Research Paper

Research Title

“Study on the Effectiveness of Alternate Wetting Drying (AWD) Technology for Boro Paddy Cultivation in Barind Areas in Bangladesh.”

Submitted To

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Student Declaration

I, Sidhratul Muntaha, declare that this report titled "**Study on the Effectiveness of Alternate Weeting Drying (AWD) Technology for Boro Paddy Cultivation in Barind Areas in Bangladesh** " is an original work undertaken by me under the guidance and direct supervision of. My internship was conducted at the ECCCP-Drought project of PKSF as a requirement for the completion of my BSS (Hons), in Social Science at East West University .

I confirm that:

1. The report presented is original and has been conducted by me in accordance with the ethical standards.
2. Any assistance received during the process has been acknowledged, and the work of others is cited and referenced.
3. I acknowledge that in accordance with PKSF regulations, any violation of academic integrity, such as plagiarism, may potentially lead to significant repercussions.

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SID:2022-1-33-053

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Supervisor Declaration

I certify that the research report titled **"Study on the Effectiveness of Alternate Wetting and Drying (AWD) Technology for Boro Paddy Cultivation in Barind Areas in Bangladesh"** has been conducted under my supervision during the student's internship at the Palli Karma-Sahayak Foundation (PKSF). The student has completed the study in accordance with the approved research proposal, ethical standards, and institutional guidelines.

To the best of my knowledge, the report is an original piece of work based on authentic data and proper methodological rigor. I have reviewed the manuscript and consider it suitable for submission as partial fulfillment of the requirements for the undergraduate degree. I wish the student continued academic success.

Internship Supervisor's Signature

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Date: 22-09-2026

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Abstract

Boro rice is the most irrigation-intensive rice season in Bangladesh, and in the drought-prone Barind tract, dependence on groundwater irrigation has raised serious concerns about the long-term sustainability of agricultural water use. Alternate Wetting and Drying (AWD)technology has been promoted as a water-saving irrigation technology capable of reducing irrigation water use without compromising rice yield. This study examines the effectiveness of AWD technology for Boro paddy cultivation in Dhamoirhat Upazila, Naogaon District, by combining quantitative and qualitative methods. A structured survey of 22 Boro rice farmers practising AWD was conducted alongside two focus group discussions (FGDs) and five key informant interviews (KIIs) with agricultural officers, development-project staff, and community-level informants.

The findings show that all surveyed farmers experienced a reduction in irrigation water use and groundwater dependence after adopting AWD, and no farmer reported a decline in rice yield; indeed, 23 percent reported a yield increase. Irrigation costs fell for the majority of farmers, although perceptions of overall production-cost savings and direct economic benefit were more mixed, with two-thirds of farmers reporting no significant perceived economic gain despite measurable reductions in irrigation frequency and cost. The principal barriers to wider and more confident adoption were informational and technical rather than financial: lack of knowledge (95%) and lack of training (91%) were the most frequently cited difficulties, while cost of equipment and irrigation infrastructure were rarely mentioned. Social influence was found to shape adoption decisions for all respondents, and all 22 farmers stated that they would recommend AWD to other Boro rice farmers. Qualitative findings from the FGDs and KIIs reinforced these results, highlighting the importance of NGO- and project-led training, field demonstrations, farmer-to-farmer learning, and continued institutional follow-up in building farmers' confidence in the technology.

The study concludes that AWD is technically effective and well accepted by farmers in this drought-prone locality, but that its full economic and climate-resilience potential depends on sustained investment in farmer training, extension support, and community-based demonstration. The study recommends expanded and repeated training programmes, wider use of demonstration plots, stronger coordination among NGOs, Partner Organisations and government agricultural

offices, and further research using metered field data and a larger, gender-inclusive sample to validate and extend these findings across the wider Barind region.

Keywords

Alternate Wetting and Drying (AWD); Boro rice; irrigation water use; water-use efficiency; drought-prone agriculture; Barind region; Bangladesh; climate-resilient agriculture; farmer adoption; mixed-methods research.

List of Acronyms

Abbreviation	Full Form
AWD -	Alternate Wetting and Drying
ECCCP-Drought -	Extended Community Climate Change Project-Drought
BRRI -	Bangladesh Rice Research Institute
BADC -	Bangladesh Agricultural Development Corporation
BARI -	Bangladesh Agricultural Research Institute
BMDA -	Barind Multipurpose Development Authority
DAE -	Department of Agricultural Extension
IRRI -	International Rice Research Institute
FGD -	Focus Group Discussion
KII -	Key Informant Interview
MIS -	Management Information System
NGO -	Non-Governmental Organization
PKSF -	Palli Karma-Sahayak Foundation
PO -	Partner Organization
RRM -	Risk and Resilience Management
H_1 -	Alternative Hypothesis

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Chapter 01: Introduction

Agriculture is one of the most important sectors of Bangladesh and plays a significant role in supporting the livelihoods of a large portion of the rural population. The agricultural sector contributes to food security, rural employment, household income, and the overall socio-economic development of the country. Among the different agricultural activities, rice cultivation holds a particularly important position because rice is the major staple food of the population. Therefore, maintaining stable and productive rice cultivation is essential for ensuring food security and supporting the livelihood of farming communities.

Boro rice is one of the major rice-growing seasons in Bangladesh. Unlike Aman rice, which depends more heavily on rainfall, Boro rice is cultivated mainly during the dry season, generally from November or December to May or June. During this period, rainfall is relatively limited, and farmers largely depend on irrigation to provide sufficient water for rice production. The expansion of Boro cultivation has contributed significantly to increasing rice production in Bangladesh. However, the heavy dependence on irrigation has also created growing concerns regarding water resources, particularly groundwater.

Boro paddy requires frequent irrigation throughout the growing season. Traditionally, many farmers have followed continuous flooding or conventional irrigation practices in which water is supplied to maintain standing water in the rice field. Although this method can provide adequate water to crops, it may also result in excessive water use. Continuous irrigation increases pressure on groundwater resources and may increase the cost of rice cultivation because farmers have to spend money on irrigation, fuel, electricity, or other related inputs. The problem becomes more serious in drought-prone areas where the availability of water is already limited.

The Barind region of Bangladesh is particularly vulnerable to water scarcity and drought-related challenges. Farmers in this region often experience irregular rainfall, high temperatures, seasonal drought, and increasing dependence on groundwater for agricultural production. As a result, irrigation water management has become an important issue for sustaining agricultural production in the region. The increasing pressure on groundwater resources creates challenges for farmers who depend on irrigation-intensive Boro cultivation for their livelihoods.

In response to these challenges, different water-saving irrigation technologies and climate-resilient agricultural practices have been promoted. One such technology is Alternate Wetting and Drying (AWD). AWD is an irrigation management technique in which rice fields are not continuously flooded. Instead, irrigation water is applied when the water level in the field falls below a certain point, allowing the field to remain temporarily dry before irrigation is provided again. This process can reduce unnecessary irrigation and improve the efficiency of water use while maintaining suitable conditions for rice growth.

Previous studies have indicated that AWD can reduce irrigation water use and improve water-use efficiency without necessarily reducing rice production. Some studies have also suggested that the technology can contribute to reducing production costs and promoting more sustainable agricultural practices (Neogi et al., 2018; Oliver et al., 2008; Das et al., 2023). Therefore, AWD has gained importance as a potential adaptation strategy for rice farmers living in areas affected by water scarcity and drought.

However, the effectiveness of an agricultural technology cannot be understood only by considering its technical performance. Farmers are the main users of agricultural technologies, and their knowledge, attitudes, experiences, economic conditions, access to information, training opportunities, and institutional support can influence whether a technology is accepted and practiced successfully. Even when a technology provides technical and economic benefits, farmers may be reluctant to adopt it if they do not have sufficient knowledge, training, confidence, or support.

Therefore, it is important to examine AWD from both agricultural and social perspectives. Understanding how AWD affects irrigation water use and rice production is important, but it is equally important to understand how farmers experience the technology, what benefits and challenges they observe, and what social, economic, and institutional factors influence its use. The present study therefore focuses on the effectiveness of AWD technology for Boro paddy cultivation in the Barind areas of Bangladesh by examining irrigation water use, production, farming costs, farmers' perceptions and experiences, and the broader factors influencing AWD adoption.

The study follows a mixed-method approach so that both measurable agricultural outcomes and farmers' experiences can be explored. Quantitative information helps examine patterns related to

irrigation, production, and costs, while qualitative information from farmers provides deeper insight into their perceptions, experiences, challenges, and the social and institutional context surrounding AWD technology. Through this approach, the study aims to provide a broader understanding of the role of AWD in promoting sustainable and climate-resilient Boro rice cultivation in drought-prone areas of Bangladesh.

1.1 Background of the Study

1.1.1 Agriculture and Rice Cultivation in Bangladesh

Bangladesh is predominantly an agrarian society in which agriculture has historically played an important role in the livelihood and socio-economic structure of rural communities. Farming provides employment, income, food, and livelihood security to millions of rural households. Rice cultivation is particularly important because rice is the primary staple food of Bangladesh. Consequently, changes in rice production can directly influence household food security, agricultural income, rural employment, and the wider national food system.

Rice is cultivated in different seasons, including Aus, Aman, and Boro. Among these, Boro rice is particularly dependent on irrigation because it is cultivated mainly during the dry season when rainfall is insufficient to meet the water requirements of the crop. The development of irrigation infrastructure and access to groundwater has contributed to the expansion of Boro cultivation and has helped Bangladesh increase its rice production.

