INSTITUTE OF HEALTH ECONOMICS
UNIVERSITY OF DHAKA

PKSF

ACADEMIC INTERNSHIP REPORT

ON

Water Security in Barind Area: The Role of Pond Re-excavation as a Climate Adaptation Measure

Conducted by:

Palli Karma-Sahayak Foundation (PKSF)

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Declaration

Student's Declaration

I certify that this report does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

……. Student's Signature

Supervisor's Declaration

I believe that this report is properly presented, conforms to the best specifications of report presentation in the university and is prima facie worthy of examination.

……. Academic Supervisor's Signature

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Acronyms

PKSF – Palli Karma-Sahayak Foundation

IHE – Institute of Health Economics

GOB – Government of Bangladesh

IDA – International Development Association

USAID – United States Agency for International Development

ADB – Asian Development Bank

IFAD – International Fund for Agricultural Development

WASH – Water, Sanitation, and Hygiene

ECCP-Drought – Extended Community Climate Change Project-Drought

PPEPP-EU – Pathways to Prosperity for Extremely Poor People-European Union

RAISE – Resilient, Adaptive, and Inclusive Social Economy

RHL – Resilient Housing and Livelihoods

RMTP – Rural Microenterprise Transformation Project

SMART – Sustainable Microenterprise and Resilient Transformation

IRMP – Integrated Risk Management Project

SEP – Sustainable Enterprise Project

PROSPER – Promoting Resilient and Sustainable Poverty Eradication

PACE – Promoting Agricultural Commercialization and Enterprises

SEIP – Skills for Employment Investment Program

BMDA – Barind Multipurpose Development Authority

NWMP – National Water Management Plan

MAR – Managed Aquifer Recharge

Executive Summary

This report presents the findings of an academic internship conducted at Palli Karma-Sahayak Foundation (PKSF), focusing on water security in the Barind region with an emphasis on pond re-excavation as a climate adaptation measure. The study, conducted under PKSF's Extended Community Climate Change Project (ECCP-Drought), addresses the severe water crisis in Chapai Nawabganj, a drought-prone area in Bangladesh. The research aimed to assess the role of pond re-excavation in enhancing water security, explore its benefits at the household level, and identify its impact on agriculture, livelihoods, and public health. A mixed-method approach was employed, combining 61 household surveys, Focus Group Discussions (FGDs), and Key Informant Interviews (KIIs) with officials from BMDA, Public Health Engineer and Proyas.

The findings indicate heavy reliance on deep tube wells, leading to groundwater depletion and long travel distances for water collection, exacerbating the water crisis. While pond re-excavation has improved water availability for livestock, household use, and fish farming, its impact on irrigation remains limited due to poor water quality and ownership barriers. A majority (63.3%) of respondents rely on pond water for toilet-related activities and 34.4% of respondents reported waterborne diseases, highlighting the public health risks associated with contaminated water sources. The study also reveals gender disparities in water governance, as women remain disproportionately burdened with water collection and have limited participation in decision-making.

To address these challenges, the study recommends expanding pond re-excavation projects, strengthening community-led water governance, promoting rainwater harvesting, and enhancing financial and technical support for farmers. Special attention should be given to ensuring equitable access to water resources and improving water quality management. This internship provided valuable research experience, enhancing skills in fieldwork, data analysis, and policy evaluation. The findings contribute to broader discussions on climate adaptation and rural resilience, offering policy insights for sustainable water management strategies in Bangladesh.

Acknowledgment

There is no substitute for experience, and one can never get the fulfillment of knowledge without trying to work in real-life circumstances. Health Economics, as a growing field of study, is becoming increasingly relevant in the present-day context. Which core objective is to help policymakers decide how to allocate resources in the healthcare sector and to ensure the best health outcomes with available resources. The Institute of Health Economics, University of Dhaka, has taken a positive attitude towards this subject and offers undergraduate degree programs, research opportunities, training courses, work for the health ministry of the country, and many more. However, if we never got the opportunity to try out our skills in a professional setting, all of our potential and capabilities would go unnoticed.

Institute of Health Economics has enabled us to get the best possible exposure and guidance in this field. And because of this, it has 34 full-credit courses, and an internship at the end of the undergraduate program is a must for our future careers as Health Economics graduates. This gives us ample opportunities to learn and explore our capabilities in real-life settings. Therefore, I would like to express my heartfelt gratitude to Prof. Dr. Syed Abdul Hamid, Institute of Health Economics (IHE), University of Dhaka, for giving me this fantastic opportunity to intern in PKSF, a top organization in Bangladesh, for a 3 months period. I want to express my deepest appreciation to my academic supervisor, Dr Nasrin Sultana, Professor, Institute of Health Economics, for providing me the guidance, support, and mentorship invaluable in all the research I conducted.

I express my gratitude to Dr. Fazle Rabbi Sadeque Ahmed, Deputy Managing Director at PKSF. It's safe to say that my journey as an intern would not have gotten off to such a positive start. I will always be indebt to Dr. AKM Nuruzzaman, General Manager, PKSF, my supervisor, for his guidance and support. Mostly, the goal of this internship would not have been achievable without help of him, who took time out of his busy schedule to make sure we were learning, growing, and flourishing. Without his skillfully designed outline and direction, the study I conducted and the report I am submitting would not have been possible.

My sincere appreciation goes to K.M. Marufuzzaman, Manager, PKSF, who was always there to help me in every step of my study; even when I felt overwhelmed by a particular challenge, he was always available to inspire me and offer assistance - even during his busiest of times. Special thanks for arranged this beautiful tour at Chapai Nawabganj and contacted the key bodies at Proyas to make our field visit successful and an absolute delight. I extend my gratitude to Dr. Md. Ferozur Rahman, Assistant Project Coordinator (ECCP-Drought), PKSF. Sir provide me knowledge of research methods, but he also provided me with knowledge of etiquette, work ethics, career guidance, and professionalism, which helped me to make the most out of my internship & my future endeavor. Also, I want to extend my sincere gratitude to Dr. Md. Jashim Uddin, AMD, PKSF for giving us a warm welcome on the commencement of my internship. Special mention to Asfak Mahmud, Deputy Manager, PKSF.

Three field visits to Jolahar, Delbari and Amarock arranged by Bokul Kumar ghosh, Project Coordinator (ECCP-Drought), Proyas. It was an invaluable experience. Special thanks to him for support and warm hospitality during the field visit.
I am immensely grateful to the Proyas team for their generous hospitality and warm welcome. In conclusion, I will forever be filled with utmost appreciation and indebtedness to Md. Fazlul Kader, PKSF.

I want to thank all the personnel for giving me this once-in-a-lifetime opportunity and supported me both directly and indirectly throughout these past three months. I am a proud intern of PKSF - the place that has helped me grow professionally and carve out my career. I hope this internship report serves as a testament to the immense knowledge and experience gained through this fantastic opportunity and that I can continue using it in my future career.

Ananna Sardar

Intern, Palli-Karma Sahayak Foundation (10 December, 2024- 10 March, 2025)
BSS (Hons), Institute of Health Economics, University of Dhaka

Preface

This internship gives the intern student a great chance to put their knowledge to use in the real world and make important research contributions. An internship is an excellent opportunity to gain new skills, interact with experienced professionals, and build a strong network. I was incredibly privileged to receive an opportunity from the Palli Karma-Sahayak Foundation, which gave me invaluable insight into my career path and how best to prepare for it. Above all, this valuable experience helped me learn a set of skills essential for success.

This internship period consisted of 3 months, starting from 10 December, 2024 to 10 March, 2025. Throughout the entire period, I was placed at Palli Karma-Sahayak Foundation and had the opportunity to work in a purely devotional atmosphere. During this period, I was able to get hands-on experience in understanding the current problems of rural people and the best methodologies to address them. I was assigned to ECCP-Drought (Environment and Climate Change Project) unit. The focus of my research was on water security, climate adaptation, public health, and specifically examining the role of pond re-excavation in mitigating water scarcity and its impacts on agriculture, livelihoods, and health outcomes. This study is significant in the context of Bangladesh's vulnerability to climate change and its efforts to achieve sustainable development.

To strengthen my research, I conducted a field visit to the three villages Jolahar, Delbari and Amarock in Chapai Nawabganj, a region affected by drought conditions. I closely examined the implementation of pond re-excavation initiatives and their impact on water availability, agricultural productivity, and community resilience. Proyas, a partner organization of PKSF, played a crucial role in facilitating this field visit. Through structured interviews and direct observations, I collected primary data that enriched my study with real-life insights.

This report presents the findings of my study, including quantitative data, qualitative insights, policy recommendations, and an overall reflection on my learning journey. It is my hope that the insights gained from this research contribute to broader discussions on climate adaptation strategies and sustainable water management practices in Bangladesh.

I am incredibly grateful for the opportunity to have interned at PKSF, where I received invaluable mentorship, professional exposure, and research experience. The knowledge and skills gained through this internship will undoubtedly play a crucial role in shaping my future career in Health Economics and sustainable development research.

Introduction

Climate change means the long-term alteration of the temperature and patterns of weather, primarily caused by human activities in the form of burning fossil fuel, deforestation, and industrialization. Changes have resulted in rising global temperatures, sea-level rise, and extreme weather events that have substantially affected ecosystems, water resources, and human livelihoods.

The adaptation strategies would then involve adjusting systems, practices, and policies to minimize adverse effects and maximize benefits. Efficient adaptation measures involve approaches such as better water resource management and agricultural innovations that help in strengthening the resiliency of the community to climate-induced hazards, including droughts.

Drought, a recurring natural calamity, frequently impacts the Barind Tract in northwest Bangladesh. Unlike sudden disasters such as cyclones or earthquakes, droughts develop gradually, making their onset, severity, and duration difficult to predict. A lack of rainfall depletes soil moisture, causes water shortages, and disrupts agriculture, food production, and livelihoods. The most immediate consequence is reduced crop yield, which threatens food security in the region.

