)	20(36)	32.8
80001-110000	26(20)	9.4(17)	20.5
110001-140000	8.3(15)	4.4(8)	12.8
140001-170000	7.2(13)	5(9)	12.2
170001-300000	9.4(17)	1.7(3)	11.1
Total	50	50	100.0

Source: Field Survey

Annual income shows that 10.6% respondents have 20000-50000 taka annual income, 32.8% have 50001-80000 taka annual income, 20.5% have 80001-110000 taka annual income, 12.8% have 110001-140000 taka annual income, 12.2% have 140001-170000 taka annual income and 11.1% have 170001-300000 taka annual income. In the distribution of annual income, respondents of Sirajganj have more annual income compare to the respondents in Godagari.

2.14.27 Annual Expenditure

Table 2.28
Annual Expenditure of the Respondents

Annual Expenditure(Taka)	In Sirajgajganj (%)	In Godagari (%)	Percent
35000-50000	0.6(1)	12.8(23)	13.3
50001-80000	12.8(23)	25.6(46)	38.3
80001-110000	14.4(26)	9.4(17)	23.9
110001-140000	11.1(20)	1.1(2)	12.2
140001-170000	4.4(8)	0.6(1)	5.0
170001-250000	6.7(12)	0.6(1)	7.3
Total	50	50	100.0

Source: Field Survey

Based on results of annual expenditure, 13.3% respondents expend 35000-50000 taka annually, 38.3% expend 50001-80000 taka, 23.9% expend 80001-110000 taka, 12.2% expend 110001-140000 taka, 5% expend 140001-170000 taka and 7.3% expend 170001-250000 taka. Considering annual expenditure, the respondents of Sirajganj spend more money comparing to Godagari.

2.14.28 Annual Savings

Table 2.29
Annual Savings of the respondents

Annual Expenditure(Taka)	In Sirajganj (%)	In Godagari (%)	Percent
3000-10000	6.1(11)	7.2(13)	13.3
10001-20000	3.9(7)	8.3(15)	12.2
20001-40000	4.4(8)	3.9(7)	8.3
40001-80000	3.3(6)	3.3(6)	6.6
80001-120000	1.1(2)	2.2(4)	3.3
00	31.1(56)	25(45)	56.1
Total	50	50	100.0

Source: Field Survey

Above chart indicates that 13.3% respondents have 3000-10000 taka annual savings, 12.2% have 10001-20000 taka annual savings, 8.3% have 20001-40000 taka annual savings, 6.8% have 40001-80000 taka annual savings, 3.3% have 80001-120000 taka annual savings and 56.1% have no annual savings. According to results of annual savings, percentage of respondents is higher in Godagari than in Sirajganj.

2.14.29 Annual Deficit

Table 2.30
Annual Deficit of the respondents

Annual Deficit(Taka)	In Sirajganj (%)	In Godagari (%)	Percent
2000-5000	5.6(10)	0.6(1)	6.1
5001-10000	1.7(3)	0.6(1)	2.3
10001-20000	1.1(2)	0	1.1
00	41.7(75)	48.9(88)	90.6
Total	50	50	100.0

Source: Field Survey

About 6.1% respondents in both the study areas have 2000-5000 taka annual deficit, 2.3% have 5001-10000 taka annual deficit, 1.1% has 10001-20000 taka annual deficit and 90.6% have no annual deficit. Data shows annual deficit of respondents in Sirajganj is higher than that of Godagari.

2.14.30 Annual Income from Rice

Table 2.31
Annual income from rice of the respondents

Annual income from rice(Taka)	In Sirajgajganj (%)	In Godagari (%)	Percent
2000-10000	10.6(19)	2.8(5)	13.3
10001-20000	13.9(25)	13.9(25)	27.8
20001-40000	14.4(26)	18.3(33)	32.8
40001-80000	10(18)	10(18)	20.0
80001-200000	0	5(9)	5.0
00	1.1(2)	0	1.1
Total	50	50	100.0

Source: Field Survey

The distribution of annual income from rice shows that 13.3% respondents have 2000-10000 taka annual income from rice, 27.8% have 10001-20000 taka, 32.8% have 20001-40000 taka, 20% have 40001-80000 taka, 5% have 80001-200000 taka and 1.1% has no annual income from rice. In case of annual income from rice, respondents of Godagari have earned more money comparing to Sirajganj.

2.14.31 Annual Income from other Crops

Table 2.32
Annual income from other crops of the respondents

Annual income from other crops(Taka)	In Sirajgajganj (%)	In Godagari (%)	Percent
1000-10000	22.2(40)	0	22.4
10001-20000	3.3(6)	8.3(15)	11.7
20001-40000	2.8(5)	19.4(35)	22.2
40001-80000	1.1(2)	13.3(24)	14.5
80001-160000	0	2.2(4)	2.3
00	20.6(37)	6.7(12)	27.2
Total	50	50	100.0

Source: Field Survey

According to the annual income from other crops, 22.4% respondents have 1000-10000 taka annual income, 11.7% have 10001-20000 taka, 22.2% have 20001-40000 taka, 14.5% have 40001-80000 taka, 2.3% have 80001-160000 taka and 27.2% have no annual income from other crops. In Sirajganj, 22.2% respondents have annual income from other crops within 1000-10000 taka while in Godagari 32.7% respondents have income within 20000-80000 taka from other crops. Therefore, income from other crops is higher in Godagari than that of Sirajganj.

2.14.32 Annual Income from other Sources

Table 2.33
Annual income from other sources of the respondents

Income from other sources(Taka)	In Sirajganj (%)	In Godagari (%)	Percent
5000-20000	0	3.3(6)	3.3
20001-40000	2.8(5)	1.1(2)	3.9
40001-80000	17.2(31)	1.7(3)	18.9
80001-160000	25(45)	1.1(2)	26.1
160001-200000	2.8(5)	0	2.8
00	2.2(4)	42.8(77)	45.0
Total	50	50	100.0

Source: Field Survey

The distribution of annual income from other sources shows that 3.3% respondents have 5000-20000 taka annual income from other sources, 3.9% have 20001-40000 taka, 18.9% have 40001-80000 taka, 26.1% have 80001-160000 taka, 2.8% have 160001-200000 taka and 45% have no annual income from other sources. In the study area of Sirajganj, 47.8% respondents have annual income from other sources while only 7.2% respondents have annual income from other sources in Godagari. So about half (42.8%) of the respondents have no income from other sources which is found in Godagari.

2.15 Findings

Study areas of present research are selected from two different agro-ecological zones; one is from Sirajganj district situated in Karatoya-Bangali Floodplains and Godagari Upazila under Rajshahi district is situated in High Ganges River Floodplain called the Barind Tract. Both of these zones are identified as zone number 4 and 11. As the two study areas are situated in two different agro-ecological zones so there are similarities and dissimilarities of physical and biotic environment. There are dissimilarities regarding landscape, soil fertility, wetland and water resources, aquatic biodiversity, but there are similarities regarding other component of environment. In Sirajganj area, all type of crops are grown while in Godagari area, all types of crops are not grown because of different type of soil and soil characteristics and availability of ground and surface water scarcity. The communication systems of both the study areas from Upazila headquarters are better than any other Upazilas of Bangladesh. Mean annual temperature of Sirajganj is about 25.5°C and in Godagari is about 26.1°C.

In the study area of Sirajganj, high land 23%, medium high land 44%, medium low land 14%, low land 4%, very low land 1%, water bodies 14% while

in the Godagari, highland 43%, medium highland 32% medium lowland 12%, lowland 2%, water bodies 11%. In Sirajganj, soils are silt loam and silt clay loam in ridges and dark grey clay soils in basins. In the Godagari most ridge soils are calcareous and basin soils are non-calcareous.

Demographic features such as ages of 92% respondents in both the study areas are 25-65 years. All the respondents are male and 98.8% respondents are married. Around 88% respondents have 1-8 family members and 70% families have 1-2 children. Number of unemployed is less because they work in the crop fields while the number of service holder is very few but there is seasonal unemployment in both the areas. In both the areas 99% of the families are Muslims and one person of Godagari is Santal. Literacy rate in the study areas is 67% of which 50% respondents overcome primary and secondary level.

In both the areas main occupation of the respondents are farming and all the respondents have skilled on farming. Around 92% of the households have 1-4 houses and more than 60% houses are made of mud wall hay roofed and tin wall tin roofed. Drinking water sources of respondents are tube wells and very few people uses supply water found in Godagari that is supplied by Barind Multipurpose Development Authority. Status of toilet is not good because 56% of the respondents have unhygienic toilet in both the areas.

Land ownership of both the areas is similar. 71% of the respondents have 0.03 to 0.18 acre of homestead and 83.3% have 0.33 to 2.99 acres of cultivated land. Over 80% respondents have no horticulture land, pond or fallow land. About 82% of the respondents have 0.36-2.99 acres of total land and 68% respondents have 0.05-1.99 acre of own cultivable land. Over half of the respondents have no land for share crop, around 28% respondents have land of leased in and amount of land leased out is low. Maximum respondents have 0.30-2.99 acres of cultivated land. More than 80% of the respondents cultivate 0.30-1.99 acre of land in kharif-1 season and in kharif-2 season. 84.4% respondents have own land for rice cultivation but 49% of the respondents have leased or sharecropped land for rice cultivation. 86% of the respondents have 0.30-2.99 acres of land to irrigate for rice cultivation. About 67% respondents use their land for commercial farming and 96.6% respondents have 0.20-0.99 acre of land for commercial farming.

Annual income of 53.3% of the respondents is within taka 50000-110000. 94% respondents have annual income from rice within taka 2000-80000 and 70.8% have annual income from other crops within taka 1000-80000. About 44%

of the respondents have annual savings within taka 3000-120000 and about 10% respondents have annual deficit within taka 2000-20000.

However, socioeconomic situation of both the study areas is not so good because there are still landless farmers who cultivate land by share crop or taking lease from other farmers. Moreover, seasonal unemployment is one of main problems faced by small and marginal farmers that show the poverty features of the study areas.

2.16 Conclusion

This chapter discusses the environmental, socio economic and demographic features of the study area. In the above discussion, the soil type and environmental feature between two study areas are little bit different. However, other feature is quite similar.

Chapter-3

Examining Irrigation Laws and Policies in Bangladesh

Aims of this chapter are to examine the irrigation laws and policies to find out the sufficiencies, insufficiencies and appropriateness of these laws and policies in respect of present requirements and sustainable irrigation in Bangladesh. Laws include Canals Act 1864, The Irrigation Act 1876, The Embankment and Drainage Act 1952, The Bangladesh Irrigation Water Rate Ordinance 1983, The Ground Water Management Ordinance 1985 and Bangladesh Water Act 2013. The policies include National Water Policy 1999, National Agricultural Policy, 2013, Evaluation of Public and Private sector involvement in Minor Irrigation Management and More Private Sector Liberalization and Expansion.

3.1 Introduction

The law means the system of policies which a particular country or community recognizes as regulating the actions of its members that it may enforce by the imposition of penalties.²⁰ Water use and management laws means that has been instigated to control the right to the use of water.²¹ Policy means a course of principle of action adopted or proposed by the government; party and business etc.²² Among the water uses, irrigation use of water is the leading input for increasing yield and production of food grains and other crops. About 90 percent of the total irrigated area of the Bangladesh has covered by minor irrigation. A well-planned irrigation management program is, therefore, essential for gradual increase of cropping intensity as well as yield. In this respect, government of Bangladesh for the development and extension of minor irrigation system in the light of National Water Policy and Water Resource Development Plan has taken appropriate steps.²³

Through the examination of laws and policies regarding irrigation in Bangladesh, it is tried to find out the relations with environment that includes water resources both surface and groundwater, biodiversity includes plants and animals of terrestrial and aquatic, sustainability of agriculture especially rice cultivation and land degradation includes erosion, deterioration of fertility and production, soil pollution etc. We need to find out the sufficiency or deficiency of existing laws and policies of irrigation and its appropriateness as present needs in Bangladesh.

²⁰ *Oxford Dictionary*. New York: Oxford University Press.

²¹ *Water Words Dictionary*. Available at www.nu.gov/programs/planning/dictionary

²² *Oxford Dictionary*. New York: Oxford University Press.

²³ Ministry of Agriculture, "National Agriculture Policy 1999", Government of the People's Republic of Bangladesh.

3.2 Laws for Irrigation Activities

3.2.1 The Canals Act, 1864 (Bengal Act No. V of 1864).

An Act to amend and consolidate the law relating to the collection of tolls on canals and other lines of navigation, and for the construction and improvement of lines of navigation in Bangladesh.

1. The following words shall have the several meanings hereby assigned to them, unless where a contrary intention shall appear from the context, that is to say:- the word "vessel" shall include any ship, barge, boat, raft, timber, bamboos or floating materials, propelled in any manner: the words "line of navigation" shall mean any navigable channel subject to the provisions of this Act: the word "channel" shall include any river, canal, khal, nala or waterway, whether natural or artificial.
2. It shall be lawful for the Government from time to time, by notification to that effect published in the official Gazette, to declare that the provisions of this Act shall apply to any navigable channel specified in such notification; and from and after such publication the provisions of this Act shall apply to, and be in force as regards, such navigable channel.
3. It shall be lawful for the Government from time to time, to authorize any person to make and open any navigable channel, or to clear and deepen any navigable channel, and to stop any watercourse, or make any tracking path, or do any other act necessary for the making or improvement of any such channel; and any navigable channel made under this section shall be rendered subject to the provisions of this Act in the manner prescribed in the last preceding section.

The Government may take possession, as for a public purpose, of any land that may be necessary for the execution of any of the above-mentioned works, under the provisions of any Act in force for the taking possession of land for public purposes.²⁴

3.2.1.1 Findings

The Canals act passed in 1864, which is assumed as an outdated and insufficient though it exists in enforcement at present also. Main purposes of this law are to make watercourse for navigation and collection of tolls; and make navigable channels in any river, canal, khal, nala or waterways. However, the law does not mention any clause or any legal framework optioning to use the

²⁴ Mohiuddin Farooque and S.Rizwana Hasan, *Laws Regulating Environment in Bangladesh* (Dhaka: Bangladesh Environmental Lawyers Association (BELA), 1996), p. 259.

water of such waterbodies for irrigation purposes and to use such waterbodies as water reservoir in dry season for irrigation. Also it does not have any clause regarding water pollution through pesticides and chemical fertilizers use in high yield variety rice field in Kharif-1 season that cause degradation of aquatic biodiversity and there is no substitute for development and conservation of aquatic resources especially fishery resources. Therefore, such outdated, insufficient and inappropriate law must be revised and amended as needs in present day.

3.2.2 The Irrigation Act, 1876

(Bengal Act No. III of 1876)

An Act to provide for irrigation in Bangladesh

3. In this Act, unless there be something repugnant in the subject or context, (1) "canal" includes-

- (a) all canals, channels and reservoirs hitherto constructed, maintained or controlled by Government for the supply or storage of water, or which may hereafter be so constructed, maintained or controlled;
 - (b) all works, embankments, structures, supply and escape-channels connected with such canals, channels or reservoirs;
 - (c) all village-channels as defined in clause (2) of this section;
 - (d) all drainage-works as defined in clause (3) of this section;
 - (e) any part of a river, stream, lake, natural collection of water or natural drainage-channel to which the Government has applied the provisions of Part II of this Act, or of which the water has been applied or used before the passing of this Act for the purpose of any existing canal;
 - (f) all lands on the banks of any canal as defined in articles (a), (b), (c), (d) and (e) of this clause, which have been acquired by Government:
- (2) "village-channel" means any channel by which water is led from a canal directly into the fields to be irrigated, and includes all subsidiary works connected with any such channel, except the sluice or outlet through which water is supplied from a canal to such channel:
- (3) "drainage work" means any work in connection with a system of irrigation which has been or may hereafter be made or improved by the Government for the purposes of the drainage of the country, whether under the provisions of Part IV of this Act or otherwise, and includes escape-channels from a canal, dams, weirs, embankments, sluices, groins and other works

connected therewith, but does not include works for the removal of sewage from towns:

(4) "flood-embankment" means any embankment constructed or maintained by the Government in connection with any system of irrigation-works for the protection of lands from inundation, or which may be declared by the Government to be maintained in connection with any such system; and includes all groins, spurs, dams and other protective works connected with such embankments:

4. Nothing contained in the Embankment and Drainage Act, 1952, shall apply to any canal or flood embankment as defined in this Act.

6. Whenever it appears expedient to the Government that the water of any river or stream flowing in a natural channel, or of any lake or other natural collection of still water, should be applied or used by the Government for the purpose of any existing or projected canal, the Government may, by notification in the official Gazette, declare that the said water will be so applied or used after a day to be named in the said notification, not being earlier than three months from the date thereof.

7. At any time after the day so named, any canal-officer acting under the orders of the Government in this behalf may enter on any land and remove any obstructions, and may close any channels, and do any other thing necessary for such application or use of the said water.

8. As soon as is practicable after the issue of such notification, the Collector shall cause public notice to be given at convenient places stating that the Government intends to apply or use the said water as aforesaid, and that claims for compensation in respect of the matters mentioned in section 11 may be made before him.

A copy of sections 11, 12 and 13 shall be annexed to every such notice.

9. When any claim for compensation is made before the Collector in accordance with the last preceding section, the Collector shall issue a notice requiring all persons interested in the matter in respect of which compensation is claimed to appear personally or by agent before him at a time and place therein mentioned (such time not being earlier than fifteen days after the date of publication of the notice), and to state the nature of their respective interests in the property affected, and the amount and particulars of their claims to compensation for such interests.

11. No compensation shall be awarded for any damage caused by-

- (a) stoppage or diminution of percolation or floods;
- (b) deterioration of climate or soil;
- (c) stoppage of navigation, or of the means of rafting timber or watering cattle.

But compensation may be awarded in respect of any of the following matters:-

- (d) stoppage or diminution of supply of water through any natural channel to any defined artificial channel, whether above or underground, in use at the date of the issue of the notification under section 6;
- (e) stoppage or diminution of supply of water to any work erected for purposes of profit on any channel, whether natural or artificial, in use at the date of the said notification;
- (f) stoppage or diminution of supply of water through any natural channel which has been used for purposes of irrigation within the five years next before the date of the said notification;
- (g) damage done in respect of any right to a water-course or the use of any water to which any person is entitled under the Limitation Act, 1908, Part IV;
- (h) any other substantial damage, not falling under any of the above clauses (a), (b) or (c), and caused by the exercise of the powers conferred by this Act, which is capable of being ascertained and estimated at the time of awarding such compensation.

In determining the amount of compensation under this section, regard shall be had to the diminution in the market value, at the time of awarding compensation of the property in respect of which compensation is claimed; and, where such market value is not ascertainable, the amount shall be reckoned at twelve times the amount of the diminution of the annual net profits of such property, caused by the exercise of the powers conferred by this Act.

12. If any supply of drinking-water is substantially deteriorated or diminished by any works undertaken in accordance with a declaration made by the Government under section 6, the canal-officer shall be bound to provide within convenient distance an adequate supply of good drinking-water in lieu of that so deteriorated or diminished, and no person shall be entitled to claim any further compensation in respect of the said deterioration or diminution.

19. Any person on whom notice may be served under the same last preceding section, and any person interested in any property in respect of which such notice has been issued, may, within six weeks of the service of such notice,

apply to the Court stating his objection to the amount of compensation as fixed by the Collector under the last preceding section, and the amount which he claims as compensation.

35. In case of any accident being apprehended or happening to a canal or flood-embankment, any canal-officer, or any person acting under his general or special orders in this behalf, may enter upon any lands adjacent to such canal or flood-embankment, and may execute all works which may be necessary for the purpose of preventing such accident, or repairing any damage done.

37. In every case of entry upon any land or building under section 7, section 33, section 34 or section 35, the canal-officer or person making the entry shall ascertain and record the nature of any crop, tree, building or other property to which damage has been done, and the extent of the damage done to any such property, and shall tender compensation to the proprietors or occupiers for all damage done to the same by the entry or by any works executed.

40. Whenever it appears to the Government that injury to the public health or public convenience, or to any canal, or to any land for which irrigation from a canal is available, has arisen or may arise from the obstruction of any river, stream or natural drainage-course, the Government may, by notification published in the official Gazette prohibit, within limits to be defined in such notification, the formation of any such obstruction, or may, within such limits, order the removal or other modification of such obstruction.

Thereupon so much of the said river, stream or natural drainage channel as is comprised within such limits shall be held to be a drainage work as defined in section 3.

43. Whenever it appears to the Government that any drainage works are necessary for the public health, or for the improvement or proper cultivation or irrigation of any lands in districts to which the provisions of the Embankment and Drainage Act, 1952, do not, apply, or that protection from floods or other accumulations of water, or from erosion by a river, is required for any lands, the Government may cause a scheme for such works to be drawn up and carried into execution, and the persons authorized by the Government to draw up and execute such scheme may exercise in connection therewith all or any of the powers conferred on canal-officers by sections 33, 34 and 35, and shall be liable to any or all of the obligations imposed upon canal-officers by sections 36 and 37.

49. Any person may, with the permission of a canal-officer, construct a new village-channel if he has obtained the consent of the owners and occupiers of the land required therefor.

59. Every owner of a village-channel shall be bound-

(a) to construct and maintain all works necessary for the passage across such village-channel of canals, village-channels, drainage-channels and public roads existing at the time of its construction, and of the drainage intercepted by it, and for affording proper communications across it for the convenience of the occupants of neighbouring lands;

(b) to maintain such village-channel in a fit of repair for the conveyance of water;

(c) to allow the use of it to others on such terms as may be declared equitable by the canal-officer

as hereinafter prescribed; and shall be entitled-

(d) to have a supply of water by such village-channel at such rates and on such terms as are prescribed by the policies made by the Government under section 99;

(e) to receive such rent for the use of the village-channel by other persons as the canal-officer may award him.

67. On receipt of such application the canal-officer shall serve notice on the owners to show cause why such permission should not be granted, and, if no objection be raised, or if any objections be raised and found invalid, shall authorize the conveyance of such supply on such conditions as may appear to him equitable.

93. Whoever, voluntarily and without proper authority, does any of the acts following, that is to say:-

(1) damages, alters, enlarges or obstructs any canal or drainage-work;

(2) interferes with, increases or diminishes the supply of water in, or the flow of water from, through, over or under any canal or drainage-work, or by any means raises or lowers the level of the water in any canal or drainage work;

(3) being responsible for the maintenance of a village- channel, or using a village-channel, neglects to take proper precautions for the prevention of waste of the water thereof, or interferes with the authorized distribution of the water therefrom, or uses such water in an unauthorized manner;

(4) corrupts or fouls the water of any canal so as to render it less fit for the purposes for which it is ordinarily used;

(5) destroys, defaces or moves any level-mark or water-gauge fixed by the authority of a public servant;

- (6) destroys or removes any apparatus, or part of any apparatus, for controlling or regulating the flow of water in any canal or drainage-work;
- (7) passes, or causes animals or vehicles to pass, in or across any of the works, banks or channels of a canal contrary to policies made under this Act after he has been desired to desist therefrom;
- (8) without the permission of the canal-officer causes, or knowingly and wilfully permits, any cattle to graze upon any flood-embankments, or tethers, or causes or knowingly and wilfully permits any cattle to be tethered upon any such embankments, or roots up any grass or other vegetation growing on any such embankments, or removes, cuts or in any way injures or causes to be removed, cut or otherwise injured, any trees, bushes, grass or hedge intended for the protection of such embankment;
- (9) violates any rule made under the Act, for breach whereof a penalty may be incurred.

shall, in case the offence shall not amount to mischief within the meaning of the Penal Code, and on conviction before a Magistrate, be liable to a fine not exceeding fifty taka or to imprisonment for a term not exceeding one month, or to both.

94. Whenever, without the authority of the canal-officer,-

- (1) pierces or cuts through, or attempts to pierce or cut through, or otherwise to damage, destroy or endanger the stability of, any flood-embankment;
- (2) opens, shuts or obstructs, or attempts to open, shut or obstruct, any sluice in any such embankments;
- (3) makes any dam or other obstruction for the purpose of diverting or opposing the current of a river on the banks whereof are flood-embankments, or refuses or neglects to remove any such dam or obstruction when so required by the canal-officer, shall in case the offence shall not amount to mischief within the meaning of the Penal Code, and on conviction before a magistrate, be liable to a fine not exceeding two hundred taka, or to imprisonment for a term not exceeding six months.²⁵

3.2.2.1 Findings

The law mentioned above is name as the Irrigation Act 1876. The main objective of this act is to serve irrigation for crop fields. In this act there is only mentioned about the use of surface water for irrigation activities quite clearly. There is no clause to address wetland or waterbodies pollution through pesticides and

²⁵ Ibid. pp. 260-265.

chemical fertilizer use in rice cultivation. There is no option for protection and conservation of aquatic biodiversity and fisheries resources are not included in this act because there may be created problems for using surface water in irrigation. The penalties of violating this irrigation act are not sufficient for present day to maintain irrigation activities because land value and cost for construction of canals are increased many times than the time of introducing this act. This act is fairly good for surface water irrigation for that time. If surface water is used in our rice field at present, it will reduce the pressure of extracting groundwater for irrigation activities. In this way, aquifer will recharge and water table will not decline as found at present. Many issues that are found in this act are very useful for irrigation activities but it is not enforced properly. If this act amends and includes the issues that are not included, it will be fruitful for irrigation activities.

3.2.3 The Embankment And Drainage Act, 1952

(EAST BENGAL ACT NO. I OF 1953).

An Act to consolidate the laws relating to embankment and drainage and to make better provision for the construction, maintenance, management, removal and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion or other damage by water.

Definitions

3. In this Act, unless there is anything repugnant in the subject or context,-

- (c) “embankment” includes every bank, dam, wall and dyke made or used for excluding water from or for retaining water upon any land; every sluice, spur, groyne, training wall, berm or other work annexed to, or portion of, any such embankment, every ban, dam, dyke, wall, groyne or spur made or executed for the protection of any such embankment or of any land from erosion or overflow by or of rivers, tides, waves or waters; and also all buildings, intended for purposes of inspection and supervision, but does not include any ail or ridge surrounding or dividing a field or any public or private road;
- (e) “land” includes interests in land and benefits arising out of land, and things attached to the earth or permanently fastened to anything attached to the earth;
- (f) “owner”, used in relation to a land, means a person who has a right, title or interest in that land, and is either in actual possession of it or has an immediate right to actual possession thereof, and include his trustee, heirs, assigns, transferees and legal representatives, but does not include a person who, under the system generally known as adhi, barga or bhag, cultivates such land:

Provided that where any person is, under the terms of any contract between him and the Government or the Authority, liable to do any act or execute any work specified in Part II of this Act, for the benefit of any area, such person shall be deemed to be the owner in relation to any land in such area and shall be deemed to be in possession of such land;

(h) "public embankment" means an embankment vested in or maintained by the Government or the Authority;

(j) "water-course" includes a line of drainage, weir, culvert, pipe or other channel, whether natural or artificial, for the passage of water.

4. (1) Every embankment, water-course and embanked tow-path maintained by the Government or the Authority, and all land, earth, pathways, gates, berms and hedges belonging to or forming part of, or standing on, any such embankment or water-course shall vest in the Government or the Authority, as the case may be.

(2) The embankments mentioned in Schedule A to this Act and every embankment and water course which may be restored to or included in such Schedule under section 37 or section 38 of this Act, and every embanked tow path as aforesaid, shall be held on behalf of the Government or the Authority; and all other public embankments and water courses shall, subject to the provision of section 65, be held by the Government or the Authority on behalf of the persons interested in the lands to be protected or benefited by such embankments or water courses, and all moneys received on account of such lands shall be credited to the cost of the construction and maintenance of such embankments and water courses respectively.

7. Subject to the provisions of Part III, whenever it shall appear to the Engineer that any of the following acts should be done or works (including any work of repair) executed, that is to say:

(2) that any embankment which connects public embankments or forms by junction with them part of a line of embankments or is necessary for the protection of the neighbouring areas, should be repair;

(3) that any embankment, or any obstruction of any kind, which endangers the stability of a public embankment or the safety of any town or village, or which is likely to cause loss of property by interfering with any water course or with the general drainage or the flood drainage of any tract of land, should be removed or altered;

- (5) that any sluice or water course should be made, or that any water course should be altered for the improvement of the public health, or for the protection of any village or cultivable land;
- (6) that any road which interferes with the drainage of any tract of land should be altered, or that any water course under or through such road should be constructed;

he shall prepare or cause to be prepared estimates of the cost of such works, including such proportion of the establishment charges as may be chargeable to the works in accordance with the prescribed policies or as may be specially directed by the Government or the Authority, together with such plans and specifications of the same as may be required. He shall also prepare or cause to be prepared from the survey map of the district, a map showing the boundaries of the lands likely to be benefited or affected by the said acts and works, and he shall issue a general notice of his intention to execute or cause to be executed such works.

8. Such general notice shall be in the prescribed form stating, as far as possible, the prescribed particulars of all lands which are likely to be affected by the proposed work and to be chargeable in respect of the expenses of executing the same and shall be published in the prescribed manner. A copy of the said estimates, specifications and plans together with a copy of the maps aforesaid, shall be deposited in the office of the Engineer and shall be open to the inspection of any person interested who shall be allowed to take copies thereof and to file objections, if any, against the execution of the proposed work, within thirty days from the date of the publication of such notice.

11. Any person aggrieved by a decision of the Engineer under section 10 may, within thirty days from the date of its announcement, prefer an appeal to the Project Director of the Authority to whom the Engineer is subordinate. After the expiry of the said period, the Project Director of the Authority shall proceed to consider the report and the appeal, if any, and after making such further inquiry, as he may deem necessary, may record an order confirming, modifying or reversing the Engineer's decision and shall, as soon as possible, forward the report submitted by the Engineer, together with his remarks or order on appeal, if any, for the consideration of the Government or the Authority.

Alteration of road, etc, interfering with drainage

14. (1) Whenever an order shall have been passed in cases falling under clause (6) of section 7 directing that any road owned by a local authority, which

interferes with the drainage of any tract of land, be altered, or that any water-course be constructed under or through such road, the Engineer may require such authority to make such alteration or construct such water course, and in the events of its failing to comply with such requisition in such manner and within such time as the Engineer may prescribe, the Engineer may cause the road to be altered or the water course to be constructed by the officers of the Government or the Authority.

Application for construction of sluice embankment, water courses, etc

15. (1) (a) If any person desires that a bridge, culvert, siphon or sluice be made in any public embankment for the purpose of drainage, or

(b) if, within any area which has been included in a notification under section 6, any person desires that any new embankment be erected, that any existing embankment be lengthened, enlarged, repaired or removed, or that the line of any embankment be altered, or that any new water-course be made, or that any water course be obstructed or diverted, he may make an application in writing to the Engineer.

(2) The application shall contain such particulars of the lands likely to be benefited or affected by the work as may enable the engineer to judge of the advantage which may be derived from the project.

(3) If it should appear to the Engineer that the work applied for is one which may be executed with advantage, the procedure mentioned in the 7th and following sections of this Act shall be followed in respect of the proposed work.

Power of removal of houses, trees, etc

16. Whenever the Engineer shall be of opinion that the removal of any trees, houses, huts or other buildings, situated between a public embankment and the river, is necessary, or that land is required for widening an existing embanked tow path, or for construction of a new embanked tow-path, he shall make a report to that effect to the Deputy Commissioner of the District concerned, accompanied by a detailed statement of the trees, houses, huts or other buildings to be removed or of the land required. The Deputy Commissioner shall submit such report to the Government or the Authority through the Commissioner of the Division in order that proceedings may be taken for obtaining possession of such trees, houses, huts and buildings or land in accordance with the provisions of the Land Acquisition Act, 1894, or other law for the time being in force for the acquisition of land for public purposes.

Power to make repairs

18. The Engineer may make any repairs in, and may do all acts necessary and proper for the maintenance of, any public embankment, public water course or any other work executed or taken charge of under the provisions of this Act or of any previous similar Act.

Construction of temporary dam, road-way or water courses

19. (1) Whenever any person desires that a temporary road-way should be made over, or that temporary water course should be made through, any public embankment, or that a temporary dam should be constructed in any embanked river or public water course, he shall apply to the Engineer or to any person appointed in that behalf by the Engineers.

Opening and shutting of sluices

20. Sluices constructed in any public embankment shall be opened or shut only by or with the general or special permission of the Engineer or of the officer in the immediate charge of the embankment, under such orders, either general or special, as he may receive from the Engineer.

Power to enter into and survey lands

21. (1) It shall be lawful for the Engineer, or any person whom he may authorise in writing in that behalf, in order to carry out any of the purposes of this Act, to enter upon and survey, and take levels of any land; to dig or bore into the sub soil; to do all other acts necessary to ascertain whether the land is adapted to the purpose projected by such Engineer; to set out the boundaries of the land proposed to be taken and the intended line of the work proposed to be made thereon; to mark such levels, boundaries and line, by placing marks and cutting trenches; and, where otherwise the survey cannot be completed or the levels taken, to cut down and clear away any part of any standing crop, fence or jungle:

Provided that the Engineer or such person shall not enter into any building or upon any enclosed courtyard or garden attached to a dwelling house without previously giving the occupier thereof at least seven days' notice in writing of his intention to do so, except with the written consent of such occupier.

(2) The Engineer or other person so authorised shall, at the time of such entry, tender payment for all necessary damage to be done as aforesaid, and in case of dispute as to the sufficiency of the amount so tendered, he shall at once refer the dispute to the Deputy Commissioner whose decision thereon shall be final.

Lands rendered unfit for cultivation

23. When any such land is rendered permanently unfit for cultivation by any such act as aforesaid, the Government shall, upon application for that purpose made by the owner thereof, acquire such lands under the provisions of the Land Acquisition Act, 1894, or other law for the time being in force for the acquisition of land for public purposes.

PART III

PROCEDURE IN CASES OF IMMINENT DANGER TO LIFE OR PROPERTY

Proceedings in emergencies

24. Whenever the Engineer shall be of opinion that any delay in the execution of any act or work specified in section 7 would be attended with grave danger to life or property, he may forthwith execute or cause to be executed such act or work:

Provided that he shall without delay prepare or cause to be prepared the estimates, specifications and plans of such act or work together with a copy of the map as provided in section 7, and shall cause general notice to be given that the act or work mentioned therein has already been commenced; and thereupon such proceedings and inquiries shall be had as in and by Part II of this Act are directed.

Restoration of land, etc

25. Whenever it may have been determined in the final order to be passed on any such enquiry that anything done by the Engineer under the last preceding section was unnecessary, any person who shall have sustained damage by the execution of such works shall receive compensation from the Government or the Authority to be assessed according to the provisions contained in Part IV of this Act; and, on receipt of any application to that effect by the Engineer from any person so affected, the land or the embankments or drainage shall, so far as any alteration thereof shall appear to have been unnecessary, be, at the expense of the Government or the Authority, restored as nearly as possible to the state in which they were when the Engineer commenced to act under the provisions of this Part.

Compensation for damages

28. Subject to the provisions of section 5, whenever any land other than land required or taken by the Engineer, or any right of fishery, right of drainage, right to the use of water or other right of property, shall have been injuriously affected by any act done or any work executed under the due exercise of the powers or provisions of this Act, the person in whom such property or right is vested may prefer a claim by petition to the Deputy Commissioner for compensation:

Provided that the refusal to execute any work for which application is made shall not be deemed to be an act on account of which a claim for compensation can be preferred under this section.

Procedure for compensation

30. When any such claim is made, proceedings shall be taken for determining the amount of compensation, if any, which should be made and the person to whom the same should be payable, as far as possible, in accordance with the provisions of the Land Acquisition Act, 1894, or other law for the time being in force for the acquisition of land for public purposes.

Matters to be and not to be considered in determining compensation

31. In every such case which is referred to the judge and assessors or to arbitrators for the purpose of determining whether any, and if so, what amount of compensation should be awarded the judge and assessors or the arbitrators-

(i) shall take into consideration-

- (a) the market value of the property or right injuriously affected at the time when the act was done or the work executed,
- (b) the damage sustained by the claimant by reason of such act or work injuriously affecting the property or right,
- (c) the consequent diminution of the market value of the property or right injuriously affected when the act was done or the work executed, and
- (d) whether any person has derived, or will derive, benefit from the act or work in respect of which the compensation is claimed or from any work connected therewith, in which case they shall set off the estimated value of such benefit, if any, against the compensation which would otherwise be decreed to such person; but

(ii) shall not take into consideration-

- (a) the degree of urgency which has led to the act or work being done or executed, and
- (b) any damage sustained by the claimant, which if caused by a private person, would not in any suit instituted against such person justify a decree for damages.

Penalty for unauthorised interference and abetment thereof

56. (1) Any person,-

- (a) who, without the previous permission of the Engineer, erects, or causes or wilfully permits to be erected, any new embankment, or adds to any existing

embankment, or obstructs or diverts, or causes or wilfully permits to be obstructed or diverted, any water course, if such act interferes or is likely to interfere with, counteract or impede any public embankment or any public water-course;

- (b) who, within the limits of the tract included in any prohibitory notification under section 6, without the previous permission of the Engineer, erects, or causes or wilfully permits to be erected, any new embankment, or adds to any existing embankment, or obstructs or diverts, or causes or wilfully permits to be obstructed or diverted any water course; and
- (c) who abets any such act as is mentioned in clauses (a) and (b), shall be liable, on conviction, to fine which may extend to five hundred rupees or, in default of payment, to imprisonment of either description for a period not exceeding six months.
- (2) This section shall not render unlawful the repair of a breach or cut in an embankment so as to restore the embankment to the same dimensions as it had immediately before such breach occurred or cut was made; provided that-
- (i) such cut was not made under the orders of the Engineers;
- (ii) such repair is made within one year after such breach occurred or cut was made; if, however, the repair cannot be completed within this period, the sanction of the Engineer shall be obtained to the completion thereof;
- (iii) such breach or cut forms a gap or, if unrepaired may form a gap between two portions of an existing embankment which were continuous before the breach occurred or cut was made;
- (iv) the part of the embankment, in which the breach occurred or cut was made, was not erected or added to in contravention of this section or of any law for the time being in force.

Penalty for injuring embankment, etc

57. Whoever, without due authority in this behalf, cuts through or attempts to cut through any public embankment, or destroys or attempts to destroy any such embankment, or opens or shuts or obstructs any sluice in any such embankment or any public water course, shall be liable to imprisonment of either description for a term which may extend to one month or to fine which may extend to two hundred rupees.

Penalty for diverting rivers or grazing cattle on embankments

58. Whoever, without the permission of the officer in immediate charge of the embankments, makes any dam or other obstruction for the purpose of diverting or opposing the current of a river or water course wherein or whereon there are public embankments; or,

When required by the Engineer, refuses or neglects to remove any such dam or obstruction so made by him; or, without the permission of the Engineer or of the officer in immediate charge of the embankment previously obtained, cuts or otherwise alters the banks of any embanked river or water course or removes the earth from any public embankment or drives stakes into it, or, by any other wilful act, destroys or diminishes the efficiency of such embankment, or causes or knowingly and wilfully permits any cattle to graze upon any such embankment, or tethers or causes or wilfully permits any cattle to be tethered upon any such embankment or root up any grass or other vegetation growing on any such embankment, shall be liable to imprisonment of either description for a term which may extend to six months or to fine which may extend to two hundred rupees.²⁶

3.2.3.1 Findings

The main purposes of the Embankment and Drainage Act, 1952 is to construct, maintain, manage, and control of embankments and watercourses for the better drainage of water from lands and for their protection from floods, erosion or other damages by water. However, this act is not formulated for irrigation purposes but it is very much associated with flood control and natural water drainage activities. There is option of irrigation for agriculture creating canals and irrigatable watercourse to enhance agricultural production using only surface water not groundwater. In this act, it is needed to incorporate the irrigation activities like build up water reservoir, irrigation canals, irrigation drainage systems, ground extraction, etc.

3.2.4 The Bangladesh Irrigation Water Rate Ordinance, 1983

(Ordinance No. XXXI of 1983).

An Ordinance to consolidate and amend the law relating to the imposition of water rate for supply, regulation or storage of water for irrigation or drainage

Definitions

2. In this Ordinance, unless there is anything repugnant in the subject or context,-

²⁶ Ibid. pp. 310-317.

(b) “Board” means the Bangladesh Water Development Board constituted by the Bangladesh Water and Power Development Boards Order, 1972 (P.O. No. 59 of 1972); (c) “canal” means any canal, channel, including field channel, plot channel and intake channel, river, stream, water course, reservoir, pump or tube well constructed, installed, maintained or controlled by the Government or by the Board or by the Corporation for supply, regulation or storage of water for the purpose of irrigation or drainage, and includes any work, embankment, structure, supply or escape channel connected with any such canal, channel or reservoir, and any land on the bank of any canal as defined in this clause;

(d) “Corporation” means the Bangladesh Agricultural Development Corporation established under the Bangladesh Agricultural Development Corporation Ordinance, 1961 (E.P. Ord. XXXVII of 1961);

Ordinance to override other laws

3. The provisions of this Ordinance shall have effect notwithstanding anything to the contrary contained in any other law or in any contract for the time being in force.

Imposition of water rate

4. (1) Whenever the Government is of opinion that lands within any area are benefited or are likely to be benefited by water supplied or regulated by the Government or by the Board or by the Corporation through any canal during any financial year, the Government may, by notification, declare its intention to impose in such area, hereinafter referred to as the notified area, a water rate for such financial year.

Provided that the water rate so specified for a crop season shall not exceed such rate as may be prescribed:

Provided that the water rate so determined may vary from one notified area to another notified area and from one year to another year.

Determination of water rate etc

5. (1) The water rate to be imposed in a notified area shall be determined by such authority and in such manner as may be prescribed:

Provided that the water rate so determined may vary from one notified area to another notified area and from one year to another year.

(2) Notwithstanding anything to the contrary contained in section 4, a water rate determined for a financial year shall remain in force and be payable for subsequent financial years unless the notification published under that section is rescinded or the rate is varied under sub-section (1).

(3) Notwithstanding anything to the contrary contained in any other law for the time being in force or in any custom, usage or contract, a water rate determined under sub-section (1) shall be payable in respect of all agricultural lands in the notified area.

Remission

6.(1) If, for any reason, there is, in any financial year, a total or partial failure of crops in any land in the notified area, the Government may grant total or partial remission of the water rate in respect of such lands.

Free Passage of water for irrigation or drainage

8. (1) For the purpose of irrigation or drainage of lands in the notified area, the owners or occupiers of such lands shall be bound to afford free passage for water through or over all lands in their possession and for that purpose, to allow, when so required by the Deputy Commissioner, by an order in writing, construction and maintenance of such channels as may be necessary:

Provided that the capacity of such channels shall not exceed in any case two cusecs of flow.

(2) If any person refuses to comply with an order under sub section (1), the Deputy Commissioner may cause the channel to be constructed or maintained and may impose a penalty which may extend to five times the water rate assessed on such land.

(3) Notwithstanding anything contained in any other law for the time being in force, no person shall be entitled to claim any compensation for any damage or loss which may be caused as a result of construction or maintenance of any channel under sub section (1) or sub section (2):

Provided that he shall be entitled to remission of water rate in respect of that portion of land which is affected by such construction or maintenance of channels.

Penalty for diversion of normal flow of water by obstruction, etc

9. (1) If, without any written permission of the Deputy Commissioner, any obstruction is put in any channel referred to in section 8 or other canal or any cut is made on the bank thereof as a result of which the normal flow of water through

(a) take such measures as he may consider necessary to remove such obstruction or to close such cut;

- (b) impose a penalty, which may extend to ten times the water rate assessed for the financial year during which the obstruction is put or the cut is made, on the persons who are the owners or occupiers of lands irrigated by, or filled up with, water so diverted, after giving them an opportunity of showing cause against the imposition of such penalty:

Provided that no such penalty shall be imposed on any person who proves to the satisfaction of the Deputy Commissioner that such obstruction was put or such cut was made without his knowledge or consent.

- (2) Any person aggrieved by an order imposing a penalty under this section may, within thirty days from the date of receipt of the order, appeal to such appellate authority as may be prescribed, and the decision of the appellate authority in such appeal shall be final.

Prevention of unauthorised use or waste of water

10. (1) It shall be the duty of the owners or occupiers of lands in the notified area to take proper precautions for the prevention of waste of the water supplied through any canal in the area or use of such water in an unauthorised manner.

(2) If water supplied through a canal be suffered to run to waste, the person by whose act or neglect such water is suffered to run to waste shall be liable to pay a penalty which may extend to ten times the water rate that could be charged if the water so wasted were supplied in bulk.

(3) If water supplied through a canal in the area be used in an unauthorised manner, the person by whose act or neglect such use has occurred shall be liable to pay a penalty which may extend to five times the water rate assessed on the land in which such water is used or on which such water has flowed.

Note: Policies have been framed under section 15 of this Ordinance as Irrigation Water Rate Policies, 1992.purpose²⁷

3.2.4.1 Findings

The Bangladesh Irrigation Water Rate Ordinance enacted in 1983. The reasons for enacting this law are to impose one sort of water charge for the purpose of water supply for irrigation and drainage activities. It is a very important for irrigation activities because if the water charge is not imposed then nobody realizes the real value of water. By obeying this act, lawful use of water and their

²⁷ Ibid. pp. 274-277.

protection can be assured. So this law is needed to implement rigorously and properly in irrigation activities so that everybody should obey this act properly for sustainable water use in irrigation.

3.2.5 The Ground Water Management Ordinance, 1985

(Ordinance No. XXVII of 1985).

An Ordinance to manage the ground water resources for agricultural production

Definitions

2. In this Ordinance, unless there is anything repugnant in the subject or context,-

- (a) “aquifer” means a body of saturated soil at any depth below ground level that can store and transmit sufficient quantity of water to the wells;
- (d) “deep tube well” means a tube well called as such operated by a submersible pump set or turbine pump coupled with a prime mover capable of pumping ground water when the pumped water level depth is more than 7 metres;
- (e) “deep set hand-pumped tube well” means a hand-pumped well used for either irrigation or water supply where the pump valve is set below the surface and operated remotely by a pump rod operated from the surface and is capable of pumping ground water when the pumped water level depth is more than 8 metres;
- (i) “shallow tube well” means a tube well called as such operated by a centrifugal pump coupled with a prime mover but only capable of pumping water when the vertical distance between the centrifugal pump and the pumped water level depth is within 7 metres;
- (j) “static water level” means the depth from ground level to the saturated water level beneath the ground surface where no pumping has taken place;
- (k) “suction lift hand-pumped tube well” means hand-pumped well used for either irrigation or potable water supply when the pump valves are situated above ground level but is only capable of operation when the vertical distance between the pump valve and the pumped water level depth is within 8 metres;
- (l) “tube well” means a deep tube well, shallow tube well, suction lift hand-pumped well or deep set hand-pumped well used for irrigation or water supply;

Upazila Irrigation Committee

4. There shall be constituted, in the prescribed manner, a Upazila Irrigation Committee in each Upazila for the purposes of this Ordinance.

License for tube well

5. (1) No tube well shall be installed in any place without a licence granted by the Upazila Parishad.

(2) An application for license for installation of a tube well shall be made to the Upazila Parishad in such form as may be prescribed.

(3) No application shall be entertained by the Upazila Parishad unless it is accompanied by such fee as may be prescribed.

(4) On receipt of an application for licence, the Upazila Parishad shall direct the Committee to hold a local enquiry and submit a report on the following points, namely:-

(a) the aquifer condition of the soil where the tube well is to be installed;

(b) the distance of the nearest existing tube well;

(c) the area likely to be benefited by the tube well;

(d) the likely effect on the existing tube wells including tube wells used for domestic purpose;

(e) the suitability of the site for installation of the tube well; and

(f) the conditions on which a licence, if any, may be granted.

(5) If, on consideration of the report of the Committee, the Upazila Parishad is satisfied that the installation of tube well applied for-

(a) will be beneficial to the areas for which it is to be installed, or

(b) will not have any adverse effect upon the surrounding area, or

(c) is otherwise feasible,

it may grant the licence applied for.

Offences

10. Whoever contravenes any provision of this Ordinance or policies made thereafter shall be punishable with fine which may extend to two thousand taka.²⁸

²⁸ Ibid. pp. 317-318.

- (4) 00Rj tmiZ00 A_@Rj vavi nBtZ c0vvnZ tKvb cvwb;
- (5) 00Rj vavi 0 A_@c0KwZK m0 ev KwI gfvte LbbKZ tKvb b`-b`x, Lvj, wej, nvl i, evl o, `xvN, cKzi, n0, SYPev Abjfc tKvb avi K;
- (6) 00Rj vfvig0 A_@Ggb tKvb fvg thLvfb cvmbi Dcwi Zj fvgZtj i mgvb ev KvQvKwQ _vfk ev hvnv mgtq mgtq, `f Mfxi Zvq wbgw%Z _vfk Ges thLvfb mvavibZ wfRv gwUtz RbYq Ges wUwKqv _vfk Ggb DwMw` RbYq;
- (7) 00RvZxq cvwb bxwZ0 A_@mi Kvi KZK, mgq mgq cYxZ RvZxq cvwb bxwZ;
- (8) 00RvZxq cvwb m0u` cwi Kibv0 A_@aviv 15 Gi Aaxb cwi l` KZK Abtgw` Z RvZxq cvwb m0u` cwi Kibv;
- (9) 00bepx KvgwU 0 A_@aviv 9 Gi Aaxb MwZ KvgwU;
- (10) 00bqSY0 A_@bwI xKiY Ges kZPivcl Ašf0 nBte;
- (11) 00cwi` kR0 A_@aviv 14 Gi Aaxb cwi` kR wnvte PvgZvc0B tKvb KgRZv ev KgPvix;
- (12) 0cwi l` 0 A_@aviv 4 Gi Aaxb MwZ RvZxq cvwb m0u` cwi l`;
- (13) 00cvb00 A_@aviv 3 Gi Dcaviv (1) G Dtj mLZ tKvb cvwb;
- (14) 0cvwb m0u` 0 A_@fwi` cvwb, fMf0` cvwb l ew0i cvwb Z_v evqgUti i cvwb; Ges b`xi tgvnbv, cvwbavi K`li, cweb fvg, Rj vfvig, Rj vavi tdviftkvi, DcKj ev Abjfc tKvb Avavi ev`vftbi cvwb Dnvi Ašf0 nBte;
- (15) “পানি সম্পদ উন্নয়ন প্রকল্প” অর্থ পানি সম্পদ উন্নয়নের জন্য গৃহীত কোন কার্যক্রম, কর্মসূচী বা Dt`vM, thgb tmP, eb`v wbgSY e`e`vcbvi l cvwb w0vktbi Rb` wbgZ th tKvb aitYi হাইড্রোলিক অবকাঠামো নির্মাণ, নদীর তীর সংরক্ষণ, ড্রেজিং বা অনুরূপ কোন কার্যক্রম, কর্মসূচী ev Dt`vM;
- (16) 0cvwb m0u` cwi Kibv ms`v0 A_@cvwb m0u` cwi Kibv AvBb 1992 (1992 mftbi 12 bs AvBb) Gi Aaxb c0Zw0Z cvwb m0u` cwi Kibv ms`v;
- (17) 00cvwb msKUvcbaGj vKv00 A_@aviv 17 Gi Aaxb tNwI Z tKvb Gj vKv;
- (18) 00cvwb avi K`li (Aquifer)00A_@ fMf0` wkv v A_ev gwEKv`fti i Ggb tKvb`li hvnv cvwb aviY Ges cwi enY Kwi tZ cfti Ges hvnv nBtZ cvwb DtEjv b Kiv hvq;
- (19) 0c0Zcij b Avt`k0 A_@aviv 12 Gi Aaxb BmjKZ tKvb Avt`k;
- (20) 00tdviftkvi00 A_@ermti i tftKvb mgq fiv KvUvj tRvqvi (Ordinary spring tide) Gi mgq b`xi me0g0cvmbi`li (low water mark) nBtZ mtePP cvwb`li (high water mark) Gi ga`eZPAsk; Ges The Port Act, 1908 Abhvqx tNwI Z b`x e`i l mgy`a e`i Gj vKvq mtePP cvwb`li nBtZ b`xi Zxi 50(cAvk) wgvvi Ges Ab`vb` Gj vKvq Bnv mtePP cvwb šli nBtZ 10(`k) wgvvi chšve`IZ Gj vKv;

- (21) 00tdSR`vix Kvh0 A_ Code of Criminal Procedure. 1898 (Act V of 1898);
- (22) 00eul o00 A_ LjvKwZi Ggb tKvb n0 hnvvi Rj tmZ mg tqi weeZ0b axti axti w`wgZ nBqv cwoqv0;
- (23) 00ewa00 A_gwU ev Abjfc Dcv`vb 0viv wbgZ W`vg, I qyj (wall), WwBK, teox eua, ev Abjfc tKvb eua;
- (24) 00ej 00 A_c0KwZK bxPyRvqMv ev eEvKvi Gj vKvK eSvBte hnvv ew0cvZ ev b`xi cwbi 0viv cmeZ nq Ges hnvv mgM0ermi cwbtZ wbg3/4Z _vK ev erm0i Avs0kK mgq Avs0kK ev cY0`0 _vK;
- (25) 00e`w00 A_ tKvb e`w0 ev tKvb c0Z0vb, K00vbx, mwgwZ. Askx`vvi Kvi evi, dvg0ev ms0e0aex ev Ab` tKvb ms`vi Dnvi A0f0 nBte;
- (26) 00FMf0, cwbo A_ F0t0i bxtPi tKvb cwmb hnvv tKvb Rj vavti i ga` w`qv c0v0nZ nq ev fet0i Dci c0KwZK ev Kw0.g Dcvtq D0Evj b Kiv hvq;
- (27) 00f0wi `cwbo A_ f0gi Dnvi fv0Mi Rj vavti i tKvb cwmb;
- (28) 00f0g00 A_ State Acquisition and Tenancy Act, 1950 (E.B. Act No. XXVIII of 1950) Gi section 2(16) G m0v0qZ tKvb land;
- (29) 00gnvcwi Pvj K00 A_ cwmb m00` cwi K0i bv ms`vi gnvcwi Pvj K;
- (30) 00tgvnbv0 A_ Ggb tKvb জলস্রোত যাহা স্থায়ীভাবে অথবা পযায়ক্রমে সমুদ্রমুখী যেখানে সমুদ্রের Rj i wk hnvvi we`0z cwi gvc0hvM`, f0g nBtZ c0v0nZ cwbi m0nZ wgvkZ nq;
- (31) 00mi Kvi 00 A_GB AvB0bi D0i k` c0YK0i cwmb m00` g0Yvj q;
- (32) 00msi 00Y00 A_ cwmb m000` i Dc0hvMxZv ew0, AcPq I 0q nvmKiY, cwi i 0Y I mj 00vI A0f0 nBte;
- (33) 00mj 00v00 A_ cwmb m00` msi 000Yi Rb` we0a-wb0l a ev kZ0ivc;
- (34) 00mj 00v Av0` k00 A_ aviv 27 Gi Aaxb BmjKZ tKvb Av0` k; Ges
- (35) 00nvl o00 A_ 0wU wfb0eb`xi ga`0tj c0KwZKfvte m0 KovB AvKwZi en`vKvi tKvb wbg0f0g |

3 | cwbi AwaKvi I Dnvi e`envi | -

- (1) AvcvZZt ej er Ab` tKvb AvB0b wfb0zi hnvv wKQ0 _vK0 bv tKb, iv00i mxgvbvf0 wbgewYZ cwbi mKj AwaKvi Rb00Yi c00 i v00i Dci AvcZ _wKte, h_v: -
 - (K) f0wi `cwmb;
 - (L) fMF0` cwmb;
 - (M) mvgv` K cwmb;

(N) এখনি চম্ব; Ges

(O) এখনি চম্ব |

(2) GB AvBtbi weavbvej mvtctf, mfcq cwb Ges cwi "Qbzv I cqtwb®vktbi Rb" e'envh© cwb i AwaKvi mevaKvi wnmvte wefepZ nBte |

(3) Dcaviv-(1) G hrvn wKQB _vKK bv tKb, e'w³ gwj Kvbvaxb fvgi f'ewi ' cwb i mKj AwaKvi D³ fvgi gwj tKi _vKte Ges wZwb GB AvBtbi weavbvej mvtctf Dnv e'envi Kwi tZ cwi teb:

Zte kZ©_vtK th, D³ cwb i AcPq I Ace'envi tivaKti Ges Dnv i mj flv I msi flti c0qvrBt befnx KugwU `elg'nxbfvte thtKvb fvgi gwj tKi c0Z mj flv Avt`k Bmj Kwi tZ cwi te |

(4) GB AvBb KvhRi nBevi Ae'ewZ cte°ej er tKvb AvBb, weva, c0eva, AvBtbi flgzv m'ubctKvb c0v ev i xwZ, Pw³, j vBtmY ev cvigti Aaxb cwb e'envti tflti Dc-aviv (1) Gi tKvb wKQB tKvb e'w³tK ewi Z Kwi te bv Ges GB AvBb 0viv mxwZ, ewi Z, wbgwZ ev ewiZj Kiv bv nBtj cwb i D³ ifc e'envi Pj gvb I Ae'vnZ _vKte:

Zte kZ©_vtK th, cwb i D³ ifc e'envti AwaKvi Dch³ KZetfl i AbgwZ e'ZxZ n'isli thvM' nBte bv |

(5) Dc-aviv (3) Gi Aaxb cwb e'envti m'evat_c0Z`K e'w³ i e'w³gwj Kvbvaxb ev iv0tq fvgtZ eZ°E _vKte (easement):

Zte kZ©_vtK th, Rj vavti i ZxieZ® fvg gwj tKi Dnv Zj t`k Ges tdviktvi i Dci tKvb c0Kvi AwaKvi _vKte bv |

wZxq Aa'vq

RvZxq cwb m'ú` cwi I` Ges Dnv i KvhRj x I flgzv

4 | RvZxq cwb m'ú` cwi I` |—

(1) GB AvBtbi Dti k'ctYKti, RvZxq cwb m'ú` cwi I` bvtg GKwU cwi I` _vKte Ges GB AvBb KvhRi nBevi ci miKvi, h_vkxN0 m'0, miKwi tMtrtU c0vcb 0viv, wbgewZ m`m` mgstq D³ cwi I` MVb Kwi te, h_v:—

(K) c0vbgšx whvb Dnv i tPqvi cvm0I nBteb;

(L) A_°gšYvj tqi `wqtZj wbtqvwRZ gšx;

(M) KwI gšYvj tqi `wqtZj wbtqvwRZ gšx;

(N) cwi Kí bv gšYvj tqi `wqtZj wbtqvwRZ gšx;

(ঙ) স্থানীয় সরকার, পল্লী উন্নয়ন ও সমবায় মন্ত্রণালয়ের দায়িত্বে নিয়োজিত মন্ত্রী;

(P) AvBb, wePvi I msm` weIqK gšYvj tqi `wqtZj wbtqvwRZ gšx;