However, the success of irrigated agriculture has also created pressure on water resources. The increasing cultivation of Boro rice means that substantial quantities of irrigation water are required during the dry season. In areas where groundwater is the main source of irrigation, intensive agricultural water extraction can create concerns regarding groundwater availability and long-term sustainability.

1.1.2 Boro Paddy Cultivation and Irrigation Dependency

Boro rice is generally cultivated during the dry months when natural rainfall is limited. Therefore, farmers need to provide irrigation at different stages of crop growth. Water is particularly important for maintaining suitable soil moisture and supporting rice development.

Traditional irrigation practices often involve maintaining a relatively high level of standing water in rice fields. Farmers may continue irrigation based on conventional knowledge or established farming practices rather than measuring the actual water requirements of the crop. Although such practices may reduce farmers' concerns about water shortages in the field, they can also result in unnecessary water use.

The high irrigation requirement of Boro rice creates both environmental and economic challenges. From an environmental perspective, excessive groundwater extraction can place pressure on local water resources. From an economic perspective, irrigation constitutes an important component of farming costs. Farmers may have to spend money on fuel, electricity, irrigation equipment, or payments to irrigation service providers. Therefore, reducing unnecessary irrigation could potentially contribute to reducing production costs as well as conserving water.

1.1.3 Climate Change and Water Scarcity in the Barind Region

The Barind region of Bangladesh is recognized as one of the areas particularly vulnerable to drought and water scarcity. The region experiences relatively dry climatic conditions and has historically faced problems associated with limited rainfall and high dependence on groundwater irrigation.

Climate variability and changing rainfall patterns can make agricultural production increasingly uncertain. Farmers depend on predictable water availability for crop production, but irregular rainfall and prolonged dry periods can increase their dependence on irrigation. At the same time, increasing demand for groundwater during the dry season may create additional pressure on existing water resources.

For farming communities in the Barind region, water is therefore not simply an agricultural input; it is an important resource directly connected with livelihood security. When irrigation water becomes difficult or expensive to access, farmers may face difficulties maintaining agricultural production. This situation highlights the importance of introducing agricultural practices that can improve water-use efficiency while maintaining crop productivity.

1.1.4 Emergence of Alternate Wetting and Drying Technology

Alternate Wetting and Drying (AWD) has emerged as one of the important water-management practices for rice cultivation. The main principle of AWD is to avoid keeping the rice field continuously flooded. Instead, irrigation is applied when the field reaches a certain level of dryness. After irrigation, the field is again allowed to dry before the next irrigation cycle.

The approach is different from conventional continuous flooding because it focuses on supplying water according to the crop's actual requirement rather than maintaining standing water continuously. By allowing the field to dry periodically, AWD can reduce unnecessary irrigation and potentially improve water-use efficiency.

Previous research has reported positive outcomes associated with AWD. Studies have indicated that AWD can reduce irrigation water use while maintaining rice yield and may also reduce irrigation-related production costs (Neogi et al., 2018; Oliver et al., 2008). Das et al. (2023) also highlighted the importance of AWD in improving water-use efficiency and supporting more sustainable agricultural practices.

1.1.5 AWD as a Climate-Resilient Agricultural Practice

The importance of AWD becomes particularly relevant in drought-prone areas such as the Barind region. Climate-resilient agriculture requires farming practices that allow farmers to maintain productivity while adapting to changing environmental conditions. Since water scarcity is one of the major challenges faced by farmers in drought-prone areas, technologies that reduce unnecessary water consumption can contribute to agricultural resilience.

AWD can potentially help farmers adapt to water scarcity by reducing the amount of irrigation water required for Boro rice cultivation. If farmers can maintain production with less irrigation, they may become less vulnerable to fluctuations in water availability. Reduced irrigation requirements may also lower the economic burden associated with water pumping.

However, the contribution of AWD to climate resilience depends on its actual use by farmers. A technology cannot contribute significantly to climate adaptation if farmers are unable or unwilling to adopt it. Therefore, understanding the practical experiences of farmers is essential.

1.1.6 Farmers' Knowledge and Adoption of AWD

Farmers' knowledge is an important factor in the adoption of agricultural technologies. AWD requires farmers to understand when irrigation should be applied and when the field can safely remain without standing water. Farmers who are accustomed to continuous flooding may initially feel uncertain about allowing their rice fields to dry.

Lack of awareness and technical knowledge can therefore become barriers to adoption. Farmers may fear that reduced irrigation will negatively affect crop growth or yield. They may also have difficulty changing established farming practices if they have limited access to agricultural extension services or technical guidance.

Training and demonstration can play an important role in reducing these uncertainties. When farmers receive practical knowledge and observe the results of AWD in actual fields, they may become more confident about using the technology. Therefore, farmers' access to information, training, and extension services needs to be considered when assessing AWD adoption.

1.1.7 Economic Considerations of AWD

Economic benefits are another important dimension of AWD technology. Irrigation is a major input in Boro rice cultivation, and farmers have to bear the costs associated with water extraction and application. If AWD can reduce the number of irrigation events or the amount of water used, it may reduce irrigation-related expenses.

However, economic benefits may differ among farmers depending on their irrigation systems, access to water, land size, production conditions, and local irrigation arrangements. Therefore, it is important to examine farmers' actual experiences rather than assuming that AWD will produce identical economic outcomes for all farmers.The present study therefore examines production costs and farmers' perceptions of economic benefits in relation to AWD technology.

1.1.8 Social and Institutional Context of AWD Adoption

The adoption of agricultural technology is not determined solely by economic benefits. Social relationships, access to information, community-level attitudes, local knowledge, and institutional support can influence farmers' decisions.

Farmers often learn agricultural practices from other farmers, local agricultural workers, NGOs, development projects, and extension services. Their willingness to experiment with a new technology may depend on the experiences of other farmers in the community. If farmers observe positive results among their peers, they may become more interested in adopting the practice.

Similarly, institutional support from government agencies, NGOs, development organizations,and agricultural projects can influence adoption.Training,field demonstrations, technical assistance,follow-up support, and access to information may help farmers overcome uncertainty regarding AWD.

Therefore, AWD adoption needs to be understood within a broader social and institutional environment rather than treating farmers' decisions as purely individual choices.

1.2 Problem Statement

Boro rice cultivation plays a central role in Bangladesh's agricultural production and food security. However, its heavy dependence on irrigation creates significant challenges, particularly in drought-prone areas. The Barind region faces a combination of water scarcity, irregular rainfall, high dependence on groundwater, and increasing irrigation requirements. These conditions create difficulties for farmers who depend on Boro rice cultivation as an important source of livelihood.

One of the major problems associated with conventional Boro cultivation is excessive dependence on irrigation water. Traditional continuous flooding practices may result in the application of more water than is actually required by the crop. This not only increases pressure on groundwater resources but can also increase farmers' production costs. In areas where groundwater availability is already limited, continued dependence on intensive irrigation may create long-term challenges for agricultural sustainability.

The problem is particularly important in the context of climate change. Changes in rainfall patterns, increasing temperature, and drought conditions can increase the uncertainty of agricultural production. Farmers in the Barind region may therefore face increasing pressure to

produce rice with limited water resources. Sustainable water management has consequently become an important requirement for maintaining agricultural productivity and protecting rural livelihoods.

AWD technology has been introduced as a potential solution to this problem. By allowing rice fields to dry periodically and irrigating only when necessary, AWD aims to reduce unnecessary water use while maintaining rice production. Previous studies have reported that AWD can reduce irrigation water use, improve water-use efficiency, and potentially lower production costs (Neogi et al., 2018; Oliver et al., 2008; Das et al., 2023). These findings suggest that AWD may be particularly relevant for drought-prone agricultural regions.

However, the existence of technical benefits does not automatically guarantee widespread adoption. Farmers may face several challenges when adopting a new agricultural practice. Lack of awareness, limited technical knowledge, insufficient training, uncertainty about yield outcomes, risk perceptions, and inadequate extension or institutional support may influence farmers' willingness to use AWD. Saha et al. (2025) and Haque et al. (2025) emphasize the importance of awareness, training, access to information, and institutional support in relation to AWD adoption.

Another important issue is that much of the existing research has emphasized the technical and agricultural effectiveness of AWD. Research has commonly examined water savings, crop yield, water-use efficiency, and environmental outcomes. Although these aspects are essential, they do not provide a complete understanding of the adoption process.

Farmers' experiences and perceptions are equally important. A technology may be technically effective but difficult to adopt in practice because of farmers' existing habits, social expectations, knowledge gaps, resource limitations, or institutional conditions. Understanding why farmers accept, reject, continue, or discontinue a technology requires attention to these broader social and economic dimensions.There is therefore a need to examine AWD not only as an irrigation technology but also as a practice embedded within the social and economic realities of farming communities. In particular, there is a need to understand how farmers perceive AWD, what challenges they experience, what benefits they observe, and what factors encourage or discourage its adoption in drought-prone Barind areas.

The present study addresses this gap by examining the effectiveness of AWD technology for Boro paddy cultivation while incorporating both agricultural and farmer-level perspectives. The study investigates changes in irrigation water use, rice production, farming costs, farmers' perceptions and experiences, and the social, economic, and institutional factors associated with AWD adoption.