Excessive groundwater extraction coupled with climate change has raised severe questions about the security of water in the Barind Tract. Due to decreased rainfall and high rates of evapotranspiration, there has been increased severity in water shortages. Specifically, severe depletions have resulted in over a meter loss of groundwater in single drought years. Such impacts have caused mass failure of hand tube wells (HTWs) with wide implications for agricultural sustainability and public health.

Droughts in Bangladesh are getting more frequent and severe. Currently, about 77% of irrigated area of the country is dependent on groundwater, but decreasing water tables create a serious threat to future agricultural productivity. If this trend keeps up, long-term sustainability will be compromised. Depletion of water resources in the Barind Tract is related not only to agriculture and economic issues but also to public health. Scarcity of clean drinking water increased its lack,

while increased the prevalence of waterborne diseases such as diarrhea, cholera, and dysentery among children and the most vulnerable populations. Women and girls are mainly suffering due to rural areas' traditional responsibility to fetch water for their families. With the lack of water and inability to find it in traditional places, they must walk long distances, spending less time on education, income-generating activities, and rest.

Climate change has increased water-related hazards in Bangladesh. Indeed, more than 70 million people in the country will be affected by different climate-induced hazards by 2050. There is a belief that conditions within the Barind Tract would worsen further with increased temperatures, sunshine hours, and decreased rainfall. On record, in extreme drought years, the rain received has been 46% below the normal, depleting soil moisture and exacerbating water shortage situations.

Adaptation measures, like ensuring water security, are urgent and highly needed in the Barind region due to accelerated climate change. Strategies such as re-excavation improve the retention capacity for surface water and serve as an alternative to over-extraction of groundwater resources. Traditionally, ponds have served an important purpose in the management of water resources, supplying irrigation, livestock, household, and even aquaculture needs. Due to siltation and general neglect and encroachment of land, much storage capacity has been lost in these traditional ponds. Their re-excavation to mitigate water shortages can capture the monsoon rainfall, thus recharging groundwater and reducing dependency on deep tube wells.

Due to this recurring drought, several government and non-government organizations have taken different initiatives for adaptation. In this area, the most important organization facilitating irrigation and also implementing drought risk reduction measures is the BMDA. The NWMP has identified drought as one of the major water-related hazards in northwestern Bangladesh and emphasizes sustainable water management strategies.

In spite of these, sustainability in the use of groundwater remains a critical issue. Though the groundwater supported 77% of the country's total irrigated land in 2007-08 (BBS 2009), its continued depletion is threatening future agricultural productivity. As such, it is integral to

incorporate pond re-excavation into larger-scale climate adaptation and rural development strategies for ensuring long-term water security.

This study will assess the effectiveness of pond re-excavation as a climate adaptation measure in the Barind Tract by evaluating its impacts on water availability, agricultural productivity, and livelihoods at the local level. The research will add to the knowledge base on sustainable water management in drought-prone areas. Additionally, it will provide policy guidelines on how pond re-excavation can be integrated into national climate adaptation strategies.

Chapter 1: An Overview of PKSF and Introduction to Environment and Climate Change Project (ECCP)

1.1 History of PKSF

PKSF was established by the Government of Bangladesh in 1990, with a mandate to contribute to poverty reduction, elimination, and development in the country. From the beginning, it is a microfinance development institution that works mainly with non-governmental organizations (NGOs) to promote and develop microfinance institutions in Bangladesh. It provides technical assistance, capacity building support, financial services and other related services to boost the performance of its partner organizations. Over the years, however, the contribution of micro-credit to poverty reduction has been analyzed through critical lenses and different studies show that access to micro-credit alone cannot create a sustainable pathway out of poverty. In 2010, PKSF took an innovative leap in its mission by redefining its core purpose to “establishing human dignity” instead of merely striving for economic freedom. This prompted the organization to initiate multiple programs toward achieving this goal and allowing it to become a trailblazer in holistic development initiatives in Bangladesh.

Figure: PKSF Building

1.2 Vision & Mission of PKSF

The motto of PKSF is sustainable poverty reduction through employment generation. It also works towards improving the livelihoods of the deprived people by providing them access to microcredit, capacity building and other interventions at the grassroots level.

The vision of PKSF is **"A Bangladesh where poverty has been eradicated; the ruling development and governance paradigm is inclusive, people-centered, equitable and sustainable; and all citizens live a healthy, appropriately educated and empowered and humanly dignified life."**

The major objectives of PKSF are:

1. The PKSF is committed to providing a variety of financial means and aid to various non-government, semi-government, government organizations, voluntary agencies and groups, societies, and local government bodies. To generate income opportunities for economically disadvantaged individuals in our society.
2. To boost the institutional capacity of POs so they can effectively manage their program for sustainable paper.
3. Devoted to establishing, encouraging, and identifying secure employment opportunities for the extremely poor, small farmers, and micro-entrepreneurs. Moreover, PKSF provides

them with assistance such as education services that will help enhance their capacity while also offering health support and risk reduction training.

1.3 Funding of PKSF

PKSF mandate authorizes PKSF management to mobilize funds in the forms of grants, loans, and contributions from a wide variety of sources which include the Government of Bangladesh (GOB), private individuals and organizations, foreign governments, international donors and lending agencies and capital markets. So far, PKSF has received funds from the GOB, the IDA/World Bank, the USAID, the Asian Development Bank (ADB), and the International Fund for Agricultural Development (IFAD).

1.4 Programs & Projects

Current programs PKSF are working on:

1. Jagoron
2. Sufolon
3. Agrosor
4. Buniad
5. WASH
6. Climate-Resilient Haor
7. ENRICH ECCP-Drought
8. Microenterprise Financing and Credit Enhancement
9. PPEPP-EU
10. RAISE
11. RHL
12. Rural Microenterprise Transformation Project (RMTP)
13. SMART
14. IRMP

Current Projects PKSF are working on:

1. Sustainable Enterprise Project (SEP)
2. PROSPER
3. Bangladesh Rural Water, Sanitation and Hygiene for Human Capital Development Project
4. Extended Community Climate Change Project- Flood (ECCCP- Flood)
5. Low Income Community Housing Support Project (LICHSP)
6. Promoting Agricultural Commercialization and Enterprises (PACE)
7. Pathways to Prosperity for Extremely Poor People (PPEPP) Project
8. Skills for Employment Investment Program (SEIP)

1.5 Background of ECCCP-Drought

Figure: Drought Problem in Barind Bangladesh

The Extended Community Climate Change Project-Drought (ECCCP-Drought) is a critical initiative aimed at addressing the escalating water crisis in the northwestern Barind region of Bangladesh, where prolonged droughts, rising temperatures, and erratic rainfall patterns have severely impacted agriculture, water security, public health, and local livelihoods. This region, characterized by its arid climate and clay-based soil, faces chronic water shortages, making it increasingly difficult for communities to access sufficient water for drinking, sanitation, and irrigation. As climate change intensifies, these challenges are expected to worsen, exacerbating food insecurity, poverty, and health risks, particularly among vulnerable populations.

ECCCP-Drought takes a comprehensive and multi-dimensional approach to mitigating these issues by focusing on sustainable water resource management, climate-adaptive agriculture, and community resilience-building. The project integrates institutional capacity development, infrastructure improvement, and local engagement to ensure long-term adaptation to drought conditions. A key intervention is the re-excavation of ponds and canals to increase water storage and implementing Managed Aquifer Recharge (MAR) systems to replenish groundwater. Additionally, the project promotes drought-resistant cropping patterns, which help farmers reduce their dependence on excessive irrigation while maintaining agricultural productivity.

Beyond its direct impact on water and food security, ECCCP-Drought also has significant social and gender implications. Water scarcity disproportionately affects women and marginalized communities, who bear the burden of fetching water and managing household resources. By increasing access to safe drinking water and promoting sustainable agricultural practices, the project not only enhances economic resilience but also contributes to public health improvements and gender equity in decision-making related to water management and livelihood strategies.

My research explores the effectiveness of these interventions—particularly the role of pond re-excavation—in improving water availability, agricultural sustainability, and community resilience in the drought-prone Barind region. Through field-based investigations, this study aims to assess how these measures contribute to long-term water security, climate adaptation, gender dynamics, and overall well-being in the face of worsening climate conditions.

Chapter 2: Description of Internship & Study Area, PO

2.1 Internship Description

The internship is a non-credit course done in fulfillment of the requirements for a Bachelor of Social Science in Health Economics. The main objective of this internship program is to gain practical experience in the field of health economics and to develop a better understanding of research and its implementation concepts. Moreover, the interns would be required to put their theoretical knowledge into practice and develop analytical skills.

During my internship at Palli Karma-Sahayak Foundation (PKSF), I had the opportunity to conduct an in-depth study on the role of pond re-excavation in addressing water scarcity and its impact on agricultural productivity, local livelihoods, public health, and gender dynamics in the Barind region. This research aimed to assess how water security interventions, particularly pond re-excavation, contribute to mitigating drought-induced challenges in one of Bangladesh's most climate-vulnerable areas.

Over the course of 12 weeks, I engaged in extensive fieldwork, interacting with local communities, agricultural stakeholders, and public health professionals to understand the broader implications of water scarcity in the Barind region. The study particularly focused on how re-excavated ponds enhance water availability for irrigation, drinking, and household use, thereby influencing agricultural productivity, health outcomes, and gender roles within affected communities.

This report outlines the objectives, methodologies, and key findings of my research, emphasizing the economic and social benefits of improved water access. It explores how water resource management strategies, such as pond re-excavation, contribute to climate adaptation efforts, ensuring sustainable livelihoods, food security, and public health resilience in drought-prone areas. Additionally, the study examines the gendered impacts of water scarcity, particularly how women bear the burden of water collection and household management in times of crisis.