- (Q) fwg gšŸvj tqi `vqfZi;wb tqvRZ gšŸ;
 - (R) cvnb mæú` gšŸvj tqi `vqfZi;wb tqvRZ gšŸ;
 - (S) ci i vó`gšŸvj tqi `vqfZi;wb tqvRZ gšŸ;
 - (T) grm` I cŃY mæú` gšŸvj tqi `vqfZi;wb tqvRZ gšŸ;
 - (U) tbš cwi enY gšŸvj tqi `vqfZi;wb tqvRZ gšŸ;
 - (V) cwi tek I eb gšŸvj tqi `vqfZi;wb tqvRZ gšŸ;
 - (W) cvnb mæú` gšŸvj tqi `vqfZi;wb tqvRZ cŃZ gšŸ (hw` _v†K);
 - (X) RvZxq msm†` i cvnb mæú` gšŸvj q mæúwKŸ `vqx KugwU i mfvciZ;
 - (Y) gšŸ cwi I ` mŸPe;
 - (Z) cŃvbgšŸ Kvh† tqi gŸ` mŸPe;
 - (_) cŃvbgšŸ KZŸ g†bvbxZ cŃvmbK ŸefvMmgŸ nB†Z GKRb Kwi qv msm` m`m`;
 - (^) fwg gšŸvj tqi vmbqi mŸPe ev mŸPe;
 - (a) A_ŸwZK mæúKŸefv†Mi vmbqi mŸPe ev mŸPe;
 - (b) grm` I cŃY mæú` gšŸvj tqi vmbqi mŸPe ev mŸPe;
 - (c) KwI gšŸvj tqi vmbqi mŸPe ev mŸPe;
 - (d) cwi tek I eb gšŸvj tqi vmbqi mŸPe ev mŸPe;
 - (e) `vbxq mi Kvi gšŸvj tqi vmbqi mŸPe ev mŸPe;
 - (f) ci i vó`gšŸvj tqi vmbqi mŸPe ev mŸPe;
 - (g) tj vRm†j wJf I msm` velqK Ÿefv†Mi vmbqi mŸPe ev mŸPe;
 - (h) cwi Kí bv Kugk†bi KwI , cvnb mæú` I cj Ÿ cŃZŃvb Ÿefv†Mi m`m`;
 - (i) evsj v†` k cvnb Db†b tev†WŸ gnvci Pvj K;
 - (j) cvnb mæú` cwi Kí bv cwi I †` i gnvci Pvj K;
 - (k) thš_ b`x Kugk†bi m`m`;
 - (l) Bbw÷wJDU Ae BwÄwbqvm®evsj v†` k Gi tç†WwU;
 - (m) Bbw÷wJDU Ae w†cŸgv BwÄwbqvm®evsj v†` k Gi tç†WwU;
 - (n) cŃvbgšŸ KZŸ g†bvbxZ 3 (wZb) Rb cvnb w†kI Á;
- (o) cŃvbgšŸ KZŸ g†bvbxZ temi Kwii tm"Qv†mex ms`vi (GbwRI) 1(GK) Rb cŃZwba; Ges
 (p) cvnb mæú` gšŸvj tqi vmbqi mŸPe ev mŸPe, whwb Dnvi m`m`-mŸPeI nB†eb |
- (2) cwi I †` i g†bvbxZ m`m`M†Yi tgqv` nB†e 2 (^ß) ermi , Z†e g†bvbxZ †Kvb m`m` ,
 tgqv` †kI nBevi c†e®th †Kvb mgq, cŃvbgšŸi D†i †k` `Ÿi Khy³ c††hv†M `xq
 c`Z`vM Kwii †Z cwi †eb Ges Z` KZŸ c`Z`vMc† MpxZ nBevi Zwii L nB†Z mskŃ c`wJ
 kb` nBqv†Q ewj qv MY` nB†e |

(3) mi Kvi, cŕqRtb, mi Kwii tM†R†U cŕVcb ōviv, cwi l† i m`m` msL`v nwm ev eŕx Kwii †Z cwi te |

5 | cwi l† i Kvhŕej x | – GB AvB†bi D†i k` c†YK†i Ges Dnvi weavvej x mv†c†ŕ, cwi l` nBte mteP bŕwZ wbaŕ Yx KZŕŕ Ges Z`†i †k` cwi l† i Kvhŕej x nBte wbgŕc, h_v:–

(K) cwb mŕú† i mgwšZ Dbŕb, mŕye`envi, wbi vc` Avni Y, mŕg eUj, mŕŕv I mŕŕŕŕ wel†q bŕwZ wbaŕ Y I w`K-wb†`Rbv cŕ vb;

(L) cwb mŕú† i mgwšZ Dbŕb wŕwŕZK†i জাতীয় পানি সম্পদ পরিকল্পনা সংক্রান্ত w`K-wb†`Rbv cŕ vb;

(M) RvZxq cwb mŕú` cwi Kí bv Ab†gv` b I Dnvi ev`ŕvqb wŕwŕZKi Y; Ges

(N) cwi l` KZŕ wŕwŕ ŐKZ Ab` th†Kvb Kvhŕej x mŕúv` b Kiv |

6 | cwi l† i mfv | –

(1) Dc-aviv (2) Gi weavb mv†c†ŕ, cwi l` Dnvi mfv KvhŕxwZ wbaŕ Y Kwii †Z cwi te |

(2) cwi l† i mfv †Pqvi cvimb KZŕ wŕwŕ ŐKZ `vb I mg†q cwi l† i m`m`-mŕPe KZŕ AvnZ nBte |

(3) cwi l† i mfvq mfv cvwZ; Kwii te b Dnvi †Pqvi cvimb, ev Zvni Abjcw`†Z †Rŕ` m`m` |

(4) cwi l† i †Kvb m`m`c` kb` _wKevi A_ev cwi l` MV†b †Kvb †wU _wKevi Kvi†Y cwi l† i †Kvb Kvhŕev Kvhŕviv A%ea nBte bv ev Zrmŕú†K†Kvb cŕwŕDŕvcb Kiv hŕte bv |

7 | AvšRŕZK I Avŕwŕj K mn†hwMzv Av`vb-cŕ vb | –

(1) GB AvBb I AvcvZZt ej er Ab`vb` AvB†bi weavvej mv†c†ŕ, cwi l`, Dc-aviv (2) G D†j wLZ mn†hwMxZv Kvhŕi Kwii evi j†ŕ, th†Kvb we†`kx ivŕ, mi Kvi ev AvšRŕZK ev Avŕwŕj K ms`vi mŕwZ cŕqRbxq mg†SvZv `ŕi K, Pwŕ, Kb†fkb, wUw ev Abjfc †Kvb BŕU†gU (instrument) mŕúv` b Kwii †Z mi Kvi†K ci vgk`cŕ vb Kwii †Z cwi te |

(2) সরকার, পরিষদের পরামর্শক্রমে, নিম্নবর্ণিত িel†q th†Kvb we†`kx ivŕ, mi Kvi ev AvšRŕZK I Avŕwŕj K ms`vi mn†hwMzv Av`vb-cŕ vb Kwii †Z cwi te, h_v:–

(K) Avfbaecwb mŕú` mŕúwKŕ wefbaeZ`-Dcvŕ wewbgq I we†kŕ Y;

(L) AvšRŕZK b`xi Dci thŕ` Rwi c, mgŕŕv I M†el Yv Ges Dnvi i vmvqubK Ges `Re`†Y cŕZ†i†a যৌথ কার্যক্রম;

(গ) আন্তর্জাতিক নদীসমূহের পানি সম্পদের উন্নয়ন, আহরণ ও বন্টন কার্যক্রম; এবং

(ঘ) পানি সম্পদ সংশ্লিষ্ট শিক্ষা ও প্রশিক্ষণ কার্যক্রম ।

8 | RvZxq cwb bŕwZ cŕq†bi ŕgZv | –

(1) mi Kvi, Dc-aviv (2) Gi weavvej mv†c†ŕ, mgq, mi Kwii tM†R†U cŕVcb ōviv, cwb সম্পদ সংক্রান্ত জাতীয় পাŕw bŕwZ cŕq†bi Kwii †Z cwi te |

- (2) Dc-aviv (1) Gi Aaxb RvZxq cwb bxnZ cŷqtbi tŷtŷ miKvi cwb mʔú`i mwnZ msukó RbŷMvóx I msMVŷbi gZvgZ Mŷtbi Rb` weia 0viv wbaŷi Z c×wZŷZ MYi bwb i AvŷqvRb Kwi te Ges i bwbŷZ cŷB gZvgZ weŷPbvq Avwbqv RvZxq cwb bxnZ Pwŷŷ Kwi ŷZ nBte |
- (3) mi Kvi RvZxq cwb bxnZŷZ Dchy³ KZŷŷ KZŷ cwb i gj` wbaŷŷYi bxnZgvj v Aŷŷŷ i tŷtŷ mi Kvi wbgewŷZ weŷ qmn cŷwŷZK Ab`vb` weŷ q weŷPbv Kwi te, h_v:-
- (K) cwb e`envŷi i Dŷŷ k` ev tŷtŷ;
 - (L) cwb tmev tŷvMxi mvq_;
 - (M) cwb AvniY I mieivŷni cŷKZ LiP;
 - (N) tmev tŷvMx ev Dnvi tkYx weŷkŷŷ i Avw_ŷ ŷŷgZv I AbMŷi Zv;
 - (O) cwb i Pwv`v I mieivn;
 - (P) mi Kvi KZŷ weŷwPZ Ab` tKvb cŷwŷZK weŷ q |
- (4) Dc-aviv (1) Gi Aaxb RvZxq cwb bxnZ cŷxZ bv nl qv chŷŷ GB AvBb Kvhŷŷ i nBevi Ae`ewZ cŷe`mi Kvi KZŷ cŷxZ RvZxq cwb bxnZ, GB AvBŷbi weavbwevj i mwnZ mvqÄm`cY`h I qv mvŷcŷŷ, ej er _wKŷe |

ZZxq Aa`vq

wbeŷx Kwgwŷ Ges Gi `wqŷZi KZŷ I ŷŷgZv

9 | wbeŷx Kwgwŷ | -পরিষদেও কার্যক্রম সুষ্ঠুভাবে পরিচালনার জন্য উহার একটি নির্বাহী কমিটি থাকিবে
Ges wbeŷx wbgewŷZ m`m`MŷYi mgŷŷq MwZ nBte, h_v:-

- (K) cwb mʔú` gŷŷvj ŷqi `wqŷZi wŷqvwRZ gŷŷ;
- (L) `vbxq mi Kvi, cj ŷ Dbqŷb I mgevq gŷŷvj ŷqi `wqŷZi wŷqvwRZ gŷŷ;
- (M) Kwŷ gŷŷvj ŷqi `wqŷZi wŷqvwRZ gŷŷ;
- (N) cwŷ ŷek I eb gŷŷvj ŷqi `wqŷZi wŷqvwRZ gŷŷ;
- (O) grm` I cŷwY mʔú` gŷŷvj ŷqi `wqŷZi wŷqvwRZ gŷŷ;
- (P) fwg gŷŷvj ŷqi `wqŷZi wŷqvwRZ gŷŷ;
- (Q) cwb mʔú` gŷŷvj ŷqi `wqŷZi wŷqvwRZ cŷZ gŷŷ (hw` _vŷK);
- (R) cwŷ Kí bv Kwgkŷbi Kwŷ, cwb mʔú` I cj ŷ cŷZôvb wefvŷMi m`m`;
- (S) Kwŷ gŷŷvj ŷqi wwbqi mwPe ev mwPe;
- (T) `vbxq mi Kvi wefvŷMi wwbqi mwPe ev mwPe;
- (U) tj wRmŷj wŷf I msm` weŷ qK wefvŷMi wwbqi mwPe ev mwPe;
- (V) cwb mʔú` gŷŷvj ŷqi wwbqi mwPe ev mwPe;
- (W) grm` I cŷwY mʔú` gŷŷvj ŷqi wwbqi mwPe ev mwPe;

- (X) cwi tek I eb gšÿvj țqi vmbqi mipe ev mipe;
- (Y) fwg gšÿvj țqi vmbqi mipe ev mipe;
- (Z) cwi tek Ava` Bti i gncwi Pvj K;
- (_) evsj v` k cvmb Dbqb tevWf gncwi Pvj K;
- (^) `vbxq mi Kvi cKŠkj Ava` Bti i cãvb cKŠkj x;
- (a) Rb`^` cKŠkj Ava` Bti i cãvb cKŠkj x;
- (b) thš_ b`x Kvgktbi m`m`;
- (c) mi Kvi KZR gtbvbxZ 2 (^ B) Rb cvmb wetkIA;
- (d) mi Kvi KZR gtbvbxZ temi Kwii tm`Ovtmex ms`vi (GbwRI) 1 (GK) Rb cãZmbwa; Ges
- (e) cvmb m`u` cwi Kí bv ms`vi gncwi Pvj K, vmb Dnvi m`m`-mipeI nBteb |
- 10 | vbeñx KvguJi `vqZi | KZE` | – vbeñx KvguJi `vqZi | KZE` nBte vbgie/c, h_y:-
- (K) cvmb m`u` vel țq cwi I` KZR cõ E vbt` Rbv, mpcwi k, BZ`w` cKvk, cPvi, cwi exñY I gj`vqb;
- (L) RvZxq cvmb bwiZ I RvZxq cvmb m`u` cwi Kí bv cPvi, cwi exñY I gj`vqb;
- (গ) জাতীয় পানি নীতি ও জাতীয় পানি সম্পদ পরিকল্পনা, ব্যবস্থাপনা ও আন্তঃখাত সমন্বয় সংক্রান্ত সকল বিষয়ে কার্যক্রম গ্রহন;
- (N) পানি সম্পদ ব্যবস্থাপনা সংক্রান্ত বিষয়ের উপর পর্যাবৃত্তে পরিষদকে অবহিতকরণ ও পরামর্শ প্রদান;
- (ঙ) উপযুক্ত কর্তৃপক্ষের মধ্যে সমন্বয় সাধন ও আন্তঃসংস্থা বিরোধ নিষ্পত্তি সংক্রান্ত নীতি নির্ধারণ ও cõqvRbxq vbt` Rbv cõ vb Ges cõqvRtb Dnv vb`u`EKiY; Ges
- (P) cwi I` KZR AwcZ Ab` th tKvb Kvhewj m`u` b |
- 11 | vbeñx KvguJi mfv | –
- (1) GB AvBti weavbvevi mvtcñ, vbeñx KvguJ Dnvi mevi KvhE`xwZ vbañY Kwii țZ cwi te |
- (2) নির্বাহী কমিটি সকল সভা, সরকারের সম্মতিক্রমে, উহার সদস্য-মিপি KZR AvnZ nBte Ges mfvicwZ KZR vbi` KZ `vb I mgțq D³ mfv AbjõZ nBte |
- (3) vbeñx KvguJi mfvq Dnvi mfvicwZ mfvicwZZi Kwii țeb |
- (4) vbeñx KvguJi tKvb m`m`c` kb` _vñKevi A_ev vbeñx KvguJ MVtb tKvb ÎawU _vñKevi Kvi țY vbeñx KvguJi tKvb Kvh`ev Kvhñiv A`ea nBte bv ev Zrm`u`țKñKvb cKãD` vcb Kiv hvBte bv |
- 12 | cãZcvj b Av` k (compliance order) Bmj Kwii evi ñlgZv | –
- (1) h_vh_ AbynÜvb, cixñv- vbi xñv ev Rwi țci djvdțj i vfvE`Z hw` vbeñx KvguJ tKvb ÎawU _vñKevi Kvi țY vbeñx KvguJi vbKU cZxqgvb nq th, tKvb e`w³ ev Dchj³ KZE`ñ aviv 18,19,20,21,22,24 I 26 Gi tKvb weavb ev Ovocțîi tKvb kZ`ev mjñv

Avf`tki tkvb weia wbtla ev kZcZcvj b ev cwi cvj b Kwi tZtQ bv ev j sNb ev j sNtbi tPov Kwi tZtQ Zvrv nBtj AvcvZZt ej er Ab` tkvb AvBtb wfbzi hvrv wKoz_vKK bv tkb wbehx KvguU ev ZrKZR gZvcB tkvb KgRZP, D³ e^{w3} ev Dchy³ KZEqtK Avf`tk Dvj mLZ wv` e mgtqi gta` GB AvBb ev mj qv Avf`tki tkvb weia-wbtla ev kZcZcvj b Kwi evi Rb` cZcvj b Avf`k Bmj Kwi tZ cwi te |

(2) wbehx KvguU ev ZrKZR gZvcB KgRZP Dc-aviv (1) G Dvj mLZ cZcvj b Avf`k, aviv 42 Gi weavb mvctq weia oviv wbañi Z cxwZtZ Rwi Kwi te |

(3) cZcvj b Avf`tki ggobhvqx tkvb Dchy³ KZEqt (e^{w3} e^{ZxZ}) GB AvBb ev mj qv Avf`tki tkvb weia-wbtla ev kZev Ovocfi kZcZcvj b bv Kti, Zvrv nBtj wbehx KvguU, D³ KZEqtK aviv 29 Gi Aaxb wePvi wefvMxq Kvhaviv Mhb ev Rwi gvrv Avtvc bv Kwiqv Dnvi cavbtK D³ ifc weia-weavb ev kZcZcvj b bv Kwi evi KviY e^{vL} Kwi evi Rb`, GB AvBtbi Ab`vb` weavtb wfbzi hvrv wKOB_vKK bv tkb, KvguU mfvq Zje Kwi tZ cwi te Ges D³ KviY mtSrl RbK bv nBtj `vqx e^{w3} tk wPwYz Kwiqv Zvrv weiax cOqvRbxq e^ev Mhtbi Rb` cwi t` i wku mpcwi k cOvb Kwi tZ cwi te |

(4) cZcvj b Avf`tk Ab`vb` vel tqi mrvZ wogewZ vel qw` I Dvj L_wkTe, h_v:-

- (K) weia-wbtla ev j sNbKvixi bvg I wKvbvrvn cY% weeiY;
- (L) j sNz weia-weavb ev kZewj i weeiY;
- (M) cZcvj tbi mgqmxgv;
- (N) wbehx KvguU KZR wv` eKZ Ab` tkvb cOqvRbxq vel q |

(5) cZcvj b Avf`tk Avil Dvj L_wkTe th, Dchy³ KviY e^{ZxZ} D³ Avf`k cZcvj b bv Kiv Rwi gvrvthvM` Ges `Ubxq GKul Aciva |

(6) cZcvj b Avf`k Bmji cte^owbehx KvguU ev ZrKZR gZvcB tkvb KgRZP weia oviv wbañi Z cxwZtZ msuk e^{w3} ev KZEqtK i bvbvi hv³m¹/2 mthvM cOvb Kwi te Ges wv^xisMhtbi tqt ZrKZR Dc^wncZ e³e^w wetePbv Kwi te |

(7) cZcvj b Avf`k Rwi i vel quU, weia oviv wbañi Z cxwZtZ, wOU I Btj KUwbK gva`tg MYweAwB oviv euj cKvk I mvavtY` cPtii e^ev Kiv hvBte |

13 | AcwviY Avf`k (removal order) Bmj Kwi evi qgZv | -

(1) GB AvBb ev mj qv Avf`tki tkvb weia-wbtla ev Ovocfi tkvb kZ^oj sNb Kwiqv hw` কোন ব্যক্তি বা উপযুক্ত কর্তৃপক্ষ পানি সম্পদের উপর এমন কোন স্থাপনা নির্মাণ বা ভরাত কার্যক্রম Mhb Ktib hvrv Rj tmtZi `vfwek cevtn evav mrv ev Dnvi MwZc_cwievZ Kti Zvrv nBtj AvcvZZt ej er AY` tkvb AvBtb hvrv wKoz_vKK bv tkb, wbehx KvguU ev ZrKZR gZvcB tkvb KgRZP D³ Rj tmtZi `vfwek cevn wvOZKti Avf`tk Dvj mLZ wv` e

- সময়ের মধ্যে উক্ত স্থাপনা অপসারণ বা ভরাট কার্যক্রমে ব্যবহৃত উপকরণ ev Dcv`vb Acmvi Y Kwi evi Rb` D³ e`w³ ev Dch³ KZঐ†¶i Dci Acmvi Y Av†`k Bmj Kwi †Z cwi †e |
- (2) wbe†hx Kugul ev ZrKZঐ ¶lgZvc†B KgRZP Dc-aviv (1) G D†j mLZ c†Zcvj b Av†`k, aviv 42 Gi weavb mv†c†¶¶i weia Øviv wba††i Z c×wZ†Z Rwi Kwi †e |
- (3) Acmvi Y Av†`k Bmji c†e¶wbe†hx Kugul ev ZrKZঐ ¶lgZvc†B †Kvb KgRZP weia Øviv wba††i Z c×wZ†Z msukó e`w³ ev KZঐ¶†K i`bwbi h³m½Z m†hvM cØvb Kwi †e Ges w×vš†M††bi †¶†† ZrKZঐ Dc`wcz e³e` we†Pbv Kwi †e |
- (4) Acmvi Y Av†`k Dwj mLZ wbw`Ø mg†qi g†a` †Kvb Dch³ Kvi Y e`ZxZ `vcbv Acmvi Y বা ভরাট কার্যক্রম বন্ধ করা না হইলে আপাততঃ বলবৎ অন্য কোন আইনে ভিন্নতর যাহা কিছুই _vKK bv †Kb, wbe†hx Kugul, Rj †m†Zi `†vweK c†vn wbuØZK††, weia Øviv wba††i Z পদ্ধতিতে নোটিশ প্রদান করিয়া উক্তরূপ স্থাপনা অপসারণ বা ভরাট কার্যক্রমের প্রকৃত খরচ উক্ত e`w³ i wku nB†Z aviv 43 Gi weavb mv†c†¶¶i weia Øviv wba††i Z c×wZ†Z Av`vq Kwi †Z cwi †e |
- (5) Acmvi Y Av†`k Ab`vb` we††qi minZ wgewYঐ we†qw` I D†j L _wK†e, h_v:-
 (ক) স্থাপনা নির্মাণকারীর বা ভরাট কার্যক্রম গ্রহনকারীর নাম ও ঠিকানাসহ পূর্ণাঙ্গ বিবরণ;
 (L) A%aa `vcbv ev fi vU Kvhঐমের বিবরণ;
 (M) Acmvi †Yi mgqmvgv;
 (N) wbe†hx Kugul KZঐ wbw`ØKZ Ab` †Kvb we†q |
- (6) স্থাপনা অপসারণ বা ভরাট কার্যক্রমে ব্যবহৃত উপকরণ বা উপাদান অপসারণের প্রকৃত খরচ অপসারণ কার্যক্রম গ্রহনের পূর্বে সংশ্লিষ্ট ব্যক্তির বক্তব্য বিবেচনা করিয়া নির্ধারণ করিতে হইবে ।
- (7) Acmvi Y Av†`k Rwi i we†qul, weia Øviv wba††i Z c×wZ†Z, wcu I B†j KU†bK gva†g MYweÁwB Øviv e†j c†Kv I m†v†Y` c†v†i i e`v Kiv hvB†e |
- 14 | gnvcwi Pvj K KZঐ m†v†eK m†vqZv cØvb I cwi `k†Ki ¶lgZv Ac† |—
- (1) gnvcwi Pvj K wbe†hx Kugul i Kvh†w†j m†v††e m†v`†bi j†¶¶ Dn†K mKj c†Kvi c†Kv†bK I m†v†eK m†vqZv cØvb Kwi †e |
- (2) GB AvB†bi D††k` c†YK††, gnvcwi Pvj †Ki `wqZ†nB†e wge†fc, h_v:-
 (K) cwi I` I wbe†hx Kugul KZঐ M†xZ b†wZ I Kg†šv ev `†vqb I c†qvM Kiv;
 (L) cwi I` I wbe†hx Kugul w†` Rbvi Av†j v†K Dnvi m†vq Dc`vc††bi w†w†E mKj c†Kvi cØ†e;
 (M) th †Kvb `vb ev c††† Gj vKv cØk† Kiv;
 (N) GB AvBb m†v†wKঐ we††q Rbm†PZbZv m†v†i j†¶¶ c†qvRbxq c`†¶c M†b Kiv;
 (O) cwi I` I wbe†hx Kugul KZঐ, mgq mgq, Awcঐ Ab`vb` `wqZ†cvj b Kiv |

- (4) Dc-aviv (3) Gi Aaxb c⁰qvRbxq e^e-v M⁰tbⁱ ci vbe⁰fx KvguU D³ cwi Kⁱ bvi GKuU Lmov me⁰vavi⁰Yi AwFgZ M⁰tbⁱ Rb⁰ mi Kwi tM⁰RtU c⁰K-c⁰Kv Kwi te Ges wWvRUvj , Btj KU⁰bk ev w⁰c⁰U wgvWqvq Dnvi e^uj c⁰Pvtⁱ i c⁰qvRbxq e^e-v M⁰tb Kwi te |
- (5) RvZxq cwb m⁰u⁰ cwi Kⁱ bvi tKvb w⁰l⁰q tKvb e^w3 i tKvb g⁰š^e ev m⁰cwi k _w⁰k⁰tj Dc-aviv (4) Gi Aaxb tM⁰RU c⁰Kvtki Zwi L nBtZ 90 (beYB) w⁰ tbi g⁰ta⁰ vbe⁰fx KvguU ev ZrKZ⁰ w⁰b⁰ŠKZ Kg⁰RZ⁰P ev Kvh⁰q⁰ tqi w⁰bKU D³ g⁰š^e ev m⁰cwi k wWvRUvj , wj wLZfv⁰te ev Ab⁰ tKvb Dcv⁰q⁰ wLj ev tc⁰Y Kwi tZ cwi te |
- (6) Dc-aviv (5) Gi Aaxb c⁰B g⁰š^e ev m⁰cwi k hw⁰ _vtK, w⁰tkd Yce⁰ Dnv w⁰tePbvq j Bqv vbe⁰fx KvguU RvZxq cwb m⁰u⁰ cwi Kⁱ bviU c⁰ptc⁰Z Kwi te Ges Dnv cwi t⁰ i Ab⁰gv⁰ tbi Rb⁰ Dc⁰-vcb Kwi te |
- (7) cwi l⁰ Dnvi mfvq RvZxq cwb m⁰u⁰ cwi Kⁱ bvi Dci h_vh_ Av⁰tj vPbv Kwi qv Dnvi h_v_Švi w⁰l⁰q w⁰b⁰ŠZ nBqv Dnv Ab⁰gv⁰ b Kwi tZ cwi te ev Dnv⁰Z c⁰qvRbxq m⁰stkvab Avbqb Kwi tZ cwi te ev c⁰qvRbxq m⁰stkvab Kwi evi Rb⁰ vbe⁰fx KvguU tK w⁰t⁰ R c⁰vb Kwi tZ cwi te |
- (8) cwi l⁰ KZ⁰ Ab⁰gv⁰ tbi ci vbe⁰fx KvguU RvZxq cwb m⁰u⁰ cwi Kⁱ bviU mi Kwi tM⁰RtU c⁰Kv Kwi te Ges cwb m⁰u⁰ g⁰š⁰Yj tqi l⁰qemvBtU c⁰Pvi Kwi te |
- (9) Dc-aviv (7) Gi Aaxb RvZxq cwb m⁰u⁰ cwi Kⁱ bv P⁰vš⁰ bv nI qv ch⁰Š⁰, GB AvBb Kvh⁰Ši nBevi Ae⁰ew⁰Z c⁰te⁰cwb m⁰u⁰ cwi Kⁱ bv ms⁰-v KZ⁰ c⁰YxZ National Water Management Plan GB AvBb l RvZxq cwb b⁰w⁰Zi w⁰avbv⁰wj i m⁰w⁰Z mvg⁰Am⁰-c⁰Y⁰ nI qv m⁰vt⁰ct⁰q, c⁰qvRbxq Aw⁰f⁰thvRbmn ej er _w⁰k⁰te |
- (10) vbe⁰fx KvguU P⁰vš⁰KZ RvZxq cwb m⁰u⁰ cwi Kⁱ bvi GKuU Kuc cwb m⁰u⁰ Db⁰qb c⁰Kⁱ M⁰tbKvix ev c⁰YqbKvix ev ev⁰-lvqbKvix mKj ms⁰-v ev Dch⁰Š KZ⁰ev⁰ ev⁰-vbxq mi Kvi c⁰Z⁰v⁰tbi w⁰bKU tc⁰Y AvBb l RvZxq cwb b⁰w⁰Zi w⁰avbv⁰wj Ab⁰niY Ges RvZxq cwb m⁰u⁰ cwi Kⁱ bv g⁰ta⁰ _w⁰k⁰qv cwb m⁰u⁰ Db⁰qb c⁰Kⁱ M⁰tb l ev⁰-lvq⁰tbi Rb⁰ Ab⁰iva Kwi te
- (11) Dc-aviv (10) Gi Aaxb c⁰Š Ab⁰iva c⁰t⁰ Ab⁰-vb⁰ w⁰l⁰q i m⁰w⁰Z Avi l D⁰tj l _w⁰k⁰te th, GB AvBb ev Q⁰voc⁰t⁰ tKvb kZ⁰ev m⁰j⁰ q⁰Av⁰ tki tKvb w⁰wa-⁰w⁰t⁰l a ev kZ⁰c⁰Z⁰cvj b Kiv eva⁰-Zvgj K Ges Dch⁰Š KviY e⁰-ZxZ Dnv c⁰Z⁰cvj b bv Kiv Rwi gv⁰vt⁰h⁰M⁰ Ges GKuU⁰ _Übxq Aciva |
- (12) GB AvB⁰tbi Aaxb RvZxq cwb m⁰u⁰ cwi Kⁱ bv P⁰vš⁰ nBevi ci cwb m⁰u⁰ Db⁰qb c⁰Kⁱ M⁰tbKvix ev c⁰YqbKvix ev ev⁰-lvqbKvix c⁰Z⁰-K ms⁰-v ev Dch⁰Š KZ⁰ev⁰ ev⁰-vbxq mi Kvi

cĀZōvb RvZxq cwb mṣú` cwi Kí bvi mwnZ mvgĀm` i wLq D³ cĀKí Mōb ev cŸqb ev ev`ēvqb Kwi tZ eva` _wKte |

e`vL`vt GB avivq ŪAeewmKivó A_ēyó, eid, Zlvi cvZ, BZ`w` nBtZ mṑ cēvn th AĀj ev AĀj mgñi Dci w` tḡ cēwinZ nBqv Rj vavti cūZZ nq |

16 | cwb mṣú` Dbqb cĀKí i QvocĀ BmjKiY | –

(1) AvciZZt ej er Ab` tKvb AvBtb wfbz i hrvn wKOB _vKk bv tKb, cwb mṣú` Dbqb cĀKí RvZxq cwb mṣú` cwi Kí bvi mwnZ mvgĀm` i wLq D³ cĀKí MōbKvix, cŸqbKvix বা বাস্তবায়নকারী সংস্থা, উপযুক্ত কর্তৃপক্ষ, স্থানীয় সরকার প্রতিষ্ঠান প্রকল্পের কার্যক্রম শুরু Kwi evi cteB, wewa ōviv wbañi Z c×wZ ev ktZ, wbeñx KugwUj wBKU Avte` b Kwi te |

(2) Dc-aviv (1) Gi Aaxb Avte` b cĀBi ci wbeñx KugwU D³ Avte` b Ges msukó cĀKí i KvMRw` chñj vPbvší RvZxq cwb mṣú` cwi Kí bvi mwnZ Avte` bKZ cĀKí wL mvgĀm` cY`wKbv Dnv wboZ Kwi te Ges wewa ōviv wbañi Z c×wZ I ktZ`D³ Avte` b gĀj Kwi qv QvocĀ Bmj Kwi te A_ev bvgĀj Kwi qv KviY AewZ Kwi te |

(3) hw` tKvb cwb mṣú` Dbqb cĀKí MōbKvix, cŸqbKvix ev ev`ēvqbKvix tKvb ms`v, Dchj³ KZ`ñ ev `vbxq miKvi cĀZōvb QvocĀi tKvb kZ`j sNb Kti ev GB AvBtbi tKvb weavvewj j sNb Kti, Zvrv nBtj , wewa ōviv wbañi Z c×wZtZ, cŸqvRbxq AbjmŪvb Kwi qv wbeñx KugwU wboZ nBqv D³ ms`v, KZ`ñ ev cĀZōvbK wewa ōviv wbañi Z c×wZtZ i bwbi hñ³ m½Z mñhvM cŵvb Kwi qv D³ cĀKí i AbKtj cŵĒ QvocĀ cĀ`vni Kwi tZ cwi te Ges D³ ijc cĀ`vnti i wclw wclw I Btj KUbK gva`tg euj cĀKk I cŵvi Kwi tZ cwi te |

cĀg Aa`vq

cwb e`nvi wqšY Ges cwb mṣú` i mj`ñv I msi`ñY

17 | cwb msKUvcbaGj vKv tNvI Yv I Dnvi e`ē`vcbv | –

(1) miKvi wbeñx KugwUj mpcwi tki wfwĒtZ Rj vavi ev cwbavi K`ñi i mj`ñvi Rb`, h_vh_ AbjmŪvb, cix`ñv wix`ñv ev Rwi tci djvdtj i wfwĒtZ, miKwi tM`RtU cĀvcb ōviv, thtKvb Gj vKv ev Dnvi Askwētkl ev cwb mṣú` msukó thtKvb fwtK wov` ō mgtqi Rb` cwb msKUvcbaGj vKv wnmvte tNvI Yv w` tZ cwi te |

(2) Dc-aviv (1) Gi Aaxb Rwi KZ cĀvcb tgSRv g`vc I `wM bñt Dtj` Kwi qv cwb msKUvcbaGj vKvi mxgvbv wov` ō Kwi tZ nBte |

(3) wbeñx KugwU cwb msKUvcbaGj vKvi mṑz e`ē`vcbv wboZ Kwi evi j tñ`, GB AvBtbi weavvewj mvctññ, mj`ñv Avt` k ōviv thtKvb wewa-wbtl a Avti vc Kwi tZ cwi te |

18 | cwb msKUvcbaGj vKvq cwb m^ut` i AM^uraKvi wfv^EK eⁿvi | AeⁿviwZ |—

(4) AvciZZt ej er Ab` tKvb AvBtb wfb^zi hvnv wKQB _vKK bv tKb, RvZxq | `vbxq জনগোষ্ঠীর স্বার্থে, পানি সংকটাপন্ন এলাকার পানির প্রাপ্যতা সাপেক্ষে, নিম্ন ক্রমানুযায়ী পানির AvniY ev eⁿvi Kwi tZ nBte, h_v:-

(K) Lvevi cwb;

(L) Mn^vj x cwb;

(M) Kwl KvR;

(N) grmⁿ Pvl ;

(O) cwi t^tki fvi mvgⁿ;

(P) ebⁿ c^vx;

(Q) b` x^tZ cwb c^evn AⁿbaivLv;

(R) wkⁱ LvZ;

(S) j ebv³Zv wq^sy;

(T) weⁿ jr Drcvⁿ b;

(U) weⁿbvⁿ b; Ges

(V) Abⁿvbⁿ |

(5) wbeⁿx Kvgw, miKwi tM^tR^tU c^Avcb Øviv, mswkⁿ GjvKvi AvⁿmvⁿRK Aeⁿv | RbM^tYi gZvg^tZi wfv^EtZ Dc-পারা (১) উল্লিখিত ক্রম পরিবর্তন করিতে পারিবে।

(6) GB avivi D^ti kⁿ c^tYK^ti tKvb cwb msKUvcbaGj vKvi cwbi c^ocⁿZvi w^el^tq, w^eva Øviv wbaⁿi Z c^xwZ^tZ, w^wRUvj , B^tj KUⁿbK ev w^cU w^gw^qvq MYw^AwB Øviv e^uj c^kvk | m^vavi^tYⁿ c^ovi Kwi tZ nBte |

19 | fMf^o cwbaviK `tⁱi me^og^ewbivcⁿ AvniY w^eva-w^bta |—

(1) AvciZZt ej er Ab` tKvb AvBtb wfb^zi hvnv wKQB _vKK bv tKb, wbeⁿx Kvgw , h_vh_ AbⁿÜvb, cixⁿv-wixⁿv ev Rwi^tci djvd^ti wfv^EtZ, miKwi tM^tR^tU c^Avcb Øviv, th^tKvb GjvKvi fMf^o cwbaviK `tⁱi me^og^ewbivcⁿ AvniY mxgv (safe yield) wbaⁿY Kwi tZ cwi te |

(2) fMf^o cwbaviK `tⁱi me^og^ewbivcⁿ AvniY mxgv th GjvKvi Rbⁿ c^ohvRⁿ nBte tmB GjvKvi tg^sRv g^vc | `vM b^ut D^tj L Kwi qv Dnvi mxgvbv Dc-aviv (1) Gi Aaxb Rwi KZ c^Avcb w^b Kwi tZ nBte |

(3) tKvb eⁿ ev Dch³ KZ^e fMf^o cwbaviK `tⁱi me^og^ewbivcⁿ AvniY mxgv | weⁿgvb Abⁿvbⁿ AvB^tbi w^eav^vewj m^vt^t, fMf^o cwb Avni^tYi Rbⁿ w^eva Øviv wbaⁿi Z c^xwZ^tZ, Mfxi ev AMfxi bj Keⁿvcⁿ Kwi tZ cwi te |

(4) fMf[©] cwbaviK [~]ti meibgæmbivc` AvniY wbuðZ Kwi evi j t^{¶¶} wbeñx KigulU, GB AvBtbi weavbvej mvtct^{¶¶}, mj ¶¶ Avt` k Øviv thtKvb wea-wbtl a Avt[¶]vc Kwi tZ cwite |
 e`vL`vt GB avivq ōmbivc` AvniY mxgυ0 A[©]cwbaviK [~]li nBtZ Ggb tKvb cwigrY DtEj b hrvni dtj cwbaviK [~]li wbi vc` I mj w¶Z [~]vtK |

20 | Rj tmtZi [~]fvweK cævn wbuðZKiY |—

(1) Dch^³ KZ[©]t^{¶¶}i Abguz e`ZxZ tKvb e`w^³ ev ms[~]v, Rj vavti ,ZxieZ[¶]nDK ev bv nDK, [~]vcbv wbg^{¶¶} Kwi qv ev Rj vavi fivU Kwi qv ev Rj vavi nBtZ gwU ev ewj DtEj b Kwi qv Rj tmtZi [~]fvweK cævn eÜ ev Dnvi cævtn evav m[¶] ev Dnvi MwZc_ cwieZ[¶] ev cwieZ[¶]bi tPóv Kwi tZ cwite bv:

Zte kZ[©][~]vtK th, Rj vavti i Dbq[¶]bi [~]vt[©]ev Dnvi Zxti i fv½b tivaKtí h_vh_ mgx^{¶¶}vi
 ভিত্তিতে এবং উপযুক্ত কর্তৃপক্ষের অনুমোদনক্রমে, জলাধারে যেকোর স্থাপনা নির্মাণ বা জলাধার সম্পূর্ণ
 ev Dnvi Askw[¶]kl fivU Kiv hvBte:

Avi I Zte kZ[©][~]vtK th, c⁰KwZK eb`vi Kej nBtZ RbmvariY I Zvnt` i m[¶] i ¶¶[~]Dch^³
 কর্তৃপক্ষের অনুমোদনক্রমে, ধারা (২) এর সামগ্রিকতাকে ক্ষুন্ন না করিয়া জলাধারে বন্যা নিয়ন্ত্রণ বাঁধ
 wbg^{¶¶} Kiv hvBte |

(2) Rj tmtZi [~]fvweK cævn wbuðZ Kwi evi j t^{¶¶} wbeñx KigulU, GB AvBtbi weavbvej mvtct^{¶¶}, mj ¶¶ Avt` k Øviv thtKvb wea-wbtl a Avt[¶]vc Kwi tZ cwite |

21 | eb`v wqš[¶] eutai mj ¶¶ |—

(1) eb`v wqš[¶] eutai [~]wqZ[¶] i ¶¶[~]vt[©]Dnvi Dci ev Dnvi cvk[¶]tj tKvb e`w^³ KZ[©]t^{¶¶}i Abtgv` b e`ZxZ, tKvb c[¶]vi Ni ewo, [~]vcbv ev AeKvVtgv wbg^{¶¶} Kwi tZ cwite bv |

(2) Dc-aviv (1) G hrvn wKOB [~]vKK bv tKb, eua gReZKiY Ges mi Kvti i ebvqb Kg^{¶¶} ev [~]evq[¶]bi Rb`, c[¶]j Z b^wZgvj v AbymiYce[¶] eutai cvtk[¶]m[¶]mwZ I cwi Kwi Z Dcvtq Dch^³ e.¶ t[¶]vcY Kiv hvBte |

(3) Dc-aviv (1) G hrvn wKOB [~]vKK bv tKb, eutai mj ¶¶[~]vt[©]ev Dnvi Dci ev Dnvi cvk[¶]tj tKvb e`w^³ KZ[©]t^{¶¶}i Abtgv` bKt[¶]g moK ev iv[~]v wnmvte e`envi Kiv hvBte |

(4) hw` tKvb e`w^³, Dch^³ KZ[©]t^{¶¶}i Abguz e`ZxZ, Dc-aviv (1) Gi weavb j sNb Kwi qv eb`v wqš[¶] eutai Dci Ni ewo, [~]vcbv ev AeKvVtgv wbg^{¶¶} Kt[¶]ib, Zvrv nBtj wbeñx KigulU we`g[¶]v Ab`vb` AvBt[¶] hrvn wKOB [~]vKK bv tKb, wea Øviv wba[¶] Z c[×]wZtZ, Ac[¶]viY Avt` k c⁰vb Kwi tZ cwite |

(5) eb`v wqš[¶] eutai [~]wqZ[¶] wbuðZ Kwi evi Rb` wbeñx KigulU, GB AvBtbi weavbvej mvtct^{¶¶}, mj ¶¶ Avt` k Øviv thtKvb wea-wbtl a Avt[¶]vc Kwi tZ cwite |

22 | Rj vavi msi ǾǾY I e'e'vcbv | –

(1) AvciZZt ej er Ab' tKvb AvBtb wfbz'i hvnv wKQB _vKK bv tKb, h_vh_ AbjnÜvb, cixǾǾv-wbixǾǾv ev Rwi tci dj vd'tj i wfwÉtZ, wbeǾx KvgwUj wBKU hw` GB g'tg@cZxqgvb nq th,–

(K) tKvb c0KwZK ev Ab' tKvb Kvi tY m'tc'q cwbi Zxe^amsKU _vKvq m'tc'q cwbi Drm wnmv'te tKvb `xwN, cK'i ev Abj'fc tKvb Rj vavi msi ǾǾY Kiv Avi' c0qvRb; ev

(L) AvZw_ cwLi wbi vc` Ae'vb, Aeva wePiY Ges Afqvktg wbwÖZ Kwi evi Rb' tKvb nvl o, ewl o ev Abj'fc tKvb Rj vavi msi ǾǾY Kiv Avi' c0qvRbÑ

Zvnv nB'tj wbeǾx KvgwU, mxgvbv wvaviY Kwi qv m'tc'q cwbi Drm wnmv'te msukw Rj vavi msi ǾǾYi Rb' Dnvi gwj K ev Dch³ KZEǾtK mj ǾǾv Avt` k c0vb Kwi tZ cwii te |

(2) Dc-aviv (1) Gi Aaxb c0É Avt` k Rj vav'ti i tgSRv g'vc I `vM b^at Dtj L Kwi qv Dnvi mxgvbv wbw` 0 Kwi tZ nB'te |

(3) Rj vav'ti i m'pze'e'vcbv wbwÖZ Kwi evi j tǾǾ' wbeǾx KvgwU, GB AvB'tbi weavbvevj mvt'c'ǾǾ, mj ǾǾv Avt` k 0viv th'tKvb weva-wb'tla Av'tivc Kwi tZ cwii te |

23 | cwib AÄtj wfw³KiY I Dnvi e'e'vcbv | –

(1) cwib Kvhr'i Ges m'pze'env'ti i Dt'i t'k' msukw Ab'vb' gš'vj q, wfvM ev ms'vi mwNZ Av'tj vPbv I mgš'qceR wbeǾx KvgwU, h_vh_ AbjnÜvtbi wfwÉtZ mi Kwii tM'tR'tU c0Ävcb 0viv, th'tKvb Gj vKv'tK wbg'fc AÄtj wfw³ Kwi tZ cwii te, h_v:-

- (K) wki' cwib AÄj ;
- (L) Kwil cwib AÄj ;
- (M) Cl r t'j vbv cwib'tZ grm' Pvl (e'wKk GKqvKvj Pvi) cwib AÄj ;
- (N) n'vPwii cwib AÄj |

(2) Dc-aviv (1) G Dwj wLZ cwib AÄtj i m'pze'e'vcbv wbwÖZ Kwi evi j tǾǾ' wbeǾx KvgwU, GB AvB'tbi weavbvevj mvt'c'ǾǾ, mj ǾǾv Avt` k 0viv th'tKvb weva-wb'tla Av'tivc Kwi tZ cwii te |

24 | cwib gRZKi tY weva-wb'tla | –

(1) Dch³ KZEǾtǾǾi AbgwZ Ges GB AvBb AbjniY e'wZ'ti tK tKvb e'w³ tKvb Rj t'm'tZi cwib c0KwZK ev Kwil g avi t'k gRj Kwi tZ cwii te bv |

(2) cwib gRZKiY KgRvÜ wqš'g Kwi evi Rb' wbeǾx KvgwU, GB AvB'tbi weavbvevj mvt'c'ǾǾ, mj ǾǾv Avt` k 0viv th'tKvb weva-wb'tla Av'tivc Kwi tZ cwii te |

25 | eb'v wqš'g AÄj tNvl Yv I Dnvi e'e'vcbv | –

- (1) eb`vi Rj tmtZi c`evn wbeRdKwi evi j t`q` h_vh_ Abyu`vb I Rwi tci dj vdtj i wfvE`tZ wbeR`x KugwU, miKwi tM`RtU c`Avcb `vivi, thtKvb Rj vfwgtK, RvZiq c`OqvRbxq RbtMv`xi t`_`eb`v wqšY A`Aj wnmvte tNvl Yv Kwi tZ cwi te |
- (2) Dc-aviv (1) Gi Aaxb Rwi KZ c`Avctb eb`v wqšY A`Aj i tgsRv g`vc I `vM b`at D`tj Kwi qv Dnvi mxgvbv wv` ` Kwi tZ nBte |
- (3) Dc-aviv (1) Gi Aaxb tNvl Z eb`v wqšY A`Aj i mj`qv Rb` wbeR`x KugwU, mvavi Y t`q`t` wewa `vivi Ges w`tkl t`q`t` Av` k `vivi, D³ A`Aj i ga` w` qv eb`vi cwbi c`evn euv ev Rj vavti i cwbi c`evn cwi eZ`Kvix thtKvb KgRvU wvwl xKiY ev Dnvi Dci kZ`ivc Kwi tZ cwi te |

26 | Rj vavti i mgM`cwmb Avni`Yi wewa-wb`la |-(1) AvcvZZt ej er Ab` tKvb AvBtb wfb`zi hnvv wKQB _vKK bv tKb, Rj vavti i mgM`cwmb Avni Y Kwi qv m`u`Y`bt`kl Kiv hvBte bvt Zte kZ`_v`K th, GB AvB`bi weavbvej mvtct`q, e`w³gvj Kvbvaxb Rj vavti i cwmb Avni`Yi t`q`t` GB avivi weavbvej c`hvR` nBte bv |

27 | mj`qv Av` k Bmj I Dnvi `vivi wewa-wb`la ev kZ`ivtci` q`gZv |-

- (1) AvcvZZt ej er Ab` tKvb AvBtb wfb`zi hnvv wKQB _vKK bv tKb, wbeR`x KugwU, wewa `vivi wba`ii Z c`xwZ`Z, aviv 42 Gi weavb mvtct`q, mj`qv Av` k Bmj Kwi tZ cwi te I Rwi Kwi te |
- (2) mj`qv Av` k c`v`bi c`te, wewa `vivi wba`ii Z c`xwZ`Z, msuk` Gj vKvi RbMY`K i bwbi m`hvm c`vb Kwi qv Zrvt` i e³e` wetePbv Kwi tZ nBte |
- (3) mj`qv Av` tk Ab`vb` w`l`qi minZ Avil D`tj _v`Kte th, Dch³ KviY e`ZxZ D³ Av` k c`Zcuj b Kiv eva`Zvgj K Ges Dnv c`Zcuj b bv Kiv Rwi gvbt`hvm` Ges GKwU `Ubxq Aciva |
- (4) GB avivi D`t`k` c`YKt` mj`qv Av` k Rwi i w`l`qU, wewa `vivi wba`ii Z c`xwZ`Z, wvRuvj , B`j KU`bK I w`U wgvwqvq MY`e`A`vB `vivi e`uj c`Kvk I mvavi`Y` c`vvi Kwi tZ nBte |

28 | cwmb `tY wqšY | - cwmb `tY wqšYi t`q`t` evsj vt` k cwi tek msi`qv AvBb, 1995 (1995 m`bi 1 bs AvBb) Gi weavbvej c`hvR` nBte |

e`vL`vt `cwmb `tY` A_`c`Z``q ev ctiv`qv`te cwbi t`f`SZ, i m`vqubK ev `Re` Y`vej i` q`wZKi tKvb cwi eZ` |

I ô Aa`vq
Aciva, `Û I wePvi

29 | cÛZcvj b ev mij ¶v Avt`k j sNb Kwi evi `Û, A_©Û I Rwi gvbv | –

(1) hw` tKvb e`w³ B"QvKZfvte GB AvBtbi Aaxb Rwi KZ tKvb cÛZcvj b ev mij ¶v Avt`k j sNb Ktib ev AeÁv Ktib, Zvrv nBtj wZwb, Dc-aviv (2) Gi weavb mvtct¶¶, AbwaK 5(cuP) ermi Kvir`Û A_ev AbwaK 10(`k) nvRvi UvKv A_©Û ev Dfq `tÛ `wÛZ nBteb |

(2) hw` tKvb e`w³ B"QvKZfvte GB AvBtbi Aaxb Rwi KZ tKvb cÛZcvj b ev mij ¶v Avt`k j sNb Ktib ev AeÁv Ktib, Zvrv nBtj Dc-aviv (1) G hvrv wKQB _vKK bv tKb, vbe¶x KvgwU ev ZrKZR ¶gZvcÛB tKvb KgRZP weva Øviv vba¶i Z t¶¶, c×wZ I mxgv Abjvqx Rwi gvbv Avtvc Kwiqv cÛgevi Acivtai `vq Aetjvcb Kwi tZ cwite Ges wZxqevi ev ZrcieZ¶Z D³ Avt`k fsM ev AeÁvi t¶¶ Dnv Dc-aviv (1) Gi Aaxb Aciva wmvte MY` nBte |

(3) vbe¶x KvgwU ev ZrKZR ¶gZvcÛB tKvb KgRZP Dc-aviv (2) Gi Aaxb Rwi gvbv Avtvtci cte, weva Øviv vba¶i Z c×wZ tZ, msukó e`w³ tK tbwUtki gva`tg ibwbi h³msMZ mthvM cÛvb Kwi teb |

e`vL`vt GB avivq, ØRwi gvbvÓ At_©Av`vj Z KZR A_©Û Ašf³ nBte bv |

30 | evav cÛvtbi `Û | –

(1) hw` tKvb e`w³ GB AvBtbi Aaxb `wqZi cvj bi Z tKvb KgRZP ev KgPvixtK Zvrv i `wqZi ev KZ¶ cvj tB B"QvKZfvte evav cÛvb Kti A_ev D³ ifc tKvb e`w³ tK tKvb cÛZövb, fvg ev cKÍ GjvKv cwi`k Kwi evi Rb` h³m½Z mthvM cÛvb Kwi tZ B"QvKZfvte A`Kvi Ktib ev Aetjv Ktib, Zvrv nBtj wZwb AbwaK 5(cuP) ermi Kvir`Û A_ev AbwaK 10(`k) nvRvi UvKv A_©Û ev Dfq `tÛ `wÛZ nBteb |

(2) tKvb e`w³ Dc-aviv (1) G Dwj wLZ `wqZi cvj bi Z tKvb KgRZP Zje Abjvqx Zvrv i m¶¶L tKvb tiwR÷vi, bw_ ev `wjj `teteR Dc`vcb Kwi tZ B"QvKZfvte A`Kvi Kwi tZ ev e`_nBtj A_ev D³ ifc `wqZi cvj bi Z tKvb KgRZP m¶¶L tKvb e`w³ tK nvRi nBtZ ev Zvrv Revbe`x Mób Kwi tZ B"QvKZfvte evav cÛvb Kwi tZ ev evav cÛvtbi tPóv Kwi tZ, wZwb AbwaK 3(wZb) gym Kvir`Û A_ev AbwaK 2(`B) nvRvi UvKv A_©Û ev Dfq `tÛ `wÛZ nBteb |

e`vL`vt GB avivq, ØevavÓ At_©Av`vj Z úgwK Ašf³ nBte |

31 | wgv`v cÛvtbi `Û | –hw` tKvb e`w³ Dfí k` cÛYw` Zfvte ev ÁvZmvti tKvb wgv`v ev weKZ Z_` cÛvb ev Z_` tMvcb Ktib, Zvrv nBtj wZwb AbwaK 1 (GK) ermi Kvir`Û A_ev AbwaK 3 (wZb) nvRvi UvKv A_©Û ev Dfq `tÛ `wÛZ nBteb |

32 | Acivtai wePvi , Avgj thvM`Zv, BZ`w` |—

(1) AvcvZZt ej er Ab` tKvb AvBtb wfbz`i hrvn wKOB _vKK bv tKb, GB AvBtbi AaxY msNwUZ Acivamgn cag tkYxi Rymkqvj g`wRt`U ev tqtUfcwj Ub g`wRt`U KZR wePvh`nBte |

(2) GB AvBtbi Aaxb msNwUZ Acivamgn RwgbthvM` (bailable) I A-Avgj thvM` (non-cognizable) nBte |

(3) GB AvBtbi Aaxb msNwUZ tKvb Acivtai wePvi msw`B c`wZtZ AbyoZ nBte |

33 | tdSR`vix Kvh`wai c`qvM |— GB AvBtbi weavbvej mvtct`q, GB AvBtb ewYZ thtKvb Acivtai Z`S, wePvi , Awicj Ges Avbj w`k mKj w`lq tdSR`vix Kvh`wa c`hvR` nBte |

34 | tKv`ubx ev c`Zovb KZR Aciva msNUb |—tKvb tKv`ubx ev c`Zovb KZR GB AvBtbi AaxY tKvb Aciva msNwUZ nBtj ev tKvb weavb j`wNZ nBtj D³ Aciva ev j`Ntbi mnZ c`Z`q msuk`Zv i`nqv`Q D³ tKv`ubx ev c`Zovtbi GBifc c`Z`K cwipvj K, wbe`x, g`vrbRvi , m`Pe ev Ab` tKvb KgRZ`ev KgPvix ev c`Zvba D³ Aciva ev jsNb Kwivq`Qb evj qv MY` nBte, h`w` bv wZvb c`vY KwitZ cvtib th, D³ Aciva ev jsNb Zvni AAvZmvti msNwUZ nBqv`Q A`ev D³ Aciva ev jsNb tiva Kwievi Rb` wZvb h`vma` tPov Kwivq AKZKvh`nBqv`Qb |

e`vL`v: GB avivq:-

(K) w`Kv`ubx` ev w`c`Zovb` A`_`w`M`GZ ev w`be`wZ nDK ev bv nDK, thtKvb tKv`ubx, ms`v, c`Zovb Ask`vix Kwievi , m`g`wZ ev GKwaK e`w³ mgstq MvZ msMvb ev ms`v A`sf` nBte; Ges

(L) w`cwipvj K`O A`_`Ask`vi ev cwipvj bv tev`w`p m`m` A`sf` nBte |

35 | Acivtai mnvqZvKvix |—h`w` tKvb e`w³ tKvb Aciva msNUtb mnvqZv ev mnthvMxZv Ktib ev c`i`wPZ ev c`j` Ktib Zvni nBtj wZvb Aciva msNUbKvixi b`vq GKBfvte `vqx nBteb |

36 | Aciva wePvift`_`M`b |—gnvcwipvj K ev ZrKZR q`gZvc`B tKvb KgRZ` wj wLZ Awf`thvM e`ZxZ tKvb Av`vj Z GB AvBtbi Aaxb tKvb gvjj v wePvift`_`M`b Kwite bv |

mBg Aa`vq
weiea

37 | cwibi gj` Ae`vniZi q`gZv |— AvcvZZt ej er Ab` tKvb AvBtb wfbz`i hrvn wKOB _vKK bv tKb, miKvi , Dchj³ KZt`q`i mnZ পরামর্শক্রমে, সরকারি গেজেটে প্রজ্ঞাপন দ্বারা, জাতীয় বা স্থানীয় `ft`_`cwib tmev`fvMx th tKvb e`w³ tkYtK tKvb w`w`` mgq ev Gj vKvi t`q`T M`v`j x I mvaviY Kwil KvR e`euZ cwibi gj` c`v`bi `vq nBtZ `elg` e`wZitK Ae`vniZ c`vb KwitZ cwite |

38| Z_ cħy³i e`envi |—GB AvBtbi Aaxb tKvb Kvh©m³úv`b, ¶lgZv cħqM I `wqZi cvj tbi t¶t¶, GB AvBtbi weaZ c×wZi AwZwi³ Z_ I thvMvthvM cħy³ AvBb, 2006 (2006 mti 39 bs AvBb) Gi weavb mvtct¶¶ Ges D³ AvBtbi msÁwqZ A₃Z_ cħy³ e`envi Kiv hvBte |

39| ¶lgZv Ac¶ |—cwi I`, mvariY ev wekkl Avt`k Øviv, GB AvBtbi Aaxb Dnvi thtKvb ¶lgZv ev Kvh¶ewj cħqvRbtevt¶ Ges Zrnbw ØKZ kZ©mvtct¶¶, vbe¶hx KivwU, vbe¶hx KivwUi mfvvWZ, gnvcwi Pvj K, cwi `kR ev Ab` tKvb KgRZ¶K Ac¶ Kwi tZ cwi te |

40| cħek, ti KWEÎ hvPbv, wRÁvmvev`, BZ`w` ¶lgZv |—GB AvBtbi Dt¶k` ctYKt¶, cwi I` ev vbe¶hx KivwU ev GZ` t¶t¶ mvariY ev wekkl fvte ¶lgZvcØB cħZ`K KgRZ¶ev cwi `kR vbgæ ewYZ ¶lgZv cħqM Kwi tZ cwi te, h_v:-

(K) thtKvb miKwi ev temiKwi fvgtZ ev cKÍ Gj vKvq cħek Ges thtKvb e`w³tK wRÁvmvev` ev ti KWEÎ ev Z_ DcvE hvPbv I ch¶j vPbv Kiv;

(L) D³ fvg ev Gj vKv ev DnvtZ Aew`Z tKvb wKQzcwi `kØ Kiv; Ges

(M) D³ fvg ev Gj vKvq thtKvb AbymÜvb ev bgjv msMh ev Rwi c cwi Pvj bv Kiv |

41| cwb m³ú` cwi KÍ bv ms`vtK mnvqZvi t¶t¶ eva`evaKZv |—GB AvBtbi Aaxb ¶lgZv cħqM ev Kvh¶m³úv` tbi Dt¶t¶ cwb m³ú` cwi KÍ bv ms`v ev Dnvi wBKU nBtZ ¶lgZvcØB e`w³ thtKvb miKwi -temiKwi msweaex KZ¶¶tK, ev Dnvt`i KgRZ¶ I KgPvixtK, cħqvRbxq mnvqZv cħvtbi Rb` Abt¶iva Kwi tZ cwi te Ges GBi¶c Abt¶iva Kiv nBtj, D³ KgRZ¶ I KgPvix, KZ¶¶ ev ms`v D³ i¶c mnvqZv cħvb Kwi te |

42| Avt`k Rwi |—GB AvBtbi Aaxb BmjKZ tKvb tbwUk ev Avt`k, tKvb e`w³i Dci Rwi Kiv cħqvRb nBtj, Dn D³ e`w³i Dcti h_vh_fvte Rwi Kiv nBqv¶Q ewj qv MY` nBte, hw` Dnv-

(K) D³ e`w³ ev Zrvvi cħZwbwa KZR e`w³ fvte Mhvb Kiv nq;

(L) D³ e`w³i me¶kl ÁvZ evsj vt`tki evm`vtb ev e`emvtqi `vtb ti wRw÷KZ WvKthv¶M tcØY Kiv nq;

(M) Btj KUwbK c×wZtZ tcØY ev cØvi Kiv nq; ev

(N) eúj cKvKZ RvZxq `wbK cwÎ Kivq cKvK I cØvi Kiv nq |

43| A_©Av`vtqi c×wZ |—

(1) GB AvBtbi Aaxb tKvb e`w³i wBKU Rwi gvsvi UvKv ev cvl bv Abv`vqx _wKtj vbe¶hx KivwU Dc-aviv (2) Gi weavb mvtct¶¶, wea Øviv wba¶i Z c×wZtZ, Dnv Av`vq Kwi tZ

(2) তীব্র e^৩i বকু nBtZ GB AvBtbi Aaxb tKvb cvl bv Av`vtqi Dtík, vbeñx Kugul AvcvZzt ej er Ab` tKvb AvBtb wfbzi hrvn wKQB _vKK bv tKb, D³ e^৩i e^৩sK G^vKvD>U wdR Kwi evi Rb` thtKvb e^৩sK KZ^eñtK Abti va Kwi tZ cwi te |

44 | Z² c⁰B AwaKvi | -c⁰Z²K e^৩ Z² AwaKvi AvBb, 2009 (2009 m^tbi 20 bs AvBb) G m^ÁwqZ At²Ges D³ AvBtbi weavbvej mvtctñ, cwi l` ev vbeñx Kugul ev GB AvBtbi Aaxb ñlgZvc⁰B thtKvb Kg^RZ^PKZ^R m^áúw` Z Kvh⁰, c⁰qvMKZ ñlgZv, cvj bKZ `wqZi, M^ñxZ e^e-v ev c⁰É Av^t`k m^áú^tK²Z² c⁰Bi AwaKvi x nBteb |

45 | weva c⁰q^tbi ñlgZv | -GB AvBtbi Dtík` c^tYKtí Ges Dnvi weavbvej mvtctñ, mi Kvi, mi Kwii tM^tRtU c^Ávcb ⁰vi v weva c⁰qb Kwi tZ cwi te |

46 | BstⁱwRtZ Abw` Z cvW c^Kvk | -

(1) GB AvBb Kvh^Ri nBevi ci mi Kvi, mi Kwii tM^tRtU c^Ávcb ⁰vi v, GB AvBtbi evsj v cvtVi BstⁱwRtZ Abw` Z GKul w^bf⁰thvM² cvW (Authentic English Text) c^Kvk Kwi tZ cwi te |

(2) evsj v cvW l BstⁱwR cvtVi g^ta² we^tiv^tai tñtí evsj v cvW c⁰vb² cvBte |

47 | i^wnZKiY l tndvRZ | -(১) ধারা ৪ এবং ধারা ৯ এর অধীন যথাক্রমে জাতীয় পানি সম্পদ cwi l` Ges vbeñx Kugul M^wZ nBevi m^tM m^tM RvZxq cvwb m^áú` cwi l` Ges vbeñx Kugul গঠিত সংক্রান্ত ইতোপূর্বে জারীকৃত সকল প্রজ্ঞাপন রহিত হইবে এবং উক্ত প্রজ্ঞাপনসমূহের দ্বারা গঠিত RvZxq cvwb m^áú` cwi l` Ges vbeñx Kugul wej ß nBte |

(2) Dc-aviv (1) Gi Aaxb wej ß nI qv m^tÉ:l, wej ß RvZxq cvwb m^áú` cwi l`, tñtí gZ, vbeñx কমিটি কর্তৃক কৃত কার্যক্রম ev M^ñxZ e^e-v GB AvBtbi Aaxb KZ ev M^ñxZ nBqv^tQ ewj qv MY² nBte Ges GB AvBtbi m^wnZ mvg^Ám²cY⁰nI qv mvtctñ Ae^vnZ _wKte |²⁹

3.2.6.1 Findings

The above Water Act 2013 passed in May 02, 2013. The goal of this act is to bring an effective facilitation to ensuring integrated, equitable and sustainable management, development and utilization of water resources and their conservation and protection. However, it does not have any clause about creation and conservation of water reservoir. On the other hand, this water act has options to fill up or stop the water channels of rivers for recovery of land by the permission of the proper authority, which shows lack of this act, because stopping or closing any natural watercourse or channel creates hazards of biodiversity and land degradation and silt the waterbodies. The description of this law is detailed in the draft but now it is concised. Many issues are not properly

²⁹ Bangladesh Gazette, *Bangladesh Water Act, 2013* (Dhaka: Bangladesh Govt. Press, 2013), pp. 2771-2793.

addressed. This law mentioned about penalties to violet law is sufficient. However, the concern authority must implement this act efficiently as required in present needs and stakeholder's compliance is needed for the protection and conservation of water resources for sustainable development processes.