The central problem addressed by this study is therefore the challenge of achieving sustainable Boro rice production in a drought-prone region where irrigation water is increasingly important but potentially limited. The study seeks to determine whether AWD can provide a practical approach to reducing irrigation water use while maintaining agricultural production and supporting farmers' livelihoods.

1.3 Objectives of the Study

1.3.1 General Objective

The general objective of this study is to examine the effectiveness of Alternate Wetting and Drying (AWD) technology for Boro paddy cultivation in the drought-prone Barind region of Bangladesh, considering both its agricultural performance and farmers' perceptions and experiences.

1.3.2 Specific Objectives

1. To assess changes in irrigation water use and irrigation frequency associated with the adoption of AWD technology.
2. To examine the effect of AWD on Boro rice yield and on irrigation-related and overall production costs.
3. To explore farmers' knowledge, training experiences, and understanding of AWD application.
4. To identify the major challenges and barriers farmers face in adopting and sustaining AWD practice.

5. To examine the social, economic, and institutional factors that influence farmers' decisions to adopt AWD.

1.4 Research Questions

1. How does AWD technology affect irrigation water use, rice production, and farming costs in Boro paddy cultivation in Barind areas?
2. What are farmers' perceptions, experiences, challenges, and the social, economic, and institutional factors influencing the adoption of AWD technology?
3. How can AWD technology contribute to sustainable and climate-resilient agriculture in drought-prone Barind areas?
4. What are the principal barriers that limit farmers' confidence in, and wider adoption of, AWD?

1.5 Hypothesis(H_1):

The use of Alternate Wetting and Drying (AWD) technology in Boro rice cultivation reduces seasonal irrigation water use by approximately 15-30% compared to conventional continuous flooding irrigation, thereby improving water-use efficiency.

1.6 Significance of the Study

This study is significant because it examines the effectiveness of AWD technology in reducing irrigation water use while maintaining Boro rice production in the drought-prone Barind region. The findings can help farmers, NGOs, development organizations, and policymakers understand the benefits and challenges of AWD and support more sustainable and climate-resilient agricultural practices.

Chapter 2: Literature Review

2.1 Concept of Alternate Wetting and Drying Technology

Alternate Wetting and Drying (AWD) is a water-management technique developed to improve irrigation efficiency in rice cultivation. Unlike conventional irrigation practices where rice fields are often maintained under continuous flooding, AWD allows the field to dry for a certain period before irrigation is applied again.

The main principle of AWD is based on providing irrigation water according to crop requirements rather than maintaining a continuous layer of standing water. This approach can reduce unnecessary water application and improve the efficiency of irrigation. As a result, AWD has received considerable attention as a potential water-saving practice in rice-growing regions.

For Boro rice cultivation, the importance of AWD is particularly significant because Boro production occurs during the dry season when irrigation demand is high. Therefore, a technology that can reduce irrigation requirements without negatively affecting production may provide both economic and environmental benefits to farmers.

2.2 AWD and Irrigation Water Use

A major theme in the existing literature is the ability of AWD to reduce irrigation water use. Neogi et al. (2018) examined the effectiveness of AWD in rice cultivation and reported its potential for reducing irrigation requirements while maintaining crop production.

Oliver et al. (2008) also contributed to the understanding of water-saving irrigation practices in rice cultivation. Their research demonstrates the importance of irrigation management in improving water-use efficiency and reducing unnecessary water application.

The importance of water saving is especially relevant for areas where groundwater is heavily used for agricultural irrigation. By reducing the amount of water required per season, AWD can potentially reduce pressure on groundwater resources. This makes the technology particularly relevant to drought-prone areas where water availability is already constrained.

However, the actual amount of water saved may depend on local farming conditions, soil characteristics, irrigation practices, farmer knowledge, and the way AWD is implemented.

Therefore, field-level investigation is important for understanding whether the expected water-saving benefits are experienced by farmers in the Barind region.

2.3 AWD and Rice Production/Yield

Another important issue in AWD research is whether reducing irrigation affects rice production. Farmers may be hesitant to adopt water-saving practices if they believe that less water will reduce crop yield.

Previous studies suggest that AWD can reduce water use without necessarily reducing rice yield. Neogi et al. (2018) and Oliver et al. (2008) reported findings supporting the potential of AWD to maintain rice production while improving irrigation efficiency.

This finding is important because farmers generally prioritize crop productivity when making farming decisions. If a water-saving technology is perceived as threatening yield, farmers may be unwilling to adopt it even if it provides environmental benefits.

Therefore, the effectiveness of AWD should be evaluated by considering both water savings and production outcomes. A technology can be considered practically effective only when farmers are able to reduce water use without experiencing unacceptable reductions in rice production.

2.4 AWD and Water-Use Efficiency

Das et al. (2023) highlighted the importance of AWD in improving water-use efficiency and supporting sustainable agricultural practices. Water-use efficiency refers broadly to producing agricultural output using water resources more efficiently.

Improving water-use efficiency is particularly important in regions where agricultural production is increasingly dependent on limited water resources. Instead of simply increasing water availability, sustainable agriculture requires better management of available water.

AWD contributes to this approach by changing the timing and quantity of irrigation. Rather than maintaining continuous flooding, farmers provide water according to field conditions. This can help reduce unnecessary water application and improve the overall efficiency of irrigation.

The literature therefore suggests that AWD has potential not only as a water-saving technique but also as a broader sustainable water-management practice.

2.5 AWD and Production Costs

Water management is closely related to the economic cost of rice cultivation. Irrigation requires financial expenditure, particularly when farmers depend on pumps, fuel, electricity, or irrigation service providers.

Prior studies suggest that AWD can reduce irrigation requirements and thereby contribute to lowering production costs (Neogi et al., 2018; Oliver et al., 2008). If fewer irrigation events are required, farmers may spend less on pumping and related irrigation expenses.

However, the economic benefit of AWD may vary according to local conditions. Farmers with different irrigation arrangements may experience different levels of cost reduction. For example, farmers who pay for irrigation on the basis of irrigation frequency may benefit differently from those who have their own irrigation equipment.

Therefore, examining the relationship between AWD and production cost at the farmer level is important for understanding its economic effectiveness.

2.6 Farmers' Awareness and Knowledge

Farmers' knowledge and awareness are important factors in the adoption of new agricultural technologies. AWD requires farmers to understand the principle of allowing the rice field to dry before applying irrigation. Farmers who have limited knowledge about the technology may misunderstand the process or may fear that drying the field will damage the crop.

Saha et al. (2025) and Haque et al. (2025) emphasized the role of farmers' awareness, training, access to information, and institutional support in successful AWD adoption.

Knowledge can be obtained through agricultural extension services, NGO programmes, training sessions, demonstration plots, fellow farmers, and development projects. Therefore, farmers' access to these sources of knowledge can influence their confidence in adopting AWD.

2.7 Training and Extension Support

Training is another important factor influencing the adoption of AWD. Since AWD differs from conventional irrigation practices, farmers may need practical guidance to understand when and how irrigation should be applied.

Saha et al. (2025) and Haque et al. (2025) identify training and institutional support as important factors related to adoption. Training can reduce uncertainty by providing farmers with practical knowledge about the technology.

Agricultural extension workers and development organizations can also provide follow-up support. Such support may be particularly important during the initial stages of adoption because farmers may encounter practical difficulties when applying the technology.

Therefore, the availability and quality of training and extension services should be considered when examining why some farmers adopt AWD while others may remain dependent on conventional irrigation practices.

2.8 Barriers to AWD Adoption

Although AWD has potential technical and economic benefits, farmers may face different barriers to its adoption. Pearson et al. (2018) and Kabir et al. (2020) highlighted factors such as limited technical knowledge, risk perception, and inadequate extension services as important considerations in agricultural technology adoption.

Farmers may be concerned that reducing irrigation will negatively affect crop growth or yield. Such concerns can be particularly strong when farmers have limited experience with AWD or when reliable technical support is unavailable.

In addition, farmers may prefer conventional practices because they are familiar with them. Changing established agricultural practices requires not only technical information but also confidence and willingness to experiment. Therefore, social and psychological factors can interact with economic and technical factors in shaping adoption decisions.

2.9 Social Factors Influencing Technology Adoption

Agricultural technology adoption occurs within a social environment. Farmers do not always make decisions independently; they often exchange information and experiences with other farmers, family members, community members, agricultural workers, NGOs, and local institutions.

If farmers observe successful AWD practices among neighboring farmers, they may become more willing to adopt the technology. Conversely, negative experiences or community-level doubts may discourage adoption.

Social networks can therefore influence the flow of agricultural information and shape farmers' perceptions of risk and benefit. This indicates that understanding AWD adoption requires attention to community-level processes rather than focusing only on individual farmers.

2.10 Institutional Factors Influencing AWD Adoption

Institutional support is another important dimension of technology adoption. Government agricultural agencies, NGOs, development organizations, and projects can facilitate adoption by providing training, technical assistance, information, demonstrations, and other forms of support.

Saha et al. (2025) and Haque et al. (2025) emphasize the relevance of institutional support in relation to AWD adoption. Without adequate support, farmers may face difficulties understanding the technology or solving problems encountered during implementation.

Institutional support can therefore act as a bridge between technical innovation and actual field-level adoption. The presence of supportive institutions may increase farmers' confidence and reduce perceived risks associated with adopting AWD.