By analyzing both quantitative data and qualitative insights, this research provides a comprehensive understanding of the role of pond re-excavation as a climate adaptation strategy. The findings contribute to policy discussions on sustainable water management and highlight the importance of integrated approaches to tackling water security, climate resilience, and rural development in Bangladesh.

This internship has been an invaluable experience, allowing me to apply my academic knowledge to real-world challenges. The insights gained will be instrumental in shaping my future research and career aspirations in water security, climate adaptation, and public health economics.

2.2 PROYAS-Partner Organization

Proyas Manobik Unnayan Society is a non-governmental organization dedicated to the development and empowerment of disadvantaged communities in Bangladesh. Established in 2000 and officially registered under various national authorities, Proyas focuses on improving the lives of marginalized, vulnerable, and indigenous populations. The organization emphasizes local-level participation, resource utilization, and skill development to ensure sustainable progress. Through initiatives in education, technology, microfinance, and social justice, Proyas works to enhance self-reliance and advocate for equal rights, fostering a society free from deprivation and discrimination.

PROYAS Vision

1. Believes all humans have creativity and potential for change.
2. Advocates for social justice and self-reliance through people's participation.
3. Aims to establish a society free from deprivation and discrimination.
4. Focuses on holistic development and ensuring basic rights for all.

PROYAS Mission

1. Empowers disadvantaged people through participation in development.
2. Strengthens local organizations and utilizes local resources for sustainability.
3. Enhances technical skills and self-awareness among vulnerable groups.
4. Facilitates equal access to public and private services.
5. Works for the betterment of oppressed, poor, and marginalized communities.

2.3 Study Area

The study was conducted across three villages: Jolahar, Delbari, and Amarock, located in Chapai Nawabganj. The majority of the population in these areas is Christian and Hindu, with a smaller Muslim community. The residents of Jolahar and Delbari predominantly belong to the Sultan community. The majority of the population is engaged in agriculture, with additional livelihoods related to livestock farming. Both male and female members of the community participate actively in agricultural activities, contributing to the local economy. Each community has undertaken pond re-excavation projects, which play a critical role in improving water availability. The water from these ponds is utilized for a variety of purposes, including irrigation for fish production, livestock watering, and household needs, such as washing and bathing. The study explores the impacts of water scarcity, pond re-excavation, and how these initiatives influence agricultural productivity, local livelihoods, and gender dynamics in these rural communities.

Figure: Female Farmer

Chapter 3: Literature Review

3.1 Literature Review

Water security in the Barind region of Bangladesh is a critical concern, given the area's reliance on groundwater and the increasing threats posed by climate change. Water security encompasses access to adequate, safe, and sustainable water resources for domestic, agricultural, and industrial purposes while mitigating water-related risks (Grey & Sadoff, 2007). The Barind region, which includes Rajshahi, Naogaon, and Chapainawabganj districts, is a drought-prone area experiencing severe water scarcity due to erratic rainfall patterns, groundwater depletion, and inefficient water

management strategies (Islam et al., 2019). The region receives lower annual rainfall compared to other parts of Bangladesh, making it highly dependent on groundwater extraction for irrigation. However, over-extraction of groundwater has led to declining water tables, making access to water increasingly difficult (Ahmed, 2012).

Climate change has intensified water insecurity in the Barind Tract by increasing drought frequency, reducing groundwater recharge, and altering seasonal water availability (Ahmed & Alam, 1998). Rising temperatures and shifting monsoon patterns have resulted in prolonged dry spells, further exacerbating water stress in the region (Ahmed, 2005). The Barind Multipurpose Development Authority (BMDA) has played a crucial role in addressing water scarcity by expanding deep tube well irrigation networks. However, studies suggest that this approach is unsustainable in the long term, as groundwater is being extracted at a faster rate than it is being replenished (Shamsudduha et al., 2009). To mitigate this crisis, alternative adaptation strategies such as rainwater harvesting, surface water storage, and pond re-excavation have been proposed (Islam et al., 2019).

Drought is a recurring problem in the Barind region, affecting both agricultural productivity and local livelihoods. Farmers and government agencies have implemented various adaptation strategies to cope with water scarcity. Farmer-led adaptation measures include crop diversification, re-excavation of ponds, and the adoption of alternative economic activities (Islam et al., 2019). Many farmers have shifted from water-intensive crops like rice to drought-resistant crops such as wheat, maize, and pulses to reduce irrigation demands (Islam et al., 2019). Pond re-excavation has emerged as an effective means of storing surface water and reducing reliance on deep tubewells (Rahman & Mahbub, 2012). Farmers who utilize pond water for irrigation report lower costs and improved crop yields compared to those dependent solely on groundwater sources (BMDA, 2016).

In addition to individual efforts, government initiatives have played a vital role in water resource management. The BMDA has expanded irrigation infrastructure by installing deep tubewells and underground pipelines to optimize water distribution (BMDA, 2016). Other initiatives include the promotion of rainwater harvesting and the excavation of small ponds to enhance surface water storage capacity (Islam et al., 2019). While these measures have provided short-term relief, long-term sustainability remains a challenge due to continued groundwater depletion and the need for improved maintenance of water storage systems (Shamsudduha et al., 2009).

Pond re-excavation has gained attention as a viable strategy for improving water security and climate resilience in the Barind region. Historically, ponds were widely used for multiple purposes, including irrigation, livestock, and domestic use, but many have become silted or abandoned over time (Ahmed, 2012).

Recent initiatives by government and non-governmental organizations aim to restore these ponds to their original capacity, enhancing their ability to store monsoon water for use during dry seasons (Islam et al., 2019). Re-excavated ponds provide a sustainable water source, support groundwater recharge, and reduce pressure on deep tube wells.

Studies indicate that pond re-excavation significantly improves water availability for agricultural and domestic purposes. Farmers who utilize pond water for irrigation report higher crop yields and lower irrigation costs compared to those relying solely on deep tube wells (Rahman & Mahbub, 2012). Community-managed ponds promote equitable water distribution and strengthen social resilience against droughts. Challenges such as contamination from fish farming and agricultural runoff pose risks to water quality (Islam et al., 2019). Proper governance and regular maintenance are necessary to ensure the long-term benefits of re-excavated ponds.

Water insecurity in the Barind region has significant social and economic consequences, particularly for marginalized communities. Households, especially women and children, spend considerable time fetching water, reducing opportunities for education and economic activities. The high costs associated with deep tube well irrigation disproportionately affect smallholder farmers, limiting their agricultural productivity and financial stability (Islam et al., 2019). Additionally, food security is threatened as declining water availability leads to reduced crop yields and increased dependency on expensive irrigation methods. Addressing these challenges requires comprehensive policies that integrate water conservation, community-based management, and alternative water storage solutions (Ahmed, 2005).

The literature highlights the urgent need to transition from groundwater-dependent irrigation to more sustainable water management practices in the Barind region. While deep tube well irrigation has provided short-term solutions, long-term water security requires the adoption of surface water conservation methods, improved irrigation efficiency, and stronger community-led adaptation strategies. Pond re-excavation, in particular, presents a promising approach to enhancing water availability, but its success depends on proper maintenance, financial support, and stakeholder collaboration.

Chapter 4: Methodology

4.1 Objectives of the Study

The main objective of the study is to assess the role of pond re-excavation on water security.
The specific objectives are:

- To assess the role of pond re-excavation in enhancing water security.
- To explore the benefit of pond re-excavation in household level.
- To identify role of pond re-excavation in improving public health.

4.2 Methodology

Study Area

The selection of an appropriate research technique is crucial in social sciences, as it provides researchers with systematic tools and methodologies to investigate phenomena and derive insightful conclusions. This study was conducted in three villages (i) Jolahar, Jhilim Union (ii) Delbari, Gobratola Union and (iii) Amarok, Gobratola Union —in Chapainawabganj, where residents rely on pond water for various purposes.

Research Design

This study employs a mixed-method approach, integrating both qualitative and quantitative methodologies. A purposive sampling technique was utilized to select households for participation. Data was gathered through primary and secondary sources.

4.3 Data Collection Methods

Primary Data

Primary data collection was conducted through the following methods:

Survey Questionnaire: A structured questionnaire was designed to assess the role of pond water as a climate adaptation measure. The survey method enabled the identification of specific conditions and ensured that respondents were well-informed prior to participation.

Focus Group Discussions (FGD): Three FGDs were conducted, each comprising 12 to 16 participants. These discussions provided an opportunity for open dialogue and facilitated a deeper understanding of key issues, including challenges related to irrigation, the utilization of pond water, benefits derived from pond re-excavation, and persisting water-related problems.

Key Informant Interviews (KII): In-depth interviews were conducted with key stakeholders who possess firsthand knowledge of the community and water management. Interviews were held with the following individuals:

- Executive Engineer, Barind Multipurpose Development Authority (BMDA)
- Executive Engineer, Department of Public Health Engineering (DPHE)
- Chief Executive Officer and Executive Director, Proyas
- ECCP-Drought Project Coordinator, Proyas

Secondary Data

Secondary data was obtained from books, research papers, academic reports, journals, internship papers, and relevant websites.

In this table, a summarized idea is drawn about the data collection tools, respondents and other related issues.

Data Collection Tools	Respondents	Total numbers
Personal Interviews	Household heads from pond re-excavated area	61 individual household survey
Focus Group Discussion	Household heads from pond re-excavated area	3 FGD (consists of 12 to 16 participants)
Key Informant Interviews	Executive Engineer of BMDA & DPHE, Two officers of Proyas.	4 individual KII

4.4 Sampling

A total of 61 respondents were selected using purposive sampling, focusing on households in areas where pond re-excavation had taken place. Due to time and resource constraints, additional sampling could not be conducted.

4.5 Data Analysis

The collected data was analyzed using simple statistical techniques, including frequency distributions, percentages, and cross-tabulations. Statistical analysis was conducted using SPSS and MS Excel, and results were presented in tables and graphs. Additionally, a narrative description was provided for each research question to enhance comprehension of observed trends and patterns.