3.2.7 National Water Policy, 1999

The policies set forth herein are considered essential for addressing the objectives of improved water resources management and protection of the environment. Every public agency, every community, village and each individual has an important role to play in ensuring that the water and associated natural resources of Bangladesh are used judiciously so that the future generations can be assured of at least the same, if not better, availability and quality of those resources.

3.2.7.1 River basin management

Basin planning provides the most rational basis of development of water resources under the influence of one or more major rivers. International river basins, however, such as the Ganges basin, the Brahmaputra basin, and the Meghna basin present special problems. Due to its location as the lower-most riparian, Bangladesh has no control over the rivers entering through its borders. The adverse effects of this are the floods and water scarcity, which occur frequently. Although the 1996 Treaty on Sharing of the Ganges Waters with India has brought some relief to the drought-prone area of the southwest, the water shortage problem during the dry season is likely to aggravate in the Ganges and other basins with rising demands of the increasing population. It is, however, encouraging to note that the relevant provision of the treaty will provide the basis in the futrue for discussion on sharing of waters of the common rivers.

It may take considerable effort and time for Bangladesh to work out joint plans for different river basins with other co-riparian countries. As a long-term measure, therefore, it is the policy of the government to undertake essential steps for realising basin-wide planning for development of the resources of the rivers entering its borders.

The Government will endeavour to enter into agreements with co-riparian countries for sharing the waters of international rivers, data exchange, resource planning and long-term management of water resources under normal and emergency conditions of flood, drought and water pollution. While moving towards the attainment of basin-wide plans in the long run, it will also be necessary for Bangladesh to concentrate on the development of individual hydrological areas to meet short and intermediate term requirements.

The policy of the Government of Bangladesh, in the short and intermediate term, for fostering international cooperation in water management is, in italics letter, to:

- a. Work with co-riparian countries to establish a system for exchange of information and data on relevant aspects of hydrology, morphology, water pollution, ecology, changing watershed characteristics, cyclone, drought, flood warning, etc., and to help each other understand the current and emerging problems in the management of the shared watersources.
- b. Work with co-riparian countries for a joint assessment of all the international rivers flowing through their territories for better understanding of the overall basins' potentials.
- c. Work jointly with co-riparian countries to harness, develop, and share the water resources of the international rivers to mitigate floods and augment flows of water during the dry season.
- d. Make concerted efforts, in collaboration with co-riparian countries, for management of the catchment areas with the help of afforestation and erosion control for watershed preservation and reduction of land degradation.
- e. Work jointly with co-riparian countries for the prevention of chemical and biological pollution of the rivers flowing through these countries, by managing the discharge of industrial, agricultural and domestic pollutants generated by human action.
- f. Seek international and regional cooperation for education, training, and research in water management.

3.2.7.2 Planning and management of water resources

The Government recognizes that the process of planning and managing water resources requires a comprehensive and integrated analysis of relevant hydrological, topographical, social, political, economic, environmental and institutional factors across all related water-using sectors.

The intricate nature of drainage systems within the country requires that activity for planning and management of the nation's river systems is undertaken within the context of hydrological regions. The principal river systems create natural boundaries for these regions. The hilly areas of the east form another hydrological region.

Henceforth, to address these issues the policy of the Government will be as follows:

- a. The Water Resources Planning Organisation (WARPO) will delineate the hydrological regions of the country, based on appropriate natural features, for planning the development of their water resources.

- b. WARPO will prepare, and periodically update, a National Water Management Plan (NWMP) addressing the overall resource management issues in each region and the whole of Bangladesh, and providing directions for the short, intermediate, and long runs. The plan will be executed by different agencies as determined by the Government from time to time.
- c. The NWMP and all other related plans will be prepared in comprehensive and integrated manner, with regard for the interests of all water-related sectors. The planning methodology will ensure co-operation across sectors and people's participation in the process.

Within the macro framework of the NWMP:

- d. Sector agencies of the Government and local bodies will prepare and implement subregional and local water-management plans in conformance with the NWMP and approved Government project appraisal guidelines. The Executive Committee of the National Water Resources Council (ECNWRC) will resolve any interagency conflict in this regard.
- e. The Bangladesh Water Development Board (BWDB) will implement all major surface water development projects and other FCDI projects with command area above 1000 hectares. The Local Government will implement FCDI projects having a command area of 1000 hectares or less after identification and appraisal through an interagency Project Appraisal Committee. Any interagency dispute will be resolved by means prescribed by the Government.
- f. The participation of all project affected persons, individually and collectively, will be ensured in the planning, design, implementation, and operation and maintenance (O&M) of publicly funded surface water resources development plans and projects. Local

Governments (Parishads) will be the principal agencies for coordinating these efforts.

Community level self-help groups (private) and Non-Government Organisations will also be relied on to assist in the participatory process.

The Government will further:

- g. Frame policies, procedures, and guidelines for combining water-use and land-use planning
- h. Frame, and periodically revise, the policies, procedures and guidelines on all aspects of water management
- i. Make social and environmental assessments mandatory in all plan development

Through its responsible agencies, the Government will:

- j. Undertake comprehensive development and management of the main rivers through a system of barrages and other structural and non-structural measures
- k. Develop water resources of the major rivers for multipurpose use, including irrigation, fisheries, navigation, forestry, and aquatic wildlife
- l. De-silt watercourses to maintain navigation channels and proper drainage
- m. Delineate water-stress areas based on land characteristics and water availability from all sources for managing dry season demand
- n. Take steps to protect the water quality and ensure efficiency of its use
- o. Develop early warning and flood-proofing systems to manage natural disasters like flood and drought
- p. Designate flood risk zones and take appropriate measures to provide desired levels of protection for life, property, vital infrastructure, agriculture and wetlands. In this regard the following principles will guide future action:
 - i. Regions of economic importance such as metropolitan areas, sea and air ports, and export processing zones will be fully protected against floods as a matter of first priority. Other critical areas such as district and upazila towns, important commercial centers, and places of historical importance will be gradually provided reasonable degree of protection against flood. In the remaining rural areas, with the exception of those already covered by existing flood control infrastructure, the people will be motivated to develop different flood proofing measures such as raising of platform for homesteads, market places, educational institutions, community centers, etc., and adjusting the cropping pattern to suit the flood regime.
 - ii. In future all national and regional highways, railway tracks, and public buildings and facilities will be constructed above the highest ever-recorded level of flood in the country. This principle will also apply in cases of reconstruction of existing structures of this nature.
 - iii. All plans for roads and railways embankment will adequately provide for unimpeded drainage.
- q. Undertake survey and investigation of the problem of riverbank erosion and develop and implement master plans for river training and erosion control works for preservation of scarce land and prevention of landlessness and pauperisation.
- r. Plan and implement schemes for reclamation of land from the sea and rivers.

3.2.7.3 Water rights and allocation

The ownership of water does not vest in an individual but in the state. The Government reserves the right to allocate water to ensure equitable distribution, efficient development and use, and to address poverty. The Government can redirect its use during periods of droughts, floods, cyclones, and other natural and man-made disasters, such as contamination of groundwater aquifers that threaten public health and the ecological integrity. Allocation policies will be the formal mechanism for deciding who gets water, for what purpose(s), how much, at what time, for how long, and under what circumstances water use may be curtailed. Policies for water allocation will be developed for in-stream needs (ecological, water quality, salinity control, fisheries and navigation) during low-flow periods; for off-stream withdrawal (irrigation, municipal and industrial, power), and for groundwater recharge and abstraction. Allocation for non-consumptive use (e.g. navigation) would imply ensuring minimum levels in water bodies used for that purpose.

Henceforth, the policy of the Government to regulate the use of water, where required, will be exercised in the following manner:

- a. The Government will exercise its water allocation power in identified scarcity zones on the basis of specified priorities.
- b. In general, the priority for allocating water during critical periods in the water shortage zones will be in the following order: domestic and municipal uses, non-consumptive uses (e.g. navigation, fisheries and wild-life), sustenance of the river regime, and other consumptive and non-consumptive uses such as irrigation, industry, environment, salinity management, and recreation. The above order of priority could however be changed on specific socio-economic criteria of an area by local bodies through local consensus.
- c. For sustaining rechargeable shallow groundwater aquifers, the Government will regulate the extraction of water in the identified scarcity zones with full public knowledge.
- d. Specific drought monitoring and contingency plans will be prepared for each region experiencing recurrent seasonal shortages of water with due consideration to conjunctive use of rainwater, surface water and ground water and alternative ways of satisfying demand. The contingency plan will include action to limit the use of groundwater according to priorities. Appropriate provisions of law should be made to protect specific users' rights in these extreme cases.
- e. The Government may empower the local government or any local body it deems fit, to exercise its right to allocate water in scarcity zones during

periods of severe drought, and it will monitor the water regime and enforcement of the regulations through specifically designed mechanisms.

- f. The Government may confer water rights on private and community bodies to provide secure, defensible and enforceable ownership/usufructuary rights to ground water and surface water for attracting private investment.
- g. In specifying surface water rights, the minimum requirement of stream-flow for maintaining the conveyance channel will be ensured.

3.2.7.4 Public and private involvement

Water resources management requires involvement of the public and private sectors, communities and individuals that benefit from the delivery of water-related services. The ultimate success and effectiveness of public water resources management projects depends on the people's acceptance and ownership of each project. It is important to delineate the roles and responsibilities of every one involved in water resources management. The principle that community resources should be managed by the community concerned, alongwith local government institutions unless a greater national interest prevails should guide water resource management. It is recognised that women have a particular stake in water management because they are the principal providers and carriers of water, main caretaker of the family's health, and participants in many stages of pre and post harvest activities. The policies of the Government regarding the respective roles of the public and private sectors are:

- a. Government's investments in water programme will be directed towards creation of public goods or for addressing specific problems of market failure and protecting particular community interests.
- b. Policies and programmes of any public agency involving water resources will be coordinated with the policies and programmes of all other public and private bodies to build synergy and avoid conflict.
- c. Public water institutions will, to the extent feasible, use private providers of specific water resources services in carrying out their mandates, giving preference to beneficiary groups and organisations.
- d. The management of public water schemes, barring municipal schemes, with command area up to 5000 ha will be gradually made over to local and community organisations and their O&M will be financed through local resources.
- e. Public water schemes, barring municipal schemes, with command area of over 5000 ha will be gradually placed under private management, through leasing, concession, or management contract under open competitive bidding

procedures, or jointly managed by the project implementing agency alongwith local government and community organisations.

- f. Ownership of FCD and FCDI projects with command area of 1000 ha or less will gradually be transferred to the local governments, beginning with the ones that are being satisfactorily managed and operated by the beneficiary/ community organisations.
- g. Appropriate public and private institutions will provide information and training to the local community organisations for managing water resources efficiently.
- h. Enabling environment will be created for women to play a key role in local community organisations for management of water resources.
- i. Government, where appropriate, will restructure its present institutions and design all future institutions for efficient implementation of the above policies.

3.2.7.5 Public water investment

The Government considers that a consistent and uniformly applied analytical framework for project appraisal is essential to equitable, efficient and effective water resources management. A true multi-objective analysis of the water needs of an area and the formulation of options for investment and management must consider the interrelations among different sources of water, different management schemes and the interaction between needs of different users and purposes. Investments in infrastructure may displace people and disturb ecosystems and, as such, broader water resources planning assessments and specific project appraisals must consider these cross-sectoral implications.

The policy of the Government in this regard is to ensure that:

- a. Water resource projects, as far as possible, are developed as multipurpose projects with an integrated multi-disciplinary approach from planning to implementation to monitoring.
- b. Planning and feasibility studies of all projects will follow the Guidelines for Project

Assessment (GPA), the Guidelines for Peopleís Participation (GPP), the Guidelines for

Environmental Impact Assessment (EIA), and all other instructions that may be issued from time to time by the Government.

- c. All relevant analytical procedures and evaluation methods, such as mathematical modelling, physical modelling, cost-benefit analysis, risk analysis and multi-criteria decision making are routinely used as part of water resources planning and project appraisal.

- d. Public water projects are designed with specific provision for future disinvestment, if and when feasible.
- e. Interests of low-income water users, and that of women, are adequately protected in water resource management.
- f. There is continuous updating and archiving of water resource data and basic information by relevant public sector agencies.

3.2.7.6 Water supply and sanitation

The rural areas of Bangladesh suffer from lack of quality drinking water. Surface water supplies are generally polluted and groundwater, which till now had been the best source of safe drinking water, is contaminated with arsenic in many parts of the country. Heavy withdrawals of groundwater for irrigation have also lowered the water table in many areas below the effective reach of hand tubewells. Seepage of agro chemicals into shallow aquifers may also pollute water for human and animal consumption. Salinity intrusions from seawater deep into the land in the southwest are rendering groundwater unfit for consumption. Cities and urban areas too are facing the problem of receding water table due to heavy groundwater extraction. These water supply and sanitation problems have obvious implications for public health. Diarrheal diseases, arising largely from drinking unsafe water, are a leading cause of death in the rural areas. Lack of proper sanitation and drainage facilities, inadequate water supply, and insufficient health and hygiene education are the primary causes of diseases in the urban areas. Lack of access to safe water supply in the rural areas is a special hardship for women who have to carry water over long distances, with significant impact on their health and productivity.

To address these problems, it is the policy of the Government to:

- a. Facilitate availability of safe and affordable drinking water supplies through various means, including rainwater harvesting and conservation.
- b. Preserve natural depressions and water bodies in major urban areas for recharge of underground aquifers and rainwater management.
- c. Mandate relevant public water and sewerage institutions to provide necessary drainage and sanitation, including treatment of domestic wastewater and sewage and replacement of open drains and construction of sewers, in the interest of public health.
- d. Empower, and hold responsible, municipalities and urban water and sewerage institutions to regulate the use of water for preventing wastage and pollution by human action.
- e. Mandate local governments to create awareness among the people in checking water pollution and wastage.

3.2.7.7 Water and agriculture

Support of private development of groundwater irrigation for promoting agricultural growth will continue, alongside surface water development where feasible. But there will be a renewed focus towards increasing efficiency of water use in irrigation through various measures including drainage-water recycling, rotational irrigation, adoption of water conserving crop technology where feasible, and conjunctive use of groundwater and surface water.

Water allocations in irrigation systems have to be done with equity and social justice. At the same time, serious consideration should be given to non-point pollution of water systems by fertilizer and pesticides that are either leached to the groundwater or washed off the fields to rivers and lakes. For this purpose, the policy of the Government is to:

- a. Encourage and promote continued development of minor irrigation, where feasible, without affecting drinking water supplies
- b. Encourage future groundwater development for irrigation by both the public and the private sectors, subject to regulations that may be prescribed by Government from time to time.
- c. Improve efficiency of resource utilisation through conjunctive use of all forms of surface water and groundwater for irrigation and urban water supply.
- d. Strengthen crop diversification programmes for efficient water utilisation.
- e. Strengthen the regulatory system for agricultural chemicals that pollute ground and surface water, and develop control mechanism for reducing non-point pollution from agro-chemicals.
- f. Strengthen appropriate monitoring organisations for tracking groundwater recharge, surface and groundwater use, and changes in surface and groundwater quality.

3.2.7.8 Water and industry

Excessive water salinity in the southwest region is a major deterrent to industrial growth. Also, pollution of both surface and groundwater around various industrial centers of the country by untreated effluent discharge into water bodies is a critical water management issue. The policy of the Government in this regard is that:

- a. Zoning regulations will be established for location of new industries in consideration of fresh and safe water availability and effluent discharge possibilities.
- b. Effluent disposal will be monitored by relevant Government agencies to prevent water pollution.
- c. Standards of effluent disposal into common watercourses will be set by WARPO in consultation with DOE.
- d. Industrial polluters will be required under law to pay for the cleanup of water-body polluted by them.

3.2.7.9 Water and fisheries and wildlife

Fisheries and wildlife are integral aspects of economic development in Bangladesh and strongly linked to advancement of target groups, poverty alleviation, nutrition, and employment generation. Availability of water for fisheries is thus important from the point of view of sustenance as well as commercial ventures. It is, therefore, the policy of the Government that:

- a. Fisheries and wildlife will receive due emphasis in water resource planning in areas where their social impact is high.
- b. Measures will be taken to minimise disruption to the natural aquatic environment in streams and water channels.
- c. Drainage schemes, to the extent possible, will avoid state-owned swamps and marshes that have primary value for waterfowl or other wildlife.
- d. Water bodies like baors, haors, beels, roadside borrow pits, etc. will, as far as possible, be reserved for fish production and development. Perennial links of these water bodies with the rivers will also be properly maintained.
- e. Water development plans will not interrupt fish movement and will make adequate provisions in control structures for allowing fish migration and breeding.
- f. Brackish aquaculture will be confined to specific zones designated by the Government for this purpose.

3.2.7.10 Water and navigation

Inland navigation is of substantial economic importance to Bangladesh because its numerous watercourses provide the cheapest means of transportation. Siltation, however, has disrupted river communications in many water channels. De-siltation of these channels is required not only to restore their navigational capability but also to assist surface drainage. The policies of the Government in this regard are:

- a. Water development projects should cause minimal disruption to navigation and, where necessary, adequate mitigation measures should be taken.
- b. Minimum stream-flows in designated rivers and streams will be maintained for navigation after diversion of water for drinking and municipal purposes.
- c. Dredging and other suitable measures would be undertaken, wherever needed, to maintain navigational capability of designated waterways.

3.2.7.11 Water for hydropower and recreation

Bangladesh has limited potential for hydropower due to its flat terrain and the absence of suitable reservoir area. However, it may be possible to build mini hydropower plants at small dam and barrage sites. A major environmental concern of hydropower development is the impediment to a river's natural flow

imposed by structures built on it. A hydropower facility may be restrictive for fish movement also.

Use of water for recreational purposes is useful for developing tourism facilities. Introducing these facilities at the sites of reservoirs, lakes, dighis (big ponds), sea resorts, etc. would help the tourism industry of the country. The policy of the Government is therefore that:

- a. Mini-hydropower development schemes may be undertaken provided they are economically viable and environmentally safe.
- b. Recreational activities at or around water bodies will be allowed provided it is not damaging to the environment.

3.2.7.12 Water for the environment

Protection and preservation of the natural environment is essential for sustainable development. Given that most of the country's environmental resources are linked to water resources, it is vital that the continued development and management of the nation's water resources should include the protection, restoration, and preservation of the environment and its biodiversity including wetlands, mangrove and other national forests, endangered species, and the water quality. Accordingly, water resource management actions will take care to avoid or minimize environmental damages.

Water quantity and water quality issues are uniquely linked. Poor water quality affects the availability of fresh water for different uses. Contamination of surface water bodies and groundwater aquifers by agricultural pollutants, industrial discharge, domestic pollution, and non-point source urban runoff exacerbate water quality problems and endanger both natural ecosystem integrity and public health. Other environmental problems include: excessive soil erosion and sedimentation, waterlogging and salinisation of agricultural land, groundwater depletion, watershed degradation and deforestation, reduction of biodiversity, wetland loss, saltwater intrusion, and coastal zone habitat loss.

Henceforth, all agencies and departments entrusted with water resource management responsibilities (regulation, planning, construction, operation, and maintenance) will have to enhance environmental amenities and ensure that environmental resources are protected and restored in executing their tasks. Environmental needs and objectives will be treated equally with the resources management needs. It is, therefore, the policy of the government that all water management agencies and related natural resources departments will:

- a. Give full consideration to environmental protection, restoration and enhancement measures consistent with the National Environmental Management Action Plan (NEMAP) and the National Water Management Plan (NWMP).

- b. Adhere to a formal environmental impact assessment (EIA) process, as set out in EIA guidelines and manuals for water sector projects, in each water resources development project or rehabilitation programme of size and scope specified by the Government from time to time.
- c. Ensure adequate upland flow in water channels to preserve the coastal estuary eco-system threatened by intrusion of salinity from the sea.
- d. Protect against degradation and resuscitate natural water-bodies such as lakes, ponds, beels, khals, tanks, etc. affected by man-made interventions or other causes.
- e. Completely stop the filling of publicly-owned water bodies and depressions in urban areas for preservation of the natural aquifers and environment.
- f. Take necessary steps to remove all existing unauthorised encroachments on rivers and watercourses and to check further encroachments that cause obstructions to water flows and create environmental hazards.
- g. Stop unplanned construction on riverbanks and indiscriminate clearance of vegetation on newly accreted land.
- h. Encourage massive afforestation and tree coverage specifically in areas with declining water table.
- i. Enforce the "polluter pay" principle in the development of regulatory guidelines for all regulatory actions designed to protect public health and the environment.
- j. Provide education and information to the industrial and farming communities on selfadministered pollution control mechanisms and their individual and collective responsibilities for maintaining clean water sources.

3.2.7.13 Water for preservation of haors, baors, and beels

Water bodies like haors, baors, and beels are precious assets of Bangladesh with unique regional characteristics. Apart from their scenic beauty, they have great economical and environmental value. Even during extremely dry seasons, when the smaller beels turn into quagmires, the haors and the baors retain considerable amount of water. These water bodies account for a large share of the natural capture fisheries and provide a habitat for a wide variety of aquatic vegetation and birds. They also provide sanctuary to migratory birds during winter. The haors and the beels usually connect to some adjoining river through khals. In the past, many beels have been drained through engineering interventions and turned into cropland for immediate gains. The adverse effects of such interventions have been deleterious to the environment. They have destroyed the fish and aquatic vegetables that thrive in these wetlands and are important in the diet of the rural poor. They have also blocked the flow of wastes,

discharged from the flood plains and domestic sources, which naturally move out of the beels through the khals into the river's drainage system. Only submersible dikes have provided tangible benefits in certain haor areas by enabling cultivation of high yielding variety boro rice. The Government believes that in order to assist the natural processes of groundwater recharge, maintenance of aquatic life and ecological balance, disposal of wastes through the dynamic river system, and for turning the huge water bodies into recreational areas, their planned development is essential.

It is, therefore, the policy of the Government that:

- a. Natural water bodies such as beels, haors, and baors will be preserved for maintaining the aquatic environment and facilitating drainage.
- b. Only those water related projects will be taken up for execution that will not interfere with the aquatic characteristics of those water bodies.
- c. Haors that naturally dry up during the winter will be developed for dry season agriculture.
- d. Take up integrated projects in those water bodies for increasing fish production.
- e. Natural water bodies will be developed, where possible, for recreational use in support of tourism.

3.2.7.14 Economic and financial management

Changes are required in the system of prices and other economic incentives affecting water demand and supply in Bangladesh. Unless the users pay a price for water, there will be a tendency to misuse and deplete it under scarcity conditions. Desirable practices such as conjunctive use, water-saving agricultural and industrial technologies, water harvesting, water transfers, and water recycling, both within and between sectors, will emerge only when users perceive the scarcity value of water.

A system of cost recovery, pricing, and economic incentives/disincentives is necessary to balance the supply and demand of water. Cost recovery of services such as flood control, drainage, irrigation, and wastewater treatment has not been considered adequately. Failure to recover O&M cost leads to decline of service quality and deterioration of the system. This, in turn, makes the consumers less willing to pay for the deteriorating services. An important principle, for the long-term, in this regard is that public service agencies should be converted into financially autonomous entities, with effective authority to charge and collect fees. The participation of users in managing and maintaining water facilities and operations is an important element of financial accountability. It is, therefore, the policy of the Government that:

- a. Water will be considered an economic resource and priced to convey its scarcity value to all users and provide motivation for its conservation. For the foreseeable future, however, cost recovery for flood control and drainage (FCD) projects is not envisaged in this policy. In case of flood control, drainage, and irrigation (FCDI) projects water rates will be charged for O&M as per Government policies.
- b. Relevant public water supply agencies will be gradually given authority to charge for their services.
- c. Recovery of O&M cost will, as far as possible, be made through private collection means such as leasing and other financial options. Beneficiaries and other target groups will be given preference for such contracts.
- d. The pricing structure will match the goals and needs of the water provider and the population served. Water rates will be lower for basic consumption, increasing with commercial and industrial use. The rates for surface and groundwater will reflect, to the extent possible, their actual cost of delivery.
- e. Water charges realised from beneficiaries for O&M in a project would be retained locally for the provision of services within that project.
- f. Effective beneficiary participation and commitment to pay for O&M will be realised at the project identification and planning stages by respective public agencies.
- g. Appropriate financial incentives will be introduced for water re-use and conservation, responsible use of groundwater, and for preventing overexploitation and pollution.³⁰

3.2.7.15 Findings

National water policy passed in 1999, which is sufficient enough for water resource management, protection and conservation. The objectives of this policy address issues related to the harnessing and development of all forms of surface water and ground water and management of these resources in an efficient and equitable manner keeping sustainable development processes. Moreover, it aims in ensuring the availability of water to all elements of the society including the poor and the underprivileged; and taking into account the particular needs of women and children. On other hand, it aims in accelerating the development of sustainable public and private water delivery systems with appropriate legal and financial measures and incentives including delineation of water rights and water pricing and bringing an institutional changes that will help decentralize the management of water resources and enhance the role of women in water

³⁰ Ministry of Water Resources, "*National Water Policy*", Government of the People's Republic of Bangladesh, 1999.

management. In addition, it is aimed to develop a legal and regulatory environment that will help the process of decentralization; sound environmental management and improve the investment climate for the private sector in water development and management and for developing a state of knowledge and capability that will enable the country to design future water resources management plans by itself with economic efficiency, gender equity, social justice and environmental awareness to facilitate achievement of the water management objectives through broad public participation. Irrigation as the part of national water policy covers all sectors like build up water reservoir for recharging the groundwater, irrigation management by using surface and groundwater, environmental protection for sustainable development, pollution control, aquatic and wild life protection and preservation of existing water bodies. Therefore, it covers the whole sectors of irrigation. This policy should be implemented properly that every public agency, every community, village and each individual has an important role to play in ensuring that the water and associated natural resources of Bangladesh are used judiciously so that the future generations can be assured of at least the same, if not better, availability and quality of those resources.

3.2.8 RvZxq Kwl bwiZ 2013

1.0 fvgKv

1.1 Kwl evsjv`tki A_DwiZi c`avb KgRvU Ges Rxbkx³ | Drcv`bkxj Zv I Avq eix Ges M`gxY GjvKvq Kgms`vb m`oi gva`tg wekvj Rb`Mw`oi mgixi Rb` Kwl i `iaZcY`fvgKv itqtQ | t`tki wRwMctZ Kwl LvZ (dmj, grm, c`Ym`c` Ges eb) `iaZcY`Ae`vb ivtL, ktg kixi c`q A`aR Kgms`vb thMvb Ges Kwl wfwEK wk`i c`Zovtbi c`avb Kuvvgj mieivn Kti | Kwl mvgwRK KgRvU`i GK we`tkl t`qT hv RbM`Yi Lv` I c`oi v`o`qZv, Avtqi m`thM m`x Ges `wi`a nwmKi`Yi gZ `iaZcY` we`lq, t`jvi mvt_ I Zt`c`Zv`te RwoZ | GQov, Kwl wefwbeai`Yi t`fV`c`Yi we`tkl Kti M`gxY GjvKvq t`fv`v`i evRv`i Pwin`wfwEK gvj vgv`j i Dm | ZvB M`gxY `wi`a nwmKi`Y Kwl t`qT`i Dbqb Ges Gi c`ix Zjv`SZ Kiv Acwi nvh`

1.2 dmj, grm, c`Ym`c` Ges eb DcLvZmg`ni mgw`Z ifc nj Kwl LvZ | grm I c`Ym`c` g`Yvj q, Lv` g`Yvj q, cwi`tek I eb g`Yvj q, fvg g`Yvj q, e`i I cvU g`Yvj q KZR c`Kfvt`e m`sk` Dc-LvZmg`ni Rb` bwiZ c`Yqb Kiv n`qtQ, thgb cwi`tek bwiZ 1992, RvZxq eb bwiZ 1994, RvZxq grm` bwiZ 1998, RvZxq fvg e`envi bwiZgvj v 2001, RvZxq cvU bwiZ 2002, c`Ym`c` bwiZgvj v I Kg`wi K`i bv 2005, National Livestock Development Policy-2007, RvZxq Lv` bwiZ 2008 Ges RvZxq t`w`e` Dbqb bwiZgvj v 2008 | G t`c`qT`Z dmj Dc-LvZi m`WK Dbqb KgRvU M`Y I cwi`Pvj bvi D`i`tk` Kwl g`Yvj q KZR G bwiZgvj vi Lmov c`YvZ n`qtQ | dmj Drcv`tbi j`qT` M`elYv, m`c`nviY, exR, mvi, q`i`a tmP, wecyb e`e`v Ges gvbe`c` Dbqb m`sk` we`lqmg` G bwiZgvj vq c`Z`vkv`wdK c`avb` t`c`qtQ | th`tnZ`evsjv`tki Kwl t`Z dmj LvZ AwaK `iaZcY`fvgKv

ivtL Ges miKvfi Kwl velqK weifbreKgmPz dmj LvZ mefkaK .iazi cvq, ZvB dmj LvtZi Dbqfbi Rb" cYxZ `vj j cteP avivevnKZvq OrvZxq Kwl bwxZO ktivbvtg AvfwnZ Kiv nttqQ|

1.3 cOZ eQi t`tk Kwl Rvgi cwiqvY cOq 1% nvti nfm cvt"Q Ges gWEKvi Ae¶q (fhgb, cyo Dcv`vtbi fvi mvg`nxvZv), I DePZv nwm Ges gWEKvi jeYvZv epxi dj kOZtZ gwUj .Yv.Y nwm cvt"Q| অধিকন্তু, পানিসম্পদ ও সংকুচিত হচ্ছে। ক্রমহ্রাসমান জমিতে ক্রমবর্ধমান জনগোষ্ঠীর জন্য অধিক খাদ্য উৎপাদন Ges Kwl RvZ kt`i i KuPvgj mieivni cOqRtb Kwl i Drcv`bkj Zv epx, wbeoKiY I eugLxKiYmn gj" msthvRb cOqRb|

1.4 mnmta Dbqb j¶"gvTvmg¶ni (MDGs) mstM msMvZ titL evsj vt`k miKvfi i Awfo j¶" nt"Q 2015 mvTj i gta" `wi`hxgvi bxtP emevmiZ RbtMvoX 1990 mvTj i Zj bvq 50 fvtMi bxtP bwtq Avbv| GOvovl t`tk GKwU wbfPthvM" A_¶vZK KvVtgv eRvq ivLvi Rb" cYxZ Oi o cAwel R cwi Kibv (2011-15)0 Ges OtOY Z cwi Kibv (2010-2021)0-tZ RbtMvwi `z A_¶vZK DbwZ, cj¶ AA¶tj i D"PZi cE¶x, Kwl Dbqb Ges MOgxY Kwl i mvT_ mskw A-Kwl A_¶vZK KgRvtUi Dbqfbi cOqRbxvZvi Dci .iaziAvtivc Kiv nttqQ|

1.5 tgvU t`kxq Drcv`tbi (wRwMc) D"PZi cE¶x ARB KiZ ntj Kwl LvtZ ewl R cE¶x GKBfvte epx Kivi cOqRb nte| AvaybK Kwl chv³ cOqvtMi gva'tg Kwl i Drcv`bkj Zv (dmj , D`vb, cOYmrc` , grm`mrc` Ges eb) epx Ges RvZxq I AvSRwZK evRvti tfv³vt`i mvT_ KItKi mieivn tPBb msthvTmi gva'tg Kwl tZ wRwMcDi D"PZi cE¶x ARB Kiv mae | Gi dtj t`tk `wi`Zv nttmi cvkvcwk RbMtYi RxbgvTbi Dbqb nte|

1.6 Kwl wfvEK evsj vt`tk tQvU Lvgti i fvgKvB teuk| RbMtYi A_¶vZK DbwZ Ges RweKvi t¶t¶ Kwl i e'vcK cfev itqQ| MOgxY RbtMvwi `wi`a nwm Ges Rxbgvb Dbqfbi Rb" eZvub Kwl Drcv`b e'e'vtK AwakZi MvZxj Kiv Ges tUKmB ewYwR`K Kwl Drcv`b e'e'vi cDj b Acwivh¶ Kwl tZ itqQ Lv" NvUwZ `ixKiY, wki Kvi Lvbi cOqRbxq KuPvgvtj i Afve nwm Ges cwi vgz Avqmn Kgms`vtbi mthvM mwi Acvi maebv, hv MOgxY RbtMvwi RxbhvTvi gvB Dbqfbi mnvqK nte|

1.7 chv³ cwi eZ¶bi gva'tg tUKmB Kwl wbeoKiY I eugLxKitYi Rb" cOqRb Kwl Mtelyv I mae'c'vitiYi mae'j Z `¶ I Kvhri Kwl chv³ e'e'vcbv| Gt¶t¶ h_vh_ gj" msthvRb Ges mpzevRvi e'e'vcvbi mnvqZv cOqRb| Avb-wbeo Kwl tK wUwKtq ivLvi Rb" Drcv`bkj Zv, mae'c` e'envti i `¶Zv, hTmvtvMx chv³ e'envi, Mtelyv I cix¶v KvRi mthvM-mjeav epxmn `y gvbe mae'c` mieivn eRvq ivLv AZxe .iaZcy¶ evsj vt`tk Kwl i Rb" cOqRb AwakZi `e'AvbK I chv³MZ mnvqZv| eZvub mgtqi eugvT K RvZxq Ges A_¶vZK cwi tetk Kwl Mtelyv I mae'c'vitiY e'e'vcbvq mi Kwi e'tqi Kvhrvvi Zv epx cOqRb|

1.8 Drcv`bkj Zv I gpdv epx, Aw`vZxj Zv nwm, mae'c` e'envti i `¶Zv epx, Awak cyogvbm`ubelV" km" I Kwl cy" Drcv`b, Kwl eugLxKiY I ewYwR`KxKiYi Pwv`v cty Kiv evsj vt`k Kwl i Ab`Zg P'vtj A |

1.9 বিদ্যমান জাতীয় কৃষি নীতি এপ্রিল, ১৯৯৯ এ গৃহীত হয়েছিল। সময়ের পরিক্রমায় কিছু .iaZcy¶Bmj DTMZ হয়েছে এবং কোন কোন ক্ষেত্রে নতুন মাত্রা যোগ হয়েছে। কৃষি সম্পদ হ্রাস, ক্রমহ্রাসমান জীববৈচিত্র, জলবায়ু cwi eZ¶, cOwZK `th¶Mi gvT I ZxeZv epx, Kwl DcKitiYi gj" epx, Lv" `te'i D"P gj" BZ"wi i tOYvtU Kwl tK Gme P'vtj A tgvKvtj vq wetkl fite myg Kti tZivv cOqRb| eZvub Kwl -A_¶vZK cwi w`vzi tOYvtU we"gvb Kwl bwxZtK hTmvtvMx Kiv Acwivh¶tq ctotQ|

2.0 RvZxq Kwl bwiZi Df'ik

জাতীয় কৃষি নীতির প্রধান লক্ষ্য হচ্ছে উৎপাদনশীলতা বৃদ্ধিসহ অধিকতর ফসল উৎপাদন এবং কৃষি কার্যক্রম eugLxKiYi gva'tg Kgnis'v'bi m'fhvM m'yo Kti mevi Rb' Lv' I c'p' w'bi v'c'Ev w'bi'Z Kiv Ges M'gxy Rb'Mv'oxi R'xeb'gvb Db'q'b Kiv |

2.1 m'bw' e' Df'ik'm'gnt RvZxq Kwl bwiZi m'bw' e' Df'ik'm'gna n't'Q-

- tUKmB I j vFRbK Kwl Drcv` b e'e`v w'bi'Z Kiv ;
- M'telYv Ges c'ik'f'Yi gva'tg dmt'j i Db'Z RvZ I P'v'ev` c'h'p'i tUKmB D'm'eb I m'c'hviY Kiv ;
- h_vh_ c'h'p' m'c'hviY I DcKiY e'e`v'cbvi gva'tg Drcv` b'k'j Zv e'p'x, Kgnis`vb Ges Av'tqi m'fhvM m'yo Kiv ;
- ewY'R'KxKiYi gva'tg c'Z'thwMZvgj K Kwl i c'p'j b Kiv Ges Zv Ae`v'Z i vLv ;
- Rj ev'qy c'wi e'Z'f'bi m'v't_ Aw'f'thvRb'thvM' (Adaptable) K.I.f'Ki P'wn`v w'gUv'Z m'f'lg Ggb`^ w'bf'p Ges tUKmB Kwl e'e`v` M'to t'Z'j vi Rb` c'wi K'ibv c'f'q'b Ges K'vh'xi Df`'vM M'h'Y ;
- Kwl c't'Y'i b`v'h` g'j` w'bi'Z Kiv m'n Kwl w'ec'Yb e'e`vi Db'q'b ;
- Av'S'R'ZK ev'Rv'ti i P'wn`v'gZ g'vbm'ub'e'Kwl c'Y` Drcv` t'b Dr'mv'n c'v'v' I Kwl c't'Y'i i B'v'x e'p'x i m'fhvM m'yo Kiv ;
- কৃষি পণ্য প্রক্রিয়াজাতকরণ ও কৃষি নির্ভর নতুন শিল্প স্থাপনের সুযোগ সৃষ্টি করা ; এবং

RbM't'Yi c'p' P'wn`v t'gUv't'bi Df'ik' Kwl e'ugLxKiY Ges Aw'K c'p'og'v' m'ub'e'w'f'b'ed'mj Drcv` t'b Dr'mv'n c'v'v' Kiv |

3.0 Kwl Lv'Z m'f'lgZv, `p'p'Zv, m'v'ebv Ges Av'ksKv

GKwl e`w'bo, K'vh'xi Ges dj c'h-RvZxq Kwl bwiZ c'f'q't'bi ce'RZ'n't'Q G bwiZ'g'v'v ev`'v'q't'b m's'k'w' m'f'lgZv, `p'p'Zv, m'fhvM Ges Av'ksKv'm'gna m'w'K'f'v'te w'ete'P'bv Kiv |

3.1 m'f'lgZv t

- dmj Drcv` t'bi Rb` m'v'avi YZ e'Q'i e`v'cx Ab'K'j Kwl Rj ev'qy w'e' i v'R'gvb ;
- Lv'g'vi c'h'f'q c'h'p' D'm'eb Ges c'h'p' n`'i's'i /m'c'hvi'f'Yi Rb` M'telYv-m'c'hviY c'x'w'Z w'e`'gvb ;
- Kwl M'telYv Ges Db'q't'bi Rb` w'e't'k'IA, w'e'Av'bx Ges c'ik'w'f'Z R'bej w'e`'gvb ;
- c'v'v'v' c'v'v'v' km` Drcv` t'bi Rb` j v'MmB c'h'p' w'e`'gvb ;
- t' ke`v'cx Kwl DcKiY mi e'v'n t'buI qv'K'w'e`'gvb ;
- b'Z'b c'h'p' M'h'Y Av'M'h'x I m'R'b'k'j K.I.K ;
- Kwl Kg'R'v't'Ui Rb` c'h'f'p' k'g'k'w' w'e`'gvb ;
- w'w'f'b'ed'm't'j i e`v'c'K R'x'e'w'P'I` w'e`'gvb ;
- t'm't'Pi c'w'bi c'c`'Zv ;
- w'e`'gvb m'nv'q'Z'vg'j K c'w'Z'w'v'K I w'b'q's'Y'g'j K K'v'v't'g'v ;
- mi K'v't'i i w'e`'gvb Aw'w'K m'nv'q'Zv/c'v'Yv`bv ;

- t̄ ke'vcx we'Z Kwl e'e'vcbr gubUwi's t̄bUI qvK, wewfboeKwl AĀt̄j i DctRj wfwĒK fwg I gwĒKv m̄u't̄ i Avav-we'wi Z Z_/DcvĒ I e'envi Dct̄hvMx wbt̄'Kv we''gub;
- K.I.Kt̄ i wPi vPwi Z I AwfĀZvj ä Ávb; Ges
- Kwl fZK KvW K.I.K e'vsK G'vKvD;U;

3.2 ʔZv t

- Zj bvgj Kfvte ʔ Kwl wecyb e'e'vcbr ;
- dmj KZbvĒi Avak ʔwZ ;
- Kwl KgvŪ cwi Pvj bvi Rb' K.I.t̄Ki wbr'^gj at̄bi AcĒZj Zv ;
- mxgZ cŌZŌvbK Kwl FY ;
- কৃষক সংগঠনের (ক্লাব, দল) সক্রিয়তার অভাব ;
- DcKiY (cwb, mvi, KxUvkvK BZ'w) e'envi i mxgZ ʔZv ;
- iBvbx evRv̄i i Pwn'v c't̄Yi Rb' gubm̄sZ cY' Drcv' t̄bi AcĒZj c̄h̄y³ ;
- cŌZKj cwi tek Dct̄hvMx c̄h̄y³ i AchĒZv ;
- temi Kvi x ch̄q M̄tel Yv Ges Dbq̄t̄b AchĒB wewt̄qVM ;
- AM̄hi gvb Kwl weÁvt̄b cŌk'ʔZ weÁvbx Ges AeKvWt̄vgvj K AcĒZj m̄thvM-m̄yeav ;
- Kwl t̄Z eüglxKi t̄Yi Afve ;
- Kwl DcKi t̄Yi gvb wq̄št̄Y ʔ e'e'vcbr ;
- mi Kwi I temi Kwi wekte'vj q Ges M̄tel Yv cŌZŌvbm̄ḡni ḡta' mḡšt̄qi Afve;
- Kwl t̄y't̄ Z_-c̄h̄y³ i AchĒB e'envi ;
- K.I.K I D't̄'v̄t̄ i cŌky't̄Yi AcĒZj Zv;
- gubm̄c̄baKwl DcKiY (exR,mvi I tmP) Drcv' b I mieiv̄t̄ni Achv̄BZv;
- Kwl RvZ c't̄Y'র সংরক্ষণ, প্রক্রিয়াজাতকরণের অপরিপূর্ণতা; Ges
- Kwl c't̄Y'i cwi enb e'e'vi AchĒBZv |

3.3 m̄thvM t

- n'ĩš'i thvM' AvaybK c̄h̄y³ I c̄h̄y³MZ Ávb we''gub;
- nvBeŴ c̄h̄y³ c̄h̄v̄t̄i i m̄thvM we''gub ;
- Kwl t̄Z DbZ c̄h̄y³ M̄h̄t̄Y wei vRgvb m̄v̄ebv ;
- creZ' Gj vKvnm cŌZKj Kwl-cwi tek AĀj e'envi i we''gub m̄v̄ebv ;
- ʔt̄'wK evRvi I evsj v̄t̄ kx Aajw Z we't̄'ki evRv̄t̄i D'P gj' dmj i Bvbx i m̄thvM we''gub ;
- km' eüglxKi Y Ges w̄weoKi t̄Yi wei vRgvb m̄thvM ;
- Kwl RvZ c't̄Y' gj' m̄sthvR̄t̄bi we''gub m̄thvM ;
- gj' m̄sthvR̄Z c't̄Y'i evRvi m̄ūh̄vi t̄Yi m̄thvM ;
- Kwl Lv̄Z Kgfis'vb m̄jō Ges Avq ep̄x i m̄thvM we''gub;
- dj b cv_Ŕ' n̄t̄mi m̄thvM wei vRgvb ; Ges
- e'w̄³LvZ I ewYwR'K Kwl i cŌZŌvbKxKi t̄Yi m̄v̄ebv wei vRgvb |

3.4 AvksKv t

- cwi tekMZ msKuvcbZv (Rj evqy cwi eZĒ, eb'v, Liv, So, j eYv³Zv, ti vMej vB, t̄cuKvKto i আক্রমণ এবং নদীভাংগন) বিরাজমান ;
- ক্রমাবনতিশীল মাটির স্বাস্থ্য ;
- ক্রমহাসমান চাষযোগ্য জমি এবং পানি সম্পদ ;

- AKwl KvR Kwl Rwg e`envti i gvIv epx ;
- Kwl ctYi b`vh` gj` c`Bi Awb`qZvi dtj Kwl KvR Kl.tKi wbiarmvn ;
- wej βgvb Kwl Rxe%wP` ;
- KxUvbkKtKi gvIvZwi³ I AwbqwšZ e`envi ;
- Kwl cwi tek Gi Ae¶q ; Ges
- Kwl LvZ wtkl Kti Kwl MtelYvq AcZj evtRU eiv |

4.0 MtelYv Ges Dbqb

Kwl MtelYvi gva`tg c`y³ D`eb I m`uvviY A`wZK Dbqtb , i`zcy`fwgKv cyj b Kti | ZvB Kwl Dbqtb Rb` GKwU m`gwšZ MtelYv cwi Kíbv Acwivnh¶ MtelYvi gva`tg hlvšKvix cwi eZB Avbv m`e hvi dtj Kwl mieivn-tKw`K Gi cwi etZ`wv`v-wfwEK nte | Gi Rb` c`qvRb Drcv`b gvIvi tPtq Drcv`b `¶Zv I Drcv`bkxj Zv epx | Gvovl Gi Rb` c`qvRb mgZv, Kgšs`vb, m`pzcwi tek msi¶Y, cyó, Lv`i , YMZgvb, e`emv ewYR` BZ`w` bZb aviYvi t¶mgn wetePbvq ti tL Lv` নিরাপত্তা প্রচেষ্টা চলমান রাখা । এ জন্য গবেষণা ও উন্নয়ন কার্যক্রমের সার্বিক জবাবদি`vZvi cvkicwK KvRKi Ašx¶Y, AM`aKvi cp:wba¶Y Ges m`pKi tYi `vex ivtL | Gme eúgwI K P`vtj Ä tgvKvtj vi Rb` c`vb tKškj mgn wbg`fc t

4.1 MtelYv c`Z`vbmgní cwi Pvj bv c`vZ t

- MtelYvi gvb Dbqtb Rb` RvZxq Kwl MtelYv wmt`tg mgšq, cwi Kíbv, AM`aKvi wbi fcy, পরিবীক্ষণ ও মূল্যায়ন পদ্ধতি ক্রমাগত শক্তিশালীকরণের ব্যবস্থা গ্রহণ করা হবে ;
- Kwl MtelYvq D`eb, DrKlZv mva`bi Rb` w`Avbxt` i A`ev MtelYv c`Z`vbmgníK c`Yv`bv I c`Z`vbmK cj`vi c`vb Kiv nte ;
- MtelYv KgRvÚi LiP wbe¶ni Rb` w`Avbxt` i chš Znwj c`vb Ges cKí-wfwEK KgRvÚK c`Z`vbmK ifc`vb Kiv nte ;
- MtelYv, cK¶Y I einivsb MtelYv KgRvÚi Rb` w`g vb AeKvWtgv Dbqb, c`qvRbxq I Dch³ AeKvWtgv wbg¶Y Kiv nte ; Ges
- RvZxq Kwl MtelYv wmt`tgi gva`tg GKwU MtelYv c`vZ c`Yqb hvi dtj c`Z GKK MtelYv DcKiY w`btqtMi gva`tg mtev¶ mvgwRK m`pj Ges gj` msthvRb AvRZ nte |

4.2 MtelYv cwi Kíbv I A`qb t

- MtelYv cwi Kíbv c`Yqb I AM`aKvi c`v`bi t¶t`i` wbgw`_tK kxI`li wfwEK` c`vZ Abyvi tYi I ci , i`z;Av`ivc Kiv nte ;
- mi Kwi , temi Kwi Askx` wí tZji gva`tg Mবেষণা কার্যক্রম পরিচালনায় উৎসাহ প্রদান করা হবে ; এবং
- গবেষণা কার্যক্রম পরিচালনার জন্য সময়মত ও চাহিদা মাফিক অর্থায়ন নিশ্চিত করা হবে ।

4.3 MtelYvi w`lq I t¶t` t

- গবেষণা কার্যক্রমের বিষয় হবে কৃষি নিবিড়করণ, বহুমুখীকরণ এবং সমন্বিত খামার কার্যক্রম ;
- w`vbwedmj i D`P dj bkxj, c`ZKj Zv m`v`v, `f tgv`x I `f DcKiY wbf¶ RvZ Ges Pvlv` c`y³ i D`eb I Dbqb;
- dmj msM`nvEi c`y³, D`P gj` m`vbwedmj , gj` msthvRb, Kwl e`emv e`e`vcbv Ges ewYR`;

- weKvkgvb wel q thgbt Rxe cħy³, †Kšvj ZwĒĴ (Genetic) Mtel Yv, nvBełW, Rj evqycwi eZb RwbZ cřve thgb- eb`v, Liv, mvB†Kvb, jeYv³Zv, Rj ve×Zv BZ`w` cĀZKj Zv, Pi, DP/cvvox AĀj I Mfxi cwbj dmj e`e`vcbv, tUKmB fig I cwb e`e`vcbv Ges Re-চাষাবাদ বিষয়ক গবেষণা কার্যক্রমে সহায়তা ;
- Drcv` bkxj Zv Ges tUKmB Drcv` tbi j †y` eġo`nbfP dmtj i Mtel Yv ;
- Lvgvi e`e`vcbvq mġ সমস্যাসমূহ সমাধানে গবেষণা কার্যক্রম ;
- Rj evqycwi eZĪmn Avenl qv I dmtj i Drcv` b wel qK ceġfm m`uĴKZ Mtel Yv ;
- Kwl i hwišKxKiY Ges j vMmB Kwl hšcwmZ D`m`eb wel qK Mtel Yv I Dbq̄b ;
- mgwšZ evj vB e`e`vcbv I %Re evj vBbvK D`m`eb I Dbq̄b ;
- Avštmxgv (Trans-boundary) অতিক্রম করে যে সকল রোগ বালাইয়ের সংক্রমণ ঘটে সে সকল বিষয়ে গবেষণা কার্যক্রম গ্রহণ । তাছাড়া, এক বা একাধিক উৎপাদন পদ্ধতি এবং টেকসই উৎপাদন e`e`v, `wii`a`ixKiY, Rxebgv Dbq̄b, cwiewiK Lv`wbi vcĒv I Lvgvi ewnfZ Avq eġx Ges MġgxY Dbq̄b BZ`w` wel tq Mtel Yv ;
- Kwl bmxZ I cħy³ m`cĥvi †y Awfbaavi vq Mtel Yv ; Ges
- weifbKwl -Rj evqAAĵj i Rb` cwi tek-evĴe cħy³ D`m`eb, Dbq̄b Ges tUKmB fig I cwb e`e`vcbv |

4.4 cħy³ n`iśi t

- K.I.K I Ab`vb` mjeav†fwM†` i g†a` cvi`úwiK m`uĴK Dbq̄tbi gra`tg cħy³ cwi gvRĪ, hvPvB Ges n`iśi wel tqi I ci mKj Mtel Yv cĀZōvb , i aZj cĪ vb Ki †e ; Ges
- কৃষি গবেষণা প্রতিষ্ঠান বহিরাংগন সম্প্রসারণ কার্যক্রমে বিজ্ঞানীদের সম্পৃক্ততা বৃদ্ধি করার উে`vM MħY Kiv n†e |

4.5 tmev cĪv†b mgZv t

- Kwl Mtel Yv e`e`vcbv†K we†K> †Ki†yi gra`tg Mtel Yv mjeav†fwM†` i Kv†Q mġj tciQv†bvi j †y` RvZxq Kwl Mtel Yv w†÷g cĪqvRbxq D†`vM MħY Ki †e ; Ges
- cĪZōvbK AeKvW†gv Ges gvbe-m`c` Dbq̄tbi ††† AvĀwj K chġq AmgZv `ixKi†y mi Kvi D†`vM w†e |

4.6 Z`we`v t

- Mtel Yv I Dbq̄b cwi Kí bvi D†††k` Kwl Mtel Yv cĀZōvbmgñ GKwJ wek` Z`_` fvŪvi `Zix Ki †e ; Ges
- RvZxq Kwl Mtel Yv w†÷g Gi Avl Zvaxb mKj cĀZōv†bi g†a` Ges Ab`vb` RvZxq, AvĀwj K Ges AvšRĪZK we†klwqZ Mtel Yv c†িষ্ঠানের সাথে কৃষি গবেষণা সংক্রান্ত একটি কার্যকর ই-tbUI qvK`Zix Kiv n†e |

4.7 Askx`wi Zgj K mn†hwMZv eġx t

- RvZxq Kwl Mtel Yv w†÷g fy³ cĀZōvbmgñ mi Kwi I temi Kwi Lv†Zi thš_ mn†hwMZv eġxi মাধ্যমে গবেষণা কার্যক্রম বৃদ্ধির সুযোগ সৃষ্টি করবে ;

- gŷ Y I Btj KUŷbK gva`tgi mrvvth` Kwl Z_ I cŷy³ we`vi kw³kvj xKi tYi Rb` Kwl Z_ mwfŷ, eisj vt`k tUwj wfkb Ges eisj vt`k teZvimn Ab`vb` temi Kwi wUvf I tiwVI P`vtbj _tjvi gta` mnthwMZv epxi I ci tRvi t`qv nte; Ges
- KwgDwbU tiwVI, I tpe tiwVI Ges tgeveBj thwMvthvM cŷy³i e`envi tK Kwl Z_ I cŷy³ m`u`hvi tY DrmwvZ Kiv nte|

5.4 Askx` vi Z;t

- mi Kwi I temi Kwi cŷZŷvb Ges e`w³ gwj Kvbvaxb ms`vi Askx` vi Zgj K m`cŷhvi Y KgRvU tK DrmwvZ Kiv nte ;
- Kwl cY` Drcv` t b mi Kwi -temi Kwi Askx` vi Z tK DrmwvZ Kiv nte ;
- BDwbqb Ges Dc tRjv chŷq `vbxq mi Kv t i mrvqZvq m`cŷhvi Y tmev c` vtbi Rb` wewfbœKg® tKŠkj MŷY Kiv nte ; Ges
- mnthwMZv Ges mgš tqi Rb` mi Kvi `vbxq chŷq Kwl m`cŷhvi Y Avā` Bi I mgag® G tRŷv mg tni gva`tg temi Kwi cŷZŷvb I Ab`vb` Dbqb mnthwMx` i mv t_ thwMvthvM i qv Ki te|

5.5 Kwl i Drcv` bkxj Zv t

- Lv` w bivcEv I RxeKvi mv t_ msukŷ cŷvb Lv` k t m i Drcv` t bi t q t i mi Kv t i mrvqZv Ae`vnZ _vKte Ges tRvi`vi Kiv nte| Dci š; Kl t Ki Avq Ges Kwl RvZ c t Y i i Bvbx epxi j t q i D`P g t j i dmj Drcv` t b mrvqZv cŷ vtbi c` t q c MŷY Kiv nte ;
- dm t j i w b i e o Z v e p x i R b ` w e t k l c ` t q c M ŷ Y K i v n t e G e s c w Z Z R w g t K P v t l i A v l Z i q A v b v i R b ` c ŷ P ŷ M ŷ Y K i v n t e ;
- Lv` w f v E K c y b w b i v c E v e p x i j t q i k m ` e u g L x K i t Y D t ` v M t b q v n t e ;
- mi Kvi m`cŷhvi Y I DcKiY tmev cŷvbKvix ms`vi gva`tg Kwl DcKiY (exR, mvi, tmP, KxUvbkK BZ`w`) mieivn, cŷc`Zv I weZiY cwi exŷY Ki te Ges mi Kvix I temi Kvix cŷZŷvb KZŷ mieivnKZ Kwl DcKi tYi gvb w b q š t Y K t v i c w i e x ŷ Y w b w ŷ Z K i t e ;
- w b e ŷ P Z w k Q z k t m i R b ` m n R k t Z ° F Y m r v q Z v c ŷ v t b i c ŷ P ŷ M ŷ Y K i v n t e ;
- Drcv` b epx t Z Kl.K t i t K DrmwvZ Kivi Rb` FY cŷ vtbi gva`tg chŷ Awl_ŷ mrvqZv cŷvb Kiv nte| G t q t i t q y ; c ŷ ŷ K , g a ` g c h ŷ q i K l . K G e s e M P v l x ` i A M ŷ a K v i t ` q v n t e ; G e s
- Kwl FY mnRcŷc` Kivi j t q i c ŷ Z ŷ w b K K w t g v M t o t Z v j v n t e |