2.11 AWD and Sustainable Agriculture

The literature generally indicates that AWD has potential to contribute to sustainable agricultural development through improved water management. Reducing unnecessary irrigation can help conserve water resources while maintaining rice production.

Das et al. (2023) emphasized the role of AWD in improving water-use efficiency and supporting sustainable agricultural practices. This is particularly important in drought-prone areas where agricultural sustainability depends heavily on efficient management of limited water resources.

Sustainable agriculture requires a balance between productivity, economic viability, and environmental protection. AWD has the potential to contribute to this balance by reducing water use while maintaining agricultural output and potentially reducing irrigation-related costs.

2.12 AWD and Climate-Resilient Agriculture

Climate change and climate variability create increasing challenges for agricultural communities. Drought, irregular rainfall, and water scarcity can reduce the reliability of conventional farming practices.In this context, AWD can be viewed as a potential climate-resilient agricultural practice because it allows farmers to manage irrigation more efficiently. In drought-prone regions such as the Barind area, improved irrigation management can help farmers cope with limited water availability.

However, the climate-resilience benefits of AWD depend on farmers' ability to adopt and continue using the technology. Therefore, technical effectiveness must be considered together with farmers' knowledge, economic conditions, social environment, and institutional support.

2.13 Research Gap

The existing literature provides important evidence regarding the technical benefits of AWD, particularly in relation to irrigation water use, water-use efficiency, rice production, and production costs. Studies such as Neogi et al. (2018), Oliver et al. (2008), and Das et al. (2023) provide evidence of the potential of AWD as a water-saving irrigation technology.

At the same time, other studies, including Saha et al. (2025), Haque et al. (2025), Pearson et al. (2018), and Kabir et al. (2020), indicate that farmers' knowledge, training, risk perception, extension services, and institutional support can influence technology adoption.

Despite these contributions, there remains a need to examine the effectiveness of AWD by bringing together agricultural outcomes and farmers' lived experiences. Technical effectiveness alone does not explain why farmers adopt or do not adopt the technology. There is a need to understand how farmers perceive AWD, what benefits they experience, what challenges they face, and how social, economic, and institutional conditions influence their decisions.

This gap is particularly relevant in drought-prone Barind areas where farmers face serious water-related challenges and depend heavily on irrigation for Boro paddy cultivation. Therefore, the present study seeks to contribute to the existing literature by examining AWD from both technical and socio-economic perspectives, focusing on irrigation water use, rice production, farming costs, farmers' perceptions and experiences, and the social, economic, and institutional factors influencing AWD adoption.

Chapter 3: Methodology

3.1 Research Design

This study adopted a mixed-methods research design, combining quantitative and qualitative approaches so that both measurable agricultural and economic outcomes and farmers' lived experiences of AWD could be captured within a single, integrated study. The quantitative component consisted of a structured questionnaire survey administered to Boro rice farmers practising AWD, providing descriptive statistical evidence on irrigation practices, water-saving outcomes, yield and cost effects, and adoption-related barriers. The qualitative component consisted of Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs), which provided contextual, explanatory, and experiential depth to the quantitative findings. This convergent design allowed the study to triangulate the numerical patterns emerging from the survey with the narrative accounts of farmers and institutional stakeholders, strengthening the validity and richness of the overall findings.

3.2 Study Area

The study was conducted in the Barind tract, a drought-prone agro-ecological region of north-western Bangladesh characterised by relatively low and erratic rainfall, high seasonal temperatures, and heavy reliance on groundwater irrigation for Boro rice cultivation. Specifically, primary data were collected from Lokkhitara and Chokvhobani villages under Dhamoirhat Upazila, Naogaon District. This area was purposively selected because it is representative of the water-scarcity challenges facing the wider Barind region and because AWD technology has been actively introduced there through NGO- and Partner Organisation-supported development interventions, making it possible to interview farmers with direct, first-hand experience of the technology.

3.3 Population and Sampling

The target population for the quantitative survey comprised Boro rice farmers in the study villages who had adopted AWD technology. Because AWD adoption in this locality is relatively recent and limited to farmers reached by NGO/Partner Organisation training and demonstration activities, the population of eligible AWD-practising farmers was itself small and identifiable. A

purposive sampling approach was therefore used to select all readily accessible AWD-practising farmers within the two villages, yielding a final sample of 22 respondents. Purposive sampling was considered appropriate given the exploratory, in-depth nature of the study and the relatively small and specific population of interest, although this approach limits the statistical generalisability of the findings, as noted in the study's limitations.

3.4 Data Collection Methods and Instruments

Data collect Method	**Sample Number**	**Remarks**
Quantitative data collection		
Survey	**22 Farmers**	AWD technology was provided to 100 farmers under the ECCCP-Drought project.Among them,22 AWD-adopting farmers will be selected for the questionnaire survey.
Qualitative data collection		
KIIs	**3 key Informants**	Interviews will be conducted with agricultural officers,project co-ordinator,accountant & MIS officer to collect detailed information about AWD implementation and adoption.
FGD	**02 FGDs**	There are 4 groups of AWD farmers under the project. FGDs will be conducted with farmers from 2 selected groups to explore their experiences,perceptions,and challenges regarding AWD adoption.

Table 1: Methodology Matrix

3.5 Structured Questionnaire Survey

A structured questionnaire was administered face-to-face to each of the 22 sampled farmers. The instrument was organised into six broad sections:

(i) socio-demographic characteristics (age, gender, education, occupation, farming experience, landholding size, and family size)

(ii) irrigation practices prior to AWD adoption (irrigation source and frequency)

(iii) the AWD adoption and learning process (duration of use, information source, training receipt and usefulness, and understanding of application)

(iv) water-saving outcomes (perceived change in irrigation water use, irrigation frequency, and groundwater use)

(v) economic and yield effects (irrigation cost, total production cost, yield change, and perceived economic benefit)

(vi) constraints and support needs (difficulties faced, perceived adequacy of farmers' general AWD knowledge, support required, social influence, and overall willingness to recommend AWD).

Most items used closed, categorical response options; several items relating to difficulties faced, learning sources, and support needs permitted multiple responses, reflecting the reality that farmers can experience more than one type of barrier or need simultaneously.

3.6 Focus Group Discussions (FGDs)

Two Focus Group Discussions were conducted with groups of Boro rice farmers experienced in AWD practice. The FGDs used a semi-structured guide covering farmers' initial understanding of and introduction to AWD, changes in irrigation behaviour and groundwater dependence, perceived effects on production costs and yield, benefits observed in a drought-prone context, difficulties and barriers encountered, the influence of social networks and traditional beliefs, and farmers' recommendations regarding institutional support. Discussions were conducted in Bengali, the local language, to allow farmers to express their views naturally and in detail, and were later transcribed and translated for analysis.

3.7 Key Informant Interviews (KIIs)

Three Key Informant Interviews were conducted with individuals holding relevant technical, institutional, or community-level knowledge of Boro rice irrigation, AWD implementation, and agricultural development in the study area: an Agricultural Officer,a project-related informant, an NGO/Partner Organisation representative. The KIIs used a semi-structured interview guide addressing the local irrigation situation, the perceived effectiveness of AWD, its economic implications, barriers to adoption, farmers' knowledge and training needs, existing institutional support, and recommended strategies for expanding adoption.

3.8 Data Processing and Analysis

Quantitative data from the questionnaire survey were compiled, cleaned, and coded, and analysed using descriptive statistics. Categorical variables (e.g., irrigation source, training receipt, perceived yield change) were summarised as frequencies and percentages, calculated against the total sample of 22 respondents unless otherwise indicated. For items permitting multiple responses, percentages were calculated against the total number of respondents and may therefore sum to more than 100 percent. Continuous variables (landholding size and family size) were summarised using means, standard deviations, medians, and ranges. Results are presented using bar charts, pie charts, histograms, and summary tables, each accompanied by a short interpretation.

Qualitative data from the FGDs and KIIs were transcribed, translated from Bengali to English, and analysed using a thematic approach. Transcripts were read repeatedly to identify recurring themes relating to farmers' knowledge and learning processes, changes in irrigation behaviour, perceived economic and yield effects, barriers to adoption, social influence, and institutional support needs. Illustrative quotations were retained, with English translations, to preserve the voice and nuance of participants' accounts. The qualitative themes were then compared and integrated with the quantitative survey findings to provide a fuller, triangulated understanding of AWD effectiveness and adoption in the study area.

3.9 Ethical Considerations

Participation in the survey, FGDs, and KIIs was voluntary, and informed verbal consent was obtained from each respondent prior to data collection. Respondents were informed of the purpose of the study and assured that their individual responses would be treated confidentially and used only for research purposes. No personally identifying information is reported in this study; findings are presented in aggregate or through anonymised illustrative quotations.

3.10 Limitations of the Methodology

As with any small-scale, purposively sampled field study, the methodology adopted here has certain limitations that should be borne in mind when interpreting the findings. These limitations, along with their implications, are discussed in detail in Section 4 following presentation of the results, and include the small sample size, the geographic and gender composition of the sample, and the reliance on farmers' self-reported perceptions rather than metered field measurements.

Chapter 4: Findings and Data Analysis

This chapter presents the results of a field survey undertaken to assess the effectiveness of Alternate Wetting and Drying (AWD) technology among Boro paddy farmers in the drought-prone Barind tract of Bangladesh. Primary data were collected from 22 Boro rice farmers practising AWD in Dhamoirhat Upazila, Naogaon District (Lokkhitara and Chokvhobani villages), using a structured questionnaire covering socio-demographic characteristics, pre-AWD irrigation practices, the AWD adoption and learning process, water-saving outcomes, economic and yield effects, and the constraints farmers face in using the technology.