4.6 Ethical Consideration

In conducting this research, the highest ethical standards were observed. All data collection and analysis were conducted in accordance with the guidelines of The International Ethical Guidelines for Biomedical Research Involving Human Subjects (CIOMS/WHO 2002). Prior to commencing any research project, there are important ethical considerations that must be taken into account. These include: obtaining informed consent; ensuring the privacy and confidentiality of all participants; avoiding fabrication or falsification of data; considering potential consequences and one's role as a researcher. In order to protect the right of the participants, before conducting all the

surveys, KIIs and FGDs, oral consent was obtained from all participants. Personal information was kept strictly confidential, and no identifiable data was used in the report or published. Moreover, each was entitled to a unique code number to maintain the respondents' anonymity. All study participants were provided with detailed information about the research and its objective before giving their consent.

Chapter 5: Findings from the Study

5.1 Discussion of Findings (Personal Interview)

The discussion of the findings will be based on the research questions and objectives. All results will be discussed in detail by considering any observed trends, patterns or differences.

5.1.1 Demographic Details of the Respondents

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Education	61	1	4	2.26	.964
Main occupation	61	1	3	1.20	.572
Income	61	8000	35000	15901.64	5061.966
Valid N (listwise)	61				

Education Level

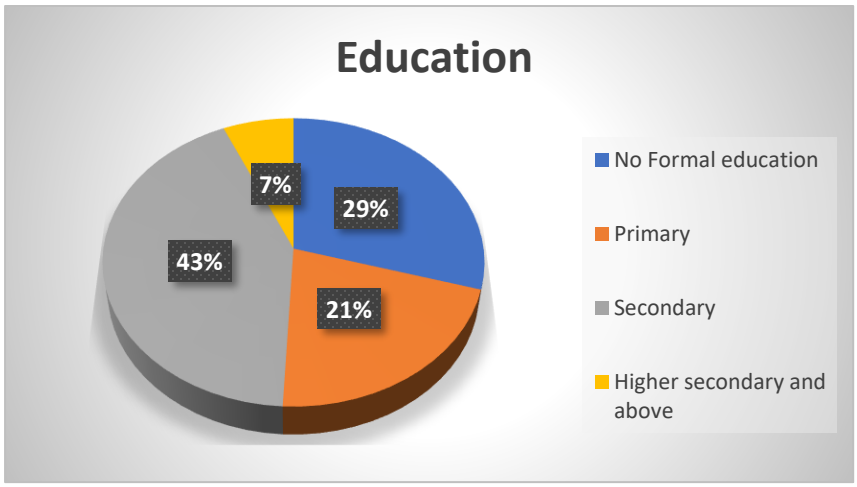
- The average education level is around 2.26, meaning most people fall between primary and secondary education.
- Since the maximum is 4 (higher secondary & above) and the minimum is 1 (no formal education), there is a wide variation in education levels.
- Standard deviation (0.964) suggests moderate spread in education levels, meaning some respondents have lower education while others are more educated.

Main Occupation (Household Head)

- The mean is very close to 1, indicating that most respondents are in occupation category 1 (likely farmer).
- The low standard deviation (0.572) suggests that most people belong to similar occupation types with little variation.

Household Monthly Income

- The average monthly income is 15,901.64, with a minimum of 8,000 and a maximum of 35,000**.**
- The high standard deviation (5,061.97) suggests significant income differences among respondents.



The pie chart showed education levels of the respondents.

- Low education levels dominate the sample:
  - 29% have no formal education.
  - 21% have only primary education.
  - Together, over 50% of respondents have primary education or below.
- Most respondents (43%) have completed secondary education.
- Only 7% have higher secondary education or beyond, indicating low access to advanced education.

Figure: Personal Interview

Correlations

		Education	Income
Education	Pearson Correlation	1	.241
	Sig. (2-tailed)		.061
	N	61	61
Income	Pearson Correlation	.241	1
	Sig. (2-tailed)	.061	
	N	61	61

Interpretation of the correlation

The Pearson correlation coefficient between education and income is 0.241. This indicates a weak positive correlation, meaning that as education increases, income tends to increase slightly, but the relationship is not strong.

5.1.2 Water Security and Agricultural Use

Primary source of water irrigation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Deep Tube well	61	100.0	100.0	100.0

We can see that, all 61 respondents (100%) reported that deep tube wells are their primary source of irrigation water. This indicates complete reliance on deep tube wells for irrigation in the surveyed area.

Figure: Deep Tube well

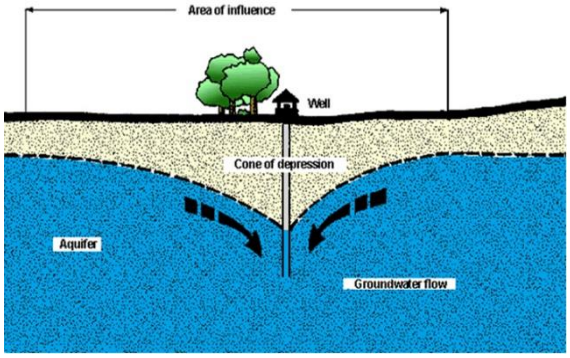
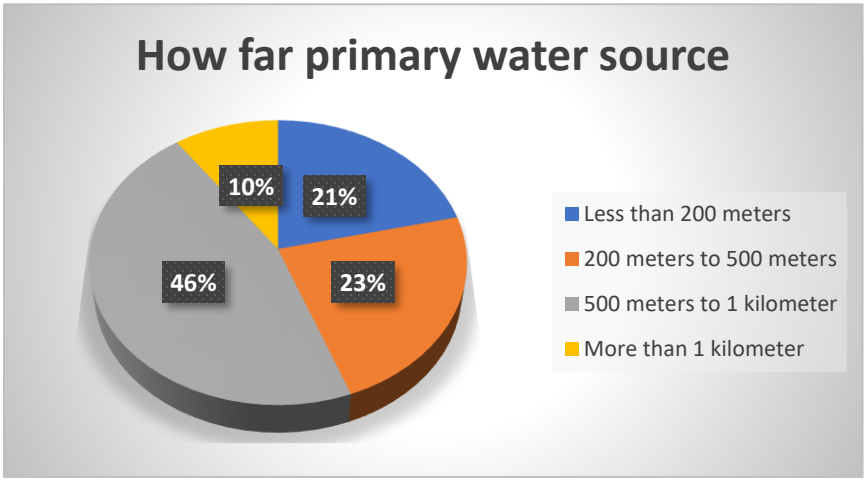


Figure: Groundwater Extraction

Complete reliance on deep tube wells for irrigation leads to excessive groundwater extraction, causing depletion and a declining water table. This reduces water availability for drinking and household use, increases soil degradation, and raises irrigation costs. Farmers face higher energy expenses as deeper wells require more fuel or electricity, affecting profitability. Over-extraction also risks land subsidence, damaging infrastructure. To mitigate these issues, sustainable water management practices such as pond re-excavation, rainwater harvesting, and efficient irrigation methods must be implemented to ensure long-term water security and agricultural resilience.



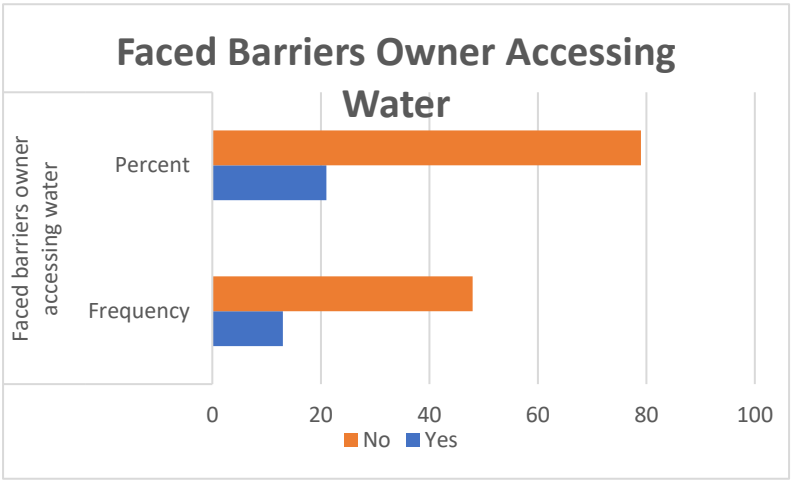
• **Less than 200 meters**: 13 respondents (21%) have their primary water source within a short distance, making access relatively easy.

• **200 meters to 500 meters**: 14 respondents (23%) fall into this range, indicating a moderate distance for water collection.

• **500 meters to 1 kilometer**: 28 respondents (46%) have to travel a significant distance, which could pose challenges for water access.

• **More than 1 kilometer**: 6 respondents (10%) must cover a long distance, which may increase costs and effort for irrigation.

Farmers depend on deep tube wells for irrigation throughout the year. However, during the dry season, when groundwater levels fall, they struggle to obtain sufficient water due to the lack of alternative irrigation sources. Farmers whose land is farther from the deep tube wells receive water later, resulting in delays that can affect crop growth and yield. This water shortage leads to decreased crop production, ultimately causing a loss in farmers' income.



The water source that farmers primarily depend on is owned by private individuals. According to the table, the majority of respondents (79%) do not face significant barriers to accessing water for irrigation. However, 21% of respondents encounter challenges such as distance from the deep tube wells, long waiting queues, and water shortages during the dry season.