5.6 YMZgvb w b ŷ q Zv t

- mi Kvi t` kxq evRvi I i Bvbx i Rb` dm t j i Drcv` b Ges mieiv tni t y t i “Good Agricultural Practices (GAP)” tK DrmwvZ Ki te ;
- উৎপাদন, প্রক্রিয়াকরণ এবং বিপণনকালে জীবাণু এবং রোগ-erj vB gy³ Ki tYi (Sanitary & Phytosanitary Measure) e`e`v MŷY Kiv nte ; Ges
- Avg` vbx I i Bvbx evRv t i i Pwv` v Abjvqx msMwb t i va tmev kw³ kvj x Kiv nte |

5.7 cĀZKj Kwl Rj evqyAĀtj i Rb" KgnP t

- cvnox, Liv-cĀY, eĀi>'; PivĀj, nvl i-evl i, Rj ve× Gj vKv Ges DcKj xq AĀj mgĀni Rb" Dchy³ cĀy³MZ mnvqZv cĀvtbi Rb" mi Kvi cĀPōv MĀY Ki ĩe |

5.8 Avc` Kvj xY Ae`v tgvKvtej v t

- thĀKvb Avc` Ges Avc` Kvj xb cieZ³mgĀq Drcv`bkxj Zv ep× Ges Kgnis`vtbi mĀhvM mĀoi Rb" mi Kvi, ĩemi Kwi cĀZōvb, GbwRI, tmevgj K cĀZōvb Ges DĀ`vMx e`w³ĀK m³ú³ KĀi ĀlvZMĀ' K.I.KĀ' i Rb" ZvrĀvYK mnvqZvnm`f, ga'g Ges `xN³gqv`x Dbq³ KgnP MĀY Ki ĩe ;
- dmtj i Āq-ĀvZ cvltq tbqvi jĀĀ" mi Kvi cĀKvZK`th³msN³vtbi ciciB Kwl cpeĀmb KgnP MĀY Ki ĩe ;
- DcKj, nvl i, vej Ges Pi AĀj mgĀni dmj i Āvi Rb" Ab`vb" Drcv`b Dc-LvZmgĀni mĀ_ mvgĀm" ĩiĀL e`e`v MĀY Kiv nte ;
- km`exgv Pvj j welq weĀepbv Kiv nte; Ges
- thĀKvb`th³Mi Ae`emZ cĀi cpeĀmb KgnP^x ĩiyKivi Rb" ŌKwl`th³ tgvKvej v Znvej Ō MVĀbi e`e`v tbqv nte |

5.9 cwiĀek I m³c` msiĀY t

- mi Kvi wbi vc` Ges ĀUKmB fivel`Āzi Rb" Avay³B cwiĀek-evĀe cĀy³ Ges AeKvWĀgv`Zix DrmwnZ Ki ĩe ;
- Rxe%³ĀPĀ msiĀY Ges ĀUKmB fvg I cwib e`e`vcbvi Rb" mgw³SZ evj vB e`e`vcbv Ges mgw³SZ km` e`e`vcbv KivĀkrm prb³rdn/ উৎসাহিত করা হবে ; এবং
- Kwl Rvq AKwl KvĀR e`envi w³q³ĀYi e`e`v MĀY Kiv nte |

5.10 Z`fvŪvi t

- Kwl LvĀZ Dbq³ Ges cwi KĀi bv cĀvq³bi Rb" Kwl msw³ō ms`vmg³Ā t`Āk we`g³v m³ú` , DcKiY, cĀy³, Drcv`b Ges wecyb e`e`v BZ`w` mKj ZĀ`i mg³Āq GKwl mgw³SZ Z`fvŪvi`Zix I nvj b³Mv` Ges ĩyYĀteyY Ki ĩe ;
- mi Kvi e`envi-evĀe K.I.K I Kwl cĀy³ i mgw³SZ Z`fvŪvi`Zix Ki ĩe ; Ges
- ZĀ`i we`Āi Ges m³peav³fvMĀ` i msw³ō Z`fvŪvi e`envĀi i welĀq cĀPōv MĀY Kiv nte |

6.0 exR I Pviv-Kj g

dmtj i Drcv`b ep× Ges Lv` wbi vcĀv ARĀbi Rb" DbZgvĀbi exR GKwl Ab`Zg cĀvb I ĩg³Āj K Kwl DcKiY | fij exR GKKfĀte dmtj i dj b 15-20 f³M ch³Āi ep× KiĀZ mĀĀg | eZ³vtb wevf³bedmtj i Rb" Pwn`vgwdK gvbm³ĀZ ext³Ri DĀj³LĀhvM` Ask mi Kwi LvZ tĀĀK mieivn Kiv nq | wKQz msL`K exR Drcv`bKvix cĀZōvb Ges GbwRI fij exR, gj Z: nvBe³W avb, f³UĀ Ges kvK-সবজির বীজ সরবরাহের কার্যক্রম ev`ēvq³ KiĀq | gvbm³ú³ext³Ri wKQz Ask e`w³ e`e`vcbvq, weĀkl KĀi K.I.K ch³Āq Drcv`b, msiĀY I e`envi Kiv nq |

6.1 dmj RvZi cRbb, Dbqb I iYvteY t

- t`kxq cŪZôvb/e`w³tK DwM cRbb KgŋPx MŋtY DrmwNz Kiv nte, ZvQov miKvi KZR Abtgw`Z dmtj i RvZ Dbqb I ewaZKiYi j t`ŋ` tgsj/wfvE` exR Drcv`b I Avg`vb Kivi t`ŋt` e`w³/tKv`úvb Ges Ab`vb` ms`vmgatK DrmwNz Kiv nte |
- exR Drcv`b I e`envq vbh³ e`w³, tKv`úvb A_ev ms`vK we`kl mjevRbK ktZ`cŪZôvbK FY cŪBi mthvM cŪvb Kiv nte ;
- cRbb ntZ wecyb chS`exR LvZi gvb Dbqtb miKwi I temi Kwi LvZ mthvM mjev cŪvbi gva`tg extRi mlg Dbqtb mnvqZv cŪvb Kiv nte ; Ges
- miKviti i ce`vgyv bmtctj`y exR Dbqb, vbeÚb Ges wecyb সংশ্লিষ্ট কার্যক্রমে যে কোন ব্যক্তি বা tKv`úvb ms`kŋ ntZ cvi te |

6.2 exR cwieaŋ I weZiY t

- miKwi, temiKwi ms`v I K.I.Kt` i cRbb exR Ges wfvE` exR cŪBtZ mnvqZv cŪvb Kiv nte;
- miKvi Ri ai x wKsev cŪKwZK`thM cieZx`Ae`v tgvKvtej vi Rb` extRi Avc`Kvj xb gRj` eRvq ivLte ; Ges
- বীজ উৎপাদন, প্রক্রিয়াজাতকরণ, সংরক্ষণ, মান নিয়ন্ত্রণ এবং বিপণন কার্যক্রমে প্রয়োজনীয় সুযোগ সুবিধা cŪZôvq miKwi I temiKwi LvZtK DrmwNz Kiv nte

6.3 miKwi I temiKwi exR wki LvZ mnvqZv t

- miKwi I temiKwi LvZ KZR Dbz gv`bi exR Drcv`tb Pw³ex K.I.Kt` i mvg`e`x Kiv nte ; Ges
- K.I.tKi gvW chq bZb RvZ Ges bZb ch³ cŪqtM K.I.Kt` i mPZbZv mwoi j t`ŋ` miKwi I temiKwi LvZ cŪqvRbxq KgŋP MŋY Ki te |

৬.৪ বীজের মান নিয়ন্ত্রণ কার্যক্রম শক্তিশালীকরণ :

- gvb m`úvax`extRi cŪc`Zv e`x`i j t`ŋ` exR cŪ`qb Ges exR wevagyv KvhRi Kivi KivR tRvi`vi Kiv nte ; Ges
- exR Avg`vbx I iBvbxmn exR Drcv`b t`tK wecyb chS`exR e`e`vi mKj avtc`YMZ gvb eRvq ivLvi e`e`v tbqv nte |

7.0 mvi

dmj Drcv`b e`x`i t`ŋt` mvi GKwU Acwi nvh`Kw DcKiY| AvaybK Kw e`e`vcvbi cŪvi I wboeo Pvlvev` i KviY mvti i Pwin`v Ae`vnZfvte e`x` jvf Ki tQ| G ewaZ Pwin`v tglvZ mgqgZ mvi mieivn wboZ Kiv Acwi nvh` i vmqvbK mvti i Amg e`envti figi Ae`ŋq I AwZwi³ cwi gvY DwM cŪ Dcv`vb AvniYi dtj GKw tK gvEKv DePZvi AebwZ NUtQ Ges Ab`w tK dmtj i dj b ŋgZv nwm cvt`Q| GgZve`vq, gvEKv DePZv eRvq ivLvi j t`ŋ` mlg mvi e`envti i cŪZ K.I.Kt` i tK DrmwNz Kivi Rb` KvhRi c`ŋc MŋY Ri ai | mvi e`e`vcv kw³ kuj x Kivi j t`ŋ` miKvi wbgvj vLZ bxwZgvj v Abyni Y Ki te |

7.1 msMh I weZiY t

- mi Kwi Ges temi Kwi Dfq chqB mar kroy, msMh o bitoron prakriya cholman থাকবে ; এবং
- AvAj K, tRj v I DctRj v chq mvti i Avc` Kuj xb gRj eRvq ivLvi c` tnc MhY Kiv nte |

7.2 YMZgvb vbqSY t

- mi Kvi K.I.K chq gvbmcvbmvti i cOc`Zv vbmOZ Ki te ;
- gvEKv, DwMc Ges cOvYKtj i Rb` qvZKi thKvb cKvi mvti i Drcv` b, Avg` vbx, wecYb, weZiY Ges e`envi vbw x Kiv nte ; Ges
- mi Kvi mvti i YMZgvb hvPvB Kivi Rb` vektotyi mthvM mjev kvkx Ki te |

7.3 Re I myg mvi caD/DrmwvZKi b t

- mi Kvi K.I.K chq Re mvi, Ktvcvó Ges RxeYymvti i e`envi DrmwvZ Ki te ;
- gvEKvi cvó Dcv` vbi cOkvZK fvimvg` eRvq ivLvi Rb` Dchy` km` web`vm AbymitYi Rb` mtPZbZv` Zix Kiv nte ;
- myg, mvktx Ges Re mvi e`envti K.I.K` i Drmwv c` vbi Rb` cOqvRbxq mnvqZv cOvb Kiv nte; Ges
- U ইউরিয়া সারের উৎপাদন ও ব্যবহার কার্যক্রম জোরদার করার পদক্ষেপ গ্রহণ করা হবে ।

7.4 mvi cwiexY t

- mi Kvi wevfbachq mvti i mi eivn, `vgRvZKiY, gj` Ges YMZgvb cwi exY Ki te |

8.0 qiz`tmP

dmj Drcv` b evxi Rb` tmPtK Kwl DcKiYmgfni gta` AZ`Sf cOqvRbxq DcKiY wntmte wetePbv Kiv nq | Rj evqy cwi eZB Ges Acwi Kwi Zfite f-Mf` cwb DtEj tbi KvitY t`tki GKw e`vcK Gj vKv kktbv tgsmtg tmtPi cwb cvt`Q bv | AvAKs, DRvtbi t`k KZR cwb e`vcbvi dtj G Ae`vi Avtiv AebvZ NUtZ cvti | AZGe, dmtj i vbeoZv I dj b evxi j tnc` GKw mycwi Kwi Z tmP e`v MhY AZ`Sf Ri ax | f-Dcwi` cwb e`envi evx Kti f-Mf` cwb e`envi Kgvvbi gvatg cwi tetki fvimvg` eRvq ivLv Ges tmP LiP ntm i I ci mi Kvi vekt i az; Avtivc Kiti | GRb` Rivxq Kwl bvxZ cwb mact` i mjeze`envti i Dci vekt i tRvi w`t`Q | mi Kvi f-Mf` cwb i Dci vofpkj Zv Kgvvbi cvkvcmk f-cwi` cwb i e`envi evxi wltq cOqvRbxq vbt` Rbv we`Z AvKvti Dc`vctbi Rb` mgvSZ qiz`tmP bmvZgvj v clyqb Kite | hv I qiz`tmP i weivU AskB temi Kwi gwj Kvbvaxb, Zelj` q tmP e`vcbv Mto tZvj vi` vqZ; mi Kvti i hvZ` f Li tP tUKmB tmP mjev cOvb macthwi Z nq | `y`y`tmP e`vcbvi tytI vbevY c`tyc tbqv nte |

8.1 tmP`yZv I cwbi Drcv`bkj Zv t

- we`gvb cwb maut` i cwi vgz e`envti i gvatg tmtPi KvhKwi Zv Ges cwbi Drcv` bkj Zv evxi Rb` tmP`yZv vbi fcy Kiv nte Ges AvajbK cwb e`vcbv chj` i we`vi NUvtbv nte;
- cOZeUKZvcY` cOZKj Gj vKv thgb Pi, cvnvx AAj, eti`AAj, Liv-cEY, nvl o Ges jeYv` AAj mn Ab`vb` AAjt tmtPi Gj vKv evxi j tnc` AvajbK tmP, v`vkb Ges cwb cOqvM cxvZmgfni cPj b Kiv nte ;

9.1 Kwl hšcwZ Drcv` b t

- Av_mvgwRK, c0KwZK cwi tek I Rj evqy cwi eZ0RwbZ Ae`vi mstM msMwZcY©Kwl hšcwZi Drcv` b I c0ZKiYtK mi Kvi DrmwnZ Ki te; Ges
- Kwl hwsšKxKiY KgRvtU wbyš Drcv` b Kvi Llvv Ges wkí c0Z0vbmgašK Dchyš mnvqZv Kiv nte |

9.2 mnvqZv I c0Yv` bv t

- Avmদানি শুষ্ক রেয়াতের সুযোগসহ কৃষি যন্ত্রপাতির পরীক্ষা প্রক্রিয়া এবং মান নির্ধারণে প্রচলিত সুবিধা অব্যাহত থাকবে যাতে এসব যন্ত্রপাতির মূল্য কৃষকের ক্রয় ক্ষমতার মধ্যে থাকে ;
- `vbxq Drcv` Kt` i tK Drmwn c0vb Kivi Rb` Ges t` kxq hšcwZi gj` Avg` vbxKZ hšcwZi gštj`i mvt_ c0ZthwMZvgj K chšq ivLvi Rb` Kwl hšcwZ `Zixi Kivvgštj i Avg` vbx i ié hysmsMZ chšq ivLvi c0P0v M0Y Kiv nte ;
- কৃষি যান্ত্রিকীকরণ কার্যক্রমকে ত্বরান্বিত করার লক্ষ্যে উৎপাদক ও ব্যবহারকারী উভয়কেই যথাযথ ঋণ mjeavmn c0qvRbxq mnvqZv c0vb Kiv nte ;
- mi Kvi wtkl wtkl Kwl hšcwZi tššš Gme hšcwZ c0ZKvi x, Drcv` K Ges K.I.K chšq DÍxcbgj K mnvqZv c` v tbi gva`tg Kwl hwsšKxKiY c0a0 Ki te;
- Kwl fZ0K I DcKiY mnvqZv, Kwl KwW0 K.I.tKi e`vsK GKvDšUi gva`tg c0vb Kiv nte; Ges
- mi Kvi K.I.K `j wfvEK Pvlvev` I wecybtK DrmwnZ Ki te |

10.0 Kwl tZ mgevq

ক্রমহাসমান চাষযোগ্য জমি এবং কৃষকের আর্থ-mvgwRK t0vvcšU mgevq wfvEK Kwl Drcv` b I wecyb e`e`v K.I.Kt` i fvm t0vvcšb mnvqK fvgKv ivLte |

10.1 mgevq wfvEK Kwl Drcv` b

- c0šK, qiz` I gvSvix Kwl Drcv` bKvix I Kwl Dt` v`v` i dmj Drcv` b w0w0Z Kivi j tšš` c0Yw` Z mgevq ev `j wfvEK Kwl Drcv` btK mi Kvi Drmwn Ges mnšhwMZv c0vb Ki te;
- `^`^fvgi gwj Klvv Aqšbeti tL mgevq wfvEK Avaj0K Kwl Drcv` b KgRvtU mi Kvi mnvqZv c0vb Ki te;
- mgevq wfvEK Kwl Drcv` b DcKib thgb-exR, mvi , evj vBvkK, Ryj vbx, Kwl hšcwZ BZ`w` msM0n Drmwn Ges mnvqZv c0vb; Ges
- `^`^fvgi gwj Klvv Aqšbeti tL mgevq wfvEK t`^0v c0Yw` Z thš_ Pvlvev` Drmwn c0vb Kiv nte |

10.2 mgevq wfvEK wecyb

- c0šK, qiz` I gvSvix Kwl Drcv` bKvix I Kwl Dt` v`v` i b`v`gj` c0š w0w0Z Kivi j tšš` mi Kvi mgevq ev `j wfvEK wecybtK Drmwn Ges mnšhwMZv c0vb Ki te ;
- mgevq wfvEK Avaj0K wecyb e`e`vi c0j b; Ges
- mgevq wfvEK Drcw` Z Kwl cY` D`Pgštj`i evRvti c0ekwaKvti mnvqZv c0vb Kiv nte |

11.0 Kwl wecYb

Kwl wecYb c×wZ Lvgyi cY" Ges Lv" I Kwl cY"i tfrv³vt`i gta" msthvM `vcb Kti | thtnZyKwl RvZ cY" evRvi RvZ Kiv c0qvRb, ZvB wecYb e`e`vi `¶Zv Avbqbtbi Rb" GKwJ kw³kvj x evRvi AeKvWtgv `Zix Kiv Avek"K | `¶ Kwl wecYb e`e`v `vcftbi gra`tg Kl.tKi `i KlvKwl Kivi kw³ ey×mn Zvt`i Drcw`Z cY"i b`vh" gj" c0Bi mthvM `Zix Ki.tZ mi Kvi mnvqZv Ki.te |

11.1 wecYb e`e`vi AeKvWtgv Dbqb t

- mi Kvi M0g"-evRvi `vcb I cvBKvix evRvti Kwl cY" weZiY e`e`vi Dbqbtbi gra`tg Drcv`b ntZ tfrv³v ch0q Kwl cY"i wbS0vU mi ei vtn mnvqZv Ki.te ;
- Drcv`bKvix I tfrv³vt`i gta" KvhRi gj" k\$Lj (Value Chain) `Zixi c0P0v tbcv nte ;
- mi Kwi I temi Kwi Dfq Lv.tZi Kwl cY"i evRvi Dbqb Dt`vM.tK DrmwnZ Kiv nte ;
- কৃষি বিপণন সংক্রান্ত প্রতিষ্ঠানসমূহ শক্তিশালীকরণ এবং পুনর্গঠন করা হবে ;
- Kwl cY"i msiyY Ges `vgRvZKi.tYi Dt`i.tk" c0qvRb gwcdK `vg Ges wngMvi myeaw` `vcftb mi Kvi x Dt`vMmn temi Kwi web.tqM.tK mi Kvi Drmwn c0vb Ki.te; Ges
- Kwl cY"i `YMZgvb cixyv I c0gZKi.tYi Rb" c0qvRbxq mthvM-myev m0j Z j`vetiUwi I cixyv tK)`a `vcftb mi Kwi -temi Kwi Askx`vwi Z;wfwEK web.tqv.tM Drmwn c0vb Kiv nte |

11.2 evRvi Z_ I m#c0viY tnev t

- কৃষক, উৎপাদক, ব্যবসায়ী, উদ্যোক্তা ও ভোক্তাদের কৃষিপণ্য এবং কৃষি উপকরণসমূহের বাজার সংক্রান্ত Z_`w msM0 I c0vi.tK mi Kvi Drmwn c0vb Ki.te ;
- mi Kvi Kl.K I Dt`v³vt`i Kwl RvZ `te"i gj" msthvRtb c0qvRnীয় সেবা প্রদান কার্যক্রম প্রবর্ধন Ki.te ;
- সঠিক মূল্য ও মানসম্পন্ন কৃষিপণ্যের বাজার সংক্রান্ত গবেষণার ক্ষেত্রে সরকারি বেসরকারি উদ্যোগসমূহকে DrmwnZ Kiv nte ;
- Drcv`b Ges Drcv`b cieZPmg.tq wbi.vc` Lv`i`i weIq mi Kvi DrmwnZ Ki.te; Ges
- Kwl cY"i c`vtKwRs, tM0ws I tj.tewj.stqi কার্যক্রম উৎসাহিত করা হবে ।

11.3 GtM0:c.tmms t

- mi Kvi Kwl cY" wfwEK wk`i.tK DrmwnZ Ki.te;
- Kwl cY"i gj" msthvRb tPbb (t`j y.tPbb) Dbqbtb KvR Kiv nte; Ges
- mi Kvi Kwl cY" wfwEK wk.ti we.tkl c0bv`bvi e`e`v M0Y Ki.te |

11.4 iBvbx I evRvi Dbqb t

- mi Kvi einwe.k!evsj vt`kx Aajwl Z RbtM0x Ges gj`avi vi evRvti Kwl RvZ cY" i Bvbx.tK DrmwnZ Ki.te ;
- mi Kvi Kwl cY" e0gtLxKi.tYi c`t¶c M0Y Ki.te Ges einwe.k!bZb I m#tebvgq evRvti i m0vb Ki.te;
- cwi.tek ev0e Kwl /`Re Kwl RvZ cY"i t`kxq I AvSR0ZK evRvi we`ti Dt`vM M0Y Kiv nte; Ges

- রপ্তানী বাজার উন্নয়ন ও এ সংক্রান্ত যোগাযোগ এবং তথ্য আহরণ ও বিতরণে ই-AeKvVtgvI weKvk DrmwNz Kiv nte|

11.5 evRvi wevAgvjv I mnvqZvKiY t

- বাজার কর্মকাণ্ড পরিচালনায় দক্ষতা বৃদ্ধির জন্য বাজার সংক্রান্ত আইন ও বিধিমালা শক্তিশালী এবং nvj bvMv` Kiv nte ;
- KvhRi evRvi cwi Pvj bvi Rb` mi Kwi I temi Kwi Askx`wi Zj Ges mgšqtk mi Kvi DrmwNz Ki te ; Ges
- Lv` `` `qs` RvwZ I ivó` wntmte wbtRt` i Ae`vb my`XKiY Ges Lv` `` wbiVcEv wbowDqZvq K.I.Kt` i b`vh`gj` c`B I fiv`vt` i mvgt`_P gta` Kwl ctY`i gj` wbaP`Y Ges Kwl wecYb e`e`v kw`kvj xKi`Yi Rb` wbt` Rbv c`vb Kivi j`j` mi Kvi Kwl gj` Kwgkb MVB Ki te|

11.6 temiKvix LvZ Kwl -emvR` mshv t

- mi Kvi e`v` Df` `v`v Ges K.I.Kt` i Kwl -বাণিজ্য কার্যক্রম গ্রহণে প্রযুক্তিগত সহায়তা প্রদান করবে ; এবং
- RvZxq Ges AvšRv`ZK evRvi Kwl emvR`i mshv emx`i j`j` Dc`hVx cwi tek mjo` Kiv nte|

12.0 Kwl tZ bvi x

t`tki tgvU gvbe-m`ut` i c`q A`aR bvi x| tmRb`, mi Kvix PvKix I Kwl tyt`I Av`iv AwaK mSL`K bvi x K.I.K Ges Kwl ktg-kw` wntmte Ašf` nI qv c`qvRb| th`nZi Kwl c`h`xi t`j`I bvi xi Ae`vb ivLir যথেষ্ট সম্ভাবনা রয়েছে, তাই কৃষি সংক্রান্ত অর্থোপার্জন কর্মকাণ্ডে নারীকে অর্থবহভাবে সম্পৃক্ত করা এবং gvbe-m`u` Dbqtb mi Kv`i i Ki Yxq w`e`c:

12.1 bvi xi qjZvqb t

- cwi emi K Lv` I c`oi wbdqZv weavb KgRvU Dbqtb bvi xi `qZv emx`tZ c`qvRbxq mnvqZv c`vb Kiv nte ;
- Kwl e`e`vcbv wetq w`vš`M`Y bvi xi AwaKzi AskM`Y DrmwNz Kiv nte ; Ges
- Kwl DcKiY c`B Ges e`e`vcbvi tyt`I bvi xi mg-AwaKvi wbowDZ Kivi wetq c`P`v M`Y Kiv nte|

12.2 Drcv` b I wecYtb AskM`Y t

- সরকার কৃষি উৎপাদন ক্ষেত্রে, বিশেষত: কৃষি প্রক্রিয়াকরণ এবং কৃষি-e`emv KgRvU M`gxY `wi`a bvi xt` i AskM`Y DrmwNz Ki te hvZ Ziv Zvt` i A`wZK Ae`vi DbwZ Ki tZ cvti ;
- Kwl tZ bvi xi c`h`MZ qjZvqbtk DrmwNz Kivi c`P`v M`Y Kiv nte ;
- Kwl c`h` c`B tZ bvi xi AwaKvi c`Z`vi gva`tg Kwl Drcv` b e`e`vq bvi xi AskM`Y tK mnRzi Kiv nte; Ges
- wefbaeKvi Kwl m`c`vi Y KgRvU thgb c`k`Y, K.I.K mgvtek I KgRvjvq bvi xi AskM`Y DrmwNz Kivi j`j` mi Kvi c`t`c M`Y Ki te|

12.3 Avtqi mshv mRb t

- Kwl wetqK wefbaeKgRvU, thgb emZevotZ evMvb, dmj KZ`bvEi KgRvU, exR Drcv` b I msi`Y, bvm`x, tgšgwQ-পালন, খাদ্য প্রক্রিয়াকরণ ইত্যাদিতে নারীর অংশগ্রহণের ক্ষেত্রে সরকার ঋণ mnvqZv c`vb Ki te;

- সরকার ক্ষুদ্র আকারের কৃষি প্রক্রিয়াকরণ, গুদামজাতকরণ ও সংরক্ষণে মহিলাদের ক্ষুদ্র ঋণ সহায়তা প্রদান
Ki te; Ges
- bvi x I c j ð li g ð a " g R j x " e l g " ` ð x Ki Y w b w ð Z K i v i c ð P ó v M ó Y K i v n ð e |

13.0 c ð K w Z K m æ c ` e " e " v c b v

Kw R w g m n c ð K w Z K m æ ú t ` i h _ v h _ m s i y Y I e " e " v c b v i D c i d m j D r c v ` b w b f P k j w e t e P b v q m i K v i G t y t I K w Z c q c ` t y c M ó Y K i t e |

- সরকার কৃষি জমির ক্রমহ্রাসমান ধারাকে নিয়ন্ত্রণের প্রচেষ্টা গ্রহণ করবে। এ লক্ষ্যে খাদ্য নিরাপত্তা
w b w ð Z K i t y i w e l q w w e t e P b v q G t b K w l R w g A K w l K v t R e " e n v i e t U i c ð P ó v t b q v n ð e ;
- m i K v i R j v e x K w l R w g c b i æ v i m n m v M i Z x i e Z P G j v K v q f w g D x v t i i g v a " t g K w l R w g e v o t b v i c ð P ó v M ó Y K i t e ;
- g v E K v , c w b , D w " c I c ó Y K j Ges e v q U t j i R x e b i q v e " e " v m s i q Y I K v h R i e " e n v t i i w e l t q e " e " v M ó Y K i v n ð e ; Ges
- m i K v i t K s j m æ ú ` (Genetic Resources) m s M ó , m s i q Y I e " e n v t i i c ð P ó v t K k w ³ k v j x K i t e |

14.0 g v b e m æ c ` D b q b

K w l w b f P t ` k w n t m t e K I . K t ` i k m " D r c v ` b q g Z v Ges R b M t Y i P w n ` v i g a " K v i e " e a v b ` t K i v Ges Z t ` i L v " w b i v c E v w b w ð Z K i t y i R b " e v s j v t ` t k i c t q v R b ` y K w l k ó g K I w k w q Z Ges c ð k w q Z g v b e m æ ú t ` i w e k v j f v U v i | K v h R i g v b e m æ ú ` D b q t b i R b " D c h j ³ g v b e m æ c ` c w i K í b v Ges t c k v M Z D b q b c ð q v R b | P v K i x K v j x b c ð k q Y I K t g P R b " c j ` Z K i v i c x w Z m n D c h j ³ c ð k q Y I w k q v c v t K R w f w E K K g m P D b q t b i g v a " t g g v b e m æ ú ` D b q b m æ e | t ` t k i c a v b P v t j A n t " Q ` q R b k w ³ ` Z i x K i v h v i v D " Z m g m v t g v K v t e j v q c h y ³ D " t e b , c ó Z ó w b K ` y Z v Ges D t " ³ v D b q b A R t b m q | m i K v i K w l K v t R w b t q w R Z M t e l K , m æ ú t v i Y w e ` I K I . K t ` i ` q Z v e j x Ges c h y ³ M Z K g R v t U b v i x i q g Z v q t b i R b " b Z b b Z b a v b a v i Y v A s f P i c w i K í b v M ó Y K i t e |

14.1 c ð k q t y i A v l Z v t

- K w l M t e l Y v I D b q b K g R v t U i m v t _ m s w k ó e " w ³ e M P K c ð k q t y i A v l Z v q A v b v n ð e ; Ges
- R v Z x q K w l c ð k q Y G K v t W g x I A b " v b " K w l w k y v Ges M t e l Y v c ó Z ó v b m g n K w l t q t I w b t q w R Z K g R Z t ` i R b " w b q w g Z c ð k q t y i A v t q v R b K i t e |

14.2 M t e l Y v L v t Z c ð k y Y t

- M t e l Y v L v t Z i e Z g v b g v b e m æ ú ` t K R v Z x q I A v S R w Z K c h e q ` q I c ó Z t h w M Z v g j K w n t m t e M t o Z j t Z c ð q v R b g w d K c ð k y t y i A v t q v R b K i v n ð e ;
- w e Á v t b i A M ó h i g v b t q t I , c h y ³ Ges K w l M t e l Y v e " e " v c b v w e l t q D " P Z i c ð k q t y i m t h v M m y ó K i v n ð e ;
- M t e l Y v I D b q b K g R v t U g v b e m æ c ` e " e n v i c w i K í b v c v q t b i I c i _ i a z j c ó v b K i v n ð e ; Ges
- কৃষি গবেষণা এবং প্রযুক্তি হস্তান্তর বিষয়ক কার্যক্রমের সাথে সংশ্লিষ্ট ব্যক্তির বৈজ্ঞানিক, কারিগরি ও ব্যবস্থাপনা সংক্রান্ত দক্ষতা বৃদ্ধি Ges c ó Z ó v b m g n i m v g _ e j x K i v i j t q " A e " v n Z c ð k q t y i i j c t i L v c v q b I e v ` e v q b K i v n ð e |

14.3 Kwl wkqyv Ges ckkqy t

- Kwl wkqyv e`v, wefkl Kti wftcgv chiq wkyv tRvi`vi Kiv nte ; Ges
- Kvhxi chy³ n`vsi I chy³ cvqb Ges Dbqb cwi Ki bv wvDZ Kivi Rb` wqvgZfvte ckkqy cwi Pvj bv Kiv nte | tckvMZ`qZv, tckv`wi Zi Ges b`vq-bwvZ teva mgbz ivLvi tKSkj wntmte K.I.K Ges mKj chiqi KgRZMYtK ckkqy cv vb Kiv nte |

14.4 exR velqK ckkqy t

- exR Drcv`b, msiyb, gvb wqsy I exRi evRvi e`vcbv velq mi Kvi x I temKvi x Dt`v³v Ges K, Kt`i tK cvqvRbxq ckkqy cv vb Kiv nte |

14.5 mvi velqK ckkqy t

- mlyg mvi e`envi velq K.I.Kt`i tK Dchy³ ckkqy cv vb Kiv nte ; Ges
- mvi e`vcbvq`qZv exi j`q` KgRZP, weAvb, mvi e`envqx, weZiYKvi x Ges Dt`v³v`i i ckkqy cv vb Kiv nte |

14.6 tmP chy³ ckkqy t

- সেচ যন্ত্র পরিচালনা, মেরামত এবং এসব যন্ত্রপাতি রক্ষণাবেক্ষণ কার্যক্রমে সরকার বেসরকারি উদ্যোক্তা ও teKvi Zi`xt`i tK Drmn I ckkqy cv vb Ki te ; Ges
- K.I.K I Kwimui Avbm`ubae`w³eM`P Rb` Lvvi cwb e`vcbv chy³ velq ckkqy kw³kj x Kiv nte hvZ Zv Avb-cv`R` I dj b-cv`R` KgvZ mnvqK nq |

14.7 hwsKxKiY velqK ckkqy

- মাঠ পর্যায়ে কৃষি যান্ত্রিকীকরণ কার্যক্রমের সংশ্লিষ্ট সুবিধাভোগী, যেমন চালক, কৃষক, যুবসমাজ, Drcv`bKvi`xt`i Kwl hscwZ tgivgZ I i`qy`te`qy velq ckkqy cv vb Kiv nte |

14.8 mthvM mjev I KgRvP cvqb t

- `f, ga`g Ges`w`tgqv`x ckkqy`yi gvb Dbq`bi Rb` Kwl wfvEK gvbe-m`c` Dbqb KgRvP Pvj yKiv nte;
- mi Kvi Kwl tZ Pwn`v wfvEK t`q`mg`ni Rb` MtelYv Ges m`c`vY e`v`vi wfvb`y`q`i ckkqy prdan sangrasu suyog s`sthi o shaktishali korbe ; Ges
- ckkqy`yi mthvM-mjev` Ggbfvte kw³kj x Kiv nte hv RvZxq I AvSRWZK chiq cvZthwMZvgj K gv`bi nte |

14.9 cvYv`bv t

- wkqyv I ckkqy, MtelYv, m`c`vY, km` Drcv`b Ges Kwl Dbqb KgRv`U DrKI`mvab`K c`ea` Ges`xkwZ cv`v`bi Rb``cj`vi cv`v`K cvZ`v`bK Kiv nte ; Ges
- Kwl weAvb, m`c`vY Ges MtelYv e`vcbv velq DrKI`mvab`i j`q` Visiting scientist, Sabbaticals Ges National fellows C` c`Z` Kiv nte ;

14.10 Askx`wi Zi;t

- Kwl t`q`i Av`bi wfvE mg`x Kiv Ges chy³ e`envi`i t`q`i DbZ Ges Dbqbkj Dfq t`kmg`ni Kwl tKw`K gvbe m`c` Dbqb cvZ`v`bmg`ni mv` tKSkj MZ Askx`wi Zi cvZ`ov mi Kvi Drmn cv vb Ki te ; Ges

- RvZxq I AvšR@ZK ch@qi wefbc@Zôvbi mvt_ kw³kvj x msthM ~vcvbi gva`tg cvi ~cwi K a`vb avi Yv weibgq I c@qvM mg× Kivi c@Pón tbqv nte |

15.0 Kwl LvZ kg

- Kwl kgK Kj `YtK Dbqb KgmmPz m@ú³ Kiv nte;
- Av_@mvgmRK Ae`v wefePbrq ti tL SjkCy@Kwl KvR (thgb t ej vBvkK c@qvM, fvi x, avi vtj v ও মূর্গীয়মান কৃষি যন্ত্রপাতি চালানো) শিশুশ্রম ক্রমান্বয়ে হ্রাস করা হবে ।

16.0 A-কৃষি কার্যক্রম

- `wi`ªGes mjeav ewAZ K.I.Kt`i A-Lvgvi LvZ Kgms`vbi mthvM mjoí gvatg` `wi`ªnvmKi tY c` t¶c MhY Kiv nte ; Ges
- दरिद्र ও সুবিধাবঞ্চিত কৃষকদের জন্য অকৃষি খাতে অর্থোপার্জন কার্যক্রমে প্রয়োজনীয় সহায়তা প্রদান করা nte |

17.0 evsj v fvlvi c@avb`

G bmxZ KvhKi Kivi ci mi Kvi, mi Kvi x tM+RU c@vcb ×viv G bmxZi Bsti RxZ Abw` Z GKwJ wbfPthvM` cvV cKvk Ki tZ cvite | evsj v cv Ges Bsti Rx cvtV tKvb weãvš/AmvgAm` t` Lv w` tj evsj vq c@vZ bmxZ MhYthvM` gtg@etePZ nte |³¹

3.2.8.1 Findings

In the Agriculture Policy 2013, primary goal of the minor irrigation management under the purview of Agriculture Policy is to accelerate crop intensification and increase yields through planned utilization of surface and groundwater in an environment friendly atmosphere. In this policy emphasis is given on surface water irrigation by storing water in small rivers, khals, beels, dighi etc. The issues like biodiversity, conversation, water management are explained detail in this policy. The priority of using surface water is point out here. So emphasis should be given to use surface water for irrigation practices.

3.2.9 Evaluation of Public and Private Sector Involvement in

3.2.10 Minor Irrigation Management

3.2.10.1 A move toward public sector control: 1984-87

In the 1983, during dry season there was greater than expected drawdown of groundwater in a number of northern districts.³² The alarm caused by this event seems to have triggered a response from the public sector that may have been partly a reaction to the erosion of agency control over minor irrigation during the

³¹ Ministry of Agriculture, *National Agriculture Policy 2013*, Government of the People's Republic of Bangladesh, 2013.

³² Gerard J Gill, *The demand for tubewell equipment in relation to groundwater availability in Bangladesh* (Dhaka: Bangladesh Agricultural Research Council, 1983).

previous decade. Actions taken in 1984 and 1985 included: (a) a ban on STW sales in 22 northern sub-district areas; (b) an embargo on the importation of the small diesel engines used in STWs; (c) standardization of engine brands; (d) formulation of the Groundwater Management Ordinance imposing a mechanism of spacing requirements on all tube wells. In addition agricultural loan disbursements were decreased following irregularities and large loan repayment defaults. STW engine distributors and importers were also vilified.³³ The result of these various actions was that STW expansion slowed in 1984³⁴ and practically stopped during 1985 through 1987. Meanwhile the groundwater level in the northern districts affected in 1983 had returned to normal in 1984 before any of the changed policies had taken effect.

During the period of 1984 to 1987 government was taken action like the ban on shallow tube wells sales, restriction on importation of small diesel engines used in shallow tube wells and formation of Groundwater Management Ordinance 1985. That action reduced the groundwater exploitation in the northern district of Bangladesh and groundwater level was normal at that time.

3.2.10.2 More private sector liberalization and expansion

The slow growth of minor irrigation sector of the previous years prompted the government to remove the restrictions imposed earlier. In 1987 the ban on importation of small diesel engines was removed. In 1988-89 import duties on irrigation equipment were eliminated and regulations on engine standardization and tube wells siting were rescinded.³⁵

For the withdrawing the restriction of importation of small diesel engine there was rapid growth of individual irrigation systems throughout the country. Therefore the use of groundwater for irrigation was increased drastically through the whole country and farmers were then tended to use groundwater excessively because it was easy to withdraw groundwater with the help of shallow engines. In this way expansion of individual irrigation system was flourished.

³³ R.W. Palmer-Jones, *Groundwater irrigation in Banglades*, Draft report for the Agricultural Sector Review, Government of the People's Republic of Bangladesh/UNDP.

³⁴ Jahangir Alam, *Evidence of the causes of low sale of STW irrigation sets in 1983-84: Implications for policy and research* (Dhaka: Bangladesh Agricultural Research Council, 1984).

³⁵ Mandal, M.A.S. and Parker, D.E. "Evaluation and implications of decreased public involvement in minor irrigation management in Bangladesh." *Short report series on locally managed irrigation*, No. 11, Colombo: International Irrigation Management Institute, 1995.

3.2.10.3 Findings

As groundwater level of northern districts was dramatically decreased in 1983, government had taken action during the period of 1984 to 1987 like the ban on shallow tubewells sales, restriction on importation of small diesel engines used in shallow tubewells and formation of Groundwater Management Ordinance 1985. Groundwater level was normal at that time. However, after that period, during 1988-89 all the restriction as mentioned above was withdrawal and again there was increased groundwater exploitation.

3.3 Major Findings

The Canal Act passed in 1864 and till exists in enforcement which is assumed as an outdated and insufficient. Main purposes of this law are to make watercourse for navigation and collection of tolls; and make navigable channels in any river, canal, khal, nala or waterways. However, the law does not mention any clause or any legal framework optioning to use the water of such water bodies for irrigation purposes and to use such water bodies as water reservoir in dry season for irrigation. Also it does not have any clause regarding water pollution through pesticides and chemical fertilizers used in high yield variety rice field in Kharif-1 season that cause degradation of aquatic biodiversity and there is no substitute for development and conservation of aquatic resources especially fishery. Therefore, such outdated, insufficient and inappropriate law must be revised and amended as needs in present day.

The law mentioned as the Irrigation Act; 1876. The main objective of this act is to serve irrigation for crop fields. In this act there is mentioned only about the use of surface water for irrigation activities quite clearly. There is no clause to address pollution by using pesticides and chemical fertilizer. Biodiversity and fishery resources are not included in this act. The penalties of violating this irrigation act are not sufficient for present day to maintain irrigation activities because land value and cost for construction of canals are increased many times than the time of introducing this act. This act was quite good for surface water irrigation for that time. If surface water is used in our rice field, it will reduce the pressure of extracting groundwater for irrigation activities. In this way aquifer will recharge and water table will not decline as found at present. Many issues that are found in this act are very useful for irrigation activities but it is not enforced properly. If this act amends and includes the issues that are not included, it will be fruitful for irrigation activities.

The main purposes of the Embankment and Drainage Act, 1952 was to construct, maintain, manage, and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion or other

damage by water. Though this act was not formulated for irrigation purposes but it is very much associated with irrigation activities. This act was made only for surface water not for groundwater. In this act it is needed to incorporate the irrigation activities like build up water reservoir, irrigation canals, irrigation drains etc.

The Bangladesh Irrigation Water Rate Ordinance enacted in 1983. The reasons for making this law are to impose one sort of water charge for the purpose of water supply for irrigation or drainage activities. It is a very important for irrigation activities because if the water charge is not imposed then nobody realizes the real value of water. Complying with this act lawful use of water and their protection can be assured. So this law is needed to apply properly in irrigation activities so that everybody should abide by this act properly.

The main purpose of the ground water management ordinance, 1985 was to manage the ground water resources for irrigation or water supply. In this act it is mentioned for taking permission from concern authority to install any shallow or deep tube wells but most of the people do not follow that law. They install shallow or deep tube wells without any permission. Authority also does not take any actions for that. Besides in case of installing shallow or deep tube wells what will be the distance between them are not clarify in this act. It does not mention any options that how many shallow/deep tube wells will be appropriate in a specific area to maintain sustainable aquifer. Adverse effect like pollution, declining biodiversity, fishery resources and groundwater table are not introduced in this act clearly. Now it is the time to amend this insufficient law for the management of groundwater resources.

The water act in 2013 is enacted as a law. The goal of this act is to give effect to Bangladesh Water Policy, 1999 for facilitating and ensuring integrated, equitable and sustainable management, development, and utilization of water resources and its conservation. It does not mention clearly about creation of water reservoir. Another matter that has been described in this act is to fill up or stop the water channels of rivers for recovery of land by the permission of the concern authority, which shows lack of this act. Over all it covers the whole area for management and protection of water resources for irrigation purposes and water supply. This law mentions about penalties for violeting this law is sufficient. Therefore, this act should be implemented and followed by the water users properly for the protection of water resources.

National water policy passed in 1999 which is sufficient enough for water resource management and protection. The objectives of this policy are to address issues related to the harnessing and development of all forms of surface water and ground water and management of these resources in an efficient and

equitable manner. Irrigation part of national water policy covers all sectors like build up water reservoir to recharge the groundwater, irrigation management by using surface and groundwater, environmental protection for sustainable development, pollution control, aquatic and wild life protection and preservation of existing water bodies. It considered all components of water resources including irrigation. This policy should be implemented properly that every public agency, every community, village and each individual has an important role to play in ensuring that the water and associated natural resources of Bangladesh are used judiciously so that the future generations can be assured of at least the same, if not better, availability and quality of those resources.

In the Agriculture Policy 2013, primary goal of the minor irrigation management under the purview of Agriculture Policy is to accelerate crop intensification and increase yields through planned utilization of surface and groundwater in an environment friendly atmosphere. In this policy emphasis is given on surface water irrigation by storing water in small rivers, khals, beels, dighi etc. The issues like biodiversity, conservation, water management are explained detail in this policy. The priority of using surface water is point out here. So emphasis should be given to use surface water for irrigation practices.

3.4 Conclusion

Irrigation is an important factor for rice production in Bangladesh. For the need of food security of our country sustainable rice production should be assured. There are some laws and policies of irrigation in our country in which some are backdated and insufficient that should be amended for maintaining sustainable irrigation practices. Recently government drafts some laws and policies that useful for irrigation in rice cultivation are not yet in enforcement to activate those laws and policies. Some of the clauses exist in present enforced laws and policies useful for irrigation activities are not properly imposed. Moreover people are not conscious to follow those policies and regulations of that laws and policies. For better irrigation practice everybody will have to think appropriate use of water for rice cultivation with the help of proper laws and policies. So each and everyone have to review laws and policies and to find out the best way for irrigation practice in rice cultivation. In this way, sustainable irrigation practice in rice cultivation can be achieved.

Chapter-4

State of Water Source, Irrigation Methods and Present Irrigation Practices

The present chapter intends to describe and explain about present state of water sources for irrigation, prescribed manuals and various methods of irrigation, traditional methods used to irrigation practices etc. Present irrigation practices in rice cultivation, which includes knowledge about irrigation, modern and traditional equipments, trainings, government initiatives of irrigation, drainage systems, reasons of excessive irrigation practice, groundwater abstraction, opportunities of alternative crops cultivation, causes of present irrigation water scarcity etc.

4.1 Background

There are so many rivers, canals and other water bodies in Bangladesh; however, most of them are dried up during dry season (March-May). Therefore, people have to depend on underground water for irrigating their rice fields. In the study area of Sirajganj there is also a branch of River Jamuna named Ichamoti, other canals but farmers do not use that surface water during their rice cultivation. Most of the farmers do not know the irrigation manuals because either they are not aware of it or they did not take any training from the DAE officers.

4.2 Water Sources in the Study Areas

It is found that groundwater table in the study area of Sirajganj is sufficient for irrigating the rice crops. It is very much easy to withdraw groundwater for irrigation. Though the river Jamuna is flowed beside Sirajganj Sadar Upazila, limited amount of surface water is found in the Karatoya and Bangali channels situated in the study area but water of these resources are not used for irrigation.

There is scarcity of surface water in study villages selected from Godagari upazila of Rajshahi district. A project was developed to uplift water from River Padma and pass through a canal to irrigate rice field in kharif-1 in Gadagari areas as well as other parts of Barind area but this project was failed due to scarcity of water in Padma River in dry season. Therefore, the rice farmers totally depend on groundwater for irrigation. So it is said that there are available surface and ground water sources in Sirajganj Upazila, on other hand, too much scarcity of surface water sources is found in Godagari upazila, thus present water sources is seemed only ground water for irrigation in both the study areas.

4.3 Irrigation System

In our country, cultivation of Boro and early Aus is not possible without irrigation. During boro season 120cm water is needed in course of whole life time of rice cultivation. Sufficient water is needed during panicle initiation to kernel development. Therefore, if scarcity of water occurs in the field then rice production decreases. It is unwise to cultivate rice in those places where there is no arrangement of irrigation water. Sufficient water needs for boro rice cultivation because rainfall is limited in dry season. On the other hand, if early Aus is cultivated in the month of falgun, Chaitra and baishak (February-March, March-April and April-May) then more irrigation water needs because at that time seasonal drought is observed and less rainfall prevails in the Barind Tract. Excess irrigation water does not need for nabi Aus and ropa Aman because during this time generally rainwater is trapped to meet up irrigation water. Nevertheless, excess irrigation will have to ensure during the month of Shrabon and karthik (July-August and October-November), otherwise, crops will damage.³⁶

Generally, at the end of panicle initiation period; kernel is developed and flower is bloomed after 25 days. Much water is needed from flowering stage to production of rice milk for boro and aus. The water shortage during this stage hampers growth of crops. Therefore, it is necessary to take appropriate steps for managing excess irrigation water for achieving better production.

4.4 Water Needs During Different Stages of Rice Cultivation is Given as Follows:

Table 4.1
Stages of rice crops according to its water needs

Stages of rice crops	Amount of water needed
During transplanting	2-3 cm
Transplanting to next 10 days	3-5 cm
After 11 days of transplanting to panicle initiation	2-3 cm
During panicle initiation to flowering stage	5-10 cm

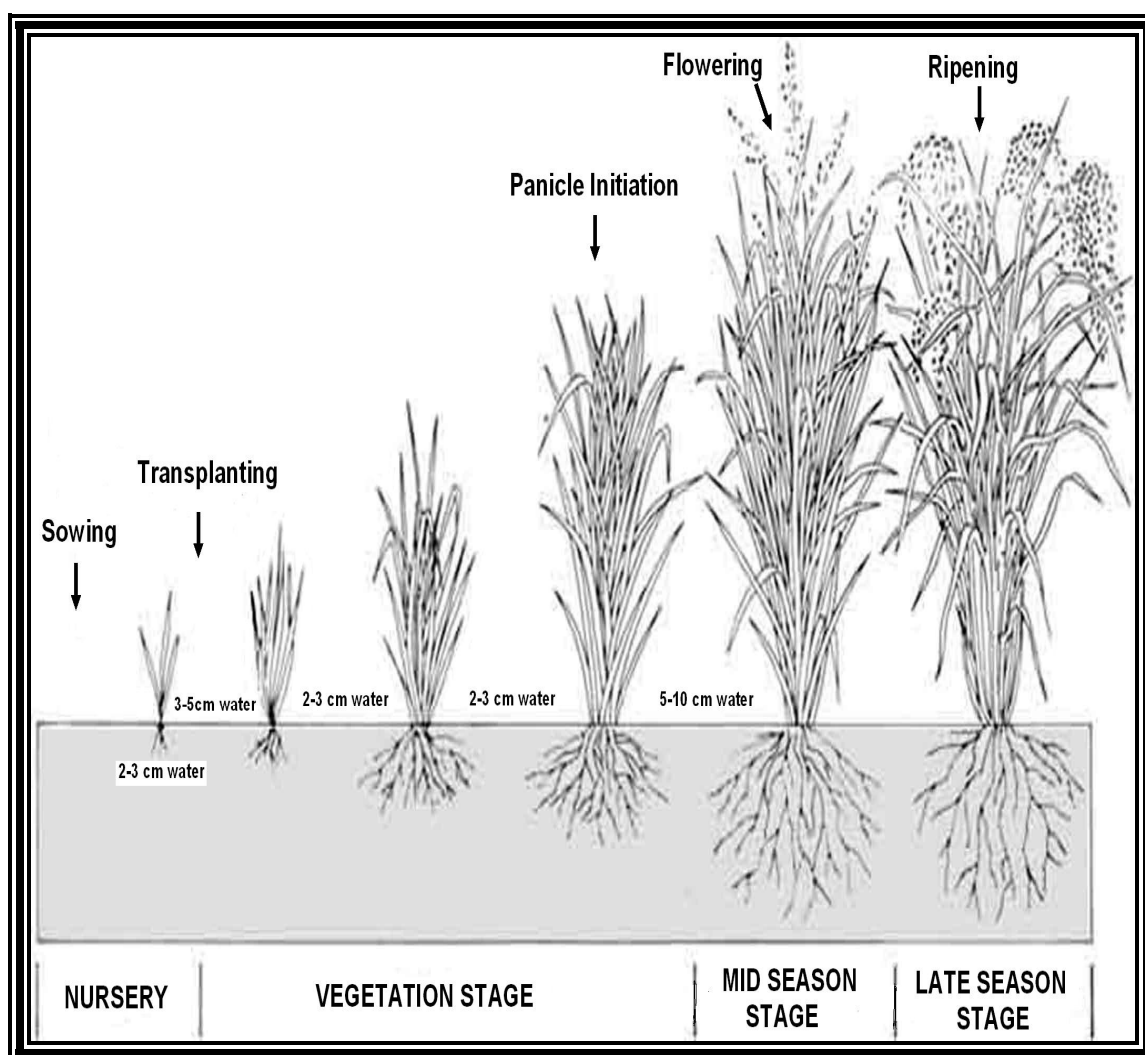
Source: Reproduction of Manual for Irrigated Crops.

Before 10-12 days of harvesting rice, water should be drained out from the rice field.³⁷

³⁶ S.M.H. Zaman and M.A. Salam, *Reproduction of Manual for Irrigated Crops* (Dhaka: Directorate of Agriculture Extension, 1992), p. kha-8.

³⁷ Ibid. p. kha-9.

Figure 4.1
Level of Irrigation water in different stages of rice cultivation



Adopted from: <http://www.fao.org>

If excessive water is found as mentioned above then as soon as possible water should be drained out otherwise number of tillers will be less, lower part of rice plants will become long and production of rice will also be less.

Generally, irrigation is given or rainwater is stored extensively in rice field. Always it will be remembered that the leveling of land should be maintained. Otherwise level of water will not remain same in all places and growth of plants will be varied. If the land is very much sloppy then water should be remain kept in particular places.

Water should be drained out before applying urea fertilizer and weed control. 2-3 days after applying urea again it is needed to apply irrigation water. Water is drained out before one week of growing panicle initiation, the land is

dried out for 3-4 days, and again water is applied for better production. There are no policies to always store water in the rice field.³⁸

4.5 Manuals of Irrigation

Production of crops depends on types of soils. The production of crops will not be satisfactory if it does not ensure use of water with low and heavy rainfall. From ancient time, in dry season boro rice is cultivated by withdrawing water with the help of indigenous don and swing basket from ponds and ditches to irrigate crops in our country. Now a day with increasing boro rice cultivation without using don and swing basket, varieties irrigation pumps imported from foreign countries are used for withdrawing water from rivers, canals, beels etc.

Puddling process is done in the rice field after plough. The objectives of this process is to made a hard layer of clay under 20-25cm deep to protect entering water beneath. Due to this process water is always stagnated and cultivation of rice becomes easier. Rice crops can give better production by tolerating stagnant water for growth. In this way, other purposes are fulfilled by storing stagnant water as follows.

Almost all the weeds die because of failing to tolerate stagnant water and for this reason weed is controlled and cost of production becomes lower. Secondly, if water is stagnated in rice field, ammonia is found without any connection with oxygen that rice crops prefer. If water is not stagnated, urea with the help of oxygen is converted to nitrate which rice crops cannot use for growth. Thus, rice production becomes lower. So this privilege gets from stagnated water in the rice field.

4.5.1 Soil Preparation

The logic of Puddling process in rice cultivation is to stay water in the field as water is not gone away. For this reason, farmers willingly increase or decrease irrigated water in their field.³⁹

4.5.2 Irrigation and Drainage

For better irrigation, any one of Kelly canal or bed canal method can be used. In the rice field, crops are not affected due to short stagnant of water but for long stagnant of water soils are bad smelled and rice crops become weak. So drainage process is needed.

³⁸ Ibid. p. kha-9.

³⁹ Ibid. pp. ka-1-2.

4.5.3 The Relationship Between Soil and Water

Soil of a land is very wetted with the supply of irrigation water and the gap that exists among the soil particles filled with water with the exclusion of air. After that if irrigation is not given then water will move downward. Generally soil moisture leaves when the excess water is moved downward from the root zone of sandy soil within 24 hours and from clayey soil within 72 hours is called F.C. For the better production of crops, soil moisture should near the field capacity. So when water holding capacity of a soil becomes 50% then irrigation water should be applied in the field without any delay.

4.5.4 Determine the time of Irrigation

The main purpose of irrigation is to keep the soil in suitable wetting condition as it ensures more production. The farmers can easily realize when water is given in the rice field. Generally, farmers dry up excess water of their field as to look wet, at that time they give excess water in the field and trap the water for staying. This process is done when a handful of soil taken in hand's thumb and when pressing on soil, it will wet the thumb but water will not pass out. In that way the timing of irrigation is determined.

4.5.5 Easy Procedure for Measurement of Soil Moisture by Hand-feel Method

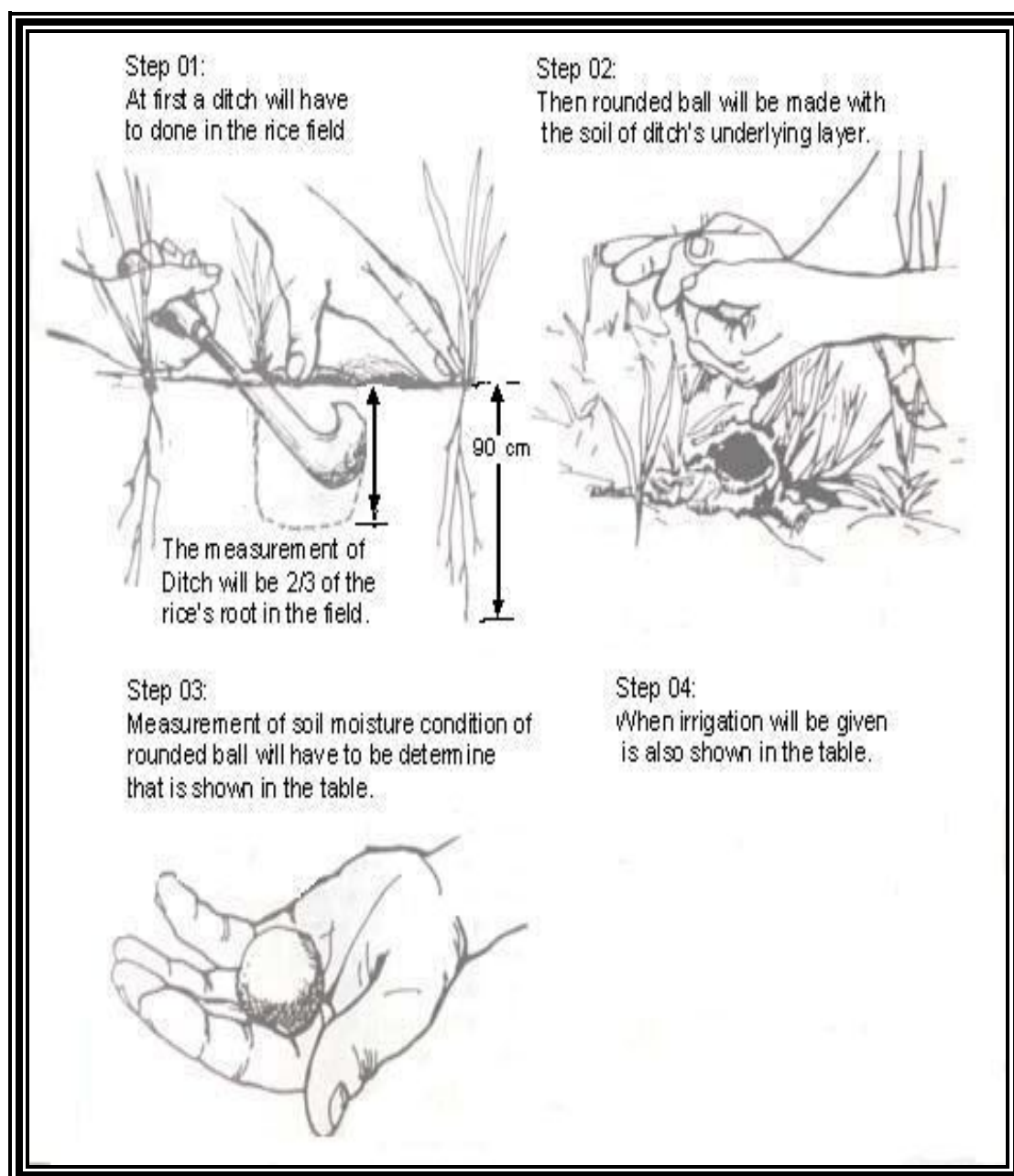
Step 01: At first, a ditch is to be dug in the rice field. The measurement of ditch is 2/3 of the rice's root in the field.