The analysis is descriptive in nature and is based entirely on the responses recorded in the field. For each survey item, responses are summarised as frequencies and percentages (n = 22 unless otherwise stated) and presented using bar charts, pie charts, and histograms,

followed by a short interpretation. Where a question allows more than one answer (e.g., difficulties faced, sources of support needed), percentages are calculated against the total number of respondents and may sum to more than 100 percent. A concise synthesis of findings and the limitations of the survey are provided at the end of the chapter.

4.1 Quantitative Variables

Understanding the background characteristics of the sampled farmers helps contextualise their responses on AWD adoption and its effects. This section presents the age structure, gender, education, occupation, farming experience, landholding size, and family size of the respondents.

4.1.1 Age of Respondents

The largest share of respondents (45%) fell in the 41-50 age group, followed by the 30-40 age group (32%). Only a small proportion of farmers were below 30 (14%) or above 50 (14%), indicating that AWD in the study area is being practised predominantly by middle-aged, experienced farmers rather than very young or elderly ones.

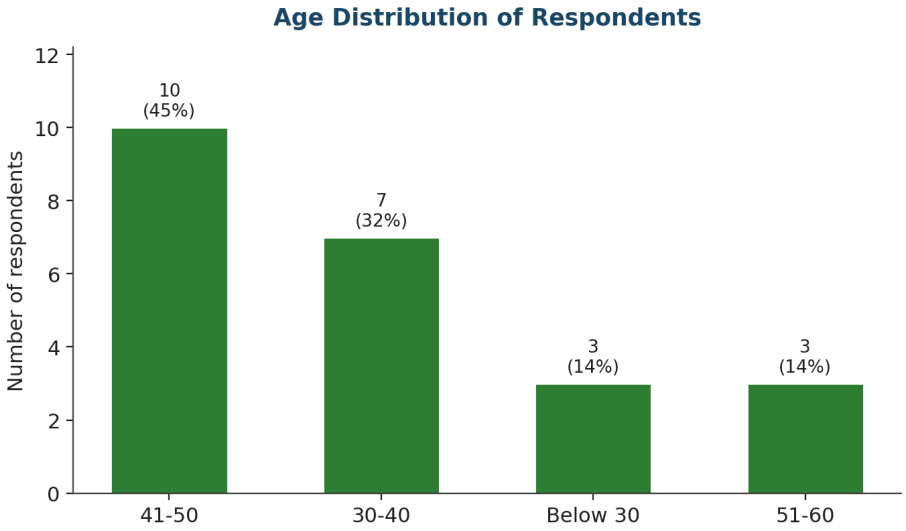

Figure 4.1: Age distribution of respondents

4.1.2 Gender of Respondents

All 22 respondents (100%) interviewed for this study were male. This reflects the male-dominated pattern of land decision-making and irrigation management commonly observed in Boro rice farming in rural Bangladesh, and it is noted here as an important limitation: the survey does not capture the perspectives of women involved in farm labour and household decisions relating to AWD.

4.1.3 Educational Qualification

Educational attainment among respondents was generally low: 41% had completed only primary-level education and a further 18% had no formal education at all. Only 5% had education above the higher-secondary level. This relatively low level of formal education is relevant to interpreting later findings on farmers' limited technical understanding of AWD and their expressed need for more training.

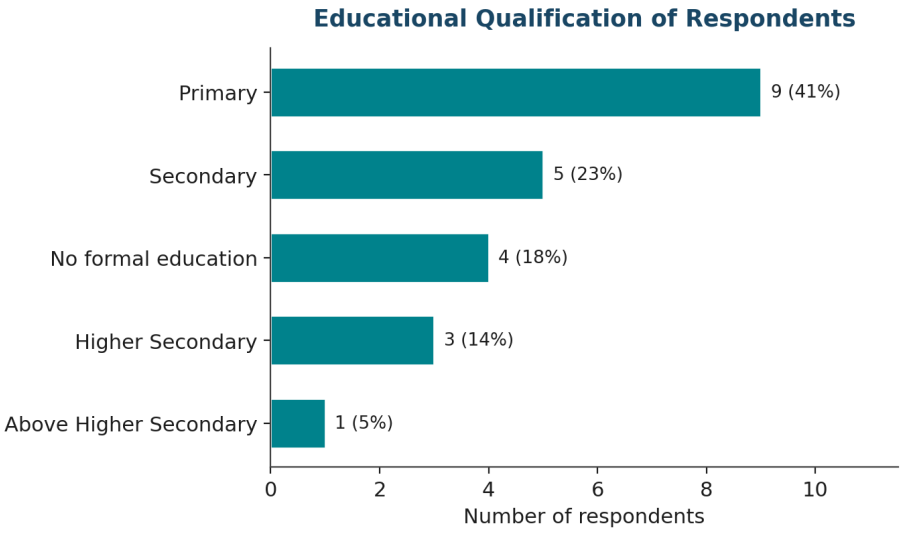

Figure 4.2: Educational qualification of respondents

4.1.4 Occupation and Farming Experience

Farming was reported as the main occupation by 95% of respondents, confirming that the sample is overwhelmingly composed of full-time farmers rather than part-time cultivators. In terms of experience, half of the respondents (50%) had been growing Boro rice for 5-10 years, while 27% had less than 5 years of experience and 23% had more than 10 years, suggesting a reasonably experienced farming community with a good working knowledge of local irrigation conditions.

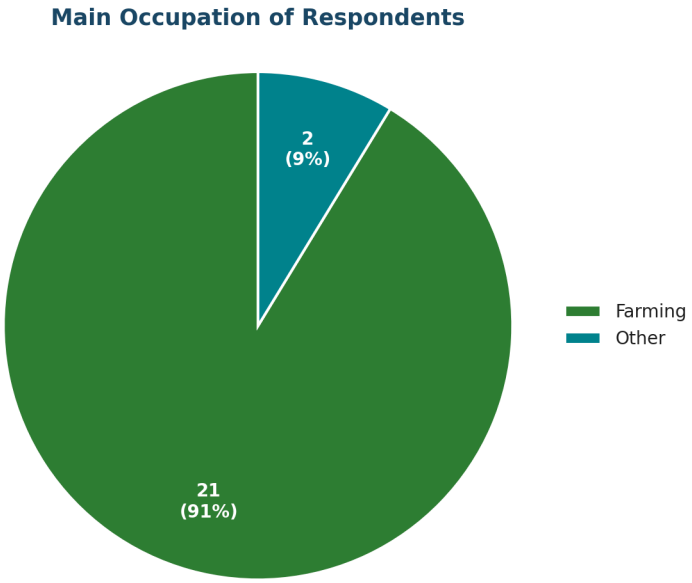

Figure 4.3: Main occupation of respondents

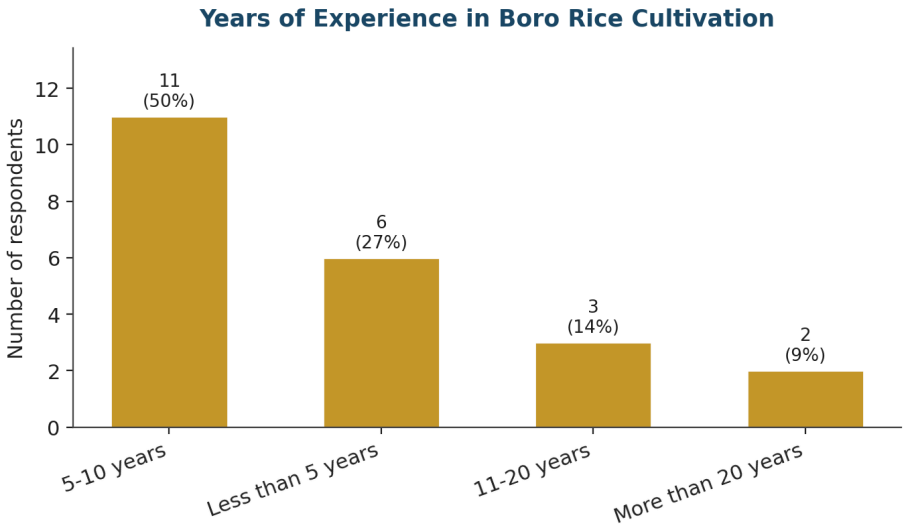

Figure 4.4: Years of experience in Boro rice cultivation

4.1.5 Landholding and Family Size

The area cultivated for Boro rice ranged from less than 1 bigha to 12 bigha, with a mean holding of about 5.4 bigha (SD ~ 3.8) and a median of 5.5 bigha, indicating a mix of small and medium landholders with a fairly wide spread. Average family size was about 7.3 members (SD ~ 1.8,

range 4-11), which is larger than the national average household size and implies a relatively high dependence on farm income and family labour.