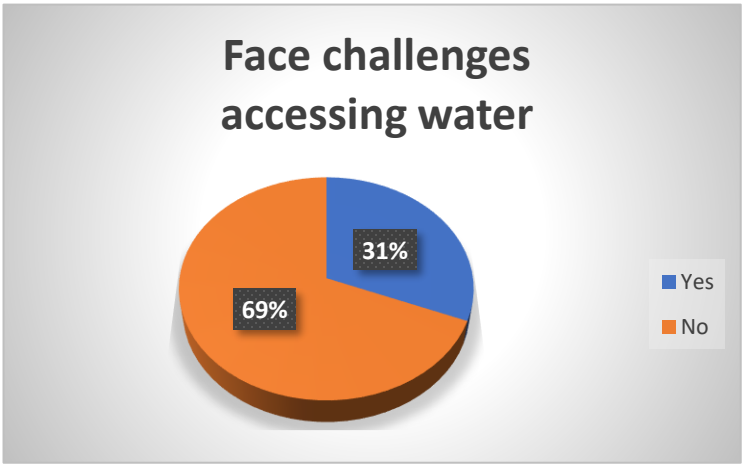
We purposively selected areas where ponds have been re-excavated, as people in these regions use pond water for various purposes. The table shows the different uses of water from these re-excavated ponds.

how to use water from re-excavated pond Frequencies

		Responses		
		N	Percent	Percent of Cases
How to use water from re-excavated pond	Use water livestock	59	47%	97%
	Use water drinking	5	4%	8%
	Use water household	61	49%	100%
Total		125	100.0%	205%

A majority of respondents reported using the water from re-excavated ponds for livestock (47%) and household needs (49%). A small percentage (4%) use the pond water for drinking purposes. The total percentage (205%) exceeds 100% because respondents could select more than one use for the water, indicating that the water is utilized for multiple purposes within the same household.

Re-excavated pond water has slightly increased water availability for agricultural purposes, with people primarily using the pond water for livestock. Almost every household in the area farms livestock, such as cows, goats, and ducks, and they use pond water directly for these purposes. However, pond water is not used for irrigation, suggesting that while the water supports livestock farming, it is not sufficient or suitable for agricultural irrigation needs.

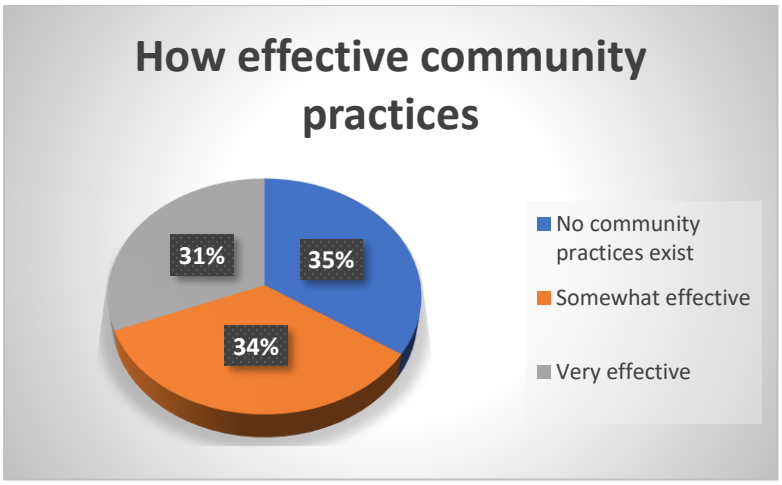


The pie presents data showing that while the majority of respondents (69%) do not face significant barriers, a notable portion (31%) still experiences difficulties in accessing water. Many respondents face barriers to using pond water due to poor water quality. When chemicals such as fish feed are added to the pond water, the water quality decreases, making it unsuitable for household and livestock use. Additionally, some households do not use pond water simply because of the physical distance between the pond and their homes, which makes it less accessible for daily use. These factors contribute to the challenges in utilizing re-excavated pond water for multiple purposes.

5.1.3 Benefit of the Pond Re-excavation

Re-excavated ponds increase the availability of water, reducing the burden on women and other household members who traditionally collect water. In Bangladesh, women primarily handle household responsibilities, and pond water is commonly used for domestic tasks and livestock care. The increased availability of water from the pond lessens women's workload, allowing them more time to engage in income-generating activities. Both men and women in these areas work in the fields, and with improved water access, women can dedicate more time to agricultural activities, vegetable cultivation, and livestock farming. In some regions, local communities have formed committees to manage pond water use and monitor fish production.

Figure: Pond Water Usage for Household Activities



The pie chart presents data on the effectiveness of community practices based on 61 responses.

The first category, "No community practices exist," accounts for 21 responses, making up 35% of the total. Accounts for 21 responses, making up 34% consider community practices to be "Somewhat effective," bringing the cumulative percentage to 69%. The remaining 19 respondents (31%) believe that community practices are "Very effective," completing the total of 100%.

These results indicate that perceptions of community practices are divided. While 65% of respondents acknowledge some level of effectiveness, a significant portion (35%) reports that no community practices exist. This suggests that in some areas, community-led initiatives are either absent or not widely recognized, while in others, they are viewed as beneficial to varying degrees. For this study, we collected data from three villages. In one village, women have been involved in community water management planning. However, in the other two villages, women have not participated in the committee. In one of these villages, no community practices exist because the pond is leased to an outsider, preventing local involvement.

The most significant benefits people have experienced due to pond re-excavation include:

1. **Increased Water Availability**

- The re-excavated ponds store more water, ensuring a reliable water source throughout the year.
- Water security, especially during dry seasons.

2. **Better Livestock Water Access**

- Farmers can now provide sufficient water for their cattle, goats, and ducks.
- Improved access to water has contributed to better livestock health and increased productivity.

Figure: Pond Water Usage for Livestock

3. **Better Household Water Access**

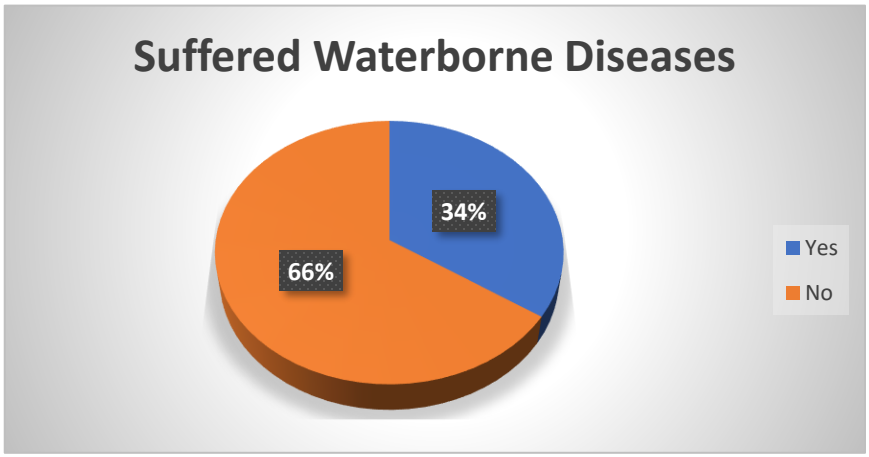
- Households have an improved and more convenient source of water for daily activities such as bathing, cleaning, and washing.
- The reduced need to travel long distances for water collection has eased the burden, particularly on women.

4. **Enhanced Fish Production**

- The availability of water has enabled local communities to engage in fish farming.
- Increased fish production contributes to both improved nutrition and additional income opportunities for households.

These benefits have collectively improved the livelihoods of people in the community.

5.1.4 Impacts on Public Health



The pie chart presents the prevalence of waterborne diseases among respondents.

- 21 respondents (34%) reported suffering from waterborne diseases.
- 40 respondents (66%) did not report suffering from such diseases.

The data suggests that waterborne diseases are a significant issue, affecting over one-third of the respondents. Many of those who suffered from waterborne illnesses reported experiencing diarrhea and cholera, which are commonly linked to the consumption of contaminated water. However, the majority (66%) did not report experiencing such diseases, which may indicate improvements in hygiene practices, better water treatment methods, or access to safer water sources in some areas. From this study we know that, a majority (63%) of respondents rely on pond water for toilet-related activities. This suggests that ponds serve as an essential water source for sanitation and hygiene practices in the community. However, 37% of respondents do not use pond water for toilet activities, which could be due to factors such as access to other water sources, concerns about water quality, or personal preferences.

People use pond water for various livelihood activities, including rearing cattle, goats, and ducks, as well as engaging in fish production. Cattle provide milk, which families consume and sell in the market. Ducks produce eggs, contributing to both household nutrition and income. Additionally, some families use pond water for vegetable cultivation, while fish harvested from the pond serve as a valuable food source.

These activities contribute to a better diet for the community. Despite widespread livestock rearing, most people prioritize selling their produce—milk, eggs, fish, and vegetables—rather than consuming them in sufficient quantities. As a result, while these activities generate income, the dietary intake of the local population remains inadequate.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.354	.254		5.327	.000
	Education	.062	.070	.122	.882	.382
	Main occupation	-.034	.115	-.040	-.291	.772
	Income	-5.521E-6	.000	-.058	-.421	.676

a. Dependent Variable: better hygiene practice

This regression analysis examines the impact of Education, Main Occupation, and Income on Better Hygiene Practice.

In a 95% confidence interval two-tailed test, the critical t-value is approximately ±1.96. Here, all t-values are below ±1.96, none of the independent variables (Education, Main Occupation, and Income) have a statistically significant effect on better hygiene practice at the 95% confidence level.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.124[a]	.015	-.037	.495

a. Predictors: (Constant), Income, Main occupation, Education

R square score of 0.15 would suggest that the model is not a very good fit to the data, as it indicates a relatively large discrepancy between the predicted and observed values.

5.2 Discussion on Findings from FGD

As part of the study, three Focus Group Discussions (FGDs) were conducted in different villages of Chapainawabganj to explore local perspectives on water security, the role of pond re-excavation, and its impact on livelihoods, agriculture, and gender roles. The discussions revealed the interconnected nature of water scarcity, livelihood challenges, and community-driven water resource management.

First FGD: In Jolahar Village

The first FGD was conducted in Jolahar village, Jhilim union, Chapainawabganj Sadar, involving 16 community members. The participation was local farmers, community leaders, and women involved in household water management. The discussion primarily focused on the role of pond re-excavation as a climate adaptation measure and the persistent water challenges in the region.