Step 02: Then rounded ball is made with the soil of ditch's underlying layer.

Step 03: Measurement of soil moisture condition of rounded ball is determined that is shown in the figure 4.2.

Step 04: When irrigation is to be given also shown in the table 4.2.

Figure 4.2
Measurement of soil moisture condition by hand's feel method



Source: Reproduction of Manual for Irrigated Crops.

Table 4.2
Procedure of determine wetness of soil by hand's feeling

Water present in soil(%of field capacity)	Fine textured soil (clayey soil)		Medium to coarse textured soil (sandy soil)	
	Soil condition	Management procedure	Soil condition	Management procedure
0-25	Dry and dust (soil is very much dry)	To give irrigation immediately	Dry soil and soil is passed out between the fingers (very dry soil)	To give irrigation immediately
26-50	If soil is taken in hand's thumb and pressed, it will produce clod but clod will break down if it is fell down.	To give irrigation immediately	Soil is dried but not free of moisture. The clod is not formed by pressing in hand's thumb.	To give irrigation immediately
51-75	If soil is taken in hand's thumb and pressed, it will produce hard and sticky clod but clod will non break down if it is fell down.	To give irrigation after two days	If soil is taken in hand's thumb and pressed, it will produce clod but clod will break down in pieces if it is fell down.	To give irrigation after one day
76-100	If soil is taken in hand's thumb and pressed, it will produce wet clod and hand's thumb will be wetted but water will not fall down.	To determine moisture condition of soil after four days.	If soil is taken in hand's thumb and pressed, it will produce clod but clod will break down if it is fell down.	To determine moisture condition of soil after two days.
>100	Soil becomes clayey. If soil is taken in hand's thumb and pressed, it will pass out within fingers	Not to give irrigation. Excess stored water will be drained out.	If soil is taken in hand's thumb and pressed, it will produce wet clod and hand's thumb will be wetted but water will not fall down.	Not to give irrigation. To determine moisture condition of soil after seven days.

Source: Reproduction of Manual for Irrigated Crops.⁴⁰

4.5.6 Stages of Rice Crops to Reduce Water Scarcity Condition

Water is given after transplanting to harden of rice milk and moisture condition of soil is 80-100%. The length of rice's root is 250-300mm.

The following table shows the amount of irrigation should be given for reaching field capacity from 50% up to 100%.

⁴⁰ Ibid. pp. ka-2-6.

Table 4.3
Depth of crop roots in different types of soil

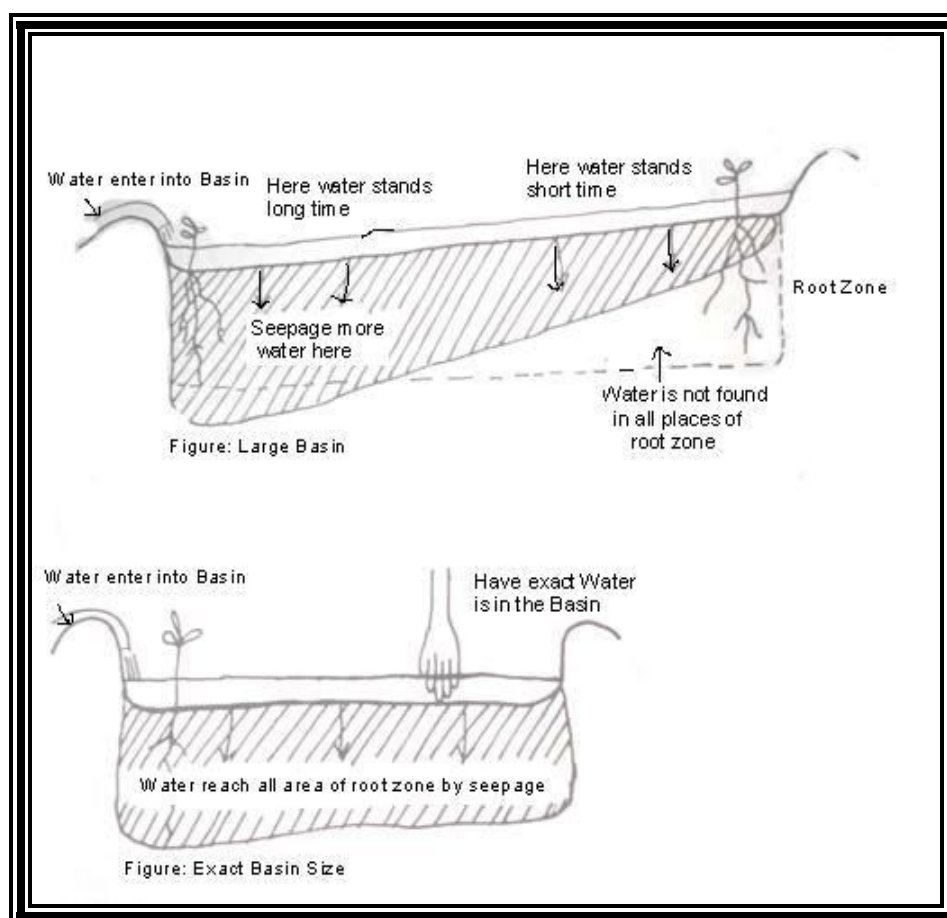
Types of soils	Depth of root (in mm)		
	Shallow deep up to 499 mm	Medium 500-999 mm	>1000 mm
Clay	4	8	12
Clay loam	4	9	13
Silty loam/ sandy clay loam	3	6	9
Sandy loam, sand	2	4	6

Source: Reproduction of Manual for Irrigated Crops.

4.5.7 Determine the Area of Land or Basin for Irrigation

If the land or basin becomes large and irrigation canal becomes narrow with low flow of water then excess time is needed to irrigate large basin. For this reason more water is leached under the ground and excess water is needed for irrigation of rice crops. If this information is not well known, requirement of irrigation cannot not fulfill within a fixed time. For this reason, farmers face the problem and part of land dry up and some part of the land becomes wet, which creates damage of crops.

Figure 4.3
Determine the area of land or basin for irrigation



Source: Reproduction of Manual for Irrigated Crops.

Table 4.4
Measurement of basin for proposed irrigation (in decimal)

1 Acre= 100 decimals				
Measurement of irrigation water flow(in cusec)	Types of Soils			
	Sand	Silt/sandy clay loam	Clay loam	clay
<½ Cusec	0.8	2.5	5.0	8.5
> ½ Cusec	1.7	5.0	10.0	17.0

Source: Reproduction of Manual for Irrigated Crops.

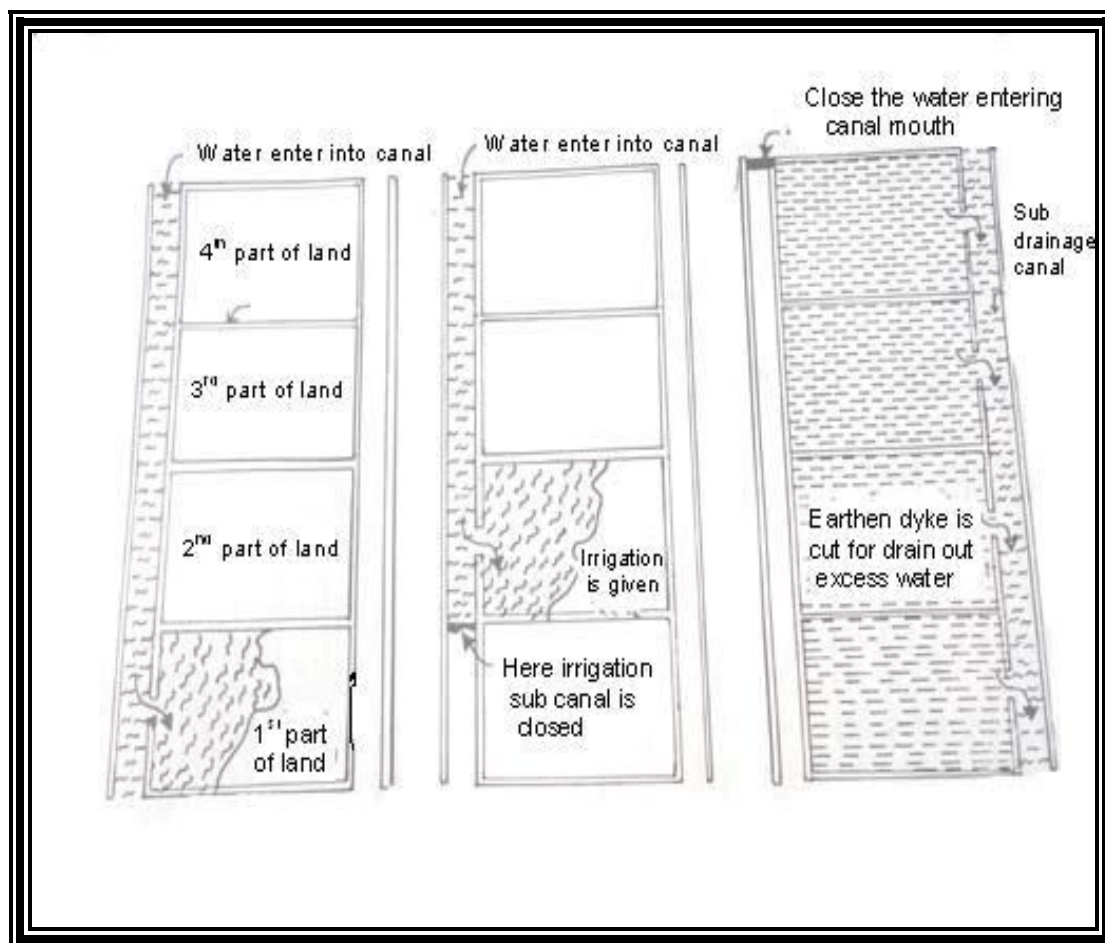
4.5.8 Various Methods of IRRIGATION

Various irrigation methods can be used such as sprinkler irrigation, drip irrigation, flooded irrigation or basin irrigation and furrow irrigation etc. Various types of irrigation methods are described for the basin. In our country as the land is smaller, basin irrigation method is suitable for irrigating the rice crops.

4.5.9 Basin Method

Basin irrigation is suitable for many field crops. Paddy rice grows best when its roots submerge in water. So basin irrigation is the best method to use for this crop. Basin or bund is prepared around the land for keeping the water. The upper part of bund is less wide than inner part. Generally inner size of bund is 40cm, size of head is 35cm and size of height is 30cm. Walking is possible on these types of bunds. After preparation of land with the help of plough and furrow, bunds are made. While preparing land, the grasses and weeds are eliminated from the bunds so that bunds become clean. The drainage becomes easier as soil is given to prepare bunds and the canal is produced in both sides of bunds. The basin depends on types of soil, which discussed earlier. So farmers prepare the size of basin that are told and also prepare a pro irrigation canal in land so as to irrigate beside another basin. Irrigation is given earlier in a basin, which is located far distance. In this way, water loss can reduce.

Figure 4.4
Basin Method of Irrigation in the Rice Field



Source: Reproduction of Manual for Irrigated Crops.⁴¹

4.6 Sources of Irrigation Water

In the study area of Sirajganj, there is a branch of River Jamuna named Ichamoti which flows between two villages of Khoksabari Union. But In dry season there is found little amount of water and in some places which are not so much deep fully dried up. In the village Char Khoksabari there is no canal but there are some small ponds, which are not usable for irrigation purposes. And in the village of saluabhita there is a canal where water is not found in dry season. It is dried up maximum time of the year. People can not use that water. So people in study area of Sirajganj are very much dependent on groundwater that is easier to withdraw. In that area in dry season, groundwater table is found average 17 feet deep. Aquifer condition is not bad because people can withdraw huge amount of water with the help of shallow pumps. In the study area of Godagari that is situated beside the river Padma. But the people of study area cannot use the

⁴¹ Ibid. pp. ka-11-13.

water of that river because it is not easier to withdraw water from the river. There is a canal found beside the village Raninagar, which is almost dried up because water can not come through the canal from the river Padma because water level of that river is lower than the bed of the canal. In the villages of Raninagar, Sheikhpur and Banduria, there are some small ponds which are not useable for irrigation purposes. Maximum of these ponds are filled with the water of irrigation pump provided by BMDA. And the groundwater table is so much deep that people can not withdraw water with the help of shallow tube wells. They have to depend on BMDA for irrigation because BMDA provide deep tube wells for irrigation in Barind Tract. Also aquifer condition is not good enough because deep tube wells cannot withdraw huge amount of water as capacity to fulfill people's requirement for their irrigation.

4.6.1 Sources of Water and Irrigation Water use

Table 4.5
Statement about sources of water and irrigation water use

Sources of Water	Percent	Sources of Irrigation Water	Percent
Yes	1.7(3)	Groundwater	100(180)
No	98.3(177)	Surface water	0(0)
Total	100(180)	Total	100(180)

Source: Field Survey

Among the farmers 1.7% respondent those who lives in Sirajganj agree that they have sources of water like ponds and 98.3% respondents of both the areas have not any water sources. And 100% respondents of both the areas use groundwater for irrigating their rice field and no one used surface water.

4.6.2 Ownership of Shallow Pumps

Table 4.6
Statement about ownership of shallow pumps

Ownership of Shallow Pumps	In Sirajganj (%)	In Godagari (%)	Percent
Yes	4.4	0	4.4(8)
No	45.6	50	95.6(172)
Total	50	50	100(180)

Source: Field Survey

In the study area of Sirajganj, 4.4% respondents have shallow pumps to withdraw water for irrigation purposes and 95.6% of both the study areas have no shallow pumps. Each person of shallow pump holders has one shallow pump to withdraw water for irrigating their rice fields.

4.7 Manuals and Methods of Irrigation

4.7.1 Manuals of Irrigation and to Status of Follow Ness

Table 4.7
Manuals of irrigation provided by DoAE

Manuals of Irrigation	Percent	Follow the Manual	Percent
Yes	0(0)	Yes	0(0)
No	100(180)	No	100.0(180)
Total	100(180)	Total	100(180)

Source: Field Survey

Above chart shows, 100% respondents have said that Department of Agriculture Extension do not provide any manuals for irrigation and no respondents follow the prescribed manuals of irrigation of Department of Agriculture Extension.

4.7.2 Methods of Irrigation used

Table 4.8
Statement about methods of irrigation

Method of Irrigation Used	Percent	Modern Method Used	In Sirajganj (%)	In Godagari (%)	Percent
Modern method	100(180)	Shallow tube wells	32.8	0	32.8(59)
Traditional method	0(0)	Deep tube wells	17.2	50	67.2(121)
Total	100(180)	Total	50	50	100(180)

Source: Field Survey

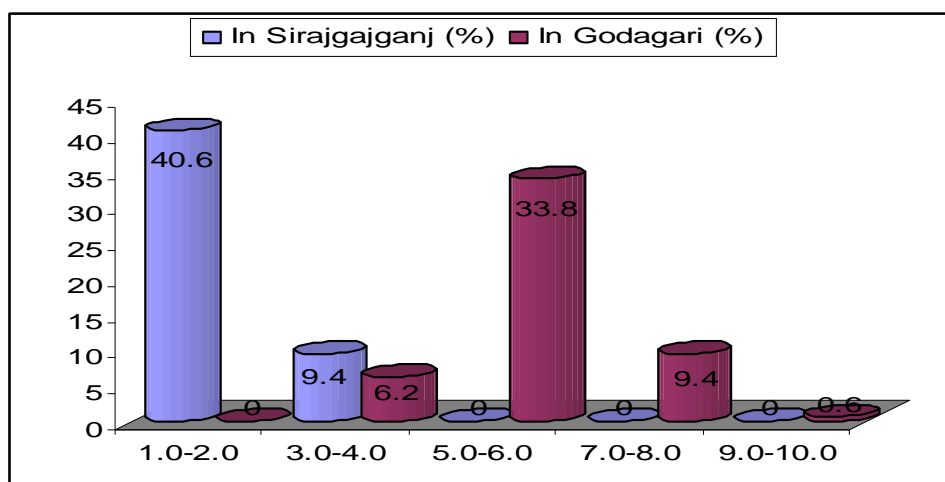
Among the farmers, 100% respondents use modern method of irrigation and no one uses the traditional one. 32.8% respondents give irrigation water by shallow tube wells those who live in study villages of Sirajganj and 67.2% respondents give irrigation by deep tube wells in their rice fields of which 50% respondents of Godagari.

4.7.3 Types of Irrigation Method Followed

In both the study area of Sirajganj and Godgari, all the respondents have followed flooded or basin type of irrigation.

4.7.4 Interval of Irrigation (day after)

Figure 4.5
Statement about intervals of irrigation

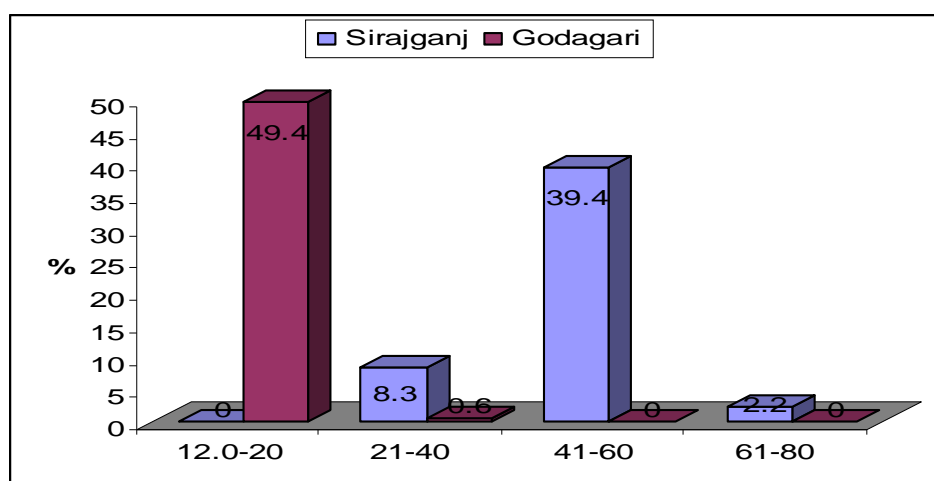


Source: Field Survey

About 40.6% respondents in the study area of Sirajganj say that irrigation is given 1-2 days after another and 9.4% say 3-4 days after another. And in Godagari, 6.2% respondents say that irrigation is given 3-4 days interval each other, 33.8% say, interval is 5-6 days, 9.4% say 7-8 days and only 0.6% says, they maintain 9-10 days interval.

4.7.5 Frequencies of Irrigation

Figure 4.6
Frequencies of irrigation in a season (days)



Source: Field Survey

In Godagari, 49.4% respondents have said total 12-20 number of irrigation is given in a season of rice cultivation and only 0.6% respondent has stated that total 21-40 number of irrigation is given. While in Sirajganj, 8.3% respondents have stated that total 21-40 number of irrigation is given, 39.4% respondents

have stated 41-60 number of irrigation is given, 2.2% respondents have stated 61-80 number of irrigation is given in a season.

4.7.6 Maintaining Optimal Water Level

Table 4.9
Maintain optimum water level in rice field

Maintain Optimal Water Level	Percent	Statement	Percent
Yes	100.0(180)	2-4 inches	96.1(173)
No	0(0)	over flooded	3.9(7)
Total	100(180)	Total	100(180)

Source: Field Survey

In both Sirajganj and Godagari, 100% respondents agree that everybody should maintain optimal water level as guided by manuals in rice field. According to the maintenance of water level, 96.1% respondents maintain 2-4 inches level of irrigation water and 3.9% respondents who lived in Sirajganj maintain over flooded irrigation in their rice field. Because it is very much easy to withdraw groundwater with the help of shallow irrigation tube wells in Sirajganj.

4.8 Present Irrigation Practices in Rice Cultivation

4.8.1 Knowledge about Irrigation in Bangladesh

4.8.1.1 Starting time of irrigation

Table 4.10
Starting time of irrigation in Bangladesh

Irrigation Started	Frequency	Percent
1968.00	1	0.6
1974.00	1	0.6
1975.00	16	8.9
1976.00	1	0.6
1978.00	3	1.6
1979.00	2	1.1
1980.00	1	0.6
1981.00	1	0.6
1984.00	64	35.5
1985.00	25	13.8
Don't know	65	36.1
Total	180	100.0

Source: Field Survey

The 36.1% respondents have said that they do not know when irrigation is started, 35.5% respondents have said that it is started in 1984, 13.8% have said that it is started in 1985, 8.9% have said that it is started in 1975 and negligible percentage of respondents states different year of starting. In the FGD session

one of the respondents of Godagari have told that irrigation is started in 1985. At first, Professor Mojibur Rahman introduced deep tube wells in Barind areas. The deep tube wells were operated by diesel oil and after that by electricity. At that time Taka 500 was taken per bigha for irrigation purposes. There were no shallow tube wells at that time in the Barind Tract but there were in other parts of Bangladesh.

4.8.2 Laws and Policies of Irrigation Practice

4.8.2.1 Laws, policies, and Government Agencies provide irrigation Facilities

Table 4.11
Laws, policies, and Government Agencies provide irrigation Facilities

Knowledge about Laws and Policies	Percent	Need to Learn Laws and Policies	Percent	Knowledge about different Agencies	Percent
Yes	0	Yes	100.0	Yes	61.7(111)
No	100.0	No	0	No	38.3(69)
Total	100(180)	Total	100(180)	Total	100

Source: Field Survey

About 100% respondents of both the study areas do not know the laws and policies of irrigation for rice cultivation. According to the necessity, 100% respondents state that it is very much needed to learn the laws and policies of irrigation. Again 61.7% respondents state that they know about different agencies such as BADC (Bangladesh Agriculture Development Corporation) and BMDA who provide irrigation facilities and 38.3% respondents do not know about that.

4.8.2.2 Implementing agency of laws and policies

Table 4.12
Implementing agency of laws and policies in study areas

Implementing Agency	Percent	Implementing Agency	Percent
Yes	61.7(111)	BMDA	81.1(90)
No	38.3(69)	PANASI	18.9(21)
Total	100(180)	Total	100(111)

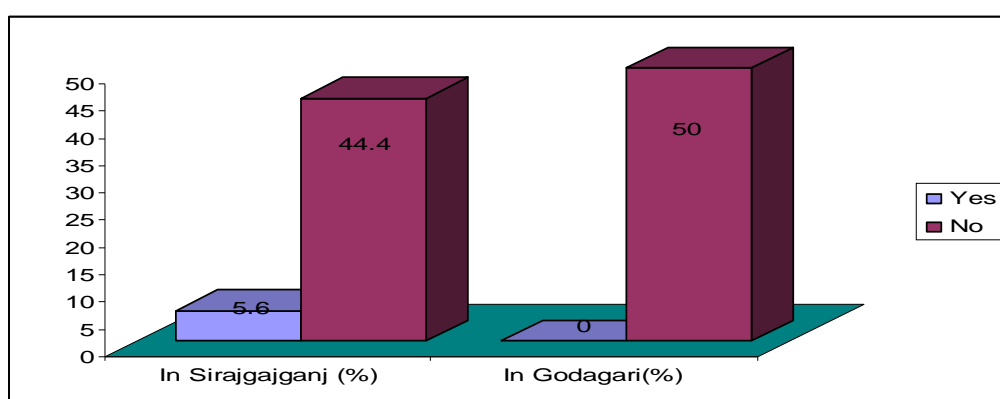
Source: Field Survey

Among the farmers, 61.7% respondents know about implementing agency of laws and policies in study areas and 38.3% do not know about implementing agency. Among the respondents who agreed with the statement, 81.1% state that implementing agency is BMDA in Godagari and 18.9% state that the name of implementing agency is PANASI Irrigation Project situated in Sirajganj. In the FGD session respondents have said that in the Barind area there are no private deep tube wells. All the deep tube wells are controlled by the BMDA. In the Sirajganj,

respondents have said that in this area, there is limited number of deep tube wells controlled by PANASI and most of the farmers use shallow pumps. Everybody in both the study areas say that government controlled deep tube wells are better than private because government has fixed rate of water for rice cultivation but in private owned tube wells impose more charge, which may not bearable for the farmers. Most of the people do not know the law of irrigation and if somebody knows, they do not follow that. Everybody set up shallow tube wells with his own wish. They think that they do not need to take permission from the concern authority.

4.8.2.3 Laws to install a tube well for irrigation

Figure 4.7
Laws to install a tube well for irrigation

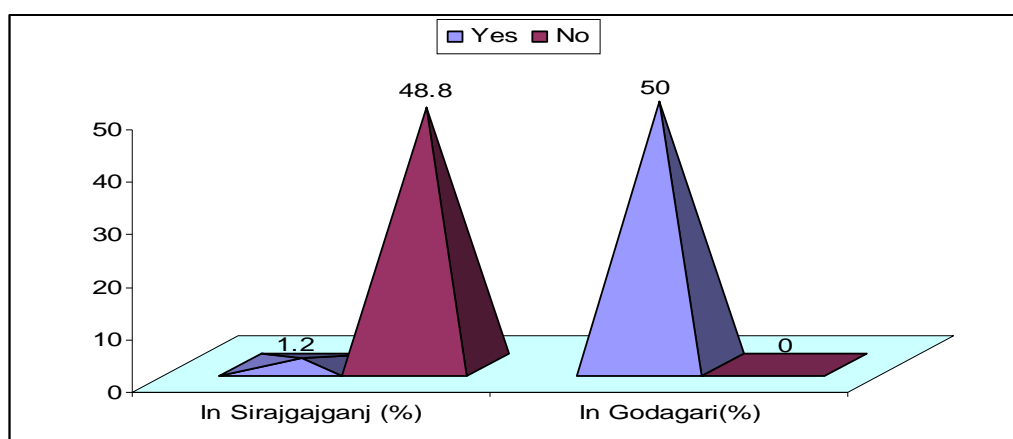


Source: Field Survey

In Sirajganj, 5.6% respondents know about the laws, which provide prior permission to install a tube wells for irrigation and 44.4% do not know about that law. In Godagari, all the respondents (50%) say that they do not know about the laws to install shallow or deep tube wells for irrigation.

4.8.2.4 Permission for tube wells installation

Figure 4.8
Seeking permission of Tube wells installation



Source: Field Survey

About 0.6% respondent of Sirajganj seeks permission from the authority before installation of tube wells, 48.8% do not seek any permission and 0.6% respondent says that there is no need to take permission because government sets up tube wells in the locality. While in Godagari, 50% respondents state that they do not need to take permission because government sets up tube wells for irrigation in the study areas.

4.8.2.5 Getting or avoiding permission to install shallow or deep tube wells

Table 4.13
Getting or avoiding permission to install tube wells

Getting Permission to Install Tube Wells	Percent	Cause for Avoiding Permission	Percent
Take permission from the DC office	0.6(1)	Do not know	14.0(25)
Take no permission	99.4(179)	Do not know about the law	12.8(23)
		Need not think to take permission	23.0(41)
		There is no scope to install private tube wells in this locality	50.2(90)
Total	100(180)	Total	100(179)

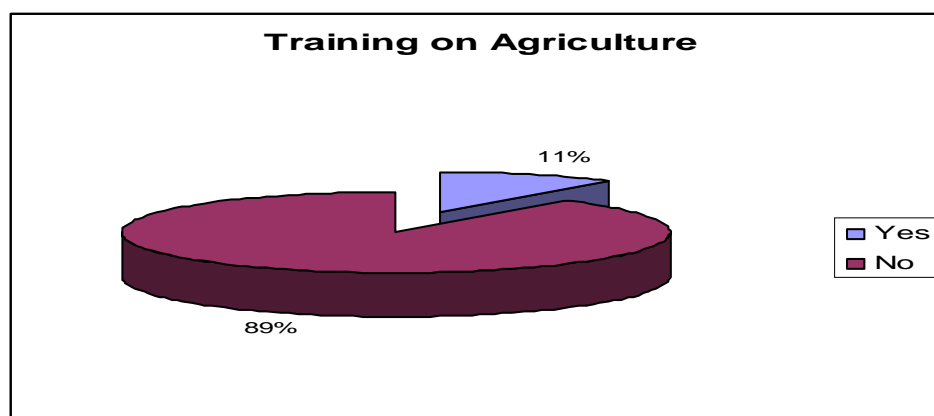
Source: Field Survey

In the study villages of Sirajganj, 0.6% respondent has taken permission from the DC office and 99.4% of both the study areas do not take any permission to install any tube wells for irrigation purposes. Among them who do not take the permission, 14% respondents say that they do not know about that, 12.8% do not know about the law for seeking permission to install tube well, 23% say that they think, there is no need to take permission, 50.2% respondents say that there is no scope to set up private tube wells in the locality.

4.8.3 Training Activities

4.8.3.1 Training and their types

Figure 4.9
Statement about training on Agriculture



Source: Field Survey

Above chart shows that 89% respondents have not any training on agriculture and only 11% respondents have training in both the study areas.

Table 4.14
Types of Training by DoAE

SL No.	Types of Training	Percent
1	Have training on fertilizer and pesticides use in different stages of rice cultivation	26.3(5)
2	Training on Integrated Pest Management(IPM)	36.8(7)
3	Training on rice and dal cultivation	26.3(5)
4	Training on wheat and jute cultivation	5.3(1)
5	Seed Preservation	5.3(1)
	Total	100(19)

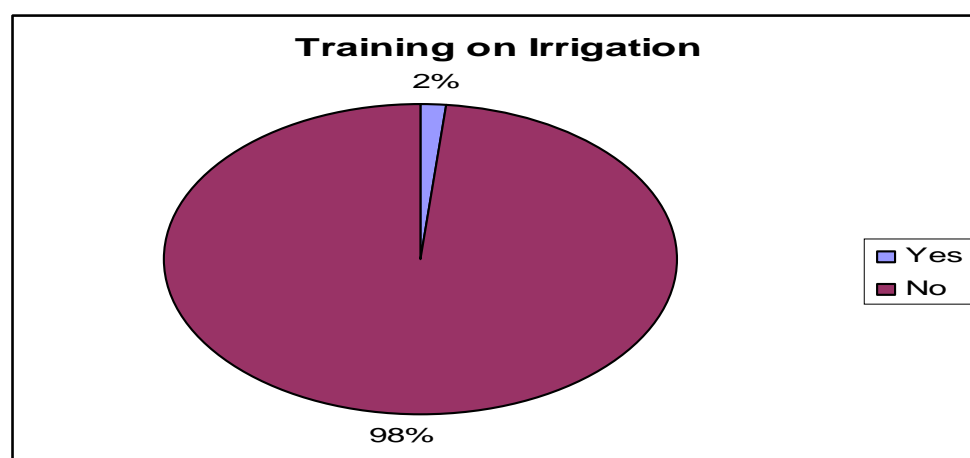
Source: Field Survey

Among the respondents who have training on agriculture, 26.3% respondents have taken training on fertilizer and pesticides use in different stages of rice cultivation, 36.8% have taken training on Integrated Pest Management(IPM), 26.3% have taken training on rice and pulse cultivation, 5.3% have training on wheat and jute cultivation and same percentage of respondents have taken training on seed preservation.

In the FGD sessions at first Tahsin Ali have stated that he does not get any training regarding irrigation. He cultivates his land by his own experience. But agriculture officer has provided training on Integrated Pest Management (IPM). Training is given on useful insects and harmful insects. Without spraying pesticide, insects can be controlled by setting up branches of trees where birds can sit down to catch the insect from the cropland. If pesticides spray, then it kills useful insects that scoff harmful insect. Hedaytul Islam has stated that he does not have any training on rice cultivation. He has experienced from his parents and ancestor. No organization has given any training regarding irrigation. He gathers knowledge from family and through his work. Masum Reza has stated that he has learnt about irrigation and rice cultivation from fallow farmers. He also states that block supervisors (field supervisor of department of agriculture extension) watches the cropland near the main road but they do not enter inside the villages. Md. Saiful Islam has stated that training is held about IPM. In that training it is taught that how seedbed is prepared and how quality seed can be produced. Besides, it teaches about protection of land from harmful pest.

4.8.3.2 Training on irrigation and their types

Figure 4.10
Training on irrigation from agricultural department



Source: Field Survey

Analysis shows that 2% respondents have stated that they have taken training on irrigation from department of agriculture extension and 98% respondents do not take any training from DAE about irrigation.

Table 4.15
Types of Training on Irrigation

SL No.	Training Types	Percent
1	Training on water level in different stages of rice cultivation	33.3(1)
2	Training on measurement the moisture condition of soil by thumb test for irrigating rice crops	66.7(2)
	Total	100(3)

Source: Field Survey

Those who have taken training on irrigation, among them 33.3% respondents state that they have taken training on state of water level in different stages of rice cultivation and 66.7% state that they have training on measurement the moisture condition of soil by thumb test for irrigating rice crops.

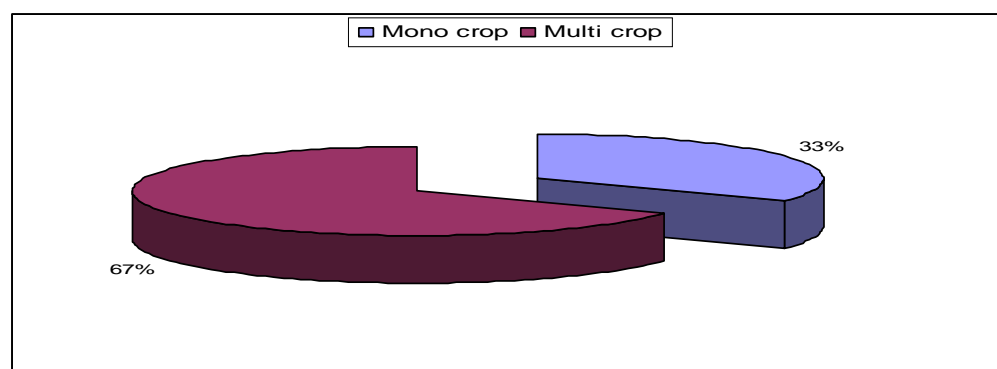
In the FGD session, Mojibur Rahman has said that he has taken training on rice, jute and rabi crops cultivation and also on irrigation. In the training session it is mentioned as soil will be taken in one's hand and presses that, if the soil produces structure and does not break then it is not needed to give water in the field. He also has said that farmers who have own shallow machine give water to the land of their wish whether water is needed or not, in that case, water needed for different stages in rice field is not followed as instructed. The level of water from first stage to last stage remains same. Other respondents have said that no training have taken about irrigation. Farmers know about irrigation from the ancestor and they achieve experiences themselves. The Barind Multipurpose Development Authority sometimes arrange training regarding irrigation but most

of the farmers do not know about that program because of carelessness of the officer and staff of that organization and farmer's ignorance and willingness.

4.8.4 Cropping Pattern and Cultivation Method

4.8.4.1 Cropping pattern

Figure 4.11
Cropping pattern in the study area



Source: Field Survey

About 33% of total respondents cultivate mono crops and 67% cultivate multiple crops.

4.8.4.2 Cultivation method

In the study area of Sirajganj and Godagari, 100% respondents use mixed method for cultivation.

4.8.4.3 Types of commercial farming

Respondents in both areas cultivate tomato, jute, sugarcane, vegetables, chillis, and maize for commercial farming.

4.8.5 Reasons of Rice Cultivation

4.8.5.1 Cultivating rice more than other crops

Table 4.16
Preference of rice cultivation and the causes

Preference of Rice Cultivation	Percent	Causes	Percent
Yes	82.2(148)	Production of other crops is less than rice	2.6(4)
No	17.8(32)	Production and labor cost in rice cultivation is less than other crops	6.8(10)
		Rice fulfill food requirement of the household round the year	83.1(123)
		Rice is less risk able crops than others	1.4(2)
		There is no option of cultivation of other crops without rice	4.1(6)
		Rice cultivation is more comfortable than other crops	2.0(3)
Total	100(180)	Total	100(148)

Source: Field Survey

Above chart shows that 82.2% respondents say that they prefer cultivation of rice more than other crops and 17.8% respondents do not prefer rice than other crops. Among them who prefer rice, 2.6% respondents state that production of other crops was less than the rice that is not profitable, 6.8% state that production and labor cost in rice cultivation is less than other crops, 83.1% respondents state that rice cultivation fulfills food requirement of their households round the year. About 1.4% states that risk factors are higher in rice cultivation than other crops, 4.1% state that there is no option of cultivation of other crops without rice, 2% state that rice cultivation is more comfortable than other crops.

In the FGD sessions respondents have stated that most of the farmers prefer rice due to their household food security though their income from rice cultivation does not increase considerably than other crops. It is cultivated to fulfill food requirement. Rice cultivation is little bit profitable. Those who have own labor get more profit in rice cultivation.

4.8.5.2 Increasing Income through rice cultivation

Table 4.17
Increasing Income through rice cultivation and their positive and negative statement

Increasing Income	Percent	Positive Statement	Percent	Negative Statement	Percent
Yes	47.8(86)	Income is increased moderately due to rice cultivation	89.5(77)	Due to food requirements and low labor cost	67.0(63)
No	52.2(94)	Income is increased slightly than cultivation of other crops	5.8(5)	Due to cultivation of rice by all the farmers around one's land	28.7(27)
		Income is increased due to low production cost	4.7(4)	Other crops do not grow well beside the rice crops	4.3(4)
Total	100(180)	Total	100(86)	Total	100(94)

Source: Field Survey

Among the farmers, 47.8% respondents agree that their income is increased through rice cultivation and 52.2% do not agree with the statement. Among them who agreed with the statement, 89.5% respondents state that income is increased moderately due to rice cultivation, 5.8% state that Income is increased to some extent than cultivation of other crops, 4.7% state that Income is increased due to low production cost. Among the respondents who do not agree

with the statement, 67% respondents state that they cultivate rice due to food requirements and low labor cost, 28.7% state that they cultivate rice due to cultivation of these crops by all the farmers surrounding their land. Only 4.3% state that they cultivate rice because other crops do not grow well beside the rice crops.

In the FGD session, Motiur Raman says about income and profit of rice cultivation. He says that farmers' profit does not come sufficient with the cultivation of rice because higher cost of labor, fertilizers and pesticides. Rice is cultivated to fulfill household food requirement. No savings can be earned by rice cultivation. He says about cultivation of wheat, mustard, etc., instead of rice as so much water does not need for other crop cultivation.

4.8.5.3 Rice cultivation profitable than other crops

Table 4.18
Profit in rice cultivation and their positive and negative causes

Rice Cultivation Profitable	Percent	Positive Statement	Percent	Negative Statement	Percent
Yes	22.8(42)	Moderate profit is got from rice cultivation	52.4(22)	To fulfill food requirement of the household round the year	81.2(112)
No	77.2(138)	Rice fulfill food requirement around the year is one of the profit	23.8(10)	Less labor and less risk are found in rice cultivation	2.1(3)
		Little bit profit is got from subtracting production cost	19.0(8)	Cultivation of rice all the farmers around one's land is a custom of an area	13.8(19)
		Rice cultivation is well profitable	4.8(2)	Other crops do not grow well beside rice crops	2.9(4)
Total	100(180)	Total	100(42)	Total	100(138)

Source: Field Survey

About 22.8% respondents state that rice cultivation is profitable than other crops and 77.2% respondents disagree with this statement. Among them who agreed with the statement, 52.4% say that rice cultivation is moderately profitable than others crops, 23.8% state that rice fulfill household food requirement round the year is the ultimate profit, 19% say that little bit profit is got from subtracting production cost of rice and 4.8% say that rice cultivation is well profitable. And

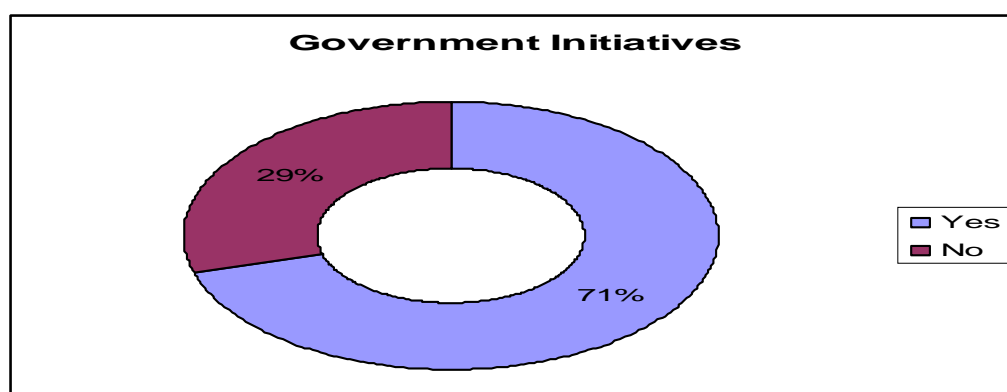
among the respondents who does not agree with the statement, 81.2% state that rice fulfills the food requirement of the household round the year, 2.1% state that less labor and less risk are found in rice cultivation, 13.8% state that cultivation of rice by all the farmers surrounding one's land is a custom of an area. And 2.9% state that other crops do not grow well beside rice crops.

In the FGD session respondents have said that in the study areas, other crops do not grow well as rice crops. And cultivation of rice is little bit profitable. If they cultivate wheat then the attack of rat becomes severe that causes production loss and at that season it is not profitable. Potato can be cultivated in this area but it is expensive which a farmer can not bear. So appropriate and demand based training on agriculture are needed in the study areas. Besides, soil must be tested to select appropriate crops for cultivation. So government should take the initiatives to solve the problem.

4.8.6 Government Initiatives of Irrigation

4.8.6.1 Government initiatives taken

Figure 4.12
Government initiatives about irrigation



Source: Field Survey

Figure shows that 71% respondents have stated that government has taken different initiatives regarding irrigation in their study area and 29% have stated that government does not take any initiatives regarding irrigation.

Table 4.19
Types of government initiatives about irrigation

SL No.	Types of Initiatives	Percent
1	Cultivation of rice with low cost of irrigation	57.5(73)
2	Set up deep tube wells for irrigation of rice crops	42.5(54)
	Total	100(127)

Source: Field Survey

Among them who agreed with the statement, 57.5% respondents state that government managed irrigation project provide irrigation at low cost than privately managed project, and 42.5% state that government sets up deep tube wells for irrigation of rice crops is not sufficient.

4.8.6.2 Willingly participate and pay per bigha

Table 4.20
Willingly participating government's initiatives for irrigation and payment per bigha

Willingly Participating Government's Initiatives	Percent	Payment per Bigha	Percent
Yes	95.0(171)	10-100	19.3(33)
No	5.0(9)	101-200	37.4(64)
		201-400	25.1(43)
		401-600	15.2(26)
		601-1000	3.0(5)
Total	100(180)	Total	100(171)

Source: Field Survey

Among the respondents, 95% state that they like to participate willingly if government takes the initiatives for modern irrigation systems and 5% do not like to participate. Among the respondents who want to take participate, 19.3% want to give 10-100 taka/bigha, 37.4% want to give 101-200 taka/bigha, 25.1% want to give 201-400 taka/bigha, 15.2% want to give 401-600 taka/bigha and 3% want to give 601-1000 taka/bigha if government takes initiatives for modern irrigation systems.

In the FGD session, one of the respondents has said that they pay 80-90 taka per one hour which is quite all right. But if the rate is reduced it will be better.

4.8.7 Irrigation drainage systems

4.8.7.1 Misuse occurred and types of drainage system

Table 4.21
Misuse or leakage of water during irrigation and Types of drainage system

Misuse or Leakage of Water	Percent	Types of Drainage System	Percent
Yes	100.0(180)	Brick built	1.1(2)
No	0(0)	Brick built, Kacca	3.3(6)
		Kacca	95.6(172)
Total	100(180)	Total	100(180)

Source: Field Survey

About 100% respondents say that there is misuse of irrigation water such as leakage through kaccha drain (earthen made) during irrigation. 1.1% respondent

says that they have brick built drain beside their fields, 3.3% say they have both brick built and kaccha drains, 95.6% say that they have mud built kaccha drains beside their rice fields. Therefore, scientific drainage systems are needed to reduce the irrigation water to an optimal level.

4.8.7.2 Construct concrete drain

Table 4.22
Construct concrete drain and misuse through kaccha drain

Constructing Concrete Drain	Percent	Type of Misuse through Kuccha Drain	Percent
Yes	100.0(180)	leakage through earthen made dyke, leakage into under ground	100.0(180)
No	0		
Total	100(180)	Total	100(180)

Source: Field Survey

Among the respondents, 100% agree that it is needed to build up concrete drainage systems for saving water. Again, 100% respondents state that water is misused by leakage through earthen made dyke and is leached into underground. In the FGD session, respondents have said that due to kaccha irrigation drain 20% irrigated water become useless. Due to muddy drains water enters into another land thus, irrigation needs one and half hour instead of one hour. Thus cost of irrigation is increased.

4.8.8 Excessive Irrigation Practice

4.8.8.1 Excessive irrigation and the causes

Table 4.23
Give excessive irrigation in the rice field and the causes

Giving Excessive Irrigation	Percent	Causes	Percent
Yes	7.2(13)	carelessly	100(13)
No	92.8(167)		
Total	100(180)	Total	100(13)

Source: Field Survey

According to the above table, 7.2% respondents agree that they give excessive irrigation in the rice field and 92.8% do not agree with that statement. And those who agreed with the statement, among them 100% respondents state that they carelessly give excessive irrigation in the rice field.

4.8.8.2 Variation of rice production through excessive irrigation

Table 4.24

Variation of rice production due to excessive irrigation and types of variation

Rice Production Variation	Percent	Types of Variation	Percent
Yes	89.4(161)	decreased	31.1(56)
No	10.6(19)	increased	68.9(124)
Total	100(180)	Total	100(180)

Source: Field Survey

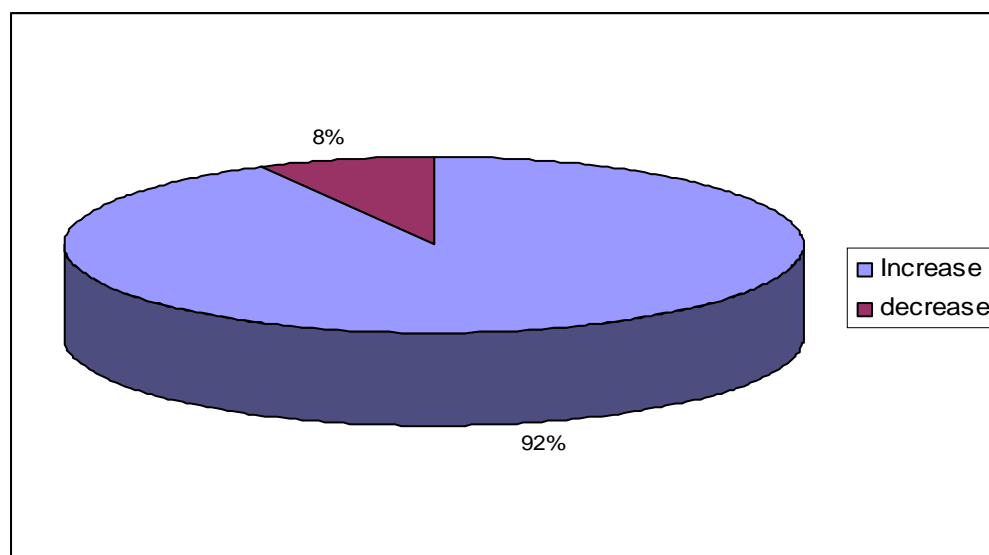
In the study areas, 89.4% respondents state rice production varies due to excessive irrigation and 10.6% state that rice production does not vary due to excessive irrigation. 31.1% respondents state that the production of rice is decreased due to excessive irrigation and 68.9% state that the production of rice is increased. However, as we know department of agriculture extension says that excessive irrigation hampers the rice production.

4.8.9 Groundwater Extraction

4.8.9.1 Status of groundwater withdrawn

Figure 4.13

Increase or decrease water withdrawn from under ground for rice cultivation

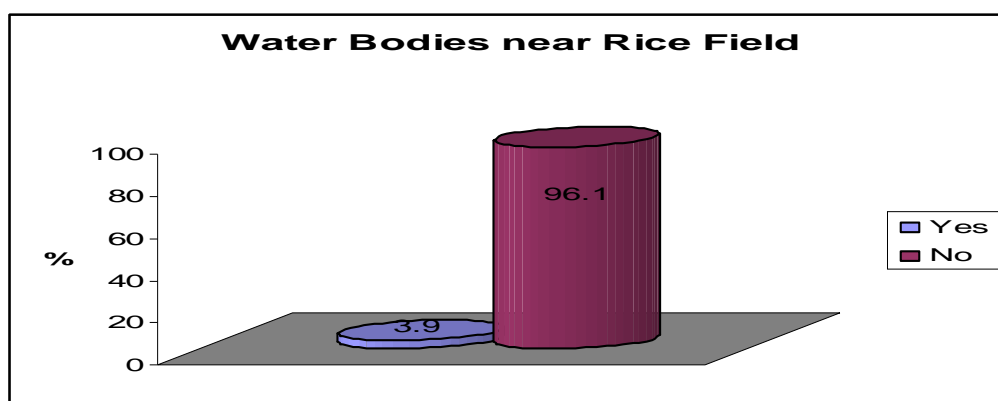


Source: Field Survey

Among the farmers, 92% respondents state that it is necessary to increase the volume of water withdrawn from underground for more rice cultivation and 8% respondents state that it is necessary to decrease the volume of water withdrawn from underground for sustainable irrigation in rice fields.

4.8.9.2 Uses surface water bodies

Figure 4.14
Any water bodies near the rice field and avoid using



Source: Field Survey

The 3.9% respondents agree that there is a river near their rice fields and 96.1% respondents say that there is no river or surface water near by their crop fields.

Table 4.25
Causes of avoiding surface water bodies

SL No.	Causes for not using that water for irrigation	Percent
1	Water is not found in proper time of irrigation	57.1(4)
2	Due to dried up rivers, canals etc. earlier	42.9(3)
	Total	100(7)

Source: Field Survey

Among the respondents who agreed with the statement, 57.1% respondents state that they can not use river water because water is not found in proper time of irrigation and 42.9% state that they can not use its water because it dries up earlier.

In the FGD session respondents have said that those who have land besides the rivers and canals cannot use surface water because they almost dry up. Therefore, they have to depend on ground water for irrigation. In this area, there is no water for irrigation without groundwater. So farmers use underground water for irrigation.

4.8.10 Cultivation of Alternative Crops

4.8.10.1 Thinking or accepting alternative crops

Table 4.26
Accept any alternative crops that consume less water

Thinking Alternatives	Percent	Accepting any Alternative Crops	Percent
Yes	91.7(165)	Yes	99.4(179)
No	8.3(15)	No	0.6(1)
Total	100(180)	Total	100(180)

Source: Field Survey

About 91.7% respondents agree that they need to think about alternative crops as 3000 liters water is needed for 1 kg rice cultivation and 8.3% do not agree with the statement. Again 99.4% respondents also agree that they will accept any alternative crops that consume less water which is valuable and edible and 0.6% respondent does not agree with that statement.

4.8.10.2 Accepting or denying alternative crops

Table 4.27
Accepting alternative crops or causes for denying

Crops	Percent	causes for denying	Percent
Wheat, Potato, Maize	11.1(20)	Rice will have to cultivate for fulfilling food requirements	100(1)
Wheat, Potato,	77.2(139)		
Potato, Maize	1.7(3)		
Vegetables	10.0(18)		
Total	100(180)	Total	100(1)

Source: Field Survey

Among them those who accept the alternative crops, 11.1% respondents want to cultivate wheat, potato and maize instead of rice, 77.2% want to cultivate wheat and potato, 1.7% wants to cultivate potato and maize and 10% want to cultivate vegetables. And those who do not accept the alternative crops, 100% respondent state that rice will have to be cultivated for fulfilling food requirements.

In the FGD session, Piyarul Islam has said about rabi crops which are viable because these consume less water as alternative of rice. The soil of barind area is clayey so other crops do not grow well without rice. But at present time production is found better by cultivating pulses. Besides mustard crops are cultivated which need less amount of water.

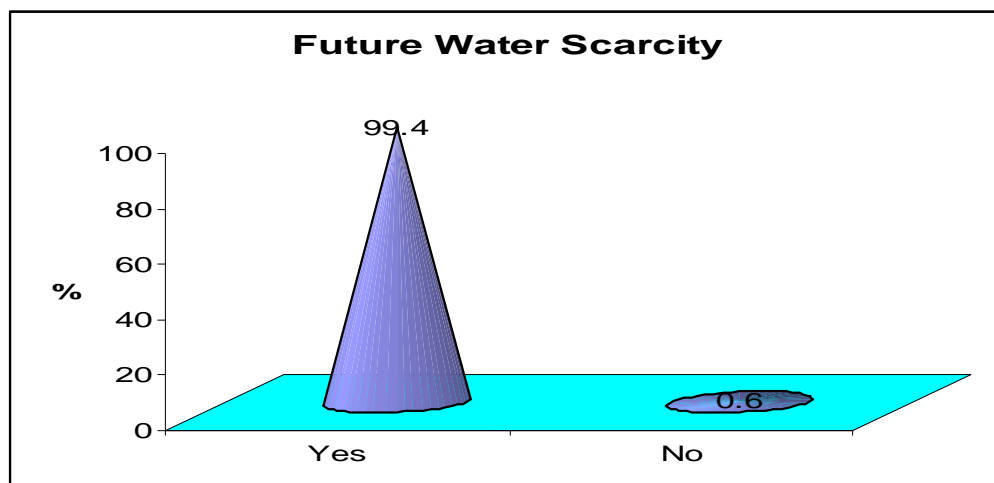
Then Mahtab Uddin have said that the ancestor cultivates rice. Now it is needed to test the soil whether other crops like corolla, potato will be grown or not. He also have said if he takes initiatives to cultivate potato or commercial crops in his land it will not be possible because everybody beside his land cultivates rice. So risk is there to cultivate other crops. Everybody should have to think about cultivation of alternative crops.

Another respondent have said that after winter season most of people want to cultivate other crops instead of rice. They say about cultivation of wheat but there is so much disturbance of rat while cultivating wheat. Without cultivation of rice all the year round Rabi crops, jute can be cultivated.

4.8.11 Irrigation Water Scarcity and Necessary Steps

4.8.11.1 Future irrigation water scarcity and the causes

Figure 4.15
Knowledge about future irrigation water scarcity



Source: Field Survey

The 99.4% respondents in the study areas agree that our country will face severe water scarcity in future and only 0.6% respondent does not agree with that statement.

Table 4.28
Reasons of Irrigation Water Scarcity

SL No.	Reasons of Irrigation Water Scarcity	Percent
1	Excessive drought, untimely rainfall	1.7(3)
2	Excessive drought, lowered groundwater level	1.1(2)
3	Excessive drought, untimely rainfall, lowered groundwater level	12.2(22)
4	Excessive drought, untimely rainfall, limited flow of river water, lowered groundwater level	85.0(153)
	Total	100(180)

Source: Field Survey

Among the respondents who agreed with the above statement, 1.7 respondent indicates the reason of water scarcity is excessive drought, untimely rainfall, 1.1% respondent indicates excessive drought and lowering groundwater level, 12.2% respondents indicate excessive drought, untimely rainfall and lowering groundwater level and 85% respondents indicate excessive drought, untimely rainfall, limited flow of river water and lowering groundwater level.

4.8.11.2 Necessary steps of the government

Table 4.29
Types of steps needed for government regarding irrigation

SL No.	Types of Taking Steps	Percent
1	More pipe will be installed more deeply in the deep tube wells	8.3(15)
2	More modernized deep tube wells will be installed	1.1(2)
3	Ensure availability of water in rivers, canals, beels etc.	33.9(61)
4	Ensure the management process of producing crops by using less amount of water	7.2(13)
5	Ensure the uplifted water layer	3.3(6)
6	Ensure availability of irrigation water by low purchasing cost of water	4.4(8)
7	To manage water in such a way that in future water scarcity is not occurred	3.3(6)
8	To manage modernized irrigation system	18.9(34)
9	To build up concrete irrigation drains and pipes for protecting misuse of irrigation water	19.4(35)
	Total	100(180)

Source: Field Survey

From the above table, all the respondents state that government needs to take necessary steps regarding water use for irrigation. And no one denies it.

Those who agreed with the statement, 8.3% respondents state that additional pipes will be installed more deeply in the deep tube wells, 1.1% respondent states that more modernized deep tube wells will be installed. Moreover, 33.9% state that it should be ensured availability of water in rivers, canals, beels etc., 7.2% state that it should be ensured the management process of producing crops by using less amount of water. And 3.3% state that it should be ensured to uplift of water layer, 4.4% state that it should be ensured availability of irrigation water by low purchasing cost, 3.3% state that water should be managed in such a way that in future water scarcity does not occur, 18.9% state that modernized irrigation system should be managed and 19.4% state that there should be built up concrete irrigation drains and pipes for protecting misuse of irrigation water.

4.9 Findings

In the study areas all the respondents use groundwater for irrigation purposes and no one uses surface water. In Sirajganj Upazila shallow tube wells are widely used to withdraw groundwater for irrigation in the rice field but in Godagari deep tube wells are widely used. No one has any scope to withdraw groundwater with shallow tube wells in Godagari because of lowering groundwater table.

In the proposed study areas; though there is irrigation manuals but either Department of Agriculture Extension does not provide to the farmers or reluctant of

farmers to use it, usually farmers do not follow it. All of the respondents follow modern irrigation methods and nobody follows traditional one. They use mainly flooded type or basin method of irrigation. Respondents do not know the actual interval and frequencies of irrigation. All of the respondents think that they maintain actual level of water in the rice field. According to their statement, 96% of the respondents follow actual level and only 4% do over flooded their rice fields but according to irrigation manual, it is wrong method.

About 36% of the respondents in the study areas said that irrigation started in 1984 in our country. Generally respondents do not know the laws and policies regarding irrigation and everybody agree that it is needed to learn relevant laws and policies. The 62% of the respondents know about the institutions providing irrigation and implementing agencies of laws and policies in the study areas and those who know mention the name BMDA in Godagari and PANASI in Sirajganj. About 6% respondents know about the laws regarding install a tube wells for irrigation. In Sirajganj, respondents do not take any permission to install tube wells while in Godagari they take permission because in Godagari only deep tube well can be installed that BMDA is implementing but respondents state that permission should take to install any sort of tube well for sustainable development processes.

In the study areas, 89.4% of the respondents have no training on agriculture and those who take training, among them 37% of the respondents take training on IPM. About 98% of the respondents do not get any training on irrigation.

About 82.2% of the respondents prefer cultivation of rice and among them, those who prefer, 83% of the respondents state rice fulfills food requirement of the household round the year as the reason. 48% of the respondent state that their income is increased through rice cultivation. Among them 89.5% of the respondents say that income is increased moderately due to rice cultivation. On the other hand around 67% respondents among them who do not accept the statement, say income is not increased but due to food requirement and low labor cost, they cultivate rice. About 23% of the respondents state that rice cultivation is more profitable than other crops and those who accept that statement among them 52.4% say that moderate profit is got from rice cultivation. On the other hand 82.1% respondents among them who do not accept that statement state that they cultivate rice due to fulfill food requirement of the household round the year. About 70.6% respondents agree about government's initiatives regarding irrigation in the study areas and they state that government provides facilities and management systems for cultivation of rice with low cost of irrigation. And 95% of the respondents agree that they willingly want to join government's initiatives for modern irrigation.

All the respondents agree that misuse or leakage of water through kaccha drain is seen during irrigation and they state the reasons that most of the drains are kaccha (made of mud). All the respondents agree that water will be saved by constructing concrete drains through community management and they indicate the misuse like leakage through earthen made dyke and leakage into the ground. About 7.2% respondents agree that they give excessive irrigation in the rice fields for their carelessness. 92.2% of the respondents state that it is necessary to increase withdrawing of groundwater for rice cultivation.