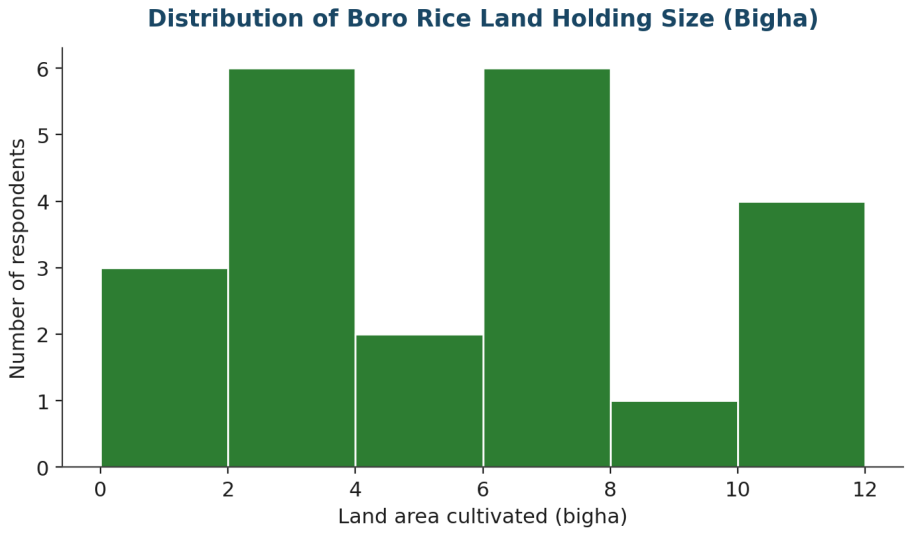

Figure 4.5: Distribution of Boro rice landholding size (bigha)

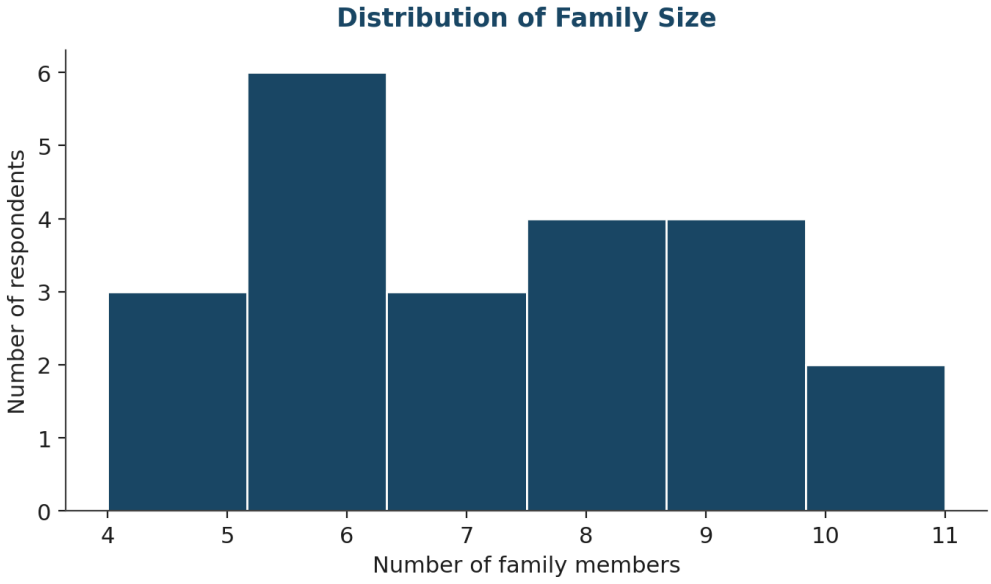

Figure 4.6: Distribution of family size

4.1.6 Irrigation Practices Before Adopting AWD

Before adopting AWD, groundwater was the dominant irrigation source, used by 82% of farmers, while 18% relied on both groundwater and surface water conjunctively; no farmer relied solely on surface water. This underlines the area's heavy dependence on groundwater extraction for Boro cultivation, which is a major driver of the seasonal groundwater decline reported in the drought-prone Barind tract.

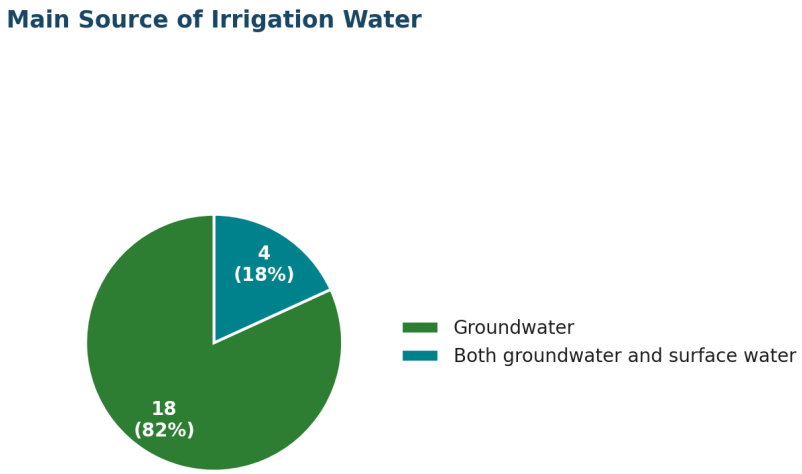

Figure 4.7: Main source of irrigation water

All 22 respondents (100%) reported that continuous flooding was their main irrigation method prior to adopting AWD. Under this method, more than half of farmers (55%) irrigated their fields every 4-5 days and 41% irrigated based on field condition, while irrigation on a strict daily basis was virtually absent. This confirms that continuous flooding, the conventional, water-intensive irrigation practice AWD is designed to replace, was universal in the study area before the intervention.

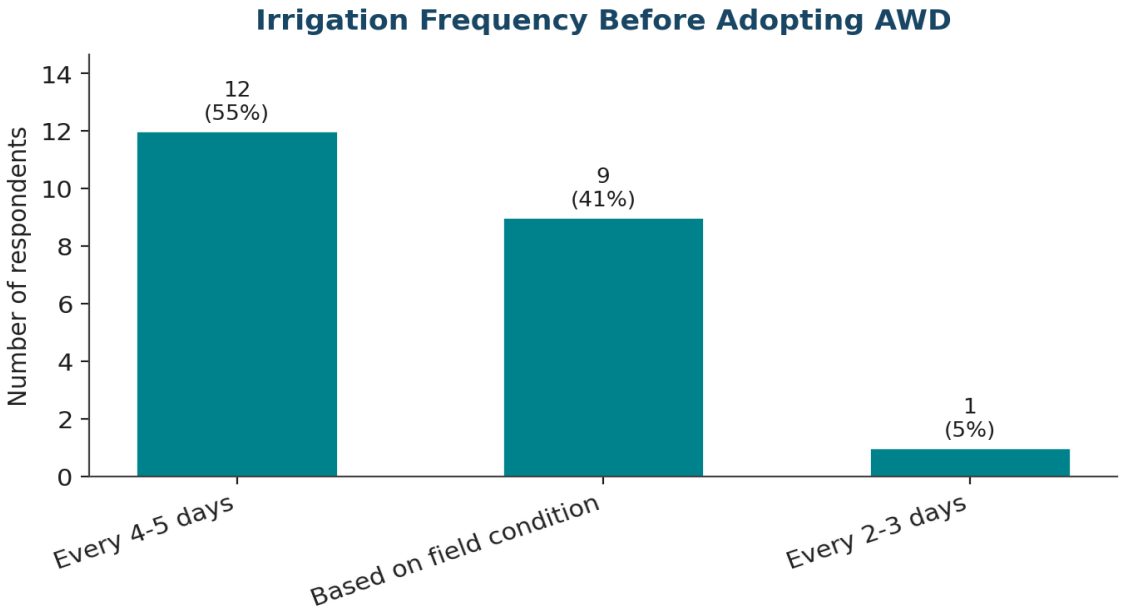

Figure 4.8: Irrigation frequency before adopting AWD

4.1.7 AWD Adoption, Learning, and Training

Adoption of AWD in the study area is recent: 55% of farmers had been using the technology for less than one year and the remaining 45% for 1-2 years; no respondent had practised AWD for more than two years. This indicates that AWD is still in an early diffusion stage in these villages.

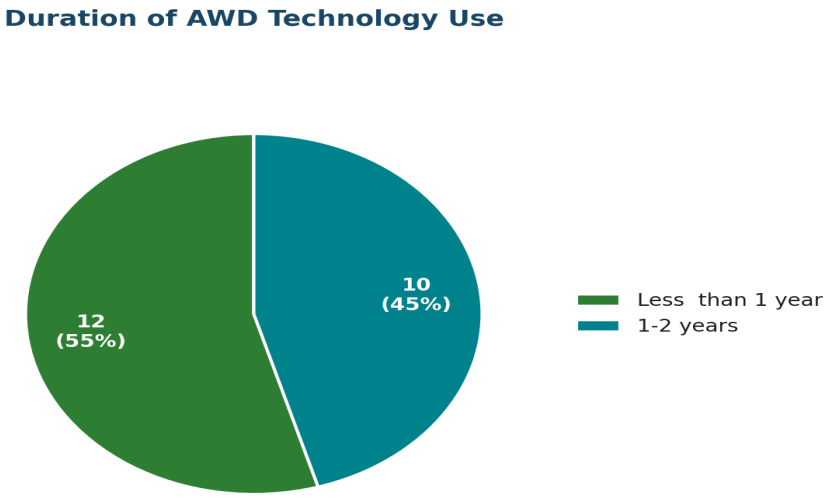

Figure 4.9: Duration of AWD technology use

NGOs/partner organisations were overwhelmingly the main channel through which farmers first learned about AWD (95%), followed by training or workshop sessions (73%, multiple sources possible); learning through agriculture officers, other farmers, or family/friends was negligible. This points to NGO-led extension as the principal driver of AWD diffusion in this locality rather than government extension services or informal farmer-to-farmer transfer.