Community members reported that agricultural irrigation in the village is largely dependent on deep tube wells. However, the high operational costs of electricity for tube wells pose a significant financial burden on farmers. Water access is rationed, allowing each farmer to irrigate only one bigha of land per turn, often leading to delays in crop production. This situation underscores the urgent need for alternative water sources, including the revival and proper utilization of ponds.

Although pond exist in the village that was re-excavated under an Integrated Water Resource Management (IWRM) initiative led by the BMDA, this is primarily used for fish farming and livestock rearing rather than irrigation. Traditionally, villagers used pond water for household activities such as washing, and bathing, but currently, the introduction of chemical-laden fish feed has deteriorated water quality, making it unsuitable for domestic consumption.

A notable aspect of water governance in Jolahar is the existence of a community water management committee, with active participation from women in decision-making processes. However, the committee faces difficulties during the dry season when water levels drop drastically, further worsening water insecurity. The participants collectively expressed a strong demand for pond re-excavation, believing that it would enhance water retention, support sustainable agricultural practices, and improve climate resilience in the village.

Second FGD: In Delbari Village

The second FGD took place in Delbari village, Gobratola union, Chapainawabganj Sadar, involving 12 community members who shared their experiences with a pond that was re-excavated in 2017 under an Integrated Water Resource Management (IWRM) initiative led by DASCO NGO.

Community members contributed 614,933 BDT, with 61,493 BDT paid collectively by villagers, to support the excavation. The pond now serves multiple purposes, including household water use, livestock rearing, and fish farming. Fish are harvested twice a year, with some consumed locally and the rest sold in markets. The income generated is reinvested in purchasing tona fish for future cycles, demonstrating a sustainable local fishery model.

Pond water has also facilitated homestead vegetable gardening, helping families cultivate crops such as pumpkin, spinach, and bottle gourd. However, despite these benefits, agricultural irrigation remains heavily dependent on deep tube wells, which charge approximately 1,900 BDT per bigha during the rice-growing season.

A major concern raised was gender disparity in pond management. Unlike Jolahar, where women actively participate in water governance, the pond in Delbari is overseen by an all-male committee, limiting women's role in decision-making. Additionally, during dry seasons, when pond water becomes insufficient, households collectively contribute funds to access deep tube well water, reinforcing the financial burden on farmers.

This FGD highlighted the success of pond re-excavation in supporting domestic and livestock water use, while also revealing persistent gaps in irrigation support and gender-inclusive water management.

Third FGD: In Amarock village

The third and final FGD was conducted in Amarock village, Gobratola union, Chapainawabganj Sadar, involving 16 community members who discussed critical water shortages, pond management issues, and the economic impact of water scarcity.

Unlike in Delbari, where a community-managed pond provided multiple benefits, the pond in Amarock is leased to external individuals, preventing local residents from accessing its fish resources unless purchased. This exclusionary leasing practice has led to frustration among community members, who feel they should have direct access to local water resources.

Water scarcity in Amarock is far more severe than in the previous two villages. The community has no individual household water taps and depends on a single water tank for daily needs. Residents queue for hours to collect water, causing significant time loss, particularly for women and farmers. Additionally, there are no hand tube wells in the area, making the village completely reliant on limited groundwater access.

During the dry season, the situation worsens as groundwater levels drop, forcing many residents to drink untreated pond water, exposing them to potential health risks. The absence of adequate drinking water infrastructure was a primary concern expressed by the participants.

For agricultural irrigation, deep tube wells remain the only option, but farmers face high operational costs, paying approximately 1,800 BDT per bigha. However, most residents do not own agricultural land; instead, they work as sharecroppers, further reducing their financial capacity to sustain farming operations.

Livestock rearing is widespread, similar to Jolahar and Delbari, but due to water scarcity, the community struggles to maintain livestock health. Additionally, during power outages, when the water tank runs dry, residents must rely entirely on pond water for sanitation, livestock maintenance, and daily chores.

The findings from this FGD underscored the urgent need for infrastructure development, including additional water storage systems, re-excavation of community-owned ponds, and equitable management policies that prevent external leasing of vital water resources.

Figure: FGD at Amarock village, Gobratola union, Chapainawabganj Sadar

Comparative Insights and Policy Implications

Across the three FGDs, several common themes emerged.

First, pond re-excavation is widely recognized as a valuable intervention that can improve water retention and support agricultural, household, and livestock water needs.

Second, deep tube well dependency remains a significant financial challenge for farmers, with high irrigation costs limiting agricultural productivity.

Third, gender disparity in water governance varies across villages, with some communities actively engaging women in decision-making, while others exclude them from management roles.

Fourth, leasing ponds to external entities deprives local residents of key resources, limiting their ability to use community water bodies for fish farming and irrigation.

Finally, severe water scarcity, particularly in Amarock Union, highlights the urgent need for alternative water infrastructure, including hand tube wells, and improved pond management strategies.

These findings indicate that future policy efforts should focus on expanding pond re-excavation projects, integrating women into water governance, and ensuring community ownership of water resources to enhance climate adaptation and rural resilience.

5.3 Remarks of Key Informants Interviews (KII)

To gain expert insights on water security challenges and the role of pond re-excavation in the Barind region, four key informant interviews (KIIs) were conducted. Each interview provided valuable perspectives on the implementation, management, and policy recommendations for improving water resource sustainability in the region.

Key Informant Interview with Engineer Md. Al Mamunur Rashid, Executive Engineer, Barind Multipurpose Development Authority (BMDA)

Engineer Md. Al Mamunur Rashid provided insights into the severity of water scarcity in the Barind region and the necessity of pond re-excavation as a climate adaptation measure. He emphasized that the region faces significant water security challenges due to the limited availability of groundwater, exacerbated by high temperatures, low rainfall, and excessive groundwater extraction for irrigation.

The pond re-excavation initiative was designed to serve two primary objectives: facilitating rainwater harvesting and enabling sustainable fish production within re-excavated ponds. These ponds not only supplement local water needs but also create additional income-generating opportunities for rural communities.

Regarding water governance, Engineer Rashid highlighted the role of community committees in managing re-excavated ponds. The government leases these water bodies to local groups, allowing communities to gain lease authorization through collective financial contributions. This model ensures greater community control over water resources, contrasting with cases where lease owners monopolize fish production and restrict access to water.

One of the most significant benefits of pond re-excavation, as noted by Engineer Rashid, is the reduction in groundwater dependency. By utilizing stored rainwater for household use and livestock rearing, the demand for groundwater extraction decreases, helping to restore groundwater balance in the region.

To further improve water resource management, Engineer Rashid suggested several policy measures, including re-excavating more ponds, rivers, and canals, enhancing the utilization of Mohananda River water for irrigation, and implementing Managed Aquifer Recharge (MAR) technology to replenish groundwater reserves and improve water quality.

Figure: KII with Executive Engineer of BMDA

Key Informant Interview with Hasib Hossain, Chief Executive Officer & Executive Director, Proyas Manobik Unnayan Society

Hasib Hossain emphasized the role of pond re-excavation in preventing desertification and enhancing water security in the Barind region. He explained that re-excavated ponds serve multiple functions, including fish production, household water use, livestock maintenance, and limited agricultural irrigation.

Community engagement plays a crucial role in the sustainable management of pond water, and local committees have been formed to oversee pond maintenance and regulate water distribution. However, he stressed that long-term success depends on active local participation and institutional support.

Hossain also discussed new initiatives by Palli Karma-Sahayak Foundation (PKSF), which has started excavating deeper ponds (15 to 17 feet) specifically for agricultural irrigation. He noted

that these deeper ponds have the potential to significantly reduce groundwater dependency by storing sufficient rainwater for farming purposes.

By implementing more pond excavation projects, Hossain believes that the pressure on groundwater resources can be mitigated, leading to long-term water sustainability in the Barind region.

Key Informant Interview with Bakul Kumar Ghosh, Project Coordinator, Proyas Manobik Unnayan Society

Bakul Kumar Ghosh highlighted the severe water security challenges faced by the Barind region, particularly the impact of water scarcity on irrigation, household consumption, livestock care, and drinking water availability. The region receives significantly less rainfall than other parts of Bangladesh, leading to a steady decline in groundwater levels—in some areas, by as much as 20 feet. This situation has intensified dependence on deep tube wells for irrigation, increasing financial burdens on farmers.

To address these issues, pond re-excavation has emerged as a key intervention to enhance water storage and reduce reliance on groundwater. Ghosh explained that the Integrated Water Resource Management (IWRM) initiative has facilitated the implementation of pond re-excavation projects, but the success of these projects depends on community engagement.

A major concern raised by Ghosh is the challenges in pond leasing systems. While the government leases ponds to communities for collective use, in many cases, an individual leaseholder restricts water access and monopolizes fish production. This practice limits economic benefits for local residents and prevents equitable water distribution.

Additionally, Ghosh emphasized the need for better enforcement of the Water Law of 2013. He pointed out that local governance structures, such as Union and Upazila Water Management Committees, must be strengthened to ensure proper oversight of pond resources. By integrating legal frameworks with community-driven initiatives, long-term water sustainability in the Barind region can be better secured.

Key Informant Interview with Amit Kumar Sarkar, Executive Engineer, Department of Public Health, Chapainawabganj Sadar

Amit Kumar Sarkar discussed the critical water security challenges in the Barind region, emphasizing that excessive groundwater extraction for agriculture has led to a sharp decline in groundwater levels. Farmers struggle to access sufficient water for irrigation, resulting in reduced agricultural yields and economic distress for rural communities.

Beyond agriculture, household water security is also at risk. Many residents in the region rely on pond water for drinking and sanitation purposes, particularly during the dry season when alternative sources are unavailable. However, the use of untreated pond water poses serious health risks, contributing to waterborne diseases such as diarrhea and skin infections. Despite these risks, limited access to clean water infrastructure forces communities to depend on unsafe water sources.