Respondents of both the areas state there is no any water bodies near their fields and those who tell their field is near by the water bodies, they mention that water is not found in appropriate time of irrigation and water is also not found due to dry up rivers, canals etc, earlier. 92% of the respondents think about alternative crops because after knowing that 3000 liters water needs for 1 kg rice production and they also willingly want to accept alternative profitable crops that consume less water but must be valuable and edible and more than 80% of the respondents emphasize on wheat and potato as alternative crops. All the respondents agree that our country will face water scarcity in future and most of them mention the causes such as excessive drought, untimely rainfall, limited flow of river water, lowering groundwater level due to excessive extraction. All the respondents state that government should take necessary steps regarding irrigation and majority of them say that it is needed to ensure availability of water in rivers, canals and beels etc.

4.10 Conclusion

From the above discussion, we know that farmers use groundwater for irrigation though there are rivers and canals in the study area. It is also true that water of those rivers and canals are not found during proper time of irrigation. And most of the farmers do not know about irrigation methods and manuals. If training from agriculture department is arranged frequently among the farmers, they can learn from that and in this way water can also be saved by using different methods. They also do not know about irrigation laws, policies and manuals. So it is necessary to take steps for providing those laws, policies and manuals of irrigation from the agriculture department of Bangladesh government.

Chapter-5

Farmers' Knowledge, Attitude and Practice towards Irrigation in Rice Cultivation

The present chapter endeavors to look at the various matters regarding KAP study for studying the farmers' knowledge attitude and practice about present practices of irrigation in respect of traditions and government laws and policies. For these, different preparations have taken such as Procedure of KAP Study, Steps in Preparation of a KAP Questionnaire, Validation of Questions, Conducting a KAP Study. KAP study has conducted on irrigation methods and manuals, irrigation training, sources of irrigation water, irrigation interval and level of irrigated water in rice field, drainage system and misuse of water, groundwater table, adverse Impact due to irrigation practices, ethical issues of irrigation practices and Irrigation Water scarcity etc.

5.1 Introduction

KAP studies are very much focused assessments that determine changes in human knowledge, attitudes and practices in response to a specific intervention, usually outreach, expression or learning. These studies have been widely used and appreciated around the world for at least forty years in public health, water supply and sanitation, family planning, education and other programs. KAP studies tell us what people know about certain things, how they feel, and how they behave. Each KAP study is unique to a particular setting and designed for a specific problem. The social surveys can cover a wide range of social values and activities, KAP studies focus specifically on the knowledge, attitudes and practice for a particular topic. The Knowledge possessed by a community refers to their understanding of that topic. Attitude refers to their feelings toward this subject, as well as any predetermined ideas they may have towards it. Practice refers to the ways in which they convey their knowledge and attitudes through their actions.⁴² In this chapter KAP studies is used to measure farmers' knowledge, attitudes and practices about irrigation in rice cultivation.

5.2 Procedure of KAP Study

At first a questionnaire is developed for this study to measure farmers' Knowledge, Attitude and Practice about irrigation. For this reason, respondents from the farmers in study areas are stratified into three groups according to their cultivable land for rice production. Then among the farmers of Sirajganj and

⁴² http://files.dnr.state.mn.us/assistance/grants/community/6kap_summary.pdf

Godagari; KAP questionnaire is surveyed through face-to-face interview and collected data are edited, coded and then analyzed. In this survey few variables are used to determine the KAP Study. These are irrigation laws and policies, irrigation methods and manuals, sources of irrigation water, interval and level of irrigation water, government initiatives towards irrigation, ethical and religious view of using irrigation water, drainage system and misuse of irrigation water, water scarcity and future steps.

5.3 Steps in Preparation of a KAP Questionnaire

5.3.1 Area Identification

The area or subject is identified and selected by which the study is conducted. For the purposes of irrigation practice in rice cultivation and its sustainability, the general area is rice cultivation through irrigation and its sustainability. More specifically, the fields of investigation are the knowledge, attitude and practices of the population with regard to these matters.

5.3.2 Question Preparation

Questionnaire preparation is conducted in different stages. The first stage in preparing questions for a KAP study I meet with agriculturist, village mentors, agriculture extension officer, religious persons and expert on irrigation activities to know the scientific ways of irrigation. This group of specialists identifies the endpoints or goals of the awareness creation activities of the irrigation practice for the farmers. Questions are prepared to test all three areas of KAP model for the study, Knowledge, Attitude, and Practices. Questions included in the Knowledge section are designed to test the level of knowledge of respondents on irrigation practice in rice cultivation. These are open-ended questions without multiple-choice where provided answers create opportunity in guessing whether this is a false or true impression of the knowledge of the population.⁴³ Questions cover the following topics:

- Irrigation laws and policies
- Government Initiatives regarding irrigation
- Irrigation methods and manuals
- Sources of irrigation water
- Interval and level of irrigation
- Drainage system of irrigation
- Misuse of irrigation water
- Groundwater table

⁴³ http://laico.org/v2020resource/files/guideline_kap_Jan_mar04.pdf

- Rice cultivation
- Adverse Impact due to irrigation practices
- Ethical issues of irrigation practices
- Water scarcity

Questions included in the Attitude section are designed to gauge the prevailing attitudes, beliefs and misconceptions among the population about their irrigation practices where there is relation with the level of knowledge. These questions are designed most effectively using different strategies. Statements are provided as questions and respondents are asked to indicate the extent to which they agree with those statements, on a pre-determined scale (not agree, not so agree, moderately agree, strongly agree).⁴⁴ The score points of this scale are 25, 50, 75 and 100.

These questions cover the following topics:

- Irrigation laws and policies
- Government Initiatives regarding irrigation
- Irrigation methods and manuals
- Sources of irrigation water
- Interval and level of irrigation
- Drainage system of irrigation
- Misuse of irrigation water
- Groundwater table
- Rice cultivation
- Adverse Impact due to irrigation practices
- Ethical issues of irrigation practices
- Water scarcity

Questions included in the Practice section are designed to assess the present state of irrigation practices of the study population with regard to their level of knowledge and sustainable irrigation. These are open-ended questions like those asked in the Knowledge section to prevent false information.⁴⁵ These questions cover the following topics:

- Irrigation laws and policies
- Government Initiatives regarding irrigation
- Irrigation methods and manuals
- Sources of irrigation water
- Interval and level of irrigation

⁴⁴ Ibid.

⁴⁵ Ibid.

- Drainage system of irrigation
- Misuse of irrigation water
- Groundwater table
- Rice cultivation
- Adverse Impact due to irrigation practices
- Ethical issues of irrigation practices
- Water scarcity

5.3.3 Validation of Questions

When the questions are prepared for the study, they are validated. This validation is considered when assessing their ease of comprehension, relevance to the proposed topics, the effectiveness in the provision be aligned with useful information, and to what extent the questions are interpreted and understood by different individuals. Validation is a preliminary test on a small group of representatives of the population. After completing questionnaire a pre-testing is conducted and analyzed for validation. This analysis validates the degree to which the questions are properly understood or misunderstood, the degree to which individuals within a group interpret the questions differently or similarly, the effectiveness of the questions in soliciting the proper information or not, and any areas of information which are neglected by the proposed questionnaire. After completing analysis, the questions are modified to reflect the results of the pre-testing. Then questionnaire is finalized for the KAP study.

5.4 Conducting a KAP Study

The first step in conducting a KAP study is the selection of the study sample on which the survey is conducted. The study sample is sufficiently large so as to represent the population without being so large that the data collection and analysis are prohibitively difficult. In choosing a sample size attention has taken into account that some of those selected respondent may be difficult or impossible to contact, or unwilling to participate in the KAP study. A sample size of approximately 180 individuals from each group will suffice as long as care is taken to ensure that the response rate is reasonably high. As mentioned earlier, division of the population into smaller categories is typically desirable as differing groups in the community have different educational, cultural, and socioeconomic backgrounds and therefore likely have differing levels of KAP. In practice, this distinction is made based on geographical characteristics of the group in either rural or urban settings. The characteristics of the overall population are considered when selecting the proportion of individuals from these categories to ensure that the population sampled reflects the population at large. The survey is

then conducted and the data is collected. A standard method for conducting the survey is decided upon in advance, and is consistent for each category surveyed so as to ensure that differences in the result are independent of the sampling method and depend solely on the characteristics of the population in question. Data is collected through face-to-face interviews with the farmers. After collection, the data is analyzed to determine the KAP level of the community. Questions in the Knowledge, which often have more than one component to a 'correct' answer is analyzed differently from those in the attitude section, which in turn is analyzed differently from those in the practice section. The preparation of tables illustrate both the percentage of those knowing each individual options and the percentage of people knowing multiple options provide a better understanding of the overall knowledge of the population. As there are some highly knowledgeable members of each group and many others who entirely lacking the knowledge, a fact that is not apparent without a more detailed breakup of the data. Analysis of the responses to the practice section is carried out in a similar fashion to those of the knowledge section, and is tailored to the specific nature of each question. In the attitude section, a numerical value is assigned to each choice in the range of responses, with the response given positive and negative scores as assigned it. In this way, a score is calculated for each individual in relation to the highest possible score. After that, collected data is edited and then analyzed. Now it is presented in this chapter of this thesis.⁴⁶

5.5 Farmers' KAP about Irrigation Laws and Policies Towards Irrigation

5.5.1 Knowledge

Table 5.1
Respondent's Level of knowledge about Irrigation laws and policies

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	10.6	Nothing Know	5.3	1	25	59.21*
No	89.4	Little Known	63.1	12	50	
		Well Known	21.1	4	75	
		Very well Known	10.5	2	100	
Total	100	Total	100	19		

Source: Field Survey

*Average score point is calculated based on total score point divide by total frequency and total score point which is come from individual score points multiply with their frequencies. The average score point is statistically called weighted mean or average and this is followed in every analysis.

⁴⁶ Ibid.

About 10.6% respondents have knowledge about irrigation laws and policies and 89.4% have no knowledge about that laws and policies. According to the level of knowledge, 10.5% respondents are very well known, 21.1% respondents are well known, 63.1% are little known and 5.3% know nothing. The average score point is 59.21. Knowledge about irrigation law and policies of the respondents is very poor and the level of knowledge is also poor.

Table 5.2
Taking permission to install Irrigation Tube wells and the awareness level

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	67.2	Don't Know	0	0	25	86.98*
No	32.8	Little Known	8.3	10	50	
		Well Known	35.5	43	75	
		Very well Known	56.2	68	100	
Total	100	Total	100	121		

Source: Field Survey

In the study areas, 67.2% respondents have said that they have knowledge about taking permission to install tube wells for irrigation and 32.8% have said they have no knowledge about that. According to the awareness level about taking permission to install TWs, 56.2% are very well known, 35.5% are well known and 8.3% are little known. The average score point is 86.98. In case of knowledge about taking permission to install irrigation tube wells, 67.2% of the respondents have stated that they know which is quite good and the level of knowledge is also good.

5.5.2 Attitude

Table 5.3
Necessities of Laws and Policies regarding irrigation and their Level of necessities

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Not essential	0	0	25	97.92*
No	0	Not so essential	0.6	1	50	
		Essential	7.2	13	75	
		Very much essential	92.2	166	100	
Total	100	Total	100	180		

Source: Field Survey

According to the attitude of the respondents, all the respondents think that it is very much needed of appropriate laws and policies regarding irrigation. And the attitude level of the respondents is 92.2% respondents think that it is very much essential, 7.2% think, it is essential, 0.6% thinks, it is not so essential. The average score point is 97.92. The attitude of the respondents regarding requirements of laws and policies about irrigation is very good and the level of attitude is also very good.

Table 5.4
Level of attitude for implementation of laws and policies in study area

Statement	Frequency	Percent	Score	Mean
Not seen	112	62.2	25	44.72*
Hardly seen	4	2.2	50	
Sometimes	54	30.0	75	
Always	10	5.6	100	
Total	180	100		

Source: Field Survey

According to the level of attitude for implementation of laws and policies in study areas, 5.6% have seen always, 30% have seen sometimes, 2.2% have hardly seen and 62.2% have not seen. The average score point is 44.72. The attitude level of the respondents regarding implementation of laws and policies by the government in the study area is not good at all.

Table 5.5
Requirements of enforcing laws and policies appropriately and Level of acceptance to enforce laws and policies

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	98.3	Don't agree	0	0	25	96.33*
No	1.7	Not so agree	0	0	50	
		Moderately agree	14.7	26	75	
		Very much agree	85.3	151	100	
Total	100	Total	100	177		

Source: Field Survey

The attitude of the respondent regarding needed to enforce laws and policies appropriately, 98.3% respondents are agreed with the statement and 1.7% does not agree. According to the attitude level, 85.3% respondents state they are very much agreed and 14.7% are moderately agreed. The average score point is 96.33. The attitude of respondents regarding necessities of enforcing laws and policies is very good and the level of attitude is also very good.

Table 5.6
Statement about appropriateness to take permission for installing tube wells for Irrigation and level of appropriateness

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Not appropriate	0	0	25	99.03*
No	0	No so appropriate	0	0	50	
		Moderately appropriate	3.9	7	75	
		Very much appropriate	96.1	173	100	
Total	100	Total	100	180		

Source: Field Survey

The attitude of the respondents, 100% respondents agree that it is appropriated to take permission for installing irrigation tube wells. If we see the attitude level, 96.6% respondents say, it is very much appropriated and 3.9% say, it is moderately appropriated. The average score point is 99.03. The attitude regarding appropriateness to take permission for installing tube wells is very good and the level of attitude is also very good.

5.5.3 Practice

Table 5.7
Compliance with the laws and policies of irrigation and Level of compliance

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	48.3	Don't comply	0	0	25	91.38*
No	51.7	Less compliance	2.3	2	50	
		Comply	29.9	26	75	
		Completely comply	67.8	59	100	
Total	100	Total	100	87		

Source: Field Survey

According to the practice of the respondents, 48.3% say that they comply with the laws and policies of irrigation and 51.7% do not agree with the statement. Moreover, the practice level of respondent shows that 67.8% say they completely comply, 29.9% say they comply and 2.3% say they sometimes comply. The average score point is 91.38.

Less than half of the respondents obey the laws and policies. Therefore, the practice of the respondents is not good but those who obey the laws and policies; their level of compliance is quite good. Farmers' Knowledge about Irrigation laws and policies towards irrigation is poor. Attitude level is good but in some cases, it is not good at all. The practice level is not good but in some cases, it is satisfactory.

5.6 Farmers' KAP about Government Initiatives Regarding Irrigation

5.6.1 Knowledge

Table 5.8
Knowledge about government initiatives regarding irrigation in study area

Statement	Frequency	Percent
Yes	144	80.0
No	36	20.0
Total	180	100

Source: Field Survey

In the study area, 80% respondents know about government initiatives regarding irrigation and 20% do not know. The knowledge level of respondents about government initiatives regarding irrigation in the study area is quite good.

5.6.2 Attitude

Table 5.9
Level of requirement of government initiatives regarding irrigation

Statement	Frequency	Percent	Score Points	Average score points
Don't need	0	0	25	99.03*
Not so much needed	0	0	50	
Needed	7	3.9	75	
Very much needed	173	96.1	100	
Total	180	100		

Source: Field Survey

Attitude level shows that 96.1% respondents think government initiatives are very much needed for irrigation and only 3.9% think it is needed for irrigation. The average score point is 99.03. Attitude level of the respondents about requirement for government initiatives regarding irrigation is very good.

Table 5.10
Statement about betterment of Govt. controlled irrigation system than private system and level of necessities for govt. control irrigation system

State ment	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Don't need	0	0	25	99.72*
No	0	Not so needed	0	0	50	
		Moderately need	1.1	2	75	
		Extremely need	98.9	178	100	
Total	100	Total	100	180		

Source: Field Survey

In the study areas 100% respondents state that government controlled irrigation system is better than privately managed. According to the attitude level, 98.9% respondents state it is extremely needed and only 1.1% states, it is moderately needed. The average score point is 99.72.

Table 5.11
Statement about necessities of govt. control irrigation system for sustainable rice production and level of necessities

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100.0	Don't agree	0	0	25	99.44*
No	0	Not so Agree	0.6	1	50	
		Moderately agree	1.1	2	75	
		Strongly agree	98.3	177	100	
Total	100	Total	100	180		

Source: Field Survey

About 100% respondents think that for sustainable rice production there needs government controlled irrigation system. According to level of attitude, 98.3% respondents are strongly agreed, 1.1% is moderately agreed and 0.6% is not so agreed. The average score point is 99.44. In the study areas, attitude level of respondents regarding government controlled irrigation system is very good. And the necessity of govt. controlled irrigation system for sustainable rice production is also very good.

5.6.3 Practice

4.15.5.1. Statement regarding government initiatives about irrigation in study area

Table 5.12
Government initiatives about irrigation in study areas and explanation of respondents

Government Initiatives	Percent	Types of Initiatives	Percent
Yes	70.6	Cultivation of rice with low cost of irrigation	57.5
No	29.4	Set up deep tube wells for irrigation rice crops	42.5
Total	100	Total	100

Source: Field Survey

According to the practice of the government initiatives, 70.6% respondents have stated that government has taken the initiatives regarding irrigation and 29.4% have stated that government have not taken any initiatives. The opinion of the respondents about practice level of governments regarding their initiatives about irrigation in the study area is good. Farmers' Knowledge Attitude and Practice about Government Initiatives regarding irrigation is good.

5.7 Farmers' KAP about Irrigation Methods and Manuals

5.7.1 Knowledge

Table 5.13
Knowledge about irrigation manuals

Statement	Frequency	Percent
Yes	150	83.3
No	30	16.7
Total	180	100

Source: Field Survey

In the study area, 83.3% respondents know about irrigation manuals and 16.7% do not know about the manuals. Therefore, the knowledge of the respondents regarding irrigation manuals is quite good.

Table 5.14
Knowledge Level about irrigation manuals for usefulness of irrigation

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Not useful	0	0	25	97.78*
No	0	Not so useful	0	0	50	
		Moderately useful	8.9	16	75	
		Very much useful	91.1	164	100	
Total	100	Total	100	180		

Source: Field Survey

About 100% respondents know that irrigation manuals are useful. According to the knowledge level, 91.1% respondents state that it is very much useful and 8.9% state that it is moderately useful. The The average score point is 97.78. The knowledge of the respondents regarding irrigation manuals is very good and the level of practice and attitude about irrigation manuals is also very good in both the study areas.

5.7.2 Attitude

Table 5.15
Level of attitude for achieving optimum production by following irrigation manuals

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Not agree	0	0	25	99.58*
No	0	Not so agree	0	0	50	
		Moderately agree	1.7	3	75	
		Strongly agree	98.3	177	100	
Total	100	Total	100	180		

Source: Field Survey

In the study areas, 100% respondents think that optimum production may be achieved through following irrigation manuals. If we see the attitude level, 98.3% respondents is strongly agreed to that matter and 1.7% is moderately agreed. The average score point is 99.58. The attitude of the respondents regarding achieving optimum production following irrigation manuals is very good and the level of attitude is also very good.

Table 5.16
Preferring modern and traditional irrigation methods

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Not prefer	97.2	175	25	25.83*
No	0	Not so prefer	2.2	4	50	
		Moderately prefer	0.6	1	75	
		Strongly prefer	0	0	100	
Total	100	Total	100	180		

Source: Field Survey

About 100% respondents prefer irrigation methods. According to the level of preferring of traditional method, 97.2% state they do not prefer and only 2.2% do not so prefer. The average score point is 25.83. According to preference level, traditional method of irrigation is very poor and the level of preference is also poor.

Table 5.17
Level of preferring systematic irrigation method

Statement	Frequency	Percent	Score Points	Average score points
Not prefer	0	0	25	100.00*
Not so prefer	0	0	50	
Moderately prefer	0	0	75	
Strongly prefer	180	100	100	
Total	180	100		

Source: Field Survey

Owing to the level of preferring of systematic irrigation method, 100% state they strongly prefer. The average score point is 100. Attitude of respondents regarding preference of systematic irrigation methods is very good and level of attitude is also very good.

5.7.3 Practice Question

Table 5.18
Following irrigation manuals

Statement	Frequency	Percent	Score Points	Average score points
Ancestor	0	0	25	79.50*
Fellow farmers	61	40.7	50	
Television/radio	1	0.6	75	
Agriculture Extension Officer	88	58.7	100	
Total	150	100		

Source: Field Survey

According to the practice level, 58.7% respondents follow the manuals provided by agriculture extension officer, 40.7% follow the manuals provided by fellow farmers and only 0.6% follows the manuals provided by television or radio. The average score point is 79.50.

Table 5.19
Using present irrigation method

Statement	Frequency	Percent	Score Points	Average score points
Self	2	1.1	25	78.06*
Ancestor	0	0	50	
Fellow farmers	76	42.2	75	
Agric officer	102	56.7	100	
Total	180	100		

Source: Field Survey

In the study areas 56.7% respondents state that they know about using irrigation method provided by agriculture extension officer, 42.2% know from fellow farmers and only 1.1% respondent knows themselves through experiences. The average score point is 78.06. Practice level of following the sources of irrigation methods and manuals is not satisfactory although more than half of the respondents follow the manuals provided by agriculture extension officers.

Table 5.20
Following the methods of irrigation manuals and its level

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	98.9	Not follow	0	0	25	93.68*
No	1.1	Not so follow	0	0	50	
		Moderately follow	25.3	45	75	
		Strongly follow	74.7	133	100	
Total	100	Total	100	178		

Source: Field Survey

About 98.9% respondents follow the methods of irrigation manuals and only 1.1% does not follow that manuals. According to the level of following manuals, 74.7% say that they strongly follow, 25.3% say that they moderately follow the irrigation manuals. The average score point is 93.68. Practice level of following the irrigation methods and manuals is not satisfactory although more than half of the respondents follow the manuals provided by agricultural extension officers. The practice of respondents regarding following of irrigation methods and manuals is very good and level of practice is also very good. Farmers' Knowledge and attitude about Irrigation methods and manuals is very good and practice level is also very good though some cases it is not satisfactory.

5.8 Farmers' KAP about Irrigation Training

5.8.1 Knowledge

Table 5.21
Level of knowledge about irrigation training program of DoAE

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	2.8	Don't know	0	0	25	60.00*
No	97.2	Little know	60.0	3	50	
		Well known	40.0	2	75	
		Very well known	0	0	100	
Total	100	Total	100	5		

Source: Field Survey

About 2.8% respondents have knowledge about irrigation training program of DoAE and 97.2% respondents have no knowledge about that training. According to the level of knowledge, 40% respondents are well known and 60% are little known. The average score point is 60. Knowledge of the respondents regarding irrigation-training program provided by DoAE is very poor and level of knowledge of those who know about training is also not good. The knowledge about irrigation training is very poor and the level of knowledge is also not satisfactory.

5.8.2 Attitude Question

Table 5.22
Necessities of irrigation training and level of requirements

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Not needed	0	0	25	99.86*
No	0	Not so needed	0	0	50	
		Needed	0.6	1	75	
		Very much needed	99.4	179	100	
Total	100	Total	100	180		

Source: Field Survey

About 100% respondents think that training is needed for irrigation. According to the attitude level, 99.4% say training is very much needed and only 0.6% says, it is moderately needed. The average score point is 99.86. Attitude of the respondents regarding requirements of training for irrigation is very good and level of attitude is also very good.

5.8.3 Practice Question

Table 5.23
Having any training on irrigation and sources of taking training on irrigation

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	8.9	Agric officer	100	16	100	100.00*
No	91.1	Fellow farmers	0	0	75	
		Ancestor	0	0	50	
		Self	0	0	25	
Total	100	Total	100	16		

Source: Field Survey

Above analysis shows that 91.1% respondents have no training on irrigation and only 8.9% have training. In case of sources of training, all of them have said that they have taken training from department of agriculture extension (DoAE). The average score point is 100. The practice of respondents regarding having training on irrigation is very poor but the level of attitude is very good. Farmers' Knowledge and their level about irrigation training are poor but the attitude level is very good. Level of practice is very poor.

5.9 Farmers' KAP about Sources of Irrigation Water

5.9.1 Knowledge

Table 5.24
Knowledge about sources of water better for irrigation

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	10.4	Do not know	0	0	25	100*
No	89.6	Little know	0	0	50	
		Known	0	0	75	
		Well known	100	18	100	
Total	100	Total	100	18		

Source: Field Survey

About 10.4% respondents in the study area have knowledge about sources of irrigation water, which is better for irrigation and 89.6% have no knowledge about that. According to the knowledge level, all the respondents are very well known. The average score point is 100. Knowledge about sources of water better for irrigation is very poor but those who have knowledge about that matter; their level of knowledge is very good.

5.9.2 Attitude

Table 5.25
Preferring sources of irrigation water

Statement	Frequency	Percent	Score Points	Average score points
Pond/dighi	2	1.1	25	97.36*
Canal	0	0	50	
River	13	7.2	75	
Groundwater	165	91.7	100	
Total	180	100		

Source: Field Survey

According to the attitude level of preferring sources of irrigation water, 91.7% respondents prefer groundwater, 7.2% prefer river water and only 1.1% prefers pond/dighi water. The average score point is 97.36. Attitude of preferring sources of irrigation water is groundwater. Therefore, the attitude of respondents is not good at all for sustainable irrigation practice in rice field.

Table 5.26
Appropriate sources of water for irrigation in study area

Statement	Frequency	Percent	Score Points	Average score points
River	9	5.0	100	98.75*
Groundwater	171	95.0	75	
Canal	0	0	50	
Pond/dighi	0	0	25	
Total	180	100		

Source: Field Survey

The suitable sources of irrigation water, 95% respondents tell that groundwater is the suitable sources of irrigation water and 5% say, river water is the suitable source. The average score point is 98.75. Knowledge level about sources of water, which better for irrigation, is very poor. Attitude level of suitable sources of irrigation water is groundwater. Therefore, attitude level is not good in case of using groundwater in respect of sustainability.

Table 5.27
Opinion about using surface water in case of availability instead of groundwater for irrigation

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	99.4	Not agreed	0	0	25	99.72*
No	0.6	Not so agree	0	0	50	
		Moderately agree	1.1	2	75	
		Strongly agree	98.9	177	100	
Total	100	Total	100	179		

Source: Field Survey

Among the respondents, 99.4% say, if surface water is available then they will not use groundwater and only 0.6% respondent is not agreed with the statement. The average score point is 99.72. The attitude of the respondents regarding not using groundwater in case availability of surface water is very good and the level of attitude is also very good.

5.9.3 Practice

In the study area, 100% respondents use groundwater for irrigation. The practice of the respondents regarding using irrigation water is groundwater. Therefore, practice level is poor. Farmers' Knowledge about sources of irrigation water is very poor but the level is satisfactory. In addition, the attitude level is not good at all. The practice level is also poor.

5.10 Farmers' KAP about Interval and Level of Irrigation

5.10.1 Knowledge

Table 5.28
Level of knowledge about four stages of interval in irrigation in rice field

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	81.7	Don't Know	0	0	25	83.50*
No	18.3	Little Know	17.7	26	50	
		Well Known	30.6	45	75	
		Very well Known	51.7	76	100	
Total	100	Total	100	147		

Source: Field Survey

About 81.7% respondents know about four stages of interval in rice field for irrigation and 18.3% do not know. According to the level of knowledge, 51.7% say, they know very well, 30.6% say, they know well and 17.7% say, they know little. The average score point is 83.50. The knowledge of respondents regarding four stages of interval in rice field irrigation is quite good and the level of knowledge is also good.

Table 5.29
Level of knowledge about prescribed method of maintain water level in different stages

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	97.8	Don't Know	0	0	25	88.21*
No	2.2	Little Know	5.0	9	50	
		Well Known	37.0	65	75	
		Very well Known	58.0	102	100	
Total	100	Total	100	176		

Source: Field Survey

Results show that 97.8% respondents know prescribed method of maintaining water level in different stages of irrigation and only 2.2% do not know. According to the level of knowledge 58% respondents state, they know very well, 37% know well and 5% know little. The average score point is 88.21. The knowledge of respondents regarding method of maintaining water level is very good and their level of knowledge is good.

Table 5.30
Knowledge regarding level of water maintain in four different stages and the level of knowledge

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	97.8	Don't Know	0	0	25	90.06*
No	2.2	Little Know	5.7	10	50	
		Well Known	28.4	50	75	
		Very well Known	65.9	116	100	
Total	100	Total	100	176		

Source: Field Survey

About 97.8% respondents know the level of water maintaining in four different stages of irrigation and only 2.2% do not know. According to the level of knowledge 65.9% respondents say, they know very well, 28.4% know well and 5.7% know little. The average score point is 90.06. Knowledge of respondents regarding level of water maintaining in four different stages is very good and the level of knowledge is also good.

5.10.2 Attitude

Table 5.31
Knowledge about better rice production following interval of irrigation in different stages and their level of acceptance

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	99.4	Not agreed	0	0	25	99.72*
No	0.6	Not so agree	0	0	50	
		Moderately agree	1.1	2	75	
		Strongly agree	98.9	177	100	
Total	100	Total	100	179		

Source: Field Survey

About 99.4% respondents say rice production will be better following interval of different stages of irrigation and only 0.6% does not agree. According to the attitude level, 98.9% respondents are strongly agreed and only 1.1% is

moderately agreed. The average score point is 99.72. The attitude of the respondents regarding following interval of irrigation in different stages of rice for better production is very good and level of attitude is also very good.

Table 5.32
Appropriateness of present interval method of irrigation and the level of appropriateness

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Not appropriate	0	0	25	99.72*
No	0	No so appropriate	0	0	50	
		Moderately appropriate	1.1	2	75	
		Very much appropriate	98.9	178	100	
Total	100	Total	100	180		

Source: Field Survey

The 100% respondents in the study area tell that present interval method of irrigation is appropriated. According to the level of appropriateness, 98.9% respondents say, interval method is very much appropriated and only 1.1% says, it is moderately appropriated. The average score point is 99.72. The attitude of the respondents regarding appropriate ness of present interval method of irrigation is very good and level of attitude is very good.

Table 5.33
Requirements to maintain optimal level of water in the rice field

Statement	Frequency	Percent	Score Points	Average score points
Not needed	0	0	25	99.72*
Not so much needed	0	0	50	
Needed	2	1.1	75	
Very much needed	178	98.9	100	
Total	180	100		

Source: Field Survey

Among the respondents, 98.9% say, it is very much needed to maintain optimal level of water in the rice field and only 1.1% says, it is not needed. The average score point is 99.72. The attitude level of necessities to maintain optimal level of water in the rice field is very good.

5.10.3 Practice

Table 5.34
Practice about following interval of irrigation and its level

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	99.4	Not follow	0	0	25	93.72*
No	.6	Not so follow	0	0	50	
		Moderately follow	25.1	45	75	
		Strongly follow	74.9	134	100	
Total	100	Total	100	179		

Source: Field Survey

About 99.4% respondents follow the interval of irrigation and only 0.6% does not follow. According to the practice level, 74.9% respondents follow interval of irrigation strongly and 25.1% follow moderately. The average score point is 93.72. Practice of the respondents following interval of irrigation is very good and the level of practice is also good.

Table 5.35
Learning sources of interval method used for irrigation

Statement	Frequency	Percent	Score Points	Average score points
Self	7	3.9	25	86.25*
Village mentors	1	0.6	50	
Fellow farmers	76	42.2	75	
Agriculture officer	96	53.3	100	
Total	180	100		

Source: Field Survey

In the study areas, 53.3% respondents say they learn interval method of irrigation from DoAE officer, 42.2% learn from fellow farmers, 0.6% learns from village mentors and 3.9% learn themselves. The average score point is 86.25. The practice level of sources of interval method used for irrigation is good.

Table 5.36
Maintaining optimal level of water in the rice field

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Not maintain	0	0	25	93.61*
No	0	Not so maintain	0	0	50	
		Moderately maintain	25.6	46	75	
		Exactly maintain	74.4	134	100	
Total	100	Total	100	180		

Source: Field Survey

About 100% respondents maintain actual level of water in the rice field. According to the practice of maintaining water level, 74.4% respondents maintain exactly and 25.6% maintain moderately. The average score point is 93.61. The practice of maintaining optimal level of water in the rice field is very good and level of practice is also good.

Table 5.37
Learning sources of maintaining water level method

Statement	Frequency	Percent	Score Points	Average score points
Self	4	2.2	25	88.06*
Village mentors	1	0.6	50	
Fellow farmers	72	40.0	75	
Agriculture officer	103	57.2	100	
Total	180	100		

Source: Field Survey

In the study areas, 57.2% respondent state they have learnt water level method of irrigation from DoAE officer, 40% have learnt from fellow farmers, 0.6% has learnt from village mentors and 2.2% have learnt themselves. The average score point is 88.06. The practice level of sources of water level method use for irrigation is quite good. Farmers' Knowledge Attitude and Practice about Interval and level of irrigation is very good but in some cases, practice level is not very good.

5.11 Farmers' KAP about Drainage System and Misuse of Water

5.11.1 Knowledge

Table 5.38
Knowledge about drainage system for irrigation in the study area and its level of knowledge

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Don't Know	0	0	25	99.44*
No	0	Little Know	0	0	50	
		Well Known	2.2	4	75	
		Very well Known	97.8	176	100	
Total	100	Total	100	180		

Source: Field Survey

Above chart shows that 100% respondents know about drainage system for irrigation in the study areas and according to the level of knowledge, 97.8% know very well and only 2.2% know well. The average score point is 99.44. Knowledge about drainage system for irrigation in the study areas is very good and the level of knowledge is also very good.

5.11.2 Attitude

Table 5.39
Causes of misuse of large volume of water through present drainage system and the level of acceptance

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Don't agree	0	0	25	99.44*
No	0	Not so agree	0	0	50	
		Moderately agree	2.2	4	75	
		Strongly agree	97.8	176	100	
Total	100	Total	100	180		

Source: Field Survey

About 100% respondents say that present drainage system causes misuse of large volume of water. According to the level of attitude, 97.8% are strongly agreed and 2.2% are moderately agreed. The average score point is 99.44. The attitude of the respondents regarding misuse of large volume of water caused by present drainage system is very good and the attitude level is also very good.

Table 5.40
Statement about reducing misuse of water by concrete drainage and the level of acceptance

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Don't agree	0	0	25	97.92*
No	0	No so agree	0	0	50	
		Moderately agree	8.3	15	75	
		Strongly agree	91.7	165	100	
Total	100	Total	100	180		

Source: Field Survey

About 100% respondents say that concrete drainage system reduces misuse of water. According to the level of attitude, 91.7% are strongly agreed and 8.3% are moderately agreed. The average score point is 97.92. The attitude of the respondents regarding reducing misuse of large volume of water by build up concrete drainage system is very good and the level of attitude is also very good.

Table 5.41
Statement about systematic irrigation to reduce misuse of irrigation water and the level of acceptance

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Don't agree	0	0	25	96.81*
No	0	No so agree	0	0	50	
		Moderately agree	12.8	23	75	
		Strongly agree	87.2	157	100	
Total	100	Total	100	180		

Source: Field Survey

In the study areas, 100% respondents say systematic irrigation can reduce misuse of irrigation water. According to the level of attitude, 87.2% are strongly agreed and 12.8% are moderately agreed. The average score point is 96.81. The attitude of the respondents regarding reducing misuse of large volume of water by applying systematic irrigation system is very good and the level of attitude is also very good.

Table 5.42
Perception about irrigation water misused by farmers' carelessness and the level of acceptance

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Don't agree	0	0	25	99.03*
No	0	No so agree	0	0	50	
		Moderately agree	3.9	7	75	
		Strongly agree	96.1	173	100	
Total	100	Total	100	180		

Source: Field Survey

About 100% respondents state that irrigation water is misused by farmers' carelessness. According to the level of attitude, 96.1% are strongly agreed and 3.9% are moderately agreed. The average score point is 99.03. The attitude of the respondents regarding misuse of water by farmers' carelessness is very good and the level of attitude is also very good.

5.11.3 Practice Question

Table 5.43
Statement about constructing concrete drain to save water and type of misuse through kuccha drain

Constructing Concrete Drain	Percent	Type of Misuse through Kuccha Drain	Percent
Yes	100	leakage through earthen made dyke, leakage into under ground	100
No	0		
Total	100	Total	100

Source: Field Survey

The practice of the respondents to observe water saving due to build up concrete drains is very good. Farmers' Knowledge Attitude and Practice about drainage system and misuse of water is very good and their level is also very good.

5.12 Farmers' KAP about Groundwater Table

5.12.1 Knowledge

Table 5.44
Knowledge about causes of ground water table downward and the level of knowledge

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	86.1	Don't know	0	0	25	83.39*
No	13.9	Little known	14.8	23	50	
		Well Known	36.8	57	75	
		Very well known	48.4	75	100	
Total	100	Total	100	155		

Source: Field Survey

Among the respondents, 86.1% know the causes of groundwater table declining and 13.9% do not know. According to the level of knowledge, 48.4% respondents know very well, 36.8% know well and 14.8% know little. The average score point is 83.39. The knowledge of the respondents regarding the causes of groundwater table decreasing is good and the level of knowledge is also good.

Table 5.45
Knowledge about groundwater recharge process and the level of knowledge

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	41.1	Don't Know	0	0	25	63.93*
No	58.9	Little Know	50.0	53	50	
		Well Known	41.5	44	75	
		Very well Known	8.5	9	100	
Total	100	Total	100	106		

Source: Field Survey

About 41.1% respondents know about groundwater recharge process and 58.9% do not know. According to the level of knowledge, 8.5% respondents know very well, 41.5% know well and 50% know little. The average score point is 63.93. The knowledge of the respondents regarding groundwater recharge process is not good and the level of knowledge is also not satisfactory.

5.12.2 Attitude Question

Table 5.46
Perception of decreasing groundwater table caused by over extracting and its level

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	98.3	Not agreed	0	0	25	97.32*
No	1.7	Not so Agree	0.6	1	50	
		Moderately agree	9.6	17	75	
		Strongly agree	89.8	159	100	
Total	100	Total	100	177		

Source: Field Survey

In the study areas, 98.3% respondents think, over extracting of groundwater causes decreasing of groundwater table and 1.7% does not think. According to the attitude level, 89.8% respondents say, they are strongly agreed, 9.6% are moderately agreed and only 0.6% is not so agreed. The average score point is 97.32. The attitude of the respondents regarding causes of water table decreasing by over extracting groundwater is very good and the attitude level is also very good.

Table 5.47
Statement about extracting and recharging ratio must be similar for sustainable irrigation and the level of attitude

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	99.4	Not agreed	0	0	25	96.65*
No	.6	Not so agree	0	0	50	
		Moderately agree	13.4	24	75	
		Strongly agree	86.6	155	100	
Total	100	Total	100	179		

Source: Field Survey

Above results state that 99.4% respondents think, extract and recharge ratio must be same for sustainable irrigation and 0.6% does not think. According to the attitude level 86.6% respondents say, they are strongly agreed and 13.4% are moderately agreed. Average score point is 96.65.

5.12.3 Practice Question

Table 5.48
Statement about observing groundwater table practically decreasing day by day and the level of acceptance

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	90.1	Not true	0	0	25	94.86*
No	9.9	Not so true	2.1	3	50	
		Moderately true	19.0	31	75	
		Exactly true	78.9	130	100	
Total	100	Total	100	164		

Source: Field Survey

About 90.1% respondents observe groundwater table practically decreasing day by day and 9.9% do not observe. The average score point is 94.86. The practice of the respondents regarding observation of groundwater table practically decreasing day by day is very good and practice level is also good. Farmers' Knowledge about groundwater table is not satisfactory but the attitude and practice level is very good.

5.13 Farmers' KAP about Adverse Impact due to Irrigation Practices

5.13.1 Knowledge

Table 5.49
Knowledge about adverse impact for cultivation of rice round the year and the level of knowledge

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	96.1	Not agreed	0	0	25	95.52*
No	3.9	Not so Agree	0.6	1	50	
		Moderately agree	16.8	29	75	
		Strongly agree	82.7	143	100	
Total	100	Total	100	173		

Source: Field Survey

Among the respondents, 96.1% know about adverse impact for cultivation of rice round the year and 3.9% do not know. According to the attitude level 82.7% respondents say, they are strongly agreed, 16.8% are moderately agreed and 0.5% is not so agreed. The average score point is 95.52. The knowledge of the respondents regarding adverse impact of cultivation of rice round the year is very good and the level of knowledge is also very good.

5.13.2 Attitude

Table 5.50
Statement about adverse impact of irrigation in dry season on other crops and the level of acceptance

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Not agreed	0	0	25	93.19*
No	0	Not so Agree	0	0	50	
		Moderately agree	27.2	49	75	
		Strongly agree	72.8	131	100	
Total	100	Total	100	180		

Source: Field Survey

In the study areas, 100% respondents think irrigation in dry season causes adverse impact on other crops. According to the attitude level, 72.8% respondents say, they are strongly agreed and 27.2% are moderately agreed. The average score point is 93.19. The attitude of the respondents regarding adverse impact of irrigation on other crops in dry season is very good and the attitude level is good.

Table 5.51
Statement about negative impacts of excessive irrigation on plants and animal and the level of acceptance

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	57.8	Not agreed	0	0	25	89.90*
No	42.2	Not so Agree	3.8	4	50	
		Moderately agree	32.7	34	75	
		Strongly agree	63.5	66	100	
Total	100	Total	100	104		

Source: Field Survey

About 57.8% respondents think, excessive irrigation causes negative impact on plants and animals and 42.2% do not think. According to the attitude level, 63.5% respondents say, they are strongly agreed, 32.7% are moderately agreed and 3.8% are not so agreed. The average score point is 89.90. The attitude of the respondents regarding negative impacts of excessive irrigation on plants and animal is not very good and the attitude level is quite satisfactory.

Table 5.52
Statement about negative impacts of excessive irrigation on human and social health and the level of acceptance

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	58.9	Not agreed	0	0	25	88.44*
No	41.1	Not so Agree	3.8	4	50	
		Moderately agree	38.7	41	75	
		Strongly agree	57.5	61	100	
Total	100	Total	100	106		

Source: Field Survey

About 58.9% respondents think excessive irrigation causes negative impact on human and social health and 41.1% do not think. According to the attitude level 57.5% respondents say, they are strongly agreed, 38.7% are moderately agreed and 3.8% are not so agreed. The average score point is 88.44. The attitude of the respondents regarding negative impacts of excessive irrigation on human and social health is not very good and the attitude level is quite satisfactory.

Table 5.53
Statement about alternatives instead of rice in kharif-1 season to save water

Statement	Frequency	Percent
Yes	175	97.2
No	5	2.8
Total	180	100

Source: Field Survey

According to the above table, 97.2% respondents say that there are alternative crops instead of rice in kharif-1 season to save water. The attitude of the respondents regarding preference of alternative crops instead of rice in kharif-1 season is very good.

Table 5.54
Perception about future water scarcity due to excessive groundwater extraction and the level of acceptance

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Not agreed	0	0	25	99.86*
No	0	Not so Agree	0	0	50	
		Moderately agree	.6	1	75	
		Strongly agree	99.4	179	100	
Total	100	Total	100	180		

Source: Field Survey

All the respondents think that future water scarcity will be occurred due to excessive groundwater extraction. According to the attitude level, 99.4% respondents are strongly agreed and only 0.6% is moderately agreed. The average score point is 99.86. The attitude of the respondents regarding future water scarcity due to excessive groundwater extraction is very good and the attitude level is also very good.

5.13.3 Practice

Table 5.55
Statement about cultivating rice round the round

Statement	Frequency	Percent
Yes	180	100.0
No	0	0
Total	180	100

Source: Field Survey

About 100% respondents say, they cultivate rice round the year. The practice of the respondents regarding avoiding cultivation of rice round the year is very poor. Farmers' Knowledge about adverse impact due to irrigation practices is very good but attitude level is not good at all though in some cases it is satisfactory. The practice level is very poor.

5.14 Farmers' KAP about Ethical Issues of Irrigation Practices

5.14.1 Knowledge

Table 5.56
Statement about knowledge of water use in Islam

Knowledge of Water Use in Islam	Percent
Yes	20.6(37)
No	79.4(143)
Total	100(180)

Source: Field Survey

In the study areas, 20.6% respondents know about use of water that Islam teaches and 79.4% respondents do not know.

Table 5.57
Knowledge about traditional/religious value system regarding water use and the level of knowledge

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	52.8	Don't Know	0	0	25	77.63*
No	47.2	Little Know	33.7	32	50	
		Well Known	22.1	21	75	
		Very well Known	44.2	42	100	
Total	100	Total	100	95		

Source: Field Survey

Around 42.8% respondents know about traditional/religious value system regarding water use and 57.2% do not know. According to the level of knowledge 44.2% respondents know very well, 22.1% know well and 33.7% know little. The average score point is 77.63. The knowledge of the respondents regarding traditional/religious value system about water use is not very good.

5.14.2 Attitude

Table 5.58
Statement about believing water as a god gifted resources and the level of trust

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Not believe	0	0	25	99.86*
No	0	Not so believe	0	0	50	
		Moderately believe	0.6	1	75	
		Strongly believe	99.4	179	100	
Total	100	Total	100	180		

Source: Field Survey

Results show that 100% respondents believe water is a god gifted resources. According to the attitude level, 99.4% respondents say, they are strongly agreed and only 0.6% is moderately agreed. The average score point is 99.86. The attitude of the respondents regarding believing water as a god gifted resources is very good and the level of attitude is also very good.

Table 5.59
Statement about necessities of obeying social/religious ethics to conserve water and the level of necessity

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Not needed	0	0	25	99.31*
No	0	Not so much needed	0	0	50	
		Needed	2.8	5	75	
		Very much needed	97.2	175	100	
Total	100	Total	100	180		

Source: Field Survey

About 100% respondents say it is needed to obey social/religious ethics to conserve water. According to the attitude level, 97.2% respondents say, it is very much needed and only 2.8% say it is moderately needed. The average score point is 99.31. The attitude of the respondents regarding necessities of obeying social/religious ethics to conserve water is very good and the attitude level is also very good though practice is not good.

Table 5.60
Statement about groundwater as a limited resource and the level of acceptance

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	97.8	Not agreed	0	0	25	99.29*
No	2.2	Not so Agree	0	0	50	
		Moderately agree	2.8	5	75	
		Strongly agree	97.2	171	100	
Total	100	Total	100	176		

Source: Field Survey

Among the farmers, 97.8% respondents think groundwater is a limited resource and 2.2% do not think. According to the attitude level, 97.2% respondents say they are strongly agreed and 2.8% are moderately agreed. The average score point is 99.29. The attitude of the respondents regarding groundwater as a limited resource is very good and the attitude level is also very good but practice is not good.

Table 5.61
Statement about not extracting groundwater unwisely and the level of acceptance

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	98.9	Not agreed	0	0	25	99.44*
No	1.1	Not so Agree	0	0	50	
		Moderately agree	2.2	4	75	
		Strongly agree	97.8	174	100	
Total	100	Total	100	178		

Source: Field Survey

About 98.9% respondents think, groundwater should not extract unwisely and 1.1% does not think. According to the attitude level, 97.8% respondents state they are strongly agreed and 2.2% are moderately agreed. The average score point is 99.44. The attitude of the respondents regarding unwisely groundwater extraction is very good and the attitude level is also very good.

Table 5.62
Using water in such a manner that next generation can get at least same water and the level of acceptance

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Not agreed	0	0	25	99.72*
No	0	Not so Agree	0	0	50	
		Moderately agree	1.1	2	75	
		Strongly agree	98.9	178	100	
Total	100	Total	100	180		

Source: Field Survey

All the respondents in the study areas think that water should be used in such a manner that next generation can get at least same water. According to the attitude level, 98.9% respondents say, they are strongly agreed and 1.1% is moderately agreed. The average score point is 99.72. The attitude of the respondents regarding using water in such a manner that next generation can get at least same water is very good and the attitude level is also very good but in practice it does not reflect.

Table 5.63
Statement about by following traditional ethics to save water misuse and the level of acceptance

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	100	Not agreed	0	0	25	98.61*
No	0	Not so Agree	0	0	50	
		Moderately agree	5.6	10	75	
		Strongly agree	94.4	170	100	
Total	100	Total	100	180		

Source: Field Survey

About 100% respondents think that we should follow traditional ethics, which can save water misuse. According to the attitude level, 94.4% respondents are strongly agreed and 5.6% are moderately agreed. The average score point is 98.61. The attitude of the respondents regarding following traditional ethics for saving water misuse is very good and the level of attitude is also very good.

5.14.3 Practice

Table 5.64
Learning sources to follow traditional/religious value system

Statement	Frequency	Percent	Score Points	Average score points
Self learned	5	5.2	25	90.82*
Village mentors	1	1.1	50	
Ancestor	15	15.8	75	
Religious persons	74	77.9	100	
Total	95	100		

Source: Field Survey

Above table indicates that 77.9% respondents follow the traditional/religious value system from religious persons, 15.8% follow from ancestor, 1.1% follows from village mentors and 5.2% follow themselves. The average score point is 90.82. The practice level of respondents regarding following traditional/religious value system is good.

Table 5.65
Statement to follow traditional/religious value system of water use and the level of acceptance

Statement	Percent	Statement	Percent	Frequency	Score Points	Average score points
Yes	93.3	Not follow	0	0	25	86.46*
No	6.7	Not so follow	3.0	5	50	
		Moderately follow	48.2	81	75	
		Exactly follow	48.8	82	100	
Total	100	Total	100	168		

Source: Field Survey

About 6.7% respondents follow traditional/religious value system of water use and 93.3% do not follow. According to the practice level, 48.8% respondents follow exactly and 48.2% follow moderately. The average score point is 86.46. The practice of the respondents regarding to follow traditional/religious value system of water use is not very good but the level of practice is good. Farmers' knowledge about ethical issues of irrigation practices is not good and the level of knowledge is also not good but the attitude level of the farmers is very good. And the practice level of the respondents is poor.

5.15 Findings

In this chapter, there is endeavor to find out the farmers' perceived knowledge regarding different issues of irrigation and their present irrigation practices to measure the level of attitude. As we know that one does not perform any work if he does hold proactive attitude on that subject though his level of knowledge is sufficient and appropriate. However, it is tried in this chapter to find out farmers' level of knowledge.

Farmer's level of knowledge (10.6%) about irrigation laws and policies is poor. Generally, score point (97.92) of attitude level is good but in some cases it is not to optimal level. So due to ignorance, farmers do not follow the irrigation laws and policies in their irrigation practice.

Knowledge and attitude (80% & 99.03) of farmers about government initiatives regarding irrigation systems is good so farmers' response toward government initiative in community-based irrigation is satisfactory.

Level of Knowledge and score point (99.58) of attitude about irrigation methods and manuals is very good and thus it is found that irrigation practice is very good (93.68) though in some cases it is not satisfactory.

Government training facilities is available but knowledge level (2.4%) of farmers is very poor but they are interested to take training means they hold proactive attitude (99.68).

Perceived knowledge about the use of irrigation water and its sources is poor (10.4%) and practice to use ground water, as water source is also poor so score point (91.7) of attitude is not good at all but in some cases it is quite satisfactory.

We ask about interval and water level in rice field and find that level of knowledge about water level in rice field is very good (83.50) but in some cases practice level is not very good that shows all farmers do not hold proactive attitude in this regard.

Study shows that knowledge and practice about drainage system and misuse of water is very good (99.44) that means it gives us an idea that their level of attitude is very good (97.92).

Farmers' Knowledge about consequences of declining the groundwater table is not satisfactory (41.1%) but they think that it is not good in the long run, so it shows that attitude level is good (97.32).

They are very much aware about adverse impact of present irrigation practices especially excessive use of ground water but attitude level is not at optimal level (57.8%) so they do not use nearby available surface water. Knowledge about ethical issues of irrigation practices is not good (20.6%) so their attitude and practice (6.7%) is not also good.

5.16 Conclusion

In the study area, almost no respondents know the laws and policies of irrigation and their attitude and practice level are not good at all. In case of training purpose, knowledge and practice are very poor. Most of the respondents do not have much knowledge about water table. In case of adverse impact, their attitude and practice are not good. If we see the ethical issues, their knowledge level is not satisfactory.

Chapter-6

Adverse Externalities of Irrigation Practice in Rice Cultivation

In this chapter, various issues discuss such as excessive irrigation practices and its impact, future irrigation, water scarcity, decreasing groundwater table, negative impact of over-exploitation of groundwater, adverse effect of irrigation on environment and socioeconomic development. In addition, hampering environment health due to irrigation, scarcity of safe drinking water due to irrigation, human health that is affected due to irrigation water, using pesticides that prohibited by the government, adverse effects of pesticides, harmful effects of metal pollutants on health, reasons of irrigation water scarcity.

6.1 Introduction

In the hydrologic cycle, an aquifer is a geologic body that is porous enough to accumulate groundwater and permeable enough to permit economic withdrawal of water for miscellaneous human uses. The water thus discharged from aquifer storage fulfils two major roles. Firstly, it can facilitate the environment by naturally maintaining and sustaining river flow, springs and wetlands. Secondly, it can give a valuable water supply to meet the growing demand of water for drinking and domestic use, irrigation and industry.⁴⁷

In spite of considerable rainfall and available fresh water, incompatible demands for groundwater use is likely to have adverse effects such as drying up of shallow wells, rising cost of pumping and deterioration of water quality, land subsidence, etc. Several authorities have clarified the safe level of ground water table in an aquifer for safe exploitation without producing any adverse effect of ground water use. Although any significant abstraction of ground water will create some environmental impact by reducing water levels, spring discharge or stream flow, thus it is important to differentiate the benefits of exploitation from the negative side effects of overexploitation.⁴⁸

The development of deeper groundwater for irrigation may make good economic sense (and be sustainable) both for middle and high-income farmers and for the local economy in general. However, adverse effect may be the declining of ground water table which is shallowed in near past during introduction of irrigation using ground water. Thus, it created difficulties of village

⁴⁷ http://nwri.gov.ng/userfiles/file/Advers_Effects_of_Over_Abstraction_of_Acquifer.pdf accessed on 12/11/2011.

⁴⁸ Ibid.

drinking water supplies by hand tube wells and shallow tube wells for irrigation and generally, poor farmers are depending on these. Declining groundwater levels is a signal of overexploitation and it is simply an indication that the groundwater system is not in equilibrium.⁴⁹

6.2 Excessive Irrigation and Its Impact

6.2.1 Variation of Rice Production and Types of Variation

Table 6.1
Variation of rice production due to excessive irrigation

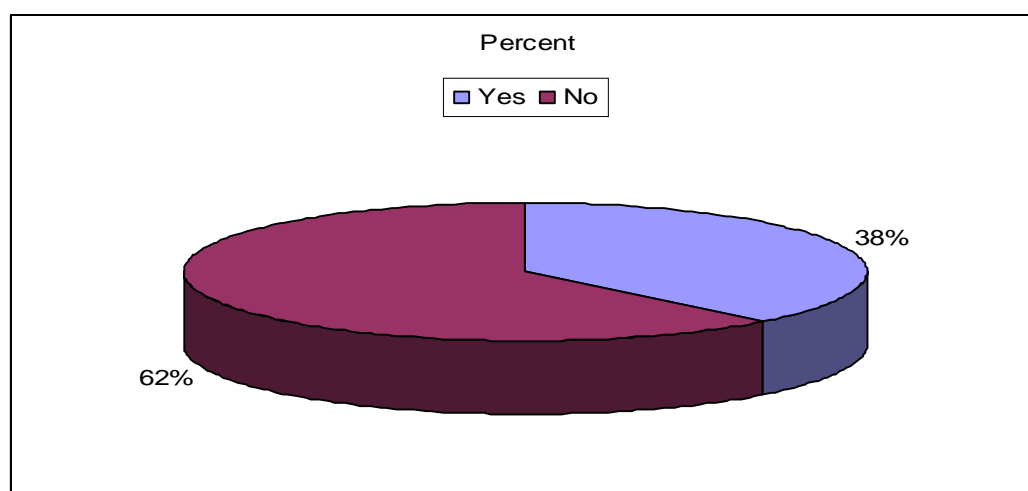
Variation of rice production	Percent	Types of Variation	Percent
Yes	89.4(161)	decreased	31.1(56)
No	10.6(19)	increased	68.9(124)
Total	100(180)	Total	100(180)

Source: Field Survey

About 89.4% respondents in the study areas agree that rice production varies due to excessive irrigation and 10.6% do not agree with the statement. Among the respondents who agreed with the statement, 31.1% respondents state that rice production is decreased due to excessive irrigation and 68.9% state that rice production is increased due to excessive irrigation.

6.2.2 Impacts of Irrigation and their Types

Figure 6.1
Impacts of excessive irrigation on other crops except rice



Source: Field Survey

⁴⁹ Ibid.

Among the respondents, 38% agree that there are impacts on other crops due to excessive irrigation in the rice fields and 62% respondents do not agree with the statement.

Table 6.2
Types of impacts due to excessive irrigation

SL No.	Types of Impacts	Percent
1	It is not possible to cultivate other crops	33.8(23)
2	Less available of irrigation water is found for other crops	8.8(6)
3	Cultivation of vegetables and seedlings are destroyed	17.7(12)
4	Production of other crops is less and died of crops	39.7(27)
	Total	100(68)

Source: Field Survey

Among them who accept the statement, 33.8% respondents say that it is not possible to cultivate other crops due to excessive irrigation in the rice fields, 8.8% respondents say, less available of irrigation water is found for other crops. Moreover, 17.7% respondents say that cultivation of vegetables, seedlings are destroyed, and 39.7% respondents say that production of other crops is less and died of crops due to excessive irrigation in the rice fields.

6.2.3 Adverse Impacts on other Crops and Employment Status

Table 6.3
Appropriate irrigation without creating adverse impacts

Not create Adverse Impacts		Impacts on Rabi Crops		Impacts on Employment	
Statement	Percent	Statement	Percent	Statement	Percent
Yes	100(180)	decreased	27.8(50)	decreased	45.0(81)
No	0	increased	72.2(130)	increased	55.0(99)
Total	100(180)	Total	100(180)	Total	100(180)

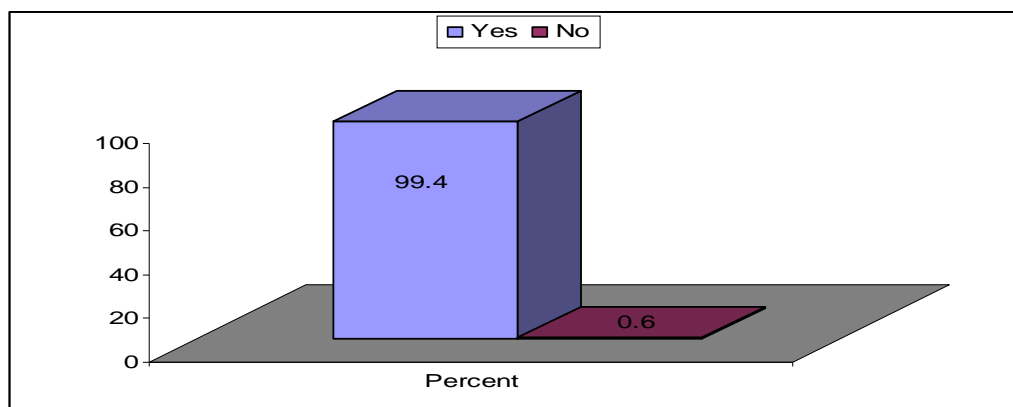
Source: Field Survey

All the respondents agree that irrigation should be given in such a way that does not create adverse impacts on other crops. Among the respondents who agreed with the statement, 27.8% respondents say that production of rabi crops is decreased and 72.2% respondents say that production of rabi crops is increased. Moreover, 45% respondents say that employment is increased due to irrigation projects and 55% state that employment is decreased. In the FGD sessions, most of the respondents have told that employment opportunity is increased with the increasing of irrigation projects to cultivation of more lands and crop intensity.

6.3 Future Water Scarcity

6.3.1 Future Severe Water Scarcity and their Reasons

Figure 6.2
Facing water scarcity in future



Source: Field Survey

In the study areas, 99.4% respondents agree that in future, our country will face severe water scarcity and only 0.6% respondent is not agreed with the statement.