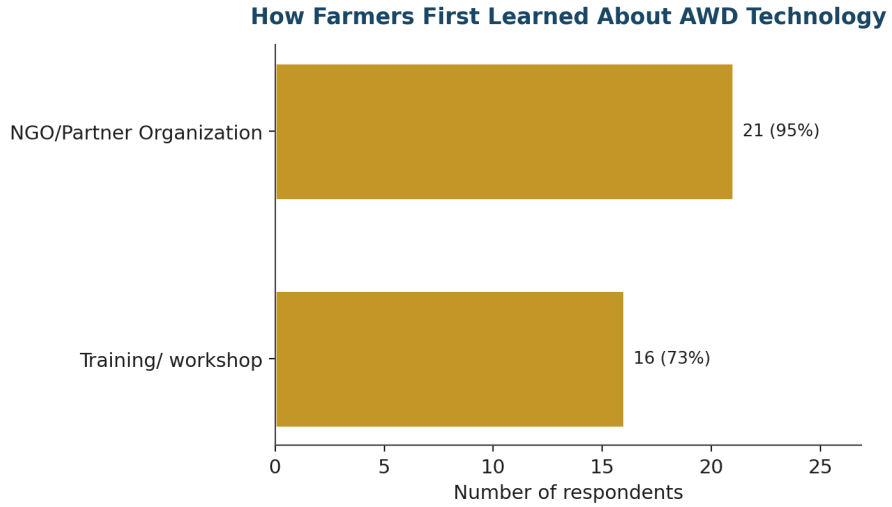

Figure 4.10: How farmers first learned about AWD technology

All respondents (100%) had received training on AWD and all rated that training as "useful" for understanding and implementing the technology (no one rated it as very useful, slightly useful, or not useful, indicating a fairly uniform, moderately positive training experience). Despite this uniform training coverage, only 91% of farmers said they fully understood how to apply AWD in their fields, while 9% still did not understand it fully, suggesting that a single round of training may not be fully sufficient for all farmers to master field-level application (e.g., correct use of the perforated field water tube to time re-irrigation).

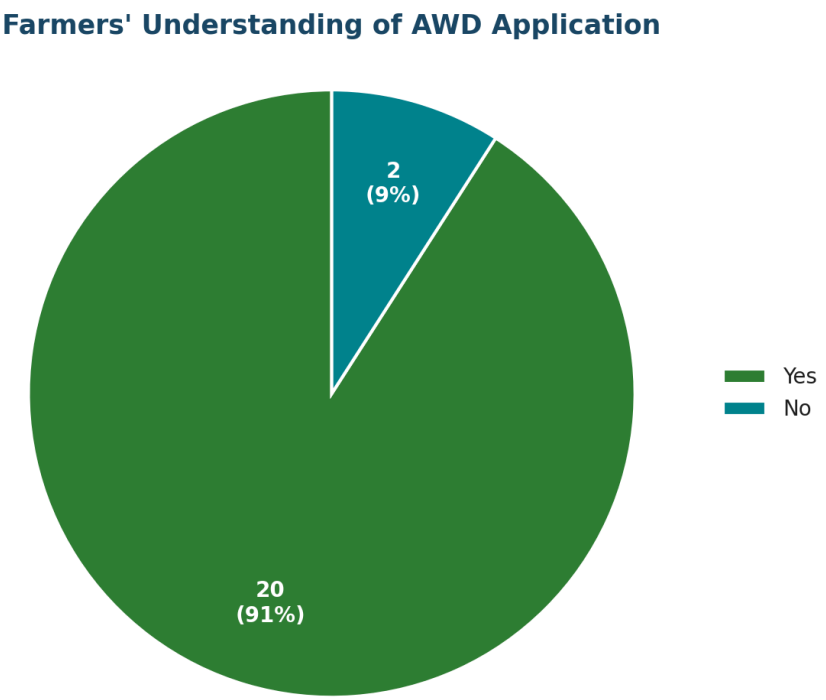

Figure 4.11: Farmers' understanding of AWD application

4.1.8 Water-Saving Impact of AWD

The core objective of AWD is to reduce irrigation water use without harming yield, and the survey results strongly support this. All 22 farmers (100%) reported some reduction in irrigation water use compared with their previous method, with 73% reporting a significant reduction and 27% a moderate ("somewhat") reduction. No farmer reported no change or an increase in water use.

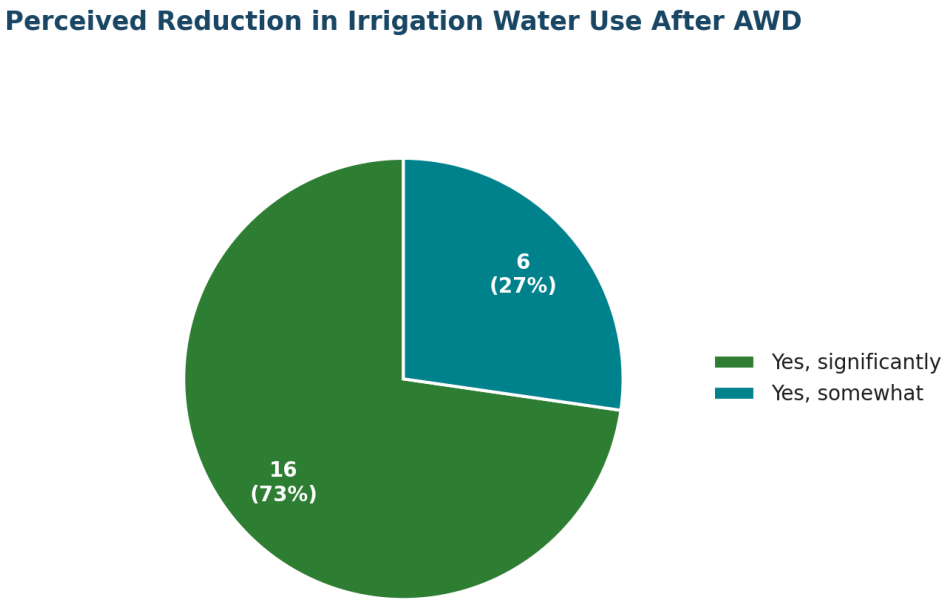

Figure 4.12: Perceived reduction in irrigation water use after AWD

In terms of irrigation frequency, 82% of farmers estimated a 21-30% reduction in the number of irrigation events compared with their earlier practice, and 18% estimated a 10-20% reduction. This is consistent with the intermittent, tube-monitored irrigation cycle that AWD prescribes in place of continuous flooding.

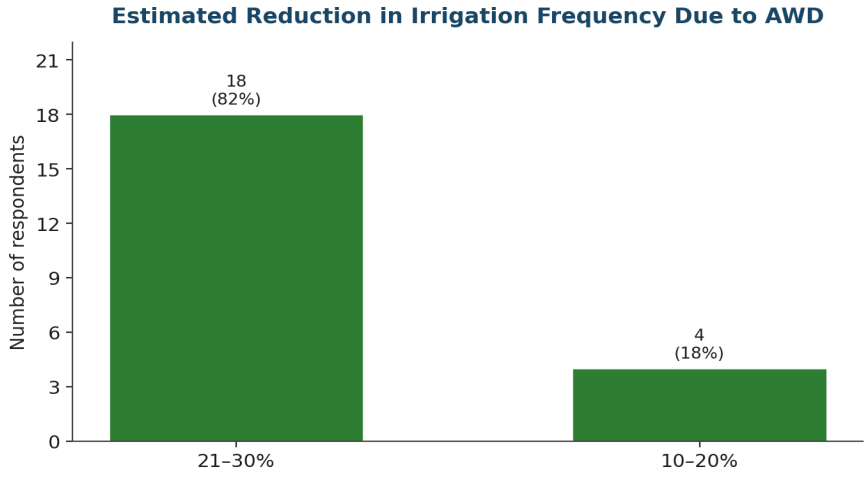

Figure 4.13: Estimated reduction in irrigation frequency due to AWD

All farmers (100%) also reported that AWD had reduced their groundwater use during Boro cultivation, and when asked what specific changes they had observed in water availability, 55% noted less pressure on groundwater and 45% noted that water was available for a longer period; no farmer reported no noticeable change. Reflecting this, all 22 respondents (100%) considered AWD suitable for drought-prone areas such as the Barind region, a unanimous, strongly positive assessment of the technology's relevance to local water-scarcity conditions.