Sarkar emphasized that sustainable water resource management is crucial to addressing these challenges. He suggested expanding pond re-excavation programs, improving rainwater harvesting infrastructure, and enhancing sanitation practices to reduce health risks. He stressed the importance of community awareness programs to promote safe water usage and hygiene practices.

Without immediate intervention, he warned that continued groundwater depletion and reliance on unsafe water sources could trigger long-term health and livelihood crises in the Barind region.

Insights from KII

The key informant interviews provided crucial insights into the water security crisis in the Barind region and the potential of pond re-excavation as a sustainable water management strategy. The experts collectively emphasized the importance of community involvement, institutional support, and policy enforcement in ensuring the long-term success of water conservation efforts.

Several common themes emerged across the interviews.

First, pond re-excavation is an effective solution for enhancing water storage, reducing groundwater dependency, and supporting multiple water needs.

Second, community participation is essential for the sustainable management of re-excavated ponds, but governance challenges such as inequitable leasing practices need to be addressed.

Third, the declining groundwater table is a serious concern, particularly for farmers dependent on deep tube wells. Alternative solutions, such as rainwater harvesting and deeper storage ponds, must be prioritized.

Fourth, health risks from unsafe water sources remain a major issue, necessitating improved sanitation infrastructure and public awareness campaigns on safe water use.

Fifth, stronger policy enforcement and legal frameworks are necessary to ensure equitable access to water resources and prevent exploitation by individual leaseholders.

By integrating community-driven water governance, scientific advancements in water storage, and effective policy implementation, the Barind region can move toward long-term water sustainability and climate resilience.

Chapter 6: Discussion & Recommendations

6.1 Discussion

The findings of this study emphasize the crucial role of pond re-excavation as a climate adaptation strategy in the Barind region of Bangladesh. Persistent water scarcity, driven by excessive groundwater extraction and declining rainfall, has placed immense pressure on local farmers and communities. While deep tube wells remain the dominant source of irrigation, their high operational costs make them unsustainable for small-scale farmers. In this context, re-excavated ponds have emerged as an alternative source of water, supporting household consumption, livestock maintenance, and, to a limited extent, agricultural irrigation. However, the effectiveness of these ponds varies across different communities, highlighting the need for improved management and equitable access.

The study reveals that in Jolahar village, the availability of re-excavated ponds has provided some relief, but concerns over water quality have restricted their use for irrigation. Contamination from fish feed and other pollutants has made the water unsuitable for agricultural purposes, limiting the benefits that could have been realized through proper pond management. In contrast, Delbari village has demonstrated a more effective model of community-led pond management. Here, a well-maintained re-excavated pond supports fish farming, vegetable cultivation, and household water use, significantly contributing to the local economy and food security. However, in Amarock village, residents face challenges in accessing pond water due to external leaseholders controlling the resource. This monopolization prevents local farmers and households from benefiting from the re-excavated pond, underscoring the importance of ensuring community ownership and equitable governance of water resources.

The study also highlights gender disparities in water governance. While some communities actively involve women in decision-making processes related to water management, others exclude them, limiting their ability to influence decisions that directly impact their daily lives. The establishment of community-led pond management committees has shown promise in ensuring sustainable water use, yet challenges persist in achieving equitable distribution and long-term maintenance. Greater efforts are needed to promote gender-inclusive governance, as women play a critical role in water collection and household water management.

Water scarcity not only affects agricultural productivity but also has significant economic implications. Farmers who rely on deep tube wells struggle with high irrigation costs, making it difficult to sustain their livelihoods. As a result, some farmers have adopted alternative livelihood strategies, such as fish farming and vegetable cultivation, to offset financial losses. However, the success of these adaptation measures depends heavily on institutional support, including financial assistance and capacity-building initiatives. Without adequate resources, small-scale farmers will continue to face difficulties in accessing and managing water resources effectively.

Despite the benefits of pond re-excavation, several barriers still limit its effectiveness. Many households face challenges related to the distance of ponds from their homes, poor water quality, and financial constraints. Additionally, waterborne diseases remain a concern, particularly in areas where untreated pond water is consumed during shortages. Regression analysis from the study indicates that education, income, and occupation do not have a statistically significant impact on better hygiene practices, suggesting that other socio-environmental factors play a more influential role. This finding highlights the need for targeted public health interventions and awareness programs to improve hygiene and sanitation practices in water-scarce communities.

To ensure the long-term sustainability of pond re-excavation as a climate adaptation strategy, several policy considerations must be addressed. First, improved governance structures are necessary to prevent monopolization of water resources by external entities and to promote fair access for all community members. Strengthening community-led water management and integrating alternative irrigation strategies, such as Managed Aquifer Recharge (MAR), can help mitigate groundwater depletion and enhance water security. Additionally, promoting sustainable agricultural practices, such as cultivating drought-resistant crops and adopting efficient irrigation techniques, can further support resilience to climate change.

Ultimately, the study underscores the importance of an integrated approach to water management, combining equitable governance, community participation, and institutional support. By addressing the existing challenges and strengthening climate adaptation measures, pond re-excavation can serve as a transformative strategy for improving water security, economic resilience, and sustainable development in drought-prone areas of the Barind regio

6.2 Recommendations

Based on the findings of this study and insights from previous research on drought adaptation, several targeted recommendations are proposed to enhance water security and climate resilience in the Barind region. These recommendations focus on governance, infrastructure, financial support, and community engagement to ensure the sustainability of pond re-excavation and other adaptation measures.

1. **Strengthening community water governance**

- Establish inclusive water management committees with active participation from community members, particularly women, to ensure fair decision-making and resource distribution.
- Introduce community-led monitoring systems to prevent the monopolization of re-excavated ponds by external leaseholders and ensure equitable access to water resources.
- Enforce the Water Law of 2013 to regulate pond leasing practices, ensuring that local farmers and households have priority over external entities.

2. **Enhancing surface water utilization and alternative irrigation methods**

- Expand pond re-excavation projects with structured long-term maintenance plans to increase water storage capacity.
- Promote rainwater harvesting systems at both household and community levels to supplement existing water sources.
- Encourage drip and sprinkler irrigation techniques to optimize water use and reduce reliance on deep tube wells.
- Develop underground pipeline networks to distribute surface water efficiently for agricultural irrigation.

3. **Addressing water quality issues**

- Implement regular water quality monitoring programs to assess the safety of pond water for irrigation, livestock, and household use.
- Encourage eco-friendly fish farming practices by introducing organic fish feed alternatives to prevent contamination of pond water.
- Establish community training sessions on sustainable pond management and safe water handling to reduce health risks.

4. **Increasing financial and technical support for farmers**

- Provide subsidies for irrigation costs and financial incentives for farmers adopting water-efficient agricultural practices.
- Introduce low-interest microfinance loans for farmers investing in climate-adaptive technologies such as drought-resistant crops and efficient irrigation systems.
- Expand training programs on sustainable water management, crop diversification, and organic farming to improve resilience against water scarcity.

5. **Promoting gender-inclusive water governance**

- Establish women-led water management committees to enhance female participation in decision-making regarding water resource allocation.
- Develop capacity-building programs for women farmers on efficient water use, irrigation management, and sustainable agriculture.
- Ensure equal access to financial resources for women engaging in agriculture and climate adaptation initiatives.

6. **Improving policy implementation and institutional support**

- Strengthen the role of local government institutions in overseeing the equitable distribution and use of re-excavated ponds.
- Integrate Managed Aquifer Recharge (MAR) technology to replenish groundwater levels and reduce dependency on deep tube wells.
- Develop a national-level policy framework for scaling up pond re-excavation projects in drought-prone areas with government and NGO collaboration.

7. **Expanding long-term research and monitoring**

- Conduct longitudinal studies to assess the impact of pond re-excavation on groundwater recharge, agricultural productivity, and community well-being.
- Monitor climate trends and water availability patterns to guide future adaptation strategies in the Barind region.
- Establish a central data-sharing platform where local authorities, researchers, and farmers can access real-time information on water resource management and climate adaptation measures.

By implementing these recommendations, the Barind region can enhance its resilience to climate change and water scarcity challenges. A multi-stakeholder approach involving government agencies, NGOs, and local communities is essential to ensure the long-term sustainability of these initiatives.

6.3 Limitations of the Research

Despite the valuable insights gained from this study, several limitations should be acknowledged. These constraints may have influenced the depth and scope of the findings and should be considered when interpreting the results.

1. **Small sample size**: The study was conducted with a limited number of respondents, which may not fully represent the broader population affected by water scarcity in the Barind region. A larger sample size could have provided more robust and generalizable findings.

2. **Purposive selection of study area**: The research was conducted in purposively selected areas rather than through random sampling. While this approach ensured that the study focused on regions where pond re-excavation initiatives had been implemented, it may not capture the full range of experiences and perspectives of other communities facing similar water security challenges.

3. **Time constraints**: The research was carried out within a short internship period, restricting the ability to conduct extensive field visits, long-term observations, or follow-up studies. A longer duration could have allowed for a more comprehensive assessment of seasonal variations in water availability and usage.

4. **Geographical coverage**: The study was limited to three unions in Chapai Nawabganj, and findings may not be fully applicable to other drought-prone areas in Bangladesh. Expanding the geographical scope could have provided a more comparative perspective.

5. **Limited availability of secondary data**: Access to recent and detailed secondary data on groundwater levels, long-term impacts of pond re-excavation, and climate adaptation strategies was restricted. A more extensive dataset could have strengthened the analysis and contextual understanding.

6. **Dependence on self-reported data**: The study relied heavily on survey responses, focus group discussions, and key informant interviews. As with any qualitative and survey-based research, there is a possibility of response bias, where participants may have provided socially desirable or inaccurate answers.