Table 6.4
Reasons of Irrigation Water Scarcity

SL No.	Reasons of Irrigation Water Scarcity	Percent
1	excessive drought, untimely rainfall	1.7(3)
2	excessive drought, lowered groundwater level	1.1(2)
3	excessive drought, untimely rainfall, lowered groundwater level	12.2(22)
4	excessive drought, untimely rainfall, limited flow of river water, lowered groundwater level	85.0(153)
Total		100(180)

Source: Field Survey

Among them who agreed with the statement, 1.7% indicates, the reasons for water scarcity is excessive drought, untimely rainfall, 1.1% indicates excessive drought, decreasing groundwater table, 12.2% indicate excessive drought, untimely rainfall, decreasing groundwater level, 85% indicate excessive drought, untimely rainfall, limited flow of river water, decreasing groundwater level.

6.4 Groundwater Table and the Level

Most people know that the "water table" is associated with ground water. The word table provides an image of a flat surface, like a tabletop, and it is commonly assumed that when a well is drilled it strikes water once it reaches below the water table. There is also a general understanding that during serious drought,

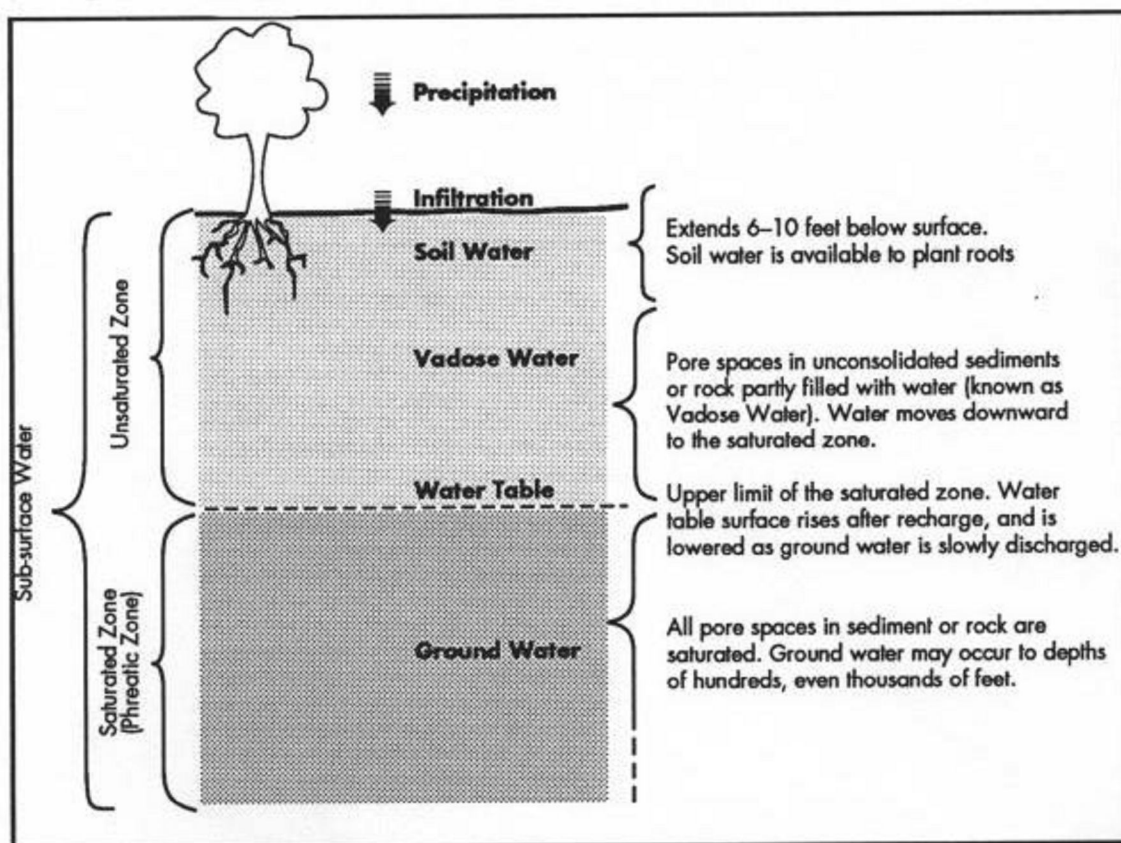
water table may drop and wells may run dry. Understanding the terminology used to describe sub-surface water can help explain why water tables may rise and fall.⁵⁰

Ground water is sub-surface water, but not all sub-surface water is ground water. Having an appreciation of the types of sub-surface water and knowledge of local geology can explain why some water table may vary by tens of feet and others in the same area may only change by inches and some hardly at all. The upper surface of ground water is the water table. Below this surface, all the pore spaces and cracks in sediments and rocks are completely filled (saturated) with water. These saturated layers, known as the saturated zone are where ground water occurs. Strictly speaking, only water found in the saturated zone is ground water. In the top layers of soil, unconsolidated sediments or bedrock, pore spaces may not be completely filled with water. Some may contain water, some air, and some may only be partly filled with water. This is known as the unsaturated zone. After heavy rainfall, this zone may be almost saturated, while during a long dry spell, it may become almost dry. Precipitation infiltrates downwards through the unsaturated zone. This infiltrating water is known as soil water when it is still shallow enough to be used by plants, and when it is below root level, but still unsaturated. With further infiltration however, excess water will eventually reach the water table. The vertical distance from the ground surface to the water table varies from place to place - it may be a few feet, or several hundred feet. Generally, the water table is deeper beneath hills and shallower beneath valleys. It is hardly ever flat. In any one place, the water table usually rises with the increasing recharge from precipitation and declines in response to seasonally dry weather, drought, or excessive pumping of ground water. If however the water table is hundreds of feet down, it may take some years for the infiltrating water to reach the saturated zone and there will be no seasonal change in water table levels.⁵¹

⁵⁰ American Ground Water Trust, Available at www.agwt.com

⁵¹ Ibid.

Figure 6.3
Groundwater Table



Adopted from: American Ground Water Trust. Available at www.agwt.com

6.4.1 Decreasing Ground Water Table and its Causes

About 100% respondents agree that groundwater is decreasing day by day.

Table 6.5
Causes of decreasing ground water table

SL No.	Causes of decreasing water level	Percent
1	Water is not found in rivers, canals and beels etc.	22.8(41)
2	Heavy drought and less availability of water in rivers, canals and beela etc.	13.3(24)
3	Heavy withdrawal of groundwater for irrigation and less availability of water in rivers, canal etc.	42.2(76)
4	Less flood and low rain fall	12.2(22)
5	Installation of large numbers of deep and shallow tube wells	.6(1)
6	Due to climate change	8.9(16)
Total		100(180)

Source: Field Survey

Those who agreed with the statement, among them 22.8% respondents say that water is not found in rivers, canals and beels in dry seasons. 13.3% respondents say that ground water level is decreasing due to drought and insufficient water is

found in rivers, canals, beels etc. In addition, 42.2% express their opinion on heavy withdrawal of groundwater for irrigation and insufficient water is found in rivers, canals, beels etc. 12.2% respondents express opinion on insufficient flood and low rainfall, 8.9% have opinion on climate change and only 0.6% has expressed opinion on installation of large numbers of deep and shallow tube wells.

In the FGD sessions, as the water is withdrawn from the ground for rice cultivation, there is shortage of water because one deep tube well driver says that it is not possible to provide water for all the cultivated land under one deep tube well at a time due to shortage of ground water. For this reason, uplift of huge volume of ground water by a deep tube well creates shortage of water for near by deep tube well. So irrigation is hampered. Due to uplift of water from the ground in dry season, maximum hand tubewells do not operate well. There is shortage of drinking water as well because hand tube well does work. Sometimes it is very difficult to take bath especially for women and children. Most of the respondents say that underground water table is decreasing day by day because of excessive withdrawn of groundwater for irrigation and in some cases implants of alien species of trees such Eucalyptus that consumes huge volume of water.

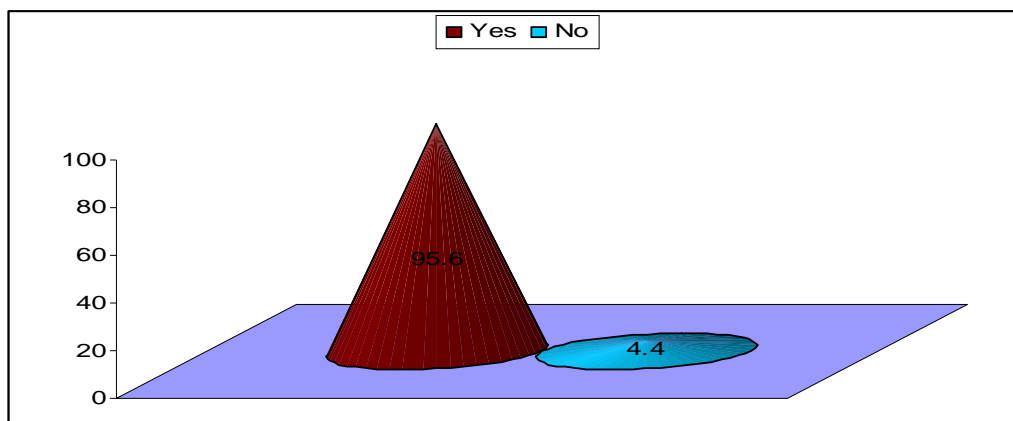
6.5 Negative Impact of Over-exploitation of Groundwater

When groundwater is exploited, water levels will decline and it continues either to do so until they stabilize at a lower level or, if abstraction is persistently greater than recharge, the aquifer is dewatered. Extended declines can result in the drying-up of shallow wells, increased pumping costs, deepen or replace boreholes and, in coastal areas, saline intrusion. In extreme cases, the aquifer may be effectively dewatered, groundwater levels having become so severely depressed that the aquifer approaches exhaustion. Such impacts can have severe socio-economic consequences. Declining groundwater levels may also cause drastic reductions in river flow and in wetland areas. The consequences may be slow down the development processes, not apparent until the problem is well entrenched and may not be reversible (such as the loss of flora and fauna from a natural habitat).⁵²

⁵² http://nwri.gov.ng/userfiles/file/Advers_Effects_of_Over_Abstraction_of_Acquifer.pdf accessed on 12/11/2011.

6.6 Condition of Water Bodies

Figure 6.4
Drying water bodies earlier due to excessive ground water harvesting

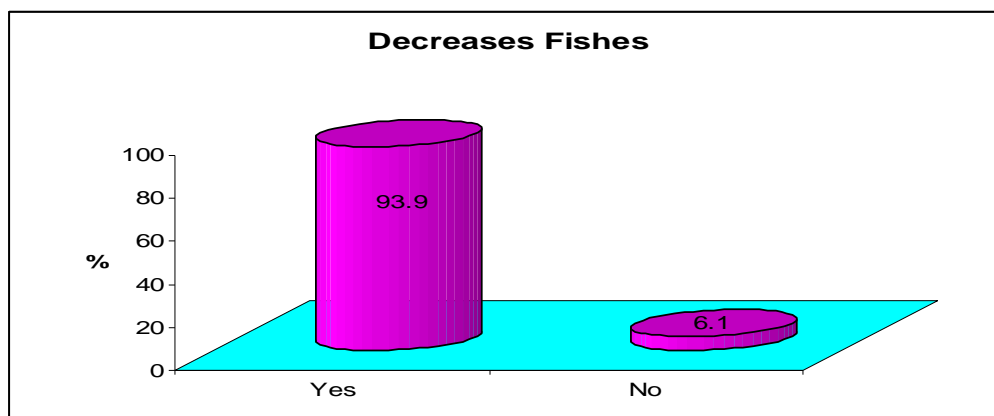


Source: Field Survey

Above figure shows that 95.6% respondents think, water bodies dry up earlier due to excessive ground water harvesting and 4.4% respondents do not think about that matter.

6.7 Declining Fishes

Figure 6.5
Decreasing fishes due to irrigation water



Source: Field Survey

About 93.9% respondents think that fishes are decreasing due to decreasing of wetlands and wetlands pollution through pesticides because irrigated water adulterated with pesticides entered nearby surface water bodies.

6.8 Adverse Effect of Irrigation Water

Table 6.6
Statement about adverse effect of irrigation water

Adverse Effects on	Percent age
Soil fertility, biodiversity, soil pollution, water pollution, Other crops, Open water Fishes	16.0(29)
Soil fertility, biodiversity, soil pollution, water pollution, Open water Fishes	9.4(17)
Soil fertility, biodiversity, soil pollution, water pollution, Other crops,	1.7(3)
biodiversity, soil pollution, water pollution, Other crops, Open water Fishes	0.6(1)
Soil fertility, biodiversity, soil pollution, water pollution,	31.1(56)
Soil fertility, biodiversity, soil pollution, Open water Fishes	0.6(1)
Soil fertility, biodiversity, soil pollution,	1.1(2)
soil pollution, water pollution,	10.0(18)
biodiversity, soil pollution, water pollution,	6.1(11)
biodiversity, soil pollution,	2.2(4)
Soil fertility, biodiversity, water pollution,	3.8(7)
Soil fertility, soil pollution,	1.1(2)
Soil fertility, biodiversity	7.2(13)
biodiversity, Other crops	1.1(2)
Soil fertility, biodiversity, Other crops	1.1(2)
biodiversity, water pollution, Other crops	0.6(1)
water pollution, Other crops	0.6(1)
Soil fertility, water pollution	0.6(1)
biodiversity, water pollution	0.6(1)
Soil fertility	0.6(1)
Biodiversity	2.7(5)
soil pollution	0.6(1)
water pollution	0.6(1)
Total	100

Source: Field Survey

Adverse effect of irrigation water shows in above table that 31.1% respondents think there is adverse effect of irrigation on soil fertility, biodiversity, soil pollution and water pollution, 16% think that adverse effect on soil fertility, biodiversity, soil pollution, water pollution, other crops and open water fishes. Moreover, 10% respondents think that adverse effect on soil pollution and water pollution, 9.4% think that adverse effect on soil fertility, biodiversity, soil pollution, water pollution and open water fishes.

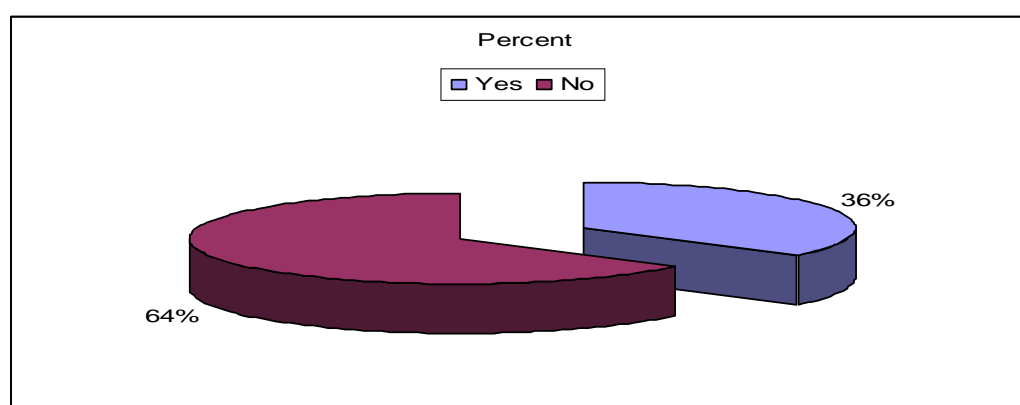
In the FGD sessions respondents have said if water is brought from the rivers the pressure of underground water will be reduced. Besides the water of river increases soil fertility, so it reduces the fertilizer cost.

Block Supervisor says that soil fertility is reduced due to cultivation of rice round the year. There is not given any rest of land for other crops thus the production of crops is not higher. He also says that it is needed to cultivate short

duration rice crops for retaining moisture for cultivation of rabi crops. BR-49, BR-51 and BR-52 are short duration variety of rice available in Bangladesh that needs to propagation among the farmers. By testing soil and maintaining cropping pattern, crops can be cultivated in our country because in India, cropping pattern is maintained for cultivating different type of crops. In our country exhibition of crops is done beside the roadside so that people can see and discuss among them about the cultivation process and they can cultivate their own land according to that process.

6.9 Condition of Environmental Health

Figure 6.6
Hampering environmental health by excessive irrigation and the changes



Source: Field Survey

According to the figure regarding environmental health, 35.6% respondents think, environmental health is hampered due to unwise irrigation and 64.4% respondents do not think about that.

Table 6.7
Types of changes in Environment

SL No.	Causes	Percent
1	Some times fog is seen due to heavy irrigation practices	95.3(61)
2	Trees are affected	3.1(2)
3	Less cyclones are occurred	1.6(1)
	Total	100(64)

Source: Field Survey

Among the respondents who give opinion on causes of hampering environmental health due to irrigation, 95.3% respondents say, sometimes fog is seen due to heavy irrigation practices, 3.1% respondents say, trees are affected and only 1.6% says less storms are occurred.

In the FGD sessions, respondents state that due to excessive irrigation environmental change is occurred. At present, seasons are two types in Bangladesh that is winter and summer.

6.10 Water Scarcity in dry Season and Scarcity of Safe Drinking Water

Table 6.8
Irrigation water scarcity and safe drinking water in dry season

Water Scarcity in Dry Season	Percent	Scarcity of Safe Drinking Water	Percent
Yes	81.7(147)	Yes	57.8(104)
No	18.3(33)	No	42.2(76)
Total	100(180)	Total	100(180)

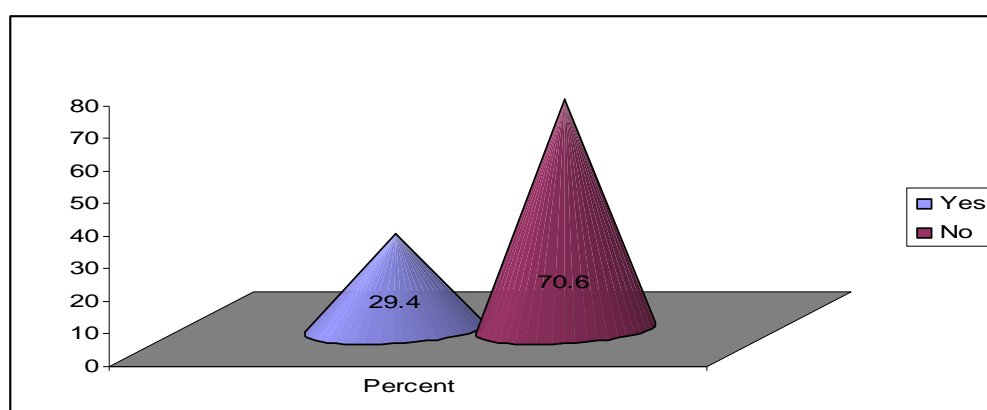
Source: Field Survey

About 81.7% respondents think, water scarcity is occurring due to irrigation in dry season and only 18.3% have negative opinion. Again 57.8% respondents think, scarcity of drinking water is observing due to irrigation and 42.2% do not think about the matter.

In the FGD sessions, President of Madrasa committee of study villages in Godagari upazila has said that there are lots of problem of the farmers but solution of these problems are limited. There is disturbance of cultivation due to shortage of water. The underground water layer is decreasing day by day due to heavy withdrawn of water from the ground with the help of deep tube wells. Beside the area under deep tube wells are excess in respect of capacity so that irrigation water is not covered the area as required. In fact, the use of river or canal water is the best way to minimize water scarcity creating from ground water use.

6.11 Human Health Problems

Figure 6.7
Impact of irrigation water on human health and the difficulties



Source: Field Survey

The above chart indicates that 29.4% respondents think, human health is affected due to present irrigation practices and 70.6% do not think about that.

Table 6.9
Types of impacts of irrigation water

SL No.	Difficulties Faced	Percent
1	Gas is formed and pain in belly	47.2(25)
2	Hair is fallen	17.0(9)
3	Hamper digestion	9.4(5)
4	Hair becomes greasy	7.5(4)
5	Eczema is seen in hands and legs	18.9(10)
	Total	100(53)

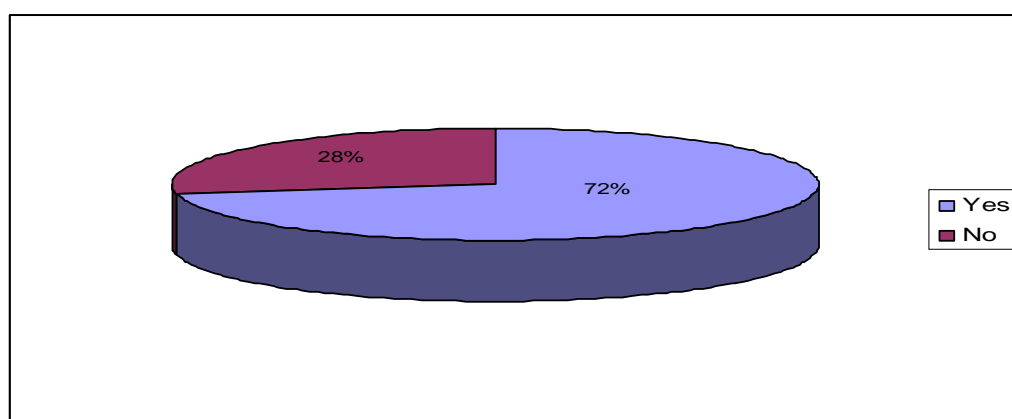
Source: Field Survey

Those who think human health is affected due to irrigation practices among them 47.2% say, gas is formed and feels pain in belly, 17% say, hair is fallen, 9.4% say, digestion is hampered, 7.5% say, hair becomes greasy, 18.9% say, eczema is formed in hands and legs.

In the FGD sessions, respondents stated that in the barind area there is less disease occurred because of dry weather and safe drinking water provide by BMDA through mini water supply plants and special hand tube wells.

6.12 Pesticides to Kill the Crabs or other Animals

Figure 6.8
Statement about using pesticides to kill the crabs or any other animals in rice field



Source: Field Survey

About 72.2% respondents in the study areas use pesticides to kill the crabs or other animals in the rice field and 27.8% do not use for these purposes.

6.13 Government Prohibited Pesticides

Table 6.10
Using government prohibited pesticides and their adverse effects

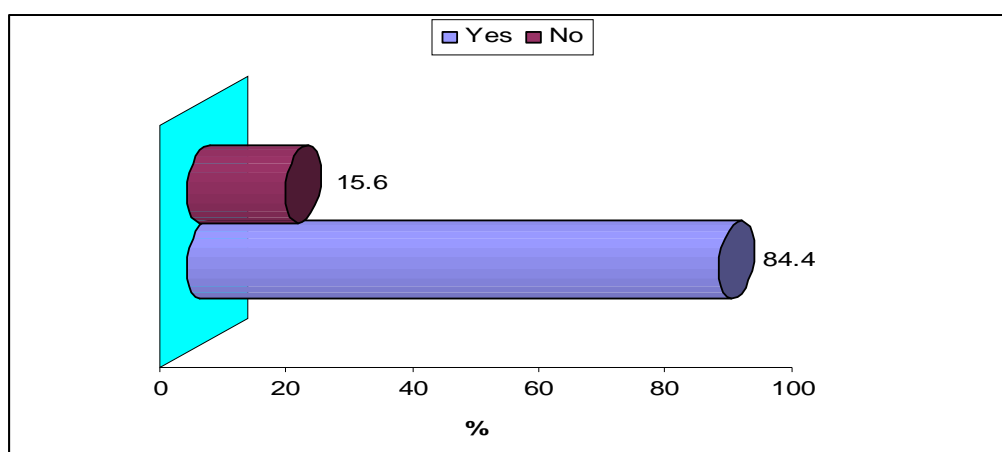
Use Government Prohibited Pesticides	Percent	Adverse Effects	Percent
Yes	12.8(23)	No	100(23)
No	87.2(157)		
Total	100(180)	Total	100(23)

Source: Field Survey

In the study areas, 12.8% respondents use pesticides that are prohibited by the government and 87.2% do not use those pesticides. Among the respondents who use the pesticides that prohibited by the government, 100% respondents do not know the adverse effect of those pesticides.

6.14 Pollution of Local Water Bodies

Figure 6.9
Pollution of local water bodies by Chemical fertilizer and pesticides and types of pollution



Source: Field Survey

Among the respondents, 84.4% think, chemical fertilizer and pesticides pollute local water bodies and 15.6% have no idea about that.

Table 6.11
Types of pollution by chemical fertilizers and pesticides

SL No.	Types of Pollution	Percent
1	Fishes and animals are lost	86.1(131)
2	Water is not used by the people for bathing and other purposes	6.0(9)
3	Color of water is changed and deteriorate	3.3(5)
4	Increase mosquitoes and flies	4.6(7)
	Total	100(152)

Source: Field Survey

Those who have positive response, 86.1% say, fishes and animals are lost due to pollution through chemical fertilizer and pesticides, 6% say, water is not used by the people for bathing and other purposes, 3.3% say, color of water is changed and deteriorated, 4.6% say, there is increased mosquitoes and flies.

In the FGD sessions, respondents stated that due to excessive irrigation, the fertilizer and pesticides go with water into the ponds and canals thus water is polluted. It hazards fishes and other species.

6.15 Harmful Effects of Metal Pollutants

Table 6.12
Minerals present in tube wells water and their harmful effects on health

Minerals	Percent	Harmful Effects on Health	Percent
Iron	37.2(67)	Gas is formed in stomach	4.5(3)
No	62.8(113)	Skin is affected	77.7(52)
		Eczema is formed in hands and legs	3.0(2)
		Do not feel any effect	10.3(7)
		Hair is badly affected	4.5(3)
Total	100(180)	Total	100(67)

Source: Field Survey

Above table shows that 37.2% respondents express the minerals iron are found in tube wells' water and 62.8% do not give opinion. Due to harmful effects of iron, 77.7% respondents state that acidity increases in stomach, 4.5% say, skin is affected, 3% say, eczema is formed in hands and legs, 4.5% state, hair is badly affected and 10.3% do not feel any effect.

6.16 Reasons of Irrigation Water Scarcity

Table 6.13
Statement about reasons of irrigation water Scarcity

Sl. No	Reasons of Irrigation Water Scarcity	Frequency	Percent
1	Excessive drought, untimely rainfall, limited flow of river water, lowered groundwater level	153	85.0
2	Excessive drought, untimely rainfall, lowered groundwater level	22	12.2
3	Excessive drought, untimely rainfall,	3	1.7
4	Excessive drought, lowered groundwater level	2	1.1

Source: Field Survey

About 85% respondents state, the reasons of water scarcity are excessive drought, untimely rainfall, limited flow of river water and decreasing of groundwater level, 12.2% state, the reasons are excessive drought, untimely rainfall, and decreasing groundwater level, 1.7% states, the reasons are

excessive drought and untimely rainfall, 1.1% states, the reasons are excessive drought, decreasing groundwater level.

In the FGD sessions respondent states, If the layer of ground water decreases gradually in future it will be very difficult to withdraw ground water so next generation will suffer. So an alternative ways should be thought. Water should be reserved in canals and rivers. For this reason, government should step forward to do that. Rivers and canals should be dredged to store water. Due to low rainfall and heavy withdrawn of underground water, the ground water table is decreasing gradually.

6.17 Findings

In both of the study areas, most of respondents agree that rice production varies due to excessive irrigation and some of the respondents say, rice production is decreasing due to excessive irrigation in the rice fields. There are some impacts of excessive irrigation on other crops as said by some of the study population. They said that they face different difficulties, created as adverse effect of unwise irrigation, to cultivating other crops such as not as much of moisture as required for other crops that causes less production. All the respondents in the study areas agree that irrigation should not give in such a way, which creates adverse effect on other crops. Moreover, most of the respondents state that production of rabi crops is also decreased due to excessive irrigation in rice field. On the other hand, about some of the respondents say that employment is also decreased due to increasing irrigation practices in the rice field.

Most of the study population in both the study areas expressed their opinion that our country will face severe water scarcity in near future in case of the present irrigation practice in rice field continues. They think that reasons of water scarcity are drought, inopportune time and insufficient rainfall, inadequate floods, limited river water flow, degradation of water bodies and declining of groundwater table due to excessive and unwise harvesting etc. All the respondents in the both study areas agree that groundwater table is also decreasing day by day in their locality. Study population are also expressed their views that water scarcity will be severed if the dependency on ground water continues instead of reexcavation of water bodies as reservoir for agriculture production.

In the study areas, maximum (more than 95.6%) respondents said that surface water bodies are dried up earlier than optimal season due to excessive groundwater harvesting, inadequate rainfall etc. They also believed that freshwater fishes are decreasing due to irrigated water with pesticides and chemical fertilizers drains into the near by surface water bodies. Irrigation using

ground water also creates adverse effects on soil fertility, biodiversity especially aquatic biodiversity, soil and water pollution etc. Excessive and indiscriminate use of ground water for irrigation hampers environmental health and due irrigation in Boro rice cultivation produces undue fog that is unexpected and inopportune in respect of seasons which is not good for environment. Boro rice cultivate in Kharif-1 season consisting of the months February-April, which is the driest season in Bangladesh, so it needs excessive irrigation water that create adverse externalities on environment. For this, water scarcity is found in dry season in the study areas and even some times, it created scarcity of safe drinking water because hand tube wells do not work at that time.

According to the study respondents there are impacts of excessive ground water harvesting for irrigation on human health and the difficulties they faced which are stomachache, hair fallen and eczema, skin diseases etc; are found in the study locale during the field survey. It is observed during field survey that more than half of the respondent use banned pesticides to kill the crabs or/ and other harmful animals in the rice fields before implanting the rice seedlings because these aquatic animals make hole in the dyke or drain through which irrigation water leakage occurs. However, these banned pesticides create serious negative impacts on environment especially aquatic resources.

Moreover, high yield variety of rice cultivation needs huge amount of chemical fertilizer and pesticides that decrease soil fertility and pollute local water bodies, it results increase of chemical fertilizer and aquatic biodiversity degradation especially fresh water fishes in Bangladesh. Furthermore, some water soluble metals like iron, lead, arsenic, cadmium (Cd) are found in shallow and deep tube wells' water. These elements are harmful to human health as well as soil fertility that is a serious hazard in long run.

6.18 Conclusion

From the above discussion, it is found that excessive irrigation has negative impacts on rice production, other crop production, surrounding environment especially aquatic resources and terrestrial environment and resources, employment generation etc. Over exploitation of underground water also causes decreasing ground water level, scarcity of drinking water, adverse effect on environment and human health, future irrigation water scarcity, and adverse effects on soil fertility, biodiversity, soil pollution, water pollution etc. Therefore, time has come to realize the above-mentioned matter and have to take necessary steps for that.

Chapter-7

Ethical Issues about Present Irrigation Practices

This chapter discusses the ethical issues regarding water use as instructed in Quran, Sunnah and Shariah. In addition, it also includes ethical issues like equity of water, ethics of throwing waste products in water bodies, use banned pesticides, ethics about water as valuable and limited resources, religious and traditional beliefs, following the traditional and religious beliefs regarding irrigation water use, groundwater deposition and abstraction, ethics about recharge and withdrawal ratio of ground water for irrigation and other purposes.

7.1 Introduction

Conservation of water is entrenched in Islam. It is quite regular in both the Quran and the Sunnah with many statements, injunction and knowledge about proper use of water. As religion still plays a great role to influence human being to follow the religious principles about water use and conservation. At the same time water plays a very crucial role within Islam as well. Awareness build up campaigns and water conservation programmes based on religious ideology have proved very constructive, beneficial and cost effective in different areas of the Muslim world. Various Islamic communication channels have often been used to campaign for the conservation of water resources. Imams of different mosque have been trained to pass on messages of water conservation while delivering special sermons during the Friday prayer. Different types of institutions issued awareness material with words or expressions employing or recalling Islamic or Quranic verses. Public awareness campaigns, when enriched with Islamic principles, can be a powerful tool for water conservation policies.⁵³

Water is an essential matter in Islam. It is a religion originated in the Arabian Peninsula, a desert area, and it spread mainly to other arid or semi-arid territories. Scarcity of water has always influenced the perception of water by Muslims. In the last decade Islam and Islamic ideology have been used to manipulate and improve people's concern on the subject of water.

7.2 Water in Islam

As a universal religion born initially in the harsh deserts of Arabia to complete the message of former prophets and convey the divine revelation in its last testament (Qur'an), Islam ascribes the most sacred qualities to water as a life-

⁵³ Francesca Gilli, "Islam, Water Conservation and Public Awareness Campaigns" *BA Arabic and Middle Eastern Studies* (Venice: University of Ca' Foscari).

giving, sustaining, and purifying resource. It is the origin of all life on earth, the substance from which God created man. The Qur'an emphasizes its centrality: "We made from water every living thing"(Qur'an 21:30). Water is the primary element that existed even before the heavens and the earth did: "And it is He who created the heavens and the earth in six days, and his Throne was upon water". (Qur'an 11:7).

The water of rain, rivers, and fountains runs through the pages of the Qur'an to symbolize God's benevolence: "He sends down saving rain for them when they have lost all hope and spreads abroad His mercy" (Qur'an 25:48). At the same time, the believers are constantly reminded that it is God Who gives sweet water to the people, and that He can just as easily withhold it:"Consider the water which you drink. Was it you that brought it down from the rain cloud or We? If We had pleased, We could make it bitter" (Qur'an 56:68-70). In this verse the believers are warned that they are only the guardians of God's creation on earth; they must not take His law into their own hands. However, importance, significance, usage of water as describe in Quran, sunnah and shariah is discuss here.

7.3 Water in the Quran

It is apparent from numerous verses in the Quran that water is a main subject matter in Islamic cosmogony and iconography as well as a recurrent topic in liturgy and daily life. One of the most famous verses pertaining to water is taken from the Sura that "We made from water every living thing" (21:30). But this is not only *Ayat* (verse) where the word *Mā'* (water) appears since it occurs more than sixty times in the Quran. The way to perform ablution is not only practical teaching related to water in the Quran since we find other verses pertaining to water distribution or condemning wastefulness. References to water in the most sacred book for Muslims are also very material and linked to every day life. Water is sent by God so that men can drink it or grow agricultural products.⁵⁴

7.4 Water in the Sunnah

Other experience linked to water can be found in the *Sunnah* (Statements or practices undertaken or approved by the Prophet considered as legally binding precedents). A very famous *hadith* (statement by the Prophet Muhammad(S) says that: "Men are co-owners in three things: water, fire and pastures". Other hadiths relate on who has the priority over water or whether water can be sold or if it should be considered a public good. Some statements even relate the quantity of water one is allowed to take for drinking or irrigation. Other sayings by

⁵⁴ Ibid.

the Prophet prohibit excess use of water sources even when in presence of an abundant flow. There are also hadiths which prove to be actual measures for preservation of water by prohibiting to defecate or urinate in the closeness of water sources thus to avoid pollution and spreading of diseases.

7.5 Water and the Shariah

There are some basic norms in the Shariah that have to be followed when consuming or managing water. Every human being, not only Muslim, has a right to drink (shafa) and quench his thirst to assure his survival. Thus, mankind has a priority in the access to water while this right is successively accorded to animals. There is also a right of irrigation (shirb) that permits people to watering their crops (Lancaster, 1996; De Chatel, 2002), but domestic use has the priority over agricultural or industrial use. Water belongs to the community and no one is allowed to own it unless they have provided labor or they have made an effort to carry it through recipients or to distribute it.⁵⁵

7.6 Ethical Issues

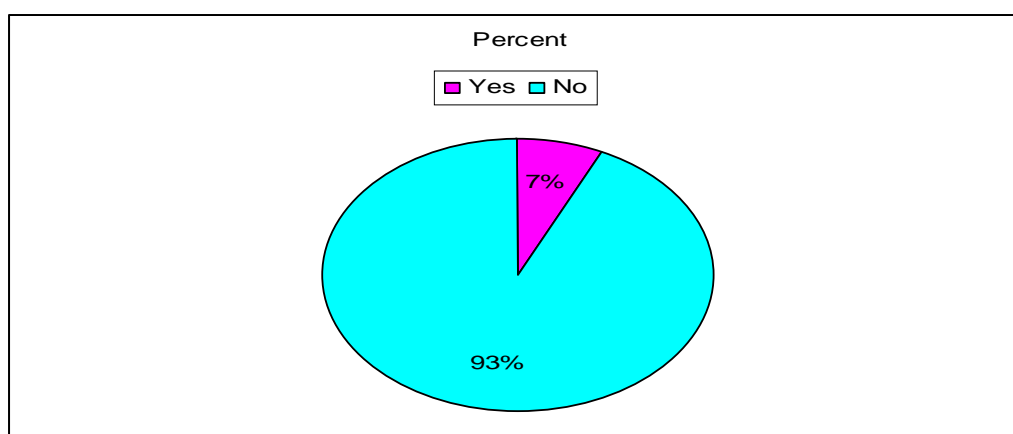
7.6.1 Equity of Water

In the study areas 100% respondents think that every one should have equity for water.

7.6.2 Ethics of Throwing Waste Products

7.6.2.1 Throwing waste products

Figure 7.1
Throwing waste products into the pond/dishes and the causes



Source: Field Survey

Among the respondents, only 7% agree that they throw waste products, cow dung etc. into the pond and ditches and 93% are not agreed with the statement.

⁵⁵ Ibid.

Table 7.1
Causes of throwing waste products

SL No.	Causes	Percent
1	Due to produce organic fertilizer	38.5(5)
2	There is no place to fall the waste products	53.8(7)
3	Due to clean the houses	7.7(1)
	Total	100(13)

Source: Field Survey

Those who agreed with the statement, among them 38.5% respondents throw waste products due to produce organic fertilizer, 53.9% say, there is no place to throw the waste products and only 7.6% throw due to clean at nearby open place of their houses.

7.6.2.2 Throwing Household waste water

Table 7.2
Fallen household waste water into nearby water bodies and its pollution

Fallen Waste Water	Percent	Pollution Occurs	Percent
Yes	52.8(95)	Yes	95.6(172)
No	47.2(85)	No	4.4(8)
Total	100(180)	Total	100(180)

Source: Field Survey

About 52.8% respondents agree that household wastewater is thrown into nearby water bodies and 47.2% respondents are not agreed. Due to throwing household wastewater, 95.6% respondents agree that pollution is occurred for that reason and 4.4% are not agreed with the statement.

7.6.3 Use Banned Pesticides

7.6.3.1 Govt. banned pesticides

Table 7.3
Using Govt. banned pesticides and their adverse effects

Govt. Banned Pesticides Use	Percent	Adverse Effects	Percent
Yes	12.8(23)	Yes	0
No	87.2(157)	No	100(23)
Total	100(180)	Total	100(23)

Source: Field Survey

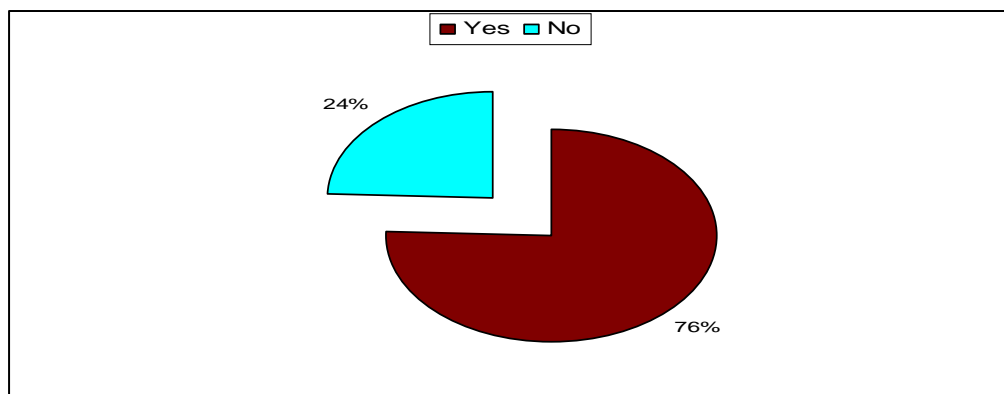
According to the above analysis, 12.8% respondents use pesticides that are prohibited by the government and 87.2% do not use those pesticides. Those who agreed with the statement among them, all the respondents do not know about adverse effects of those pesticides on water and water bodies.

7.6.4 Water as Valuable and Limited Resources

About 100% respondents think that water is valuable resource and without water, we can not survive. About 100% respondents think that everybody should careful about water use either it is for irrigation or other purposes.

7.6.4.1 Water as limited resource in earth

Figure 7.2
Statement about water is limited resource in earth



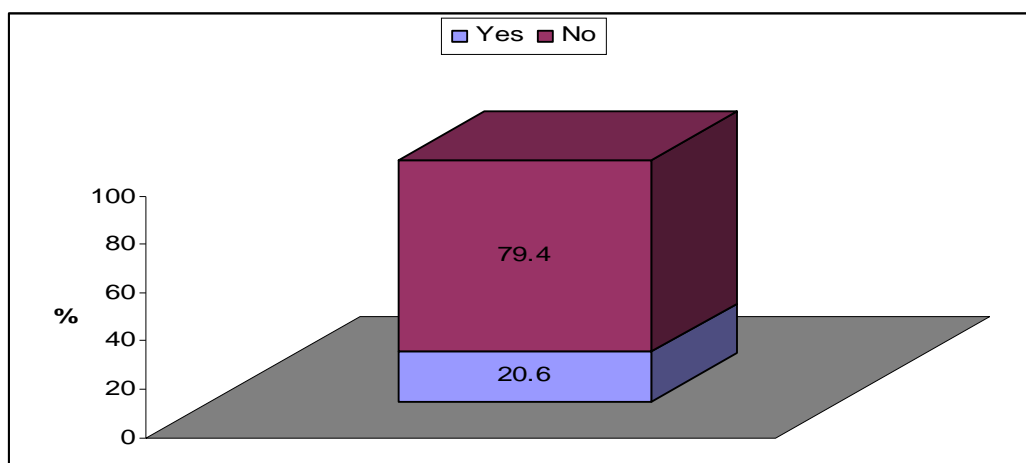
Source: Field Survey

Among the respondents, 76% know that water is limited resource in the earth and 24% respondents do not know.

7.6.5 Religious and Traditional Beliefs

7.6.5.1 Water use in Islam religion

Figure 7.3
Water use in Islam and their description



Source: Field Survey

In the study areas, 20.6% respondents know about use of water that Islam religion says and 79.4% respondents do not know.

Table 7.4
Water use according to Islam

SL No.	Description	Percent
1	Do not misuse of water	10.8(4)
2	Optimum water will have to be used	83.8(31)
3	Water will be used carefully	5.4(2)
	Total	100(37)

Source: Field Survey

Those who agreed with the statement among them, 10.8% respondents state that Islam says about preventing water misuse, 83.8% say that optimum water will have to be used and 5.4% say that water will be used carefully.

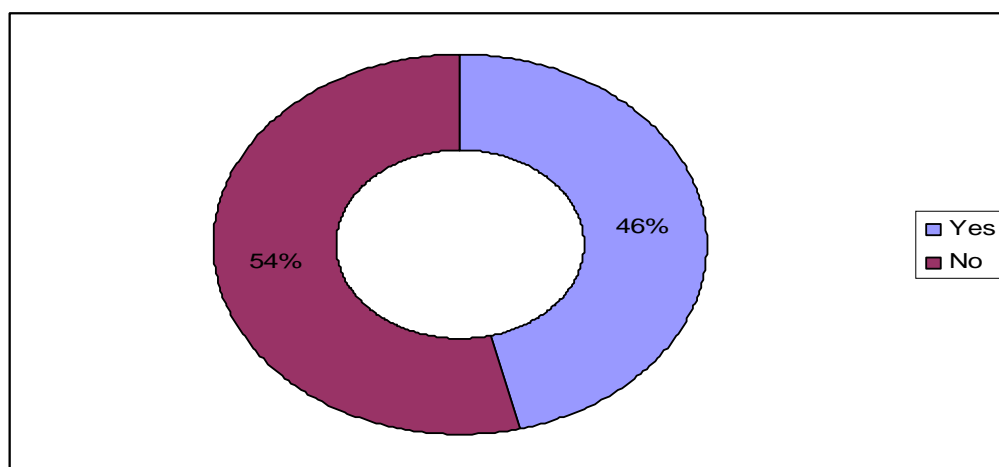
About 100% respondents are agreed with the statement that Islam says you are the user as well as keeper of water resources.

In the study areas, 100% respondents agree that everybody should use water for irrigation in such a manner that next generation can also use same amount of water for irrigation.

In the FGD sessions respondent have said that for the sake of next generation all people have to think about water use for any purposes. For that reason, most of the people say, if they use water in such a way, in future, next generation will not get same amount of water that we get at present. Therefore, it is unwise to cultivate rice round the year. Alternative crops like rabi or commercial crops will be cultivated. Thus, the use of underground water will be reduced. The emphasis will be given on the use of surface water. Water reservoir should be set up to store water.

7.6.5.2 Traditional beliefs regarding water use

Figure 7.4
Traditional beliefs regarding water use



Source: Field Survey

Above chart shows that 46.1% respondents know about traditional beliefs regarding water use and 53.9% do not know about that matter.

Table 7.5
Water use according to traditional beliefs

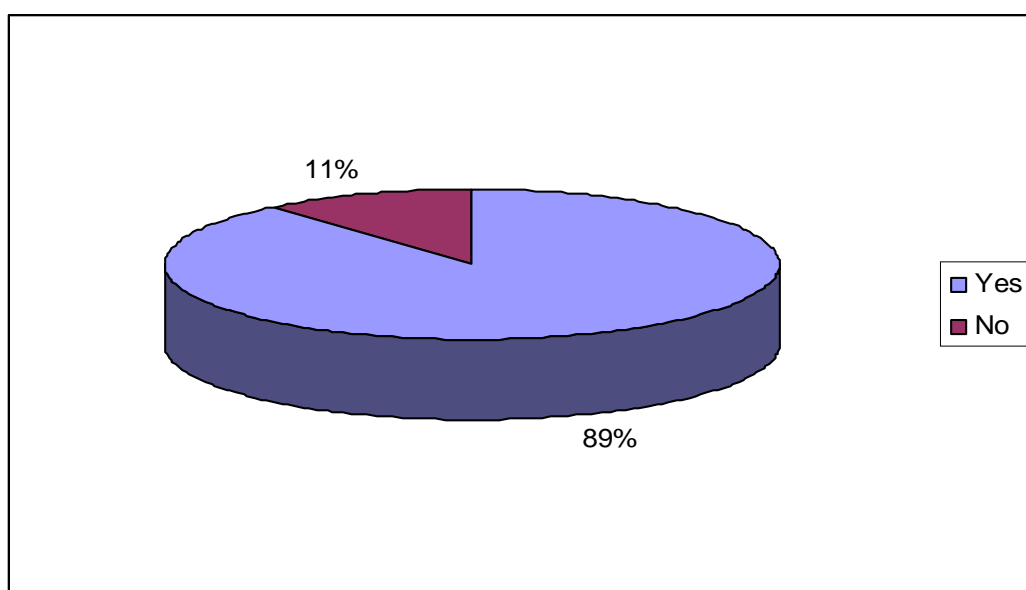
SL No.	Statement	Percent
1	Optimum water will be used for irrigation	94.0(78)
2	Prevent misuse by traditional and religious beliefs	6.0(5)
	Total	100(83)

Source: Field Survey

Those who agreed with the statement among them, 94% say that optimum water will be used for irrigation and 6% say that misuse of water will be prevented by traditional and religious beliefs.

7.6.5.3 Traditional and religious beliefs

Figure 7.5
Following the traditional and religious beliefs regarding water use and causes of rejection



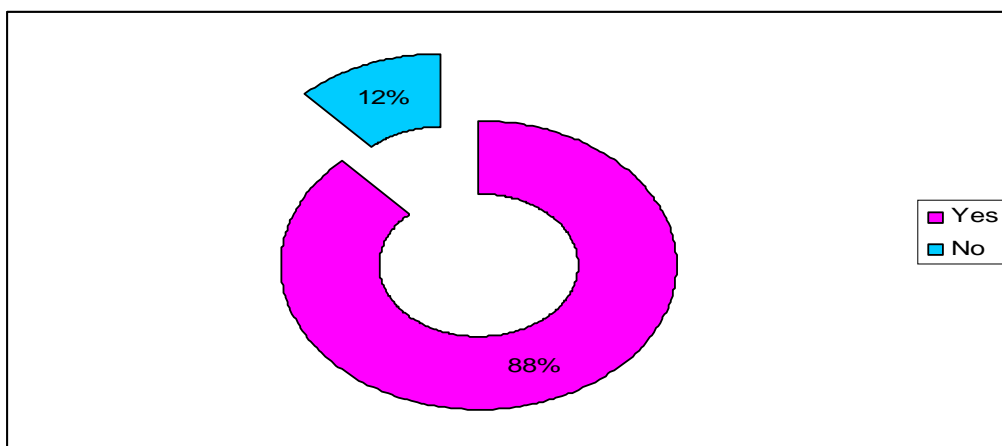
Source: Field Survey

About 88.9% respondents obey the traditional and religious beliefs regarding water use and 11.1% respondents do not obey the traditional and religious beliefs regarding water use.

Among the respondents those who do not follow the traditional and religious beliefs, they tell that they have not so much knowledge about traditional and religious beliefs.

7.6.5.4 Prevention of water misuse

Figure 7.6
Preventing water misuse by obeying religious and other traditional beliefs



Source: Field Survey

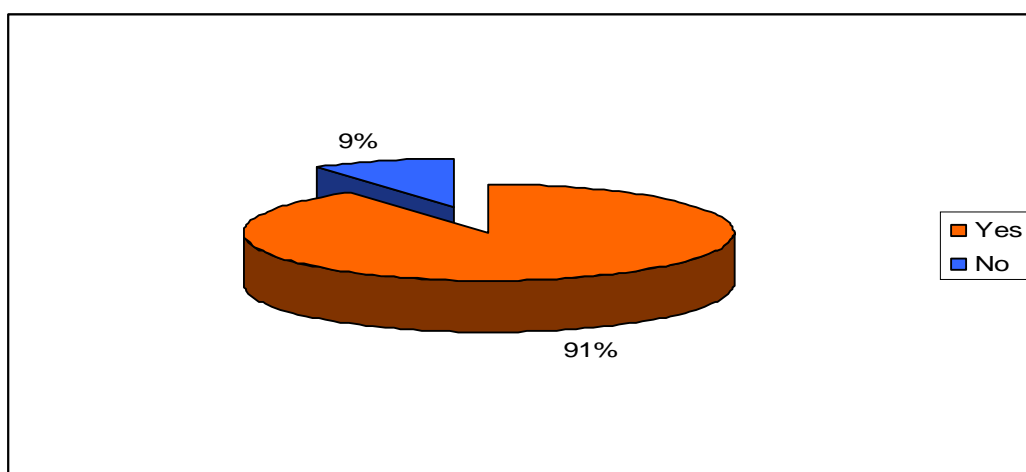
In the study areas, 88% respondents think that religious and other traditional beliefs can help to prevent misuse of water and 12% do not think that. Among the respondents who give positive statement, 100% say, if optimum water is used then misuse will be reduced.

In the FGD session, everybody says that according to Islam water should be used limited and according to one's needs.

7.6.6 Groundwater Deposition and Abstraction

7.6.6.1 Underground recharge process

Figure 7.7
Underground is recharged by rain and flood water



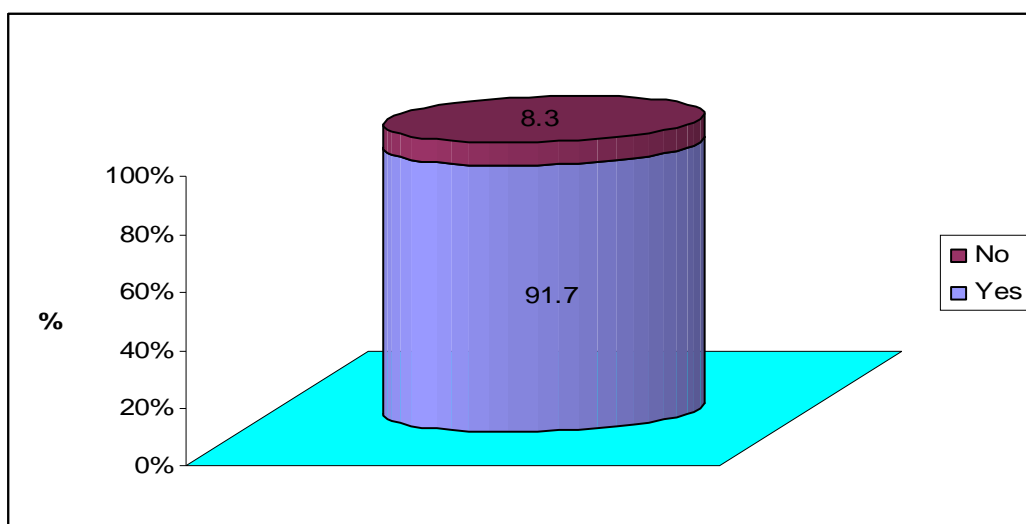
Source: Field Survey

Among the respondents, 91% know that the ground is recharged by rain and floodwater and 9% respondents do not know that.

7.6.6.2 Recharge and withdrawal ratio of groundwater

Figure 7.8

Thinking the recharge and withdrawal ratio of ground water for irrigation



Source: Field Survey

In the above diagram, 91.7% respondents think about recharge and withdrawal ratio of ground water for irrigation and 8.3% do not know that matter.

7.6.6.3 Opinion regarding recharge and withdrawal ratio

Table 7.6

Positive and Negative opinion about recharge and withdrawal ratio of groundwater

Positive Statement	Percent	Negative Statement	Percent
If excess water is deposited then more water will get for a long time	9.7(16)	There is no time to think about that	93.3(14)
If water is used limited amount then more water will be deposited	35.8(59)	Do not need to think because Allah is well known	6.7(1)
Water is deposited much by rational use of water	5.5(9)		
If water is available then next generation will get much water	21.2(35)		
Available water is to be stored	1.8(3)		
For the shake of water scarcity in the future	3.0(5)		
If withdrawal less and deposited much then water layer will be upper	23.0(38)		
Total	100(165)	Total	100(15)

Source: Field Survey

Among the respondents who give positive opinion for thinking about recharge and withdrawal ratio of groundwater, 9.7% respondents state that If excessive water is deposited under the ground then more water will be got for a long time. 35.8% respondents state that if water is used limited amount then more water

will be deposited under the ground. About 5.5% respondents state that water is deposited much by rational use of water. 21.2% state that If water is available then next generation will get much water, 1.8% states that available water will be stored, 3% state that it is needed to think for the sake of water scarcity in the future, 23% state that If rational withdrawal is maintained and deposited much then water layer will be upper. Among the respondents who give negative opinion for thinking about recharge and withdrawal ratio of groundwater, 93.3% respondents state that there is no time to think about that matter and 6.7% state that it is not needed to think because Allah is well known about that matter.

About 100% respondents in the study areas think, irrigation should give in such ways that do not create adverse impacts on other crops.

In the study areas, 100% respondents do not know something about water use from Hindu/other religious point of view.

7.7 Findings

According to the opinion of study population, it can be said that that water equity should establish for every one because it is said that no one has personal rights on water sources as common property and no one does not have the rights it pollute. Generally, open water bodies are polluted through various ways including human intervention in our country but we must refrain from it. In this research work a negligible number of respondents states that they throw waste products, cow dung into ponds, ditches, nearby canals etc; because they does not have such open place to throw or keep the waste products but they need to clean their houses. However, we know that many wastes can be kept in a pit where the wastes become valuable organic fertilizer, but it is not seen in study areas. Maximum study respondents state that they throw household waste into nearby water bodies and they agreed that it creates pollution in watr bodies. It is found in study areas especially in Sirajganj district that many of respondents use government banned pesticides, which have adverse effects on water bodies and surrounding environment.

It is found among the study responedents that maximum respondents know that water is a limited resource in the earth. Regarding water use some of respondents know the Islamic view poin as code of conduct, in this respect maximum populations express their views toward optimal use of water for various pruposes in such a manner that we can keep the same for future generation as well. Moreover, they have knowledge about traditional beliefs regarding water use by which a wise use of water can be ensured.

It is observed in the study areas that study respondents follow the traditional and religious beliefs regarding water use but some respondents do not follow these due to insufficient knowledge about religious and traditional beliefs. Study respondents agree that water misuse must be prevented by obeying religious and traditional beliefs and they think if optimal water is used ensure then misuse will be minimized.

Generally, ground water recharges by rain and flood. However, it is found in Sirajganj district, not in Godagari of Rajshahi district because in Godagari there is no flood in rainy season and there are no such water bodies, river or canals except River Padma, so ground water recharges in Godagari depends on only rain water. Study respondents have enough knowledge about groundwater recharge. They express their views that it is needed to think the recharge and withdrawal ratio of groundwater for irrigation and other purposes for sustainable use. Respondents said that recharge and withdrawal ratio of groundwater must be same so that irrigation can be done using ground water in future also. Because ground water needs optimal recharges and withdrawal for next generation, otherwise water will not be available for next generation. Those who do not know about recharge and withdrawal ratio of groundwater; among them about 93.3% of the respondents state that there is no time to think about that matter.

All the respondents in the study areas think that irrigation should give in such a way that do not create adverse impacts on other crops and environment and all of them do not know something about water use from Hindu/other religious point of view.

7.8 Conclusion

Water conservation is grounded in Islam as well as in other religion and there are traditional value systems. Islamic principles and ethics, in fact, have always advocated a good conduct towards the environment and respect for the natural resources. From the above discussion we can assume that everybody in some extent aware about their ethics but in practice they do not follow that ethics for irrigation water use in the study locale, so an appropriate programme should be taken to ensure a sustainable irrigation practice for future.

Chapter-8

State of Sustainability and Further Challenges

This chapter discusses about indicators of sustainability issues of present irrigation practices. It includes production of rice and other crops per unit of land, farmer's income, employment and profitability; Indicators of Social sustainability include Equity of water, Poverty, Household and Drinking water, Human health, Level of knowledge, etc; Indicators of Environmental sustainability include Environmental Health, Land Degradation, Soil Fertility, Biodiversity and Ecology, Other Crop Production, Groundwater Level etc.

8.1 Introduction

Sustainability comprises of three factors i.e. Social, Economical and Environmental Sustainability. If any one of these factors is degraded or imbalanced then sustainability will be hampered. So for maintaining sustainable development all three factors should come into equilibrium, otherwise it is not described as sustainable development.

8.2 Indicators for Economic Sustainability

In this study some economical indicators selected which are pointed out as follows:

- a) Production of rice and other crops per unit of land,
- b) Farmer's income,
- c) Employment,
- d) Profitability etc.

8.2.1 Purchasing Fertilizer and Manures, Pesticides and Herbicides

Table 8.1
Purchasing fertilizer, manures, pesticides and herbicides/bigha for rice

Fertilizers and Manures		Pesticides and Herbicides	
Amount(in Taka)/bigha	Percent	Amount(in Taka)/bigha	Percent
1000-1500	8.3(15)	100-200	35.0(63)
1501-2000	52.2(94)	201-300	61.7(111)
2001-3000	39.5(71)	301-500	3.3(6)
Total	100(180)	Total	100(180)

Source: Field Survey

In the study areas, 8.3% respondents say that they have spent TK1000-1500/bigha for purchasing fertilizers and manures, 52.2% have spent TK1501-2000/bigha and 39.5% have spent TK2001-3000/bigha for purchasing fertilizers

and manures. Moreover, 35% respondents have spent TK100-200/bigha for purchasing pesticides and herbicides; 61.7% have spent TK201-300/bigha and 3.3% have spent TK301-500/bigha for purchasing pesticides and herbicides for rice cultivation in the last year.

8.2.2 Purchasing Water for Irrigation

Table 8.2
Purchasing water for the amount of taka/bigha for irrigation

Purchasing Water	Percent	Amount(in Taka)/bigha	Percent
Yes	100.0(180)	140-1000	2.2(4)
No	0(0)	1001-1500	83.4(150)
		1501-2000	14.4(26)
Total	100(180)	Total	100(180)

Source: Field Survey

Among the respondents, 100% respondents agree that they have purchased irrigation water for their rice fields. About 2.2% respondents have spent TK140-1000 for purchasing irrigation water, 83.4% have spent TK1001-1500 and 14.4% have spent TK1501-2000 for purchasing irrigation water for one season.

8.2.3 Cost, Production and Selling Price of Different Rice

Table 8.3
Cost, production and selling price of different rice

Name of Rice	Cost/bigha (taka)	Production per Bigha(Mond)	Selling Price per Mond
Guti sharna, Boro-28	2800-6000	12-20	800-850
Guti sharna, Lal sharna, Boro-28	4000-5000	13-17	800-850
Guti sharna, Boro-28, Parija	2500-5000	10-17	700-850
Lal sharna, Boro-28	3500-4000	15	850
Boro-28, Aman-11	1500-7200	4-20	700-900
Boro-29, Aman-11	2500-3000	10-22	750-850

Source: Field Survey

Above table shows that cultivation cost/bigha, production per bigha(mond) and selling price per mond of Guti sharna and Boro-28 are 2800-6000 taka, 12-20 mond and 800-850 taka respectively. Cultivation cost/bigha, production per bigha(mond) and selling price per mond of Guti sharna, Lal sharna, Boro-28 are 4000-5000 taka, 13-17 mond and 800-850 taka respectively. Cultivation cost/bigha, production per bigha(mond) and selling price per mond of Guti sharna, Boro-28, Parija are 2500-5000 taka, 10-17 mond and 700-850 taka respectively. Cultivation cost/bigha, production per bigha(mond) and selling price

per mond of Lal sharna, Boro-28 are 3500-4000 taka, 15 mond and 850 taka. Cultivation cost/bigha, production per bigha(mond) and selling price per mond of Boro-28, Aman-11 are 1500-7200 taka, 4-20 mond and 700-900 taka. Cultivation cost/bigha, production per bigha(mond) and selling price per mond of Boro-29, Aman-11 are 2500-3000 taka, 10-22 mond and 750-850 taka.

8.2.4 Annual Income

The distribution of annual income shows that 10.6% respondents have 20000-50000 taka annual income, 32.8% have 50001-80000 taka annual income, 20.5% have 80001-110000 taka annual income, 12.8% have 110001-140000 taka annual income, 12.2% have 140001-170000 taka annual income and 11.1% have 170001-300000 taka annual income.

8.2.5 Annual Income from Rice

Annual income from rice indicates that 13.3% respondents have 2000-10000 taka annual income from rice, 27.8% have 10001-20000 taka annual income from rice, 32.8% have 20001-40000 taka annual income from rice, 20% have 40001-80000 taka annual income from rice, 5% have 80001-200000 taka annual income from rice and 1.1% has no annual income from rice.

8.2.6 Annual Savings from Rice Cultivation

According to annual savings, 13.3% respondents have 3000-10000 taka Annual Savings, 12.2% have 10001-20000 taka annual savings, 8.3% have 20001-40000 taka annual savings, 6.8% have 40001-80000 taka annual savings, 3.3% have 80001-120000 taka annual savings and 56.1% have no annual savings. According to annual savings percentage of respondents is higher in Godagari than the respondents of Sirajganj.

8.2.7 Annual Deficit for Rice Cultivation

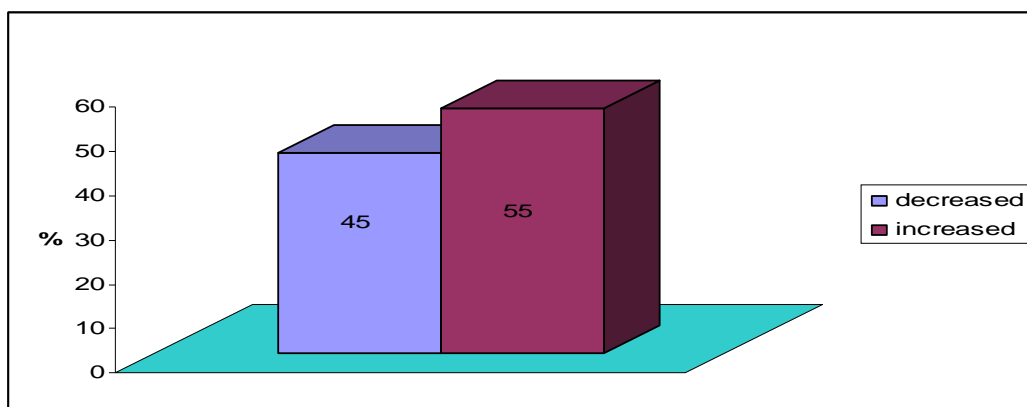
The distribution of annual deficit shows that 6.1% respondents have 2000-5000 taka annual deficit, 2.3% have 5001-10000 taka annual deficit, 1.1% has 10001-20000 taka annual deficit and 90.6% have no deficit. Annual deficit of respondents in Sirajganj is higher than that of Godagari.

8.2.8 Annual Income from other Crops

Annual income from other crops indicates that 22.4% respondents have 1000-10000 taka annual income from other crops, 11.7% have 10001-20000 taka annual income, 22.2% have 20001-40000 taka annual income, 14.5% have 40001-80000 taka annual income, 2.3% have 80001-160000 taka annual income and 27.2% have no income from other crops.

8.2.9 Employment Status

Figure 8.1
Employment status due to irrigation



Source: Field Survey

In the study areas, 45% respondents say that employment is increased due to irrigation project for rice cultivation and 55% state that employment is decreased.

8.3 Indicators of Social Sustainability

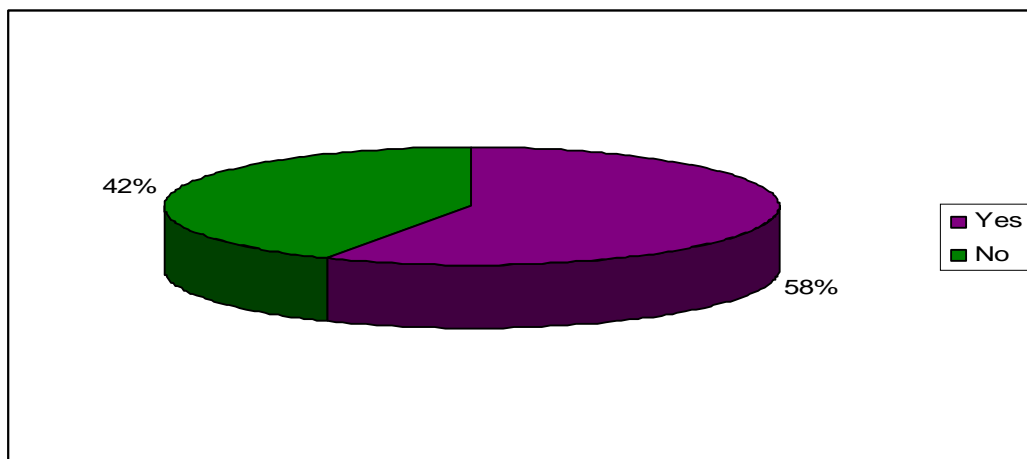
- Equity of water,
- Poverty,
- Household and Drinking water,
- Human health,
- Level of knowledge, etc.

8.3.1 Equity of Water

About 100% respondents think that every one should have equity for water though in the study areas there is insufficient equity of water use for irrigation.

8.3.2 Scarcity of Safe Drinking Water

Figure 8.2
Scarcity of safe drinking water for irrigation in dry season



Source: Field Survey

Above chart shows that 57.8% respondents think, scarcity of drinking water is observing due to irrigation and 42.2% do not think about the matter.

8.3.3 Condition of Human Health

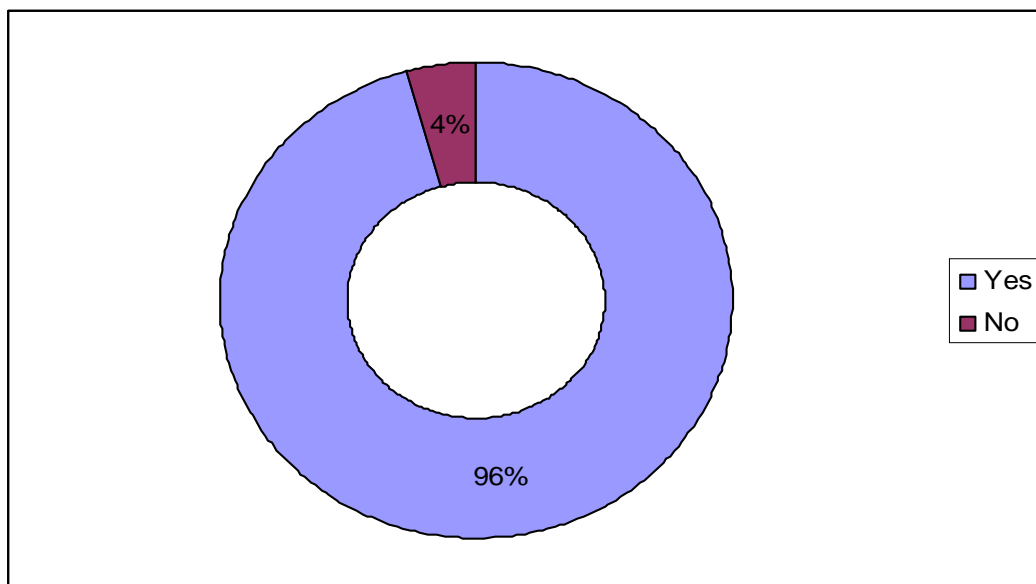
Among the study respondents, 29.4% think that human health is affected due to present irrigation practices and 70.6% do not think about that. Those who think, human health is affected due to irrigation practices, among them 47.2% say that there are some health problems such as stomachache, 17% say, hair is fallen, 9.4% say, they suffer from dysentery etc., 7.5% say, hair becomes greasy, 18.9% say, eczema is formed in hands and legs.

8.4 Indicators for Environmental Sustainability

- a) Environmental Health,
- b) Land Degradation,
- c) Soil Fertility,
- d) Biodiversity and Ecology,
- e) Other Crop Production,
- f) Groundwater Level etc.

8.4.1 Condition of Water Bodies

Figure 8.3
Drying water bodies earlier due to excessive ground water harvesting

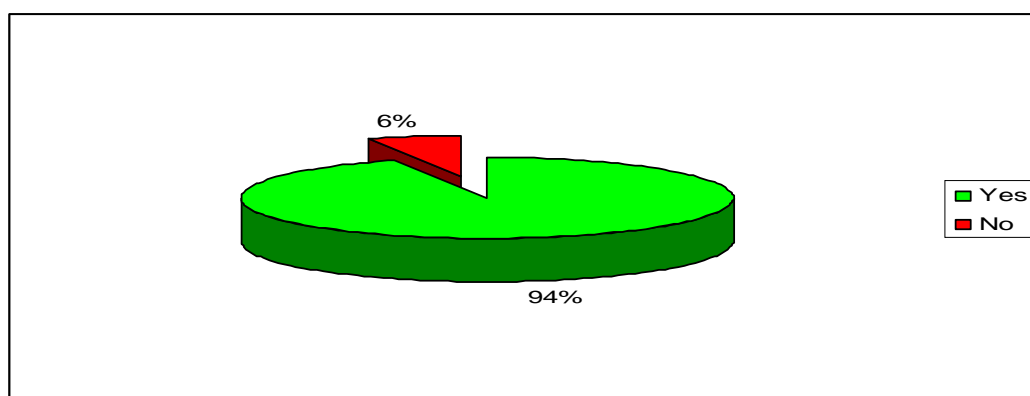


Source: Field Survey

About 96% respondents think that water bodies dry up earlier due to excessive ground water harvesting and 4% respondents do not think that matter.

8.4.2 Condition of Fishes

Figure 8.4
Decreasing fishes due to irrigation water



Source: Field Survey

According to the condition of fishes, 94% respondents think, fishes are decreasing due to early dry up of water bodies and irrigated water enters into nearby water bodies with pesticides and chemical fertilizer that create adverse impact on fish breeding and production, and 6% do not think.

8.4.3 Adverse Effect of Irrigation Water

The distribution of adverse effect of irrigation water shows that 31.1% respondents think there is adverse effect of irrigation on soil fertility, biodiversity, soil pollution and water pollution etc. About 16% think that there is adverse effect of irrigation on soil fertility, biodiversity, soil pollution, water pollution, other crops and open water fishes, 10% think that there is adverse effect of irrigation on soil pollution and water pollution, 9.4% think that there is adverse effect of irrigation on soil fertility, biodiversity, soil pollution, water pollution and open water fishes.

8.4.4 Condition of Environmental Health

Table 8.4
Hampering environmental health by excessive irrigation

Hampering Environmental Health	Percent	Causes	Percent
Yes	35.6(64)	Some times fog is seen due to heavy irrigation practices	95.3(61)
No	64.4(116)	Trees are affected	3.1(2)
		Less cyclones are occurred	1.6(1)
Total	100(180)	Total	100(64)

Source: Field Survey

Among the respondents who give opinion on causes of hampering environmental health due to irrigation, 95.3% respondents have said that sometimes fog is seen due to heavy irrigation practices in March and April when

it does not occur in past, 3.1% respondents have said, trees are affected and only 1.6% has said, less hailstorms are occurred.

8.4.5 Impacts on other Crops

About 37.8% respondents agree that there is impact on other crops due to excessive irrigation in the rice fields and 62.2% respondents do not agree with the statement. Among them who accept the statement, 33.8% respondents say that it is not possible to cultivate other crops due to excessive irrigation in the rice fields. In addition, 8.8% respondents say, less available of irrigation water is found for other crops, 17.7% respondents say that vegetable fields and seedlings are destroyed and 39.7% respondents say that production of other crops is less and crops are died due to excessive irrigation in the rice fields. Therefore, it would be said that there are adverse impacts of rice field irrigation practices on other crops production.

8.4.6 Groundwater Table and the Level

8.4.6.1 Decreasing water level and the causes

In the study areas, 100% respondents agree that groundwater is decreasing day by day.

Table 8.5
The causes decreasing water level

SL No.	Causes	Percent
1	Water is not found in rivers, canals and beels etc.	22.8(41)
2	Heavy drought and less availability of water in rivers, canals and beela etc.	13.3(24)
3	Heavy withdrawal of groundwater for irrigation and less availability of water in rivers, canal etc.	42.2(76)
4	Less flood and low rain fall	12.2(22)
5	Installation of large numbers of deep and shallow tube wells	0.6(1)
6	Due to climate change	8.9(16)
	Total	100(180)

Source: Field Survey

Those who agreed with the statement, 22.8% respondents say that water is not found in rivers, canals, beels etc., during rice field irrigation in Kharif-1 season, 13.3% respondents say that ground water level is decreasing due to heavy drought and less availability of water found in rivers, canals, beels etc. Moreover, 42.2% express their opinion on heavy withdrawal of groundwater for irrigation and less availability of water found in rivers, canals, beels etc., 12.2% respondents express opinion on less flood and low rainfall, 8.9% have opinion on climate change and only 0.6% has expressed opinion on installation of large numbers of deep and shallow tube wells that is not optimal.

8.4.7 Groundwater Table of Deep Tube Wells in 2011 and 2012 in Godagari

Table 8.6
Static Water Level of Deep Tube wells in 2011 and 2012 under Godagari Upazila

SL No	Union	Mouza	Static Ground Water Level 28/02/11	Static Ground Water Level 28/02/12	Static Ground Water Level 12/04/11	Static Ground Water Level 19/04/12	Static Ground Water Level
1	Gogram	Raninagar-1	61'-5"	62'-2"	57'-4"	61'-7"	16' - 08" 31/07/94
2	Gogram	Raninagar-3	59'-10"	61'-3"	60'-11"	68'-0"	
3	Gogram	Raninagar-5	60'-5.2"	61'-10"	62'-2"	65'-4"	
4	Gogram	Sheikhpur	49'-10"	47'-6"	49'-0"	51'-3"	14' - 11" 25/08/88
5	Gogram	Damdoma-2	103'-5"	104'-7"	106'-0"	109'-0"	63' - 00" 04/02/03
6	Gogram	Gunigram-1	110'-0"	120'-4"	107'-11"	139'-6"	

Source: Field Survey

In the study area of Godagari, it is seen that on the date of 04/03/2012, static groundwater level is decreased 01 to 10 feet compared to the date on 28/02/2011 in the deep tube wells. Again, on the date of 19/04/2012 the static groundwater level is decreased 05 to 30 feet compared to the date on 12/04/2011. And if we see the static ground water level in Raninagar-1 of Gogram union which is about 16' feet 08" inches in 31/07/1994 and at present in 19/04/2012 the water level in same place is about 61' feet 7" inches. Again if we observe the groundwater level data of Sheikhpur on 25/08/1988 which is 14' feet 11" inches and now at present groundwater level is about 109' feet on 19/04/2012. If we see the groundwater level data of Domdoma-2 on 04/02/2003 which is 63' feet and now at present groundwater level is about 139' feet 6" inches on 19/04/2012.

So above data shows that every year groundwater level is decreasing alarmingly and at present time decreasing rate is very much higher than past years. This pictures show that environmental factors are very much degraded, which create alarming situation of the future water condition for the country.

8.4.8 Groundwater Level in 2011 and 2012 in Sirajganj

Table 8.7
Static Water Level of Deep Tube wells in 2011 and 2012 under Sirajganj Sadar Upazila

SL No	Union	Mouza	Static Ground Water Level 15/11/10	Static Ground Water Level 11/11/11	Static Ground Water Level 23/03/11	Static Ground Water Level 23/03/12
1	Khoksabari	Shaluavita	10'-04"	10'-4.5"	15'-01"	16'-07"
2	Khoksabari	Shaluavita	11'-11"	14'-07"	18'-0"	19'-04"
3	Khoksabari	Shaluavita	09'-08"	09'-07"	18'-10"	20'-04"
4	Khoksabari	Shaluavita	10'-05"	10'-07"	17'-03"	18'-08"
5	Khoksabari	Shaluavita	12'-01"	12'-0"	19'-02"	20'-6"
6	Khoksabari	Char Khoksabari	12'-10"	12'-09"	20'-0"	21'-05"
7	Khoksabari	Char Khoksabari	08'-4.2"	09'-0"	16'-07"	17'-09"
8	Khoksabari	Char Khoksabari	09'-10"	09'-06"	17'-09"	19'-0"
9	Khoksabari	Char Khoksabari	10'-06"	10'-07"	18'-02"	19'-06"
10	Khoksabari	Char Khoksabari	11'-03"	11'-05"	19'-0"	20'-02"

Source: Field Survey

In Sirajganj, it is seen that on the date of 15/11/2011 static groundwater level is decreased 06 to 12 inches compared to the date on 15/11/2010. Again, on the date of 23/03/2012 the static groundwater level is decreased 01 to 1.5 feet compared to the date of 23/03/2011.

8.4.9 Static Water Level in 2008, 2009 and 2010 in Godagari

Table 8.8
Static Water Level of Deep Tube wells in 2008, 2009 and 2010 under Godagari Upazila

Union	Mouza J L No. Plot No.	Name of Month	1 st and 2 nd Half	Static Ground Water Level in 2008(in feet)	Static Ground Water Level in 2009(in feet)	Static Ground Water Level in 2010(in feet)
Godagari	Paramanda pur-1 188	January	1 st Half	58'-0"	51'-6"	60'-2"
			2 nd Half	58'-5"	52'-7"	61'-1"
		February	1 st Half	58'-9"	53'-0"	63'-3"
			2 nd Half	60'-0"	53'-7"	65'-2"
		March	1 st Half	62'-2"	53'-9"	66'-2"
			2 nd Half	63'-0"	54'-4"	66'-11"
		April	1 st Half	64'-2"	53'-3"	65'-3"
			2 nd Half	65'-4"	53'-10"	67'-8"
		May	1 st Half	64'-8"	53'-0"	60'-4"
			2 nd Half	64'-0"	50'-1"	64'-5"
		June	1 st Half	55'-0"	53'-1"	63'-4"
			2 nd Half	53'-7"	54'-9"	62'-1"
		July	1 st Half	50'-2"	71'-1"	61'-3"
			2 nd Half	48'-3"	71'-9"	58'-10"

Union	Mouza J L No. Plot No.	Name of Month	1 st and 2 nd Half	Static Ground Water Level in 2008(in feet)	Static Ground Water Level in 2009(in feet)	Static Ground Water Level in 2010(in feet)
	482	August	1 st Half	48'-2"	70'-9"	57'-9"
			2 nd Half	48'-1"	70'-2"	56'-2"
		September	1 st Half	48'-3"	68'-3"	69'-10"
			2 nd Half	48'-5"	67'-1"	70'-2"
		October	1 st Half	48'-7"	64'-0"	65'-4"
			2 nd Half	48'-11"	63'-9"	66'-5"
		November	1 st Half	49'-0"	63'-3"	64'-5"
			2 nd Half	49'-3"	62'-8"	63'-10"
		December	1 st Half	50'-0"	63'-1"	64'-5"
			2 nd Half	50'-7"	62'-6"	63'-1"

Source: BMDA Office, Godagari-1

8.4.10 Static Water Level in 2008, 2009 and 2010 in Godagari

Table 8.9

Static Water Level of Deep Tube wells in 2008, 2009 and 2010 under Godagari Upazila

Union	Mouza J L No. Plot No.	Name of Month	1 st and 2 nd Half	Static Ground Water Level in 2008(in feet)	Static Ground Water Level in 2009(in feet)	Static Ground Water Level in 2010(in feet)
Godagari	Amtuli-1 193 95	January	1 st Half	58'-0"	61'-6"	64'-6"
			2 nd Half	58'-5"	62'-7"	65'-7"
		February	1 st Half	58'-9"	63'-0"	66'-8"
			2 nd Half	60'-0"	63'-7"	68'-10"
		March	1 st Half	62'-2"	63'-9"	70'-0"
			2 nd Half	63'-0"	64'-4"	70'-9"
		April	1 st Half	64'-2"	63'-3"	59'-2"
			2 nd Half	65'-4"	63'-10"	61'-3"
		May	1 st Half	64'-8"	63'-0"	65'-3"
			2 nd Half	64'-0"	60'-1"	58'-2"
		June	1 st Half	55'-0"	63'-1"	57'-3"
			2 nd Half	53'-7"	64'-9"	65'-9"
		July	1 st Half	50'-2"	65'-2"	65'-5"
			2 nd Half	48'-3"	65'-11"	63'-9"
		August	1 st Half	48'-2"	64'-10"	62'-8"
			2 nd Half	48'-1"	63'-9"	61'-6"
		September	1 st Half	48'-3"	61'-5"	67'-9"
			2 nd Half	48'-5"	69'-6"	68'-3"
		October	1 st Half	48'-7"	65'-5"	66'-4"
			2 nd Half	48'-11"	65'-1"	67'-3"
		November	1 st Half	49'-0"	64'-5"	66'-1"
			2 nd Half	49'-3"	64'-0"	65'-9"
		December	1 st Half	52'-0"	64'-2"	65'-6"
			2 nd Half	55'-7"	63'-8"	65'-9"

Source: BMDA Office, Godagari-1

In Godagari area, if we see static ground water level from 2008 to 2010, it is seen that every year groundwater level is decreasing within average 2-3 feet.

Therefore, above data indicates that environmental sustainability is not ensured through present irrigation systems and practices in study areas as well as in other part of Bangladesh.

8.5 Findings

The majority (about 65%) of the respondents state average cost of fertilizer and pesticides per bigha are Tk. 2500 and 3000, average cost of irrigation water per bigha is taka 1700. So cost of rice production is taka 4500 without labor cost as found from collected data. Maximum respondents indicate that the overall production cost of rice is average taka 6500-7000. If they consider labor cost including respondents' individual cost taka 2500 then it becomes taka 6000-6500, which is similar to the previous total cost. If average rice production becomes 17 mound per bigha and selling prize per mound is taka 850 then selling prize of rice per bigha becomes taka 14,450. If they subtract production cost then the profit is taka 7450. Therefore, rice cultivation increases income of the farmers in that time. Average annual income of respondents from rice is taka 20,000-40,000 and annual income from other crops is taka 10,000-80,000. If we analyze annual deficit it is observed that annual deficit is around 10%, which is low in percentage. In the study areas, more than half of the respondents state that employment is increased due to irrigation project for rice cultivation because more lands are come under cultivation of rice. In overall discussion, it can be said that income is increased of the farmers and they also get profit from rice and other crop production. Economic sustainability is quite balanced in the study areas.

Every one of the study areas has awareness about equity of water. More than 50% of the respondents say that scarcity of drinking water is observed in dry season that means. About 70% respondents state that the irrigation water does not affect their health but we observed that there is drinking water scarcity during rice cultivation though overall human health condition is quite satisfactory in both the study areas. So awareness for equity of water is quite good. Human health condition is also good but condition of sanitation and drinking water is not good at all. Overall social sustainability is not well stable because of sanitation and drinking water crisis in the study areas.

In the study areas near about all respondents state that water bodies dries up earlier due to excessive ground water harvesting. So ecology is hampered. Most of the respondent state that fishes are decreasing due to

irrigated water enters into nearby surface water bodies and early dry up of water bodies. Therefore, it also hampers aquatic ecology and biodiversity. All the respondents state that there is adverse effect of irrigation water on soil fertility, biodiversity, soil pollution, water pollution, other crops, open water fisheries etc. About 40% respondents state that environmental health is hampered due to excessive irrigation. Around 40% of the respondents also state that there are adverse effects of irrigation on other crops. All the respondents state that groundwater level is decreasing day by day and around 50% of the respondents say that heavy withdrawal of groundwater for irrigation and less availability of water in rivers, canal etc.; are the causes of decreasing groundwater level. If we follow the field level primary data of groundwater table in the study areas, we see that gradually groundwater level is decreasing. Moreover, if we see the static groundwater level data collected from both the study areas, is decreasing seriously in every year, which is not good sign for the availability of groundwater resources. Again, if we observe the groundwater level data of 24 years; we can also see that decreasing level is around 36 to 46 feet that shows the environmental degradation. Through overall discussion, we can say that environmental sustainability is vulnerable due to present irrigation practices.

8.6 Conclusion

From the above discussion, it is found that economic condition is quite good in the study areas. In case of social condition, some of the indicators are quite satisfactory but some are not good. If we see sustainability of environment, it is not in a good condition because environment is seriously degraded by various components. All of the indicators are not in sustainable condition. Therefore, for overall discussion, it can be said that state of present irrigation practices does ensure sustainability in the study areas.

Chapter-9

Findings, Policy Implications, Conclusion

9.1 Findings

1. The study area of Sirajganj situated in floodplain land is fertile enough to grow almost all types of crops whereas Godagari is situated in relatively high land area where not all types of crops are grown. In both the study areas literacy rate is about 67%, which is quite good in respect of national literacy rate. Most of the families are nuclear having 1-2 children. Drinking water source is tube wells in both the study areas and pipeline supply water supplied by BMDA is found in Godagari. Drinking water is easily accessible to the people of Sirajganj but it is very difficult for the people of Godagari to withdraw water with hand tube wells because of lowering groundwater level. The condition of toilet is not good in the study area. The economic condition of the farmers is quite good because very few farmers have annual deficit. However, socioeconomic situation of both the study areas is not so good because there are still landless farmers who cultivate land with share crop or taking lease from other farmers. Moreover, seasonal unemployment is one of main problems faced by small and marginal farmers that shows the poverty features of the study areas.
2. In the Canal Act 1864, the Irrigation Act 1876, the Embankment and Drainage Act 1952, the Bangladesh Irrigation Water Rate Ordinance 1983, the Ground Water Management Ordinance 1985 etc.; there are some importance issues associated with irrigation were not enacted properly and some important issues like set up reservoir, aquatic and terrestrial biodiversity conservation, pollution, maintaining soil fertility, etc.; were not addressed in these laws. Nevertheless, the Act enacted in 2013 is not yet enforced as a law covers all sector of irrigation though some drawbacks are also found in this act. So this act is needed to enforce as early as possible. Besides, the National Water Policy 1999 and National Agriculture Policy 2013 are come into enforcement as to conserve water resources. So all these acts and policies should be taken into enforce appropriately and immediately to conserve and sustainable use of water resources for future generation.
3. In both the study areas, though there are some rivers, canals, small ponds etc., but water is not found during irrigation in dry season for rice cultivation. People uses groundwater for irrigation purposes and no one uses surface water though some land situated beside the river or canal. In Sirajganj, people can easily withdraw groundwater with the help of shallow pumps. In

the study areas, DoAE did not provide any manuals of irrigation and they did not give any training regarding irrigation. Most of the farmers follow the method inherited from ancestor. They do not know sufficiently the irrigation laws and policies. Most of the farmers prefer cultivation of rice though they state that it does not increase income and is not so profitable but rice fulfills food requirements of the farmers. They think it ensures food security for them. The irrigation canals and drains are earthen made so that misuse of water is occurred. Some farmers want to cultivate alternative crops instead of rice but they can not cultivate other crops because surroundings lands covered with rice crops.

4. Farmers' knowledge about irrigation laws and policies, irrigation water sources, irrigation training, water table and ethical issues is poor but knowledge about government initiatives regarding irrigation, irrigation methods and manuals, interval and level of irrigation, drainage system and misuse of water, adverse impact due to irrigation practices is good. Their attitude about sources of irrigation water, adverse impact due to irrigation practices is not good but attitude about government initiatives regarding irrigation, irrigation training, interval and level of irrigation, drainage systems and misuse of water, groundwater table are good. Their practice about irrigation laws and policies, sources of irrigation water, irrigation training, interval and level of irrigation, adverse impact due to irrigation practices, are not good but practice about government initiatives regarding irrigation, drainage system and misuse of water are good.
5. In the study areas, respondents state that excessive irrigation has adverse impacts on other crops, environmental and human health, and fresh water fishes etc. They also state that surface water bodies dry up due to excessive groundwater harvesting. Chemical fertilizer and pesticides pollute local water bodies along with irrigation water decreasing fishes and aquatic animals and due to excessive groundwater extracting for irrigation the soluble metals like iron, arsenic, lead and cadmium etc. found in tube wells' water are harmful for the humans as well as other animals.
6. In the study areas respondents state that everyone should have equity on water and water is limited resources on the earth. They do not have much knowledge about water use from religious point of view but they agree that by following traditional and religious beliefs irrigation water misuse can be minimized. They do not follow the ethics properly as they throw household waste and cow dung into nearby pond and ditches. They also agree that pollution occurs for this reason. They use government banned pesticides though they know that these have adverse effects. They also think about

recharge and withdraw ratio of groundwater but in practice they do not care for that.

7. In the study areas, it is observed that income is increased of the farmers and they get profit from rice and other crop production. So economic sustainability is seen quite balance in the study areas. Awareness for equity of water is quite good. Human health condition is also good but condition of sanitation and drinking water is not well enough. So social sustainability is not ensured enough through the present irrigation practices. There is scarcity of safe drinking water in the study areas during dry season. According to the study respondents, groundwater level is decreasing day by day due to excessive harvesting of groundwater for irrigation and less availability of water in rivers, canals etc., because water bodies dry up earlier. If we see the field level primary data of static groundwater level collected from both the study areas; we observe that day by day and every year gradually groundwater level is decreasing alarmingly, which is not good sign for the availability of groundwater resources. Again, if we observe the groundwater level data of 24 years collected from BMDA of Godagari Upazila; we can also see the decreasing level of groundwater is around 36 to 46 feet, which shows the environmental degradation. Therefore, it can be said that environmental sustainability is seriously hampered due to irrigation practices.

9.2 Policy Implication

1. Educational status shows that in the study areas still 32.8% respondents are illiterate. Among the literate persons, 50% respondents have primary and secondary level of education. Therefore, government should take necessary initiative and programme to improve educational status among the farmers.
2. There are some laws and policies of irrigation in our country in which some laws and policies are backdated and insufficient that should be amended for maintaining sustainable irrigation practices.
3. Recently government enacted some laws and policies, which will be useful for irrigation in rice cultivation; these are not yet come into enforcement, The government should take steps to bring into enforcement of these laws and policies immediately for conservation of water resources.
4. Farmers use groundwater for irrigation purposes and no one uses surface water. Therefore, government should take initiatives to use surface water to reduce pressure on groundwater.
5. Department of Agriculture Extension does not provide any manuals of irrigation to the farmers, so nobody properly follows that manuals because of

their ignorance and inavailability. So agriculture department should provide that manuals and training to farmers.

6. Not all the respondents know the laws and policies regarding irrigation and everybody agrees that it is needed to know the laws and policies. Government should arrange workshop and seminars for understanding these laws and policies of irrigation so that people can realize which is wrong and right.
7. Respondents have no training on agriculture and almost all (98%) the respondents have no training on irrigation. Therefore, government should take initiatives to arranging training program frequently among the farmers.
8. Respondents agree that water will be saved by constructing concrete drains. So it is needed to take initiatives by relevant government agencies for building concrete drains for passing water into the crop field.
9. As farmers are interested to cultivate rice round the year, government should take plan for encouraging alternative crops that consume less water but alternative crops should be valuable and edible as well as give subsidies to the farmers.
10. It is needed to ensure availability of water in rivers, canals, beels, ponds and other water bodies. Government should take scheme for dredging and re-excavating those water bodies for storing water in rainy season as water reservoirs.
11. Almost all the respondents agree that surface water bodies are dried up earlier due to excessive groundwater harvesting as well as other causes. So groundwater harvesting should be minimized at an optimal level and water reservoir should set up properly.
12. Farmers use government banned pesticides, which are harmful for useful animals live in rice fields. Therefore, laws should be strictly executed to stop the use of those pesticides.
13. All the respondents of the study areas state that every one should have equity of water and no one has personal rights on water use as common property. Government should arrange awareness build up campaign for conservation and lawful use of water.
14. Farmers have not sufficient knowledge on water use from the Islamic or other religious point of view but they would like to obey the religious as well as traditional value regarding water use. Therefore, government should make policy and training modules including religious and traditional value for water use, which will be very much effective for water conservation.
15. Farmers state that fishes are decreasing due to early drying up of wetlands, and irrigated water enters into nearby water bodies with chemical fertilizers and pesticides those are harmful for fish breeding as well as growing. It

degrades aquatic ecology and biodiversity. Therefore, government should take necessary steps for aquatic biodiversity especially fish conservation.

16. Government should take appropriate policy for ensuring sustainable irrigation water use for rice cultivation so that future generation can get at least same water as found in present days.

9.3 Conclusion

The present research has been conducted in five villages of two different study areas under Sirajganj Sadar Upazila of Sirajganj and Godagari Upazila of Rajshahi districts. The study areas are different in their lands and soil types. Sirajganj is situated in low land areas and Godagari is situated in relatively high Barind areas. However, there are some variation of land and soil type and climatic condition but more similarities are found in both the study areas. Socioeconomic situation of both the study areas is not so good because there are still landless farmers who cultivate land with share crop or taking leased from other farmers. Moreover, seasonal unemployment is one of main problems faced by small and marginal farmers that reveal the poverty features of the study areas.

There are important issues like set up reservoir, aquatic biodiversity conservation, pollution control etc., are not addressed sufficiently in existing laws and policies regarding irrigation and agriculture development. However, the Water Act, 2013, Agriculture Policy 2013 are enacted, as it covers all sectors of irrigation and sustainable management of water resources, it must come into enforcement immediately to conserve and sustainable use of water resources for present as well as for future generation. In both the study areas, though there are some rivers, canals, small ponds etc., but water is not found during irrigation in dry season. People use groundwater for irrigation purposes and no one uses surface water though in some areas it is available. Irrigation training facilities are not available in the study areas. People do not know the appropriate methods of irrigation and do not follow the regulatory frameworks.

Most of the farmers prefer cultivation of rice though they state that it does not increase income as expected and is not so profitable, rather they cultivate for their food security. Some of farmers want to cultivate alternative crops instead of rice but they cannot cultivate other crops because surroundings lands are covered with rice crops. Farmer's level of knowledge about irrigation laws and policies is poor. Attitude level is good but in some cases it is not to optimal level. So due to ignorance, farmers do not follow the irrigation laws and policies in their irrigation practice. Knowledge and attitude of farmers about government initiatives regarding irrigation systems is good so farmers' response toward government initiative in community based irrigation is satisfactory. Government

training facilities is available but knowledge level of farmers is very poor but they are interested to take training means they hold proactive attitude. Perceived knowledge about the use of irrigation water and its sources is poor and practice to use ground water as water source is also poor. Level of knowledge about water level in rice field is very good but in some cases practice level is not very good that shows all farmers do not hold proactive attitude in this regard. Farmers' Knowledge about consequences of declining the groundwater table is not satisfactory but they think that it is not good for long term, so it shows that attitude level is good. They are very much aware about adverse impact of present irrigation practices especially excessive use of ground water but attitude level is not at optimal level. Knowledge about ethical issues of irrigation practices is not good so their attitude and practice is not also good. It is found that excessive irrigation has adverse impacts on other crops, environmental and human health, and fresh water fishes etc., and surface water bodies dry up due to excessive groundwater harvesting. Chemical fertilizer and pesticides pollute local water bodies along with irrigation water causes decreasing fishes and aquatic animals and due to excessive groundwater extracting for irrigation the water soluble metals like iron, arsenic, lead and cadmium etc. found in tube wells' water are harmful for the humans as well as other animals. Generally, people have not sufficient knowledge about water use from religious and traditional point of view but they agree that following traditional and religious beliefs and ethics regarding water use, irrigation water misuse can be minimized. Farmers use government banned pesticides though they know that these have adverse effects. They also think about recharge and withdraw ratio of groundwater but in practice, they do not care for that. It is observed that economic sustainability is seen quite balance but social sustainability is not well stable because of degrading environmental and human health. There is drinking water scarcity in irrigation season resulted from excessive ground water harvest and hand tubes do not work. Data of static groundwater level collected from both the study areas reveals that day by day and every year gradually groundwater level is decreasing alarmingly, which is not good sign for the availability of groundwater resources. It shows the environmental degradation. So it can be assumed that environmental sustainability is frighteningly hampered due to present irrigation practices. Nevertheless, appropriate measures are not taken yet by the government or other agencies to ensure the sustainable use of ground water. Therefore, time has come to realize using ground water for irrigation and surface water as well for rice cultivation in a sustainable manner. Government should take immediate steps for conserving water for the future generation.

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Appendices:

Appendices- 1

Questionnaire for the proposed research

Irrigation Practice in Rice Cultivation and Its Sustainability in Bangladesh: Issues and Challenges
Questionnaire for the Proposed Research

VILLAGE:

UNION:

UPAZILA:

DISTRICT:

Name of Household Head:

Age		Sex:	Male		Female	
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Marital Status:	Married		Unmarried		Divorced		Widow/widower	
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Family Size		No. of Children		Adult Person		Unemployment		Employment		Student	
-------------	--	-----------------	--	--------------	--	--------------	--	------------	--	---------	--

Religion:	Muslim		Hindu		Christian		Others	
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Education:	Primary		Secondary		HSC		Graduate		Others	
------------	---------	--	-----------	--	-----	--	----------	--	--------	--

Occupation:	Farming		Small business		Day labor		Govt. employee		others	
-------------	---------	--	----------------	--	-----------	--	----------------	--	--------	--

Skill ness:	Farming		Dairy/poultry		Horticulture		Small business		Pisciculture		Others	
-------------	---------	--	---------------	--	--------------	--	----------------	--	--------------	--	--------	--

Has any member of Household got agro training? Yes No

If yes specify and tell the benefits.....

Types of Family	Joint		Nuclear		Total no. of houses	
-----------------	-------	--	---------	--	---------------------	--

House types:	Brick wall tin roofed	Mud wall tin roofed	Mud wall hay roofed	bamboo wall tin roofed	bamboo wall hay roofed	Tin wall tin roofed	pacca
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Do you have Toilet?	Yes		No		Types of Toilet:	Hygienic		Unhygienic	
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Land Ownership

Homestead		Agriculture		horticulture		pond		fallow		Total	
-----------	--	-------------	--	--------------	--	------	--	--------	--	-------	--

Total cultivated land owned		Total Amount of Share Cropping	
-----------------------------	--	--------------------------------	--

Amount of Leased in Bigha		Amount of Leased out in Bigha	
Total amount of cultivated land		Value leased/Bigha of	

Value of leased out/Bigha		Types of share cropping	
---------------------------	--	-------------------------	--

Amount of land for rice cultivation in kharif-1 season		Amount of land for rice cultivation in round the year	
--	--	---	--

Do you use your land for commercial farming?	Yes	No	If yes, amount of land	
--	-----	----	------------------------	--

Types of farming		Cropping pattern	Mono crop		Multi crop	
------------------	--	------------------	-----------	--	------------	--

Cultivation seasons of rice	
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Cultivation method	traditional		modern		mixed	
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Annual income of your household		Annual Expenditure	
---------------------------------	--	--------------------	--

Annual Savings		Annual Deficit	
----------------	--	----------------	--

Annual income from rice		Annual income from other crops	
-------------------------	--	--------------------------------	--

Types of rice, production cost and price

Name of rice	Cost/Bigha	Production/Bigha	Selling price/mond

Do you prefer rice more than other crops? Yes No If yes then why

.....

Do you think your income is creasing through rice cultivation? Yes No

If yes, what are thecauses?.....

If no, why do you cultivate rice?.....

Do you think rice cultivation is profitable than other crops? Yes No

If yes tell the reasons.....

If no then what are those crops profitable than rice.....

Sources of Household Water Use:

	Wells	Tube wells	Pond	Rivers	Supply water
Drinking					
Cooking					
Utensils Wash					
Cloth Wash					
Bathing					
Toilet use					

How much drinking water (in liters) does your household consume each day?	
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What is the bathing frequency?	Many times a day in summer	Once a day in winter	Twice a day in summer	Thrice a day in summer	others	
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How long does each shower last?	<10 min	20-30 min.	30-40 min.	40-60 min.	others
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How do you store water during water shortage season?.....

If the government offer for improvement water supply system for household with pay then would you are willing to participate in the program? Yes No

If yes, how much you willing to pay monthly?.....

If no, what are the causes?.....

Do you know when irrigation was started in our country?.....

Do you know about laws and policies of irrigation? Yes No

If yes, how you know about these laws and policies?.....

If you know how much comply with those.....

If no, do you think it is necessary to know for better irrigation practices?.....

Do you know about implementing agency of laws and policies in areas?.....

Do you know there are laws to install a tube well for irrigation?.....

Did you seek permission before the installation of your tube well? Yes No

If yes, from where did you get permission?

If no, why.....

Are there any government initiatives about irrigation in your area? Yes No

If yes then what kind of initiatives government has taken explains.....

Have you any training on irrigation from agricultural department? Yes No

If yes then explain that.....

Does the Department of Agriculture Extension provide any manual of irrigation?
Yes No

Do you follow the manual of irrigation provided by the DAE? Yes No

If yes then what are these

Method of irrigation:	Traditional		Modern		Mixed	
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Traditional:	don		belcha		swing basket		others	
--------------	-----	--	--------	--	--------------	--	--------	--

Modern:	Deep Tube wells		Shallow Tube wells		Low lift	
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Specify the interval of irrigation	Hour		Day	
------------------------------------	------	--	-----	--

Level of irrigation water:	2-4 inches	5 inches	6 inches	over flooded
----------------------------	------------	----------	----------	--------------

Total frequencies of irrigation in a season.....

Sources of irrigation water you use	Surface water		groundwater	
-------------------------------------	---------------	--	-------------	--

Surface water:	Rivers		ponds		canals		dighi		others	
----------------	--------	--	-------	--	--------	--	-------	--	--------	--

In case of surface water how you up lift the water.....

Do you have a well or any source of water? Yes No

Do you have shallow pumps to withdraw water? Yes No

If yes then how many shallow pumps do you have?.....

What type of irrigation equipments do you use?

Moveable pipes	Overheads	Drip irrigation	Flooded irrigation	others	
----------------	-----------	-----------------	--------------------	--------	--

What kind of irrigation drainage system	Brick built		Kacca	
---	-------------	--	-------	--

If the drain is kutchra then do you think misuse or leakage of water occurred during irrigation? Yes No

If yes, type of misuse: leakage through earthen made dyke.....leakage into under ground

Other type of misuse or loss:

excessively Irrigate the field	carelessly	own wish	don't know the volume	for more production	others	
--------------------------------	------------	----------	-----------------------	---------------------	--------	--

Do you think drainage must be concrete to save water?.....

If government will take initiatives for modern irrigation systems, do you willing to pay to participate? Yes No

If yse how much you willing to pay per bigha.....

Do you think rice production is varied due to excessive irrigation? Yes No

If yes please make a comment

Rice production:	decreased		increased		others	
------------------	-----------	--	-----------	--	--------	--

Do you think excessive irrigation in rice is creating impacts on other crops? Yes No

If yes please tell what kinds of impacts are creating?.....

Rabi crop production:	decreased		increased		others	
-----------------------	-----------	--	-----------	--	--------	--

Employment status:	increased		decreased		others	
--------------------	-----------	--	-----------	--	--------	--

How much of land do you irrigate for rice cultivation.....

How much of land do you irrigate for other crop production.....

How many Tk. Did you spend last year on fertilizer and manures/bigha for rice?.....

How many Tk. Did you spend last year on pesticides and herbicides for rice/bigha?.....

Did you purchase any water for irrigation for your rice production? Yes No

How many Tk. did you spend in last year for rice field irrigation/bigha?

Do you think it is needed to increase or decrease the volume of water withdrawn from under ground for cultivation?	Increase	decrease
--	----------	----------

Is the level of groundwater decreasing day by day? Yes No

If yes then what are the causes of decreasing water level.....

Do you think waterbodies dry up earlier due to excessive ground water harvesting?

Yes No

Do you think fishes are decreasing due to irrigated water goes to near by waterbodies?

Yes No

Adverse effect of irrigation water

Soil fertility biodiversity soil pollution water pollution
 Other crops Fruit plants Open water Fishes Vegetation

Do you think environmental health hampered due to irrigation? Yes No

If yes then mention.....

Do you think water scarcity is occurring due to irrigation in dry season? Yes No

Does human health affecting due to irrigation? Yes No

If yes then tell the problems of human health.....

Do you think scarcity of safe drinking water is arising due to irrigation?

Do you think every one should have equity for water? Yes No

If no then explain the matter...

Throw waste products, cow dung into the pond/ditches? Yes No

If yes then why.....

Do you use pesticides to kill the crabs or any other animals in rice field?

Yes No

Do you use any pesticides that prohibited by government?

If yes, do you know the adverse effects of those pesticides? Yes No

If yes, what are those adverse effects.....

Do you think chemical fertilizer and pesticides pollute local waterbodies?

Yes No

If yes tell what kinds of negative impact/pollution are creating.....

Existence of metal in tube wells water	Arsenic	Iron	cadmium	Calcium	Others
--	---------	------	---------	---------	--------

If metal pollutants exists what type of harmful effects on health.....

Does household waste water fallen into nearby waterbodies? Yes No

Do you think water is polluted for those reasons? Yes No

Do you think water is a valuable resource without that we cannot survive? Yes No

If yes then do think you should careful about irrigation/water use? Yes No

You should try to participate in conserving this resource

You should not use such pesticides that pollute the water during rice cultivation

You should follow the irrigation manuals provided by the Agriculture Extension

Do you know what Islam religion said about water use? Yes No

If yes explain that.....

Islam says you are the user as well as the keeper of water resource, do you agree with this?

Do you think you should use water for irrigation in such a manner that your next generation can also use water for irrigation.....

Do you know water is limited resource in earth? Yes No

Do you know ground recharges by rain and flood water? Yes No

We should think about recharge and withdrawal ratio of ground water for irrigation?

Yes No

If yes tell the causes.....

Irrigation should do in such a way that does not create adverse impacts on other crops?

Yes No

Water level should keep optimal level as guided by manuals in rice field? Yes No

Is there any river or canal or any waterbodies near the rice field? Yes No

If yes, why do you not use these for irrigation?.....

3000 l water need for one kg rice production, so we should think about alternatives?

Yes No

Do you accept any alternative crops that consume less water but valuable and edible?

Yes No

If no then why.....

If yes what kind of crops do you prefer?.....

Do you know something about water use from Hindu religious point of view?

Yes No

If yes explain that.....

Is there any traditional beliefs regarding water use? Yes No

If yes then tell what kind of traditional beliefs regarding water use?.....

Do you obey the traditional and religious beliefs regarding water use? Yes No

If No then tell the reason.....

Do you think religious and other traditional beliefs can help to misuse of water?

Yes No

If yes then how.....

Reasons of irrigation water Scarcity

excessive drought	untimely rainfall	limited flow of river water	lowered groundwater level	other	
-------------------	-------------------	-----------------------------	---------------------------	-------	--

Do you think in future the country will face severe water scarcity? Yes No

Should Government need to take any necessary steps regarding water use? Yes No

If yes then what type of necessary steps should be taken.....

Signature of the Interviewer

Questionnaire for KAP Study

Irrigation Practice in Rice Cultivation and Its Sustainability in Bangladesh: Issues and Challenges
Questionnaire for the Proposed Research

VILLAGE: UNION: UPAZILA: DISTRICT:

Name of Household Head:

There are laws and rules to regulate irrigation in rice field, do you know? Yes No

Very well Known	Well Known	Little Known	Don't Know
-----------------	------------	--------------	------------

Do you think there are needs of these laws and rules? Yes No

Very much essential	Essential	Not so essential	Not essential
---------------------	-----------	------------------	---------------

Do you think it is needed to enforce these laws and rules appropriately?

Very much agree	Moderately agree	Not so agree	Don't agree
-----------------	------------------	--------------	-------------

Do you observe implementation of these laws and rules in your areas?

Always	sometimes	Hardly seen	Not seen
--------	-----------	-------------	----------

Do you comply with these laws and rules of irrigation? Yes No

Completely comply	Comply	less compliance	don't comply
-------------------	--------	-----------------	--------------

Do you know there is need a permission to install a deep/shallow tube well?
 Yes No

Very well Known	Well Known	Little Known	Don't Know
-----------------	------------	--------------	------------

Is it appropriate to take permission before installing any tube wells? Yes No

Very much appropriate	moderately appropriate	Not so appropriate	not appropriate
-----------------------	------------------------	--------------------	-----------------

Do you know about govt. initiatives regarding irrigation in your area? Yes No

There are needs of government initiatives

Very much needed	Needed	not so much needed	not needed
------------------	--------	--------------------	------------

Do you think government control systematic irrigation is better that private?

Yes No

Government control

Extreme need	moderately need	Not so much need	don't need
--------------	-----------------	------------------	------------

Private Own

Extreme need	moderately need	Not so much need	don't need
--------------	-----------------	------------------	------------

For sustainability there is needs government control systemic irrigation?

Yes No

Strongly agree	moderately agree	not so Agree	Not agreed
----------------	------------------	--------------	------------

Do you know about the irrigation manuals? Yes No, if yes then what is the source?

Agriculture extension officer	neighbors/relatives	fellow farmers	television/radio
-------------------------------	---------------------	----------------	------------------

Do you think this irrigation manuals is very useful? Yes No

Very much useful	moderately useful	not so much useful	not useful
------------------	-------------------	--------------------	------------

Do you follow methods of irrigation manuals? Yes No

Strongly follow	moderately follow	not so follow	Not follow
-----------------	-------------------	---------------	------------

Do you think optimal production can be got by following the irrigation manuals?
Yes No

Strongly agree	moderately agree	not so Agree	Not agreed
----------------	------------------	--------------	------------

Do you have any training on irrigation? Yes No
what are the sources?

Agri officer	Fellow farmers	Ancestor	Village mentors
--------------	----------------	----------	-----------------

Do you think there are needs of training on irrigation? Yes no

Very much needed	Needed	not so much needed	not needed
------------------	--------	--------------------	------------

What methods do you use for irrigation in rice field? Traditional Systematic

Do you prefer traditional or systematic irrigation? Yes No

Traditional Irrigation

Strongly prefer	moderately prefer	not so prefer	Not prefer
-----------------	-------------------	---------------	------------

Systematic Irrigation

Strongly prefer	moderately prefer	not so prefer	Not prefer
-----------------	-------------------	---------------	------------

What is the source of methods presently you use?

agri officer	Ancestor	fellow farmers	self
--------------	----------	----------------	------

What sources of water is available in your area? Groundwater-4 river-3 canal-2
dighi/pond-1

Groundwater

Very much available	Moderately available	Not so available	Not available
---------------------	----------------------	------------------	---------------

River water

Very much available	Moderately available	Not so available	Not available
---------------------	----------------------	------------------	---------------

Canal water

Very much available	Moderately available	Not so available	Not available
---------------------	----------------------	------------------	---------------

Dighi/pond water

Very much available	Moderately available	Not so available	Not available
---------------------	----------------------	------------------	---------------

What sources of irrigation water is suitable in your locality?

Groundwater	River	Canal	dighi/pond
-------------	-------	-------	------------

What source of water do you prefer for irrigation?

Groundwater	River	Canal	dighi/pond
-------------	-------	-------	------------

If surface water is available then ground water should not be used? Yes No

Strongly agree	moderately agree	not so Agree	Not agreed
----------------	------------------	--------------	------------

Is there any prescribed method of interval of irrigation in rice field? Yes No

Do you follow the prescribed method of interval for irrigation in rice field?
Yes No

Strongly follow	moderately follow	not so follow	Not follow
-----------------	-------------------	---------------	------------

Following interval method in different stages, rice production will be better?
Yes No

Strongly agree	moderately agree	not so Agree	Not agreed
----------------	------------------	--------------	------------

What is the source of interval method you use for irrigation?

Agriculture officer	Fellow farmers	Village mentors	Self
---------------------	----------------	-----------------	------

Do you think present method of interval for irrigation is appropriate? Yes No

Very much appropriate	moderately appropriate	Not so appropriate	not appropriate
-----------------------	------------------------	--------------------	-----------------

Do you know about four stages transplanting, transplanting to 10 days, 11 days to panicle initiation, panicle initiation to flowering in irrigated field? Yes No

Very well Known	Well Known	Little Know	Don't Know
-----------------	------------	-------------	------------

Do you know about prescribed method of maintaining water level for different stages in irrigated field? Yes No

Very well Known	Well Known	Little Know	Don't Know
-----------------	------------	-------------	------------

There is need to maintain the actual level of water in the rice field

Very much needed	Needed	less needed	not needed
------------------	--------	-------------	------------

Do you know level of water should be in different stages?

2-3 inches, 3-5 inches, 2-3 inches, 5-10 inches? Yes No

Very well Known	Well Known	Little Know	Don't Know
-----------------	------------	-------------	------------

Do you maintain water level in rice field as prescribed? Yes No

Exactly maintain	Moderately maintain	Not so maintain	Not maintain
------------------	---------------------	-----------------	--------------

What are the sources of water level method do you use?

Agriculture officer	Fellow farmers	Village mentors	self
---------------------	----------------	-----------------	------

Do you think present drainage system causes misuse of large volume of water? Yes No

Strongly agree	moderately agree	not so Agree	Not agreed
----------------	------------------	--------------	------------

Do you think concrete drainage system reduces misuse of water? Yes No

Strongly agree	moderately agree	not so Agree	Not agreed
----------------	------------------	--------------	------------

Do you think systematic and control irrigation can reduce misuse of irrigation water? Yes No

Strongly agree	moderately agree	not so Agree	Not agreed
----------------	------------------	--------------	------------

Do you think irrigation water is also misused by farmer's carelessness?

Strongly agree	moderately agree	not so Agree	Not agreed
----------------	------------------	--------------	------------

Do you know about causes of water table downward? Yes No

Do you think over extracting for irrigation creates decreasing of groundwater table? Yes No

Strongly agree	moderately agree	not so Agree	Not agreed
----------------	------------------	--------------	------------

Do you know about ground water recharge process? Yes No

Very well Known	Well Known	Little Know	Don't Know
-----------------	------------	-------------	------------

Do you think extract and recharge ratio must be kept similar for sustainable irrigation? Yes No

Strongly agree	moderately agree	not so Agree	Not agreed
----------------	------------------	--------------	------------

Do you cultivate rice all the year round? Yes No

Do you know about cultivating rice all the year round creating adverse impacts? Yes No

Strongly agree	moderately agree	not so Agree	Not agreed
----------------	------------------	--------------	------------

Is there any alternative instead of rice in kharif-1 season to save water? Yes No,

What are those crops?.....

There are adverse impacts on other crops due to irrigation in dry season?

Yes No

Strongly agree	moderately agree	not so Agree	Not agreed
----------------	------------------	--------------	------------

Impact of excessive irrigating creates negative impact on other plants and animals? Yes No

Strongly agree	moderately agree	not so Agree	Not agreed
----------------	------------------	--------------	------------

Impact of excessive irrigating creates negative impact on human health and social life? Yes No

Strongly agree	moderately agree	not so Agree	Not agreed
----------------	------------------	--------------	------------

There are traditional/religious value systems regarding water use, do you know?

Yes No

Very well Known	Well Known	Little Know	Don't Know
-----------------	------------	-------------	------------

How do you know these?

Religious persons	Ancestor	Village mentors	Self learned
-------------------	----------	-----------------	--------------

Do you follow these values? Yes No

Exactly follow	Moderately follow	Not so follow	Not follow
----------------	-------------------	---------------	------------

Do you believe that water is a god gifted resources? Yes No

Strongly believe	Moderately believe	Not so believe	Not believe
------------------	--------------------	----------------	-------------

Religion says you are a user as well as a keeper of these resources, do you follow? Yes No

Exactly follow	Moderately follow	Not so follow	Not follow
----------------	-------------------	---------------	------------

Some traditional ethics can save water misuse if you follow? Yes No

Strongly agree	moderately agree	not so Agree	Not agreed
----------------	------------------	--------------	------------

It is needed for conserve water by obeying social/religious ethics? Yes No

Very much needed	Needed	not so much needed	not needed
------------------	--------	--------------------	------------

Do you think ground water is a limited resource? Yes No

Strongly agree	moderately agree	not so Agree	Not agreed
----------------	------------------	--------------	------------

As a limited resource ground water should not extract unwisely? Yes No

Strongly agree	moderately agree	not so Agree	Not agreed
----------------	------------------	--------------	------------

You should use water in such a manner that your next generation can get same?

Yes No

Strongly agree	moderately agree	not so Agree	Not agreed
----------------	------------------	--------------	------------

In future there will be water scarcity due to excessive groundwater extraction?

Yes No

Strongly agree	moderately agree	not so Agree	Not agreed
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Signature of the Interviewer

Appendix-2

Photographs



Photo-1: Shallow Pumps in Sirajganj



Photo-2: Earthen Irrigation canal in Sirajganj



Photo-3: Rice field of Sirajganj



Photo-4: Weeding in rice field



Photo-5 : Water entering into the field



Photo-6 : Collection of seedlings



Photo-7: Earthen canal in Godagari



Photo-8 : Bund preparing in Godagari



Photo-9: Drinking water supply in Godagari



Photo-10: Water uplifting from DTWs



Photo-11: Rice Field preparation by tractor



Photo-12 : Data Collection



Photo-13: Bund Repairing in Sirajganj



Photo-14: River in Study area of Sirajganj



Photo-15: Rice field in Sirajganj



Photo-16: Rice field in Godagari

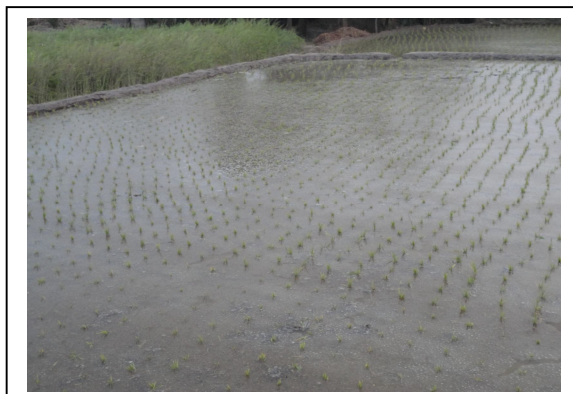


Photo-17: After transplanted of rice



Photo-18: Before transplanted of rice



Photo-19 & 20: Static water level measurement in Godagari



Photo-21: Static water level measurement in Sirajganj.



Photo-22: FGD session in Godagari



Photo-23 : FGD session in Godagari



Photo-24 : FGD session in Sirajganj



Photo-25 : Irrigation water passes in Godagari Photo-26 : Houses in Godagari



Photo-27 : Rice harvesting in Godagari Photo-28 : Irrigation water passes Through underground pipe



Photo-29: Weed picked up by farmers Photo-30: Transplanted rice crops in Sirajganj