Chapter 7: Learnings and Self-Evaluation

7.1 Learning Experience from Internship

The time I spent at PKSF, from getting acquainted with the professional atmosphere of the office to working in a completely different environment during my field research in Chapainawabganj, has been filled with valuable lessons that I will carry forward in my academic and professional journey. This internship has been an enriching experience, providing me with insights into research methodologies, project management, teamwork, and leadership skills. Through my engagement in the ECCP-Drought project, I have gained hands-on experience in the development sector, deepening my understanding of the practical challenges posed by water scarcity and the role of non-governmental organizations in addressing these issues.

Figure: Interns with AMD and Supervisors

Gather Research Knowledge

Before this internship, my research experience was limited to working as a field enumerator in a study. At PKSF, I formulated my own research question, developed a research proposal, and executed the study, which involved setting a questionnaire, conducting literature reviews, field visits, data analysis, and report writing. My research focused on water security, climate adaptation, public health, and gender issues in the Barind region, particularly examining the role of pond re-excavation in addressing water scarcity. This comprehensive research experience has significantly enhanced my ability to pursue research-based activities in the future.

Project Management

Through this internship, I learned about the role of non-governmental organizations in providing essential services that support climate adaptation and water security. The experience helped me develop an understanding of project management, from planning and budgeting to execution and evaluation. Observing and participating in the implementation of the ECCP-Drought project gave me firsthand exposure to the challenges faced by PKSF in mitigating drought impacts in water-scarce regions like the Barind Tract.

Creative Problem Solving

During fieldwork, I encountered various challenges that required innovative solutions. This internship provided me with opportunities to apply my knowledge and creativity to address these issues. I realized how small yet innovative ideas, such as community-led pond re-excavation projects, can bring substantial improvements to water availability, agricultural productivity, and public health. Through the ECCP-Drought project, I gained a deeper appreciation of how adaptive problem-solving can enhance climate resilience efforts.

Teamwork & Collaboration

The internship also allowed me to enhance my teamwork and collaboration skills. Working with PKSF peers and engaging with different stakeholders, including local communities and project coordinators, helped me develop a deeper understanding of effective team dynamics. I learned how to work in a coordinated manner, manage responsibilities, and ensure smooth implementation of research activities. These experiences have been invaluable in improving my interpersonal skills, which are crucial for any professional setting.

Leadership Skill

Leading and coordinating the field research part of my study significantly strengthened my leadership skills. I took responsibility for arranging the tour, managing the budget, and organizing accommodations while also coordinating with project personnel from Proyas and PKSF. Additionally, working closely with PKSF's staff and observing their leadership methods provided me with insights into effective leadership strategies. This experience has prepared me to take on greater leadership responsibilities in future professional and academic endeavors.

Data Analysis

Analyzing field data and preparing reports was an essential part of my internship. This process helped me develop problem-solving skills, as I had to interpret data, identify key findings, and

propose evidence-based solutions related to water security and climate adaptation. Moreover, I gained proficiency in data analysis and report writing, skills that will be beneficial in both academic and professional settings.

7.2 Influence on My Future Goal

This internship has played a pivotal role in shaping my future aspirations. I have become more aware of the practical challenges faced by rural communities regarding water security and climate change adaptation. The ECCP-Drought project has inspired me to contribute to the development sector and leverage my knowledge for the betterment of society. Additionally, this experience has helped me recognize my strengths and areas for improvement as a researcher, motivating me to pursue higher education with a focus on academic excellence, professional ethics, and organizational capabilities. These attributes will be invaluable in my future career and will be highly regarded by prospective employers.

Conclusion

This research has provided valuable insights into water security, climate adaptation, and the role of pond re-excavation in addressing water scarcity in the Barind region. The findings reveal that while deep tube wells remain the dominant irrigation source, their sustainability is questionable due to high operational costs and declining groundwater levels. Community driven pond re-excavation has emerged as a promising alternative, offering multiple benefits such as improved water availability, enhanced agricultural productivity, and strengthened resilience to drought.

The study highlights the importance of integrating gender-inclusive approaches into water governance, as equitable participation in decision-making can improve the efficiency and sustainability of water resource management. by, financial constraints and institutional challenges continue to hinder the successful implementation of climate adaptation strategies. Greater policy support, capacity-building programs, and financial assistance are necessary to ensure long-term sustainability.

Addressing the challenges of water scarcity in the Barind region requires a multi-stakeholder approach, involving government agencies, NGOs, and local communities. Future research should focus on assessing the long-term impacts of pond re-excavation, exploring innovative irrigation techniques, and strengthening community engagement in climate adaptation measures. By implementing these strategies, the region can move towards a more sustainable and resilient water management system, ensuring improved livelihoods and public health outcomes for vulnerable populations.

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Chapter 8: Appendix

8.1 Questionnaire for the Survey (Individual Interview)

Section 1: Demographic and Household Information

Serial No.	Question	Answer	Code	Skip
101	Respondent's name		-	
102	Gender		-	
103	Age		-	
104	Contact no		-	
105	Religion		1. Islam 2. Hindu 3. Christianity 4. Buddhism 5. Others (mention here)	
106	Education level		1. No formal education 2. Primary 3. Secondary 4. Higher secondary or above	
107	Main occupation		1. Farmer 2. Entrepreneur 4. Service (Govt./Private) 5. Day Labor 6. Tanti/Handloom Artist 7. Rickshaw puller 8. Others (mention here)	
108	Numbers of household members			
109	Household monthly income			
110	Household monthly expenditure			

Section 2: Water Security and agricultural use

Serial No.	Question	Answer	Code	Skip
201	What is your primary source of water for irrigation purposes?		1. Groundwater (tube well/STW) 2. Surface water (pond, canal, river) 3. Others	
202	How far is the primary water source from your agricultural field?		1. Less than 200 meters 2. 200 meters – 500 meters 3. 500 meters – 1 kilometer 4. More than 1 kilometer	
203	How many months per year are water available from your primary source?		1. 1–3 months 2. 4–6 months 3. 7–9 months 4. 10–12 months	
204	When water is not available from the primary source, what alternative sources do you use?		1. Distant ponds 2. Neighbor's water source 3. Purchased water from private suppliers 4. Government-supplied water source	
205	Who owns the water source you primarily depend on?		1. Household-owned 2. Community-owned 3. Private individual 4. Government	
206	Have you ever faced barriers from the owner in accessing water for agriculture?		1. Yes 2. No	
207	If yes, describe the barriers (open ended).			
208	Are you aware of any pond re-excavation projects in your area?		1. Yes 2. No	
209	How do you use the water from the re-excavated pond for?		1. Irrigation for crops 2. Livestock 3. Drinking 4. Household purpose	

210	Has the re-excavated pond increased water availability for agricultural use?		1. Yes 2. No	
211	How has the re-excavated pond increased water availability for agricultural use?		1. Significantly 2. Moderately 3. Slightly 4. Negligibly	
212	Has the re-excavated pond reduced your reliance on groundwater for irrigation?		1. Yes 2. No	
213	How many months per year does the re-excavated pond provide sufficient water for your needs?		1. 1–3 months 2. 4–6 months 3. 7–9 months 4. 10–12 months	
214	Do you face any challenges in accessing water from the re-excavated pond?		1. Yes 2. No	
215	How do you face any challenges in accessing water from the re-excavated pond?		1. Conflict with other users 2. Water not sufficient for demand 3. Physical distance to the pond 4. Poor water quality 5. Others	

Section 3: Household and Community Impact

Serial No.	Question	Answer	Code	Skip
301	Has the availability of water reduced the burden on women/household members for water collection?		1. Yes 2. No	
302	If yes, how has this time been reallocated?		1. Farming 2. Household tasks 3. Income-generating activities 4. Others	
303	How effective do you think the community's practices are in managing pond water use?		1. Very effective 2. Somewhat effective 3. No effective 4. No community practices exist	
304	Have women in the community been involved in water management planning?		1. Yes 2. No	
305	Have there been any conflicts in your community over access to pond water?		1. Yes 2. No	
306	What are the most significant benefits you have experienced due to pond re-excavation?		1. Increased water availability 2. Reduced irrigation costs 3. Improved crop productivity 4. Better household water access 5. Others	

307	What are the biggest water-related challenges you still face, even after the pond re-excavation?		1. Insufficient water during the dry season 2. Poor water quality for irrigation 3. High competition for water access 4. Distance to the pond 5. Lack of proper maintenance of the pond 6. Others	
308	What improvements would you suggest for similar pond re-excavation projects in the future? (Open ended)			

Section 4: Public Health and livelihood

Serial No.	Question	Answer	Code	Skip
401	Has access to pond water improved your agricultural productivity and household income?		1.Significantly increased 2.Modarately increased 3. No change 4.Modarately decreased 5.Significantly decreased	
402	Have you started any new income-generating activities (e.g., fish farming, vegetable gardening) related to pond water?		1. Yes 2. No	

403	Have you or any household member suffered from waterborne diseases (e.g., diarrhea, skin infections) in the past year?		1. Yes 2. No	
404	Has improved water availability helped maintain better hygiene practices on your farm or in your household?		1. Yes 2. No	

8.2 Questionnaire for Focused Group Discussion (FGD)

Meeting Place:
Date:
Time:

Serial	Name of the Participants	Occupation	Mobile No.	Signature
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

1. What were the biggest water-related challenges before pond re-excavation?
2. Since pond re-excavation, how has overall access to water changed in the community?
3. Have women and marginalized groups benefited from improved water access? If yes, how?
4. How has water access influenced new livelihood opportunities?
5. What role does the community play in maintaining the pond? Who is responsible?
6. What support or improvements are needed for better water security in this region?

8.3 Key Informant Interview (KII)

General information
Name of Respondent:
Designation:
Mobile:
Institution/Organization:
Union:
Upazila:
District:

1. Do you think water security challenges are significant in the Barind region? If so, what are the key challenges?

2. Do you know how the pond re-excavation project was designed, and what were its main objectives?

3. Do you think community members and local institutions have been effectively involved in water management?

4. Do you see re-excavated ponds as a useful solution for reducing dependence on groundwater?

5. Do you have any policy recommendations for improving water resource management in this region?