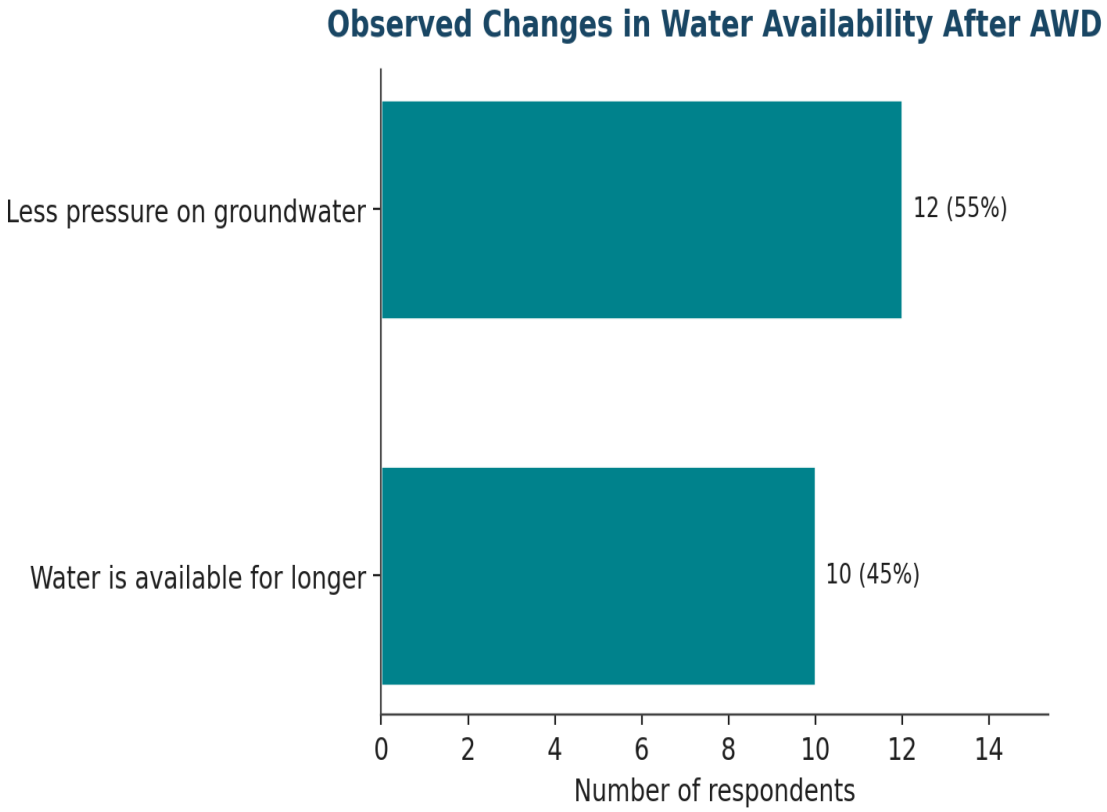

Figure 4.14: Observed changes in water availability after AWD

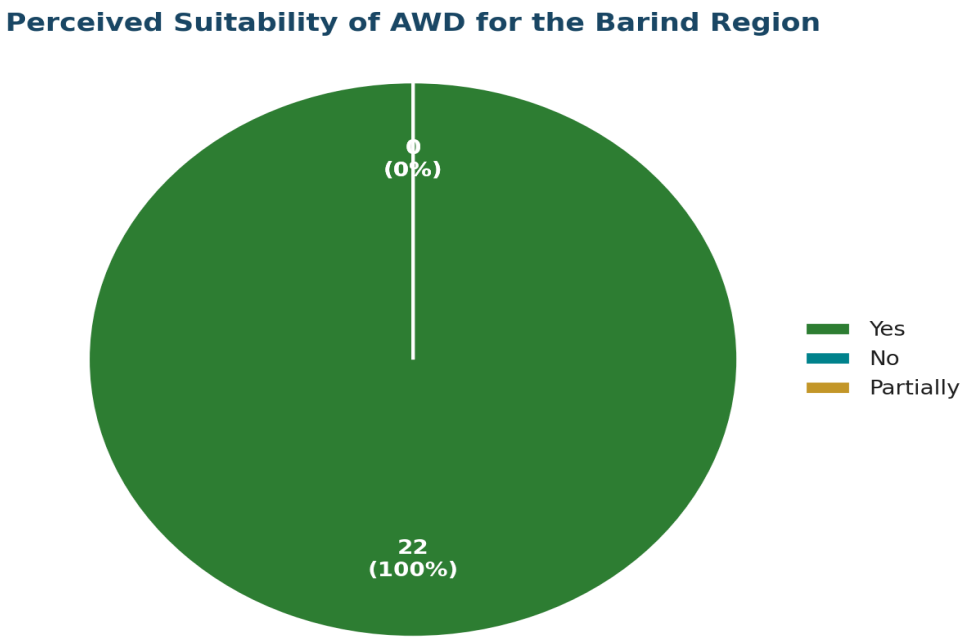

Figure 4.15: Perceived suitability of AWD for the Barind region

4.1.9 Economic and Yield Impact of AWD

On irrigation cost, 77% of farmers reported some reduction ("somewhat") and 23% reported no change; no farmer reported a significant cost reduction or an increase in cost. When asked more broadly whether AWD had reduced their total Boro rice production cost, opinion was more divided: only 36% said yes, 23% said no, and 41% could not say, indicating that while irrigation-specific costs fell, farmers do not uniformly perceive this as translating into lower overall production costs (which also include labour, fertiliser, and other inputs).

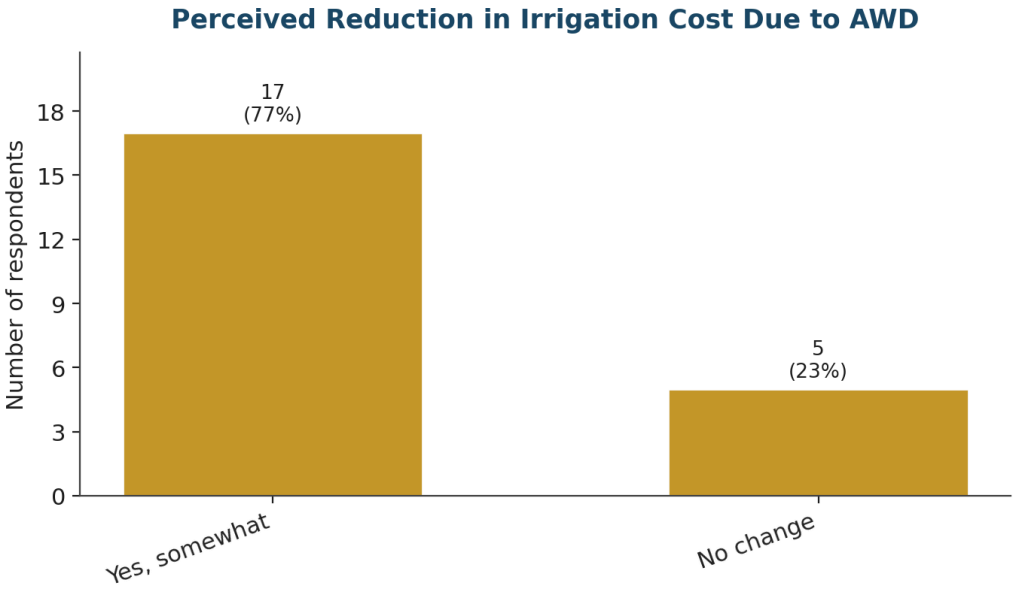

Figure 4.16: Perceived reduction in irrigation cost due to AWD

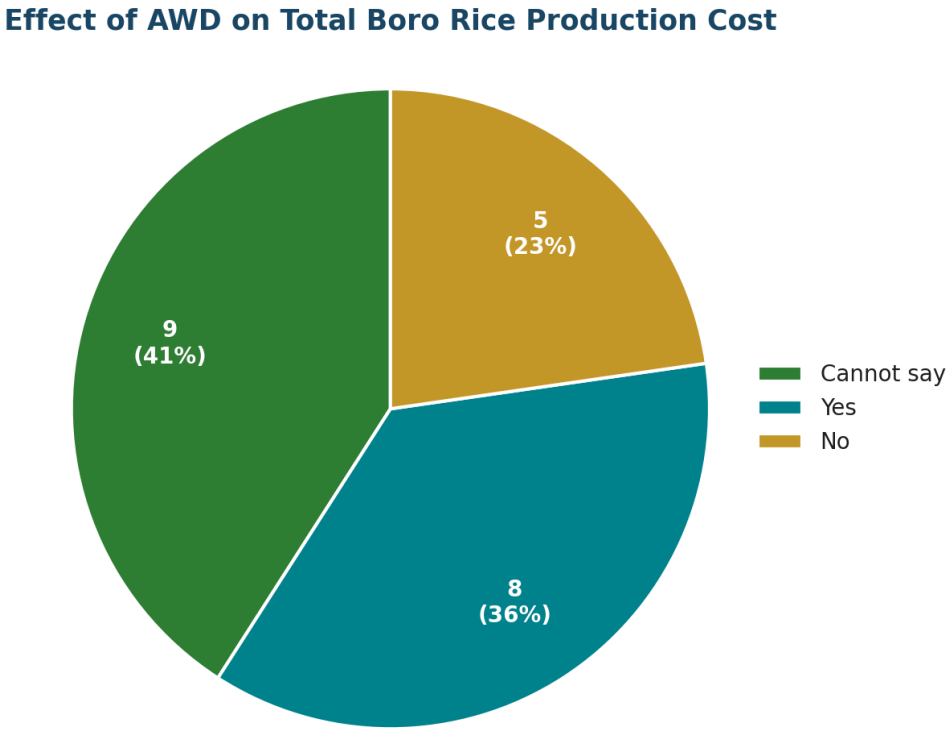

Figure 4.17: Effect of AWD on total Boro rice production cost

Importantly, no farmer reported a decrease in yield after adopting AWD: 77% observed no significant change in yield and 23% observed an increase, reinforcing the well-documented finding that AWD can achieve water savings without compromising rice yield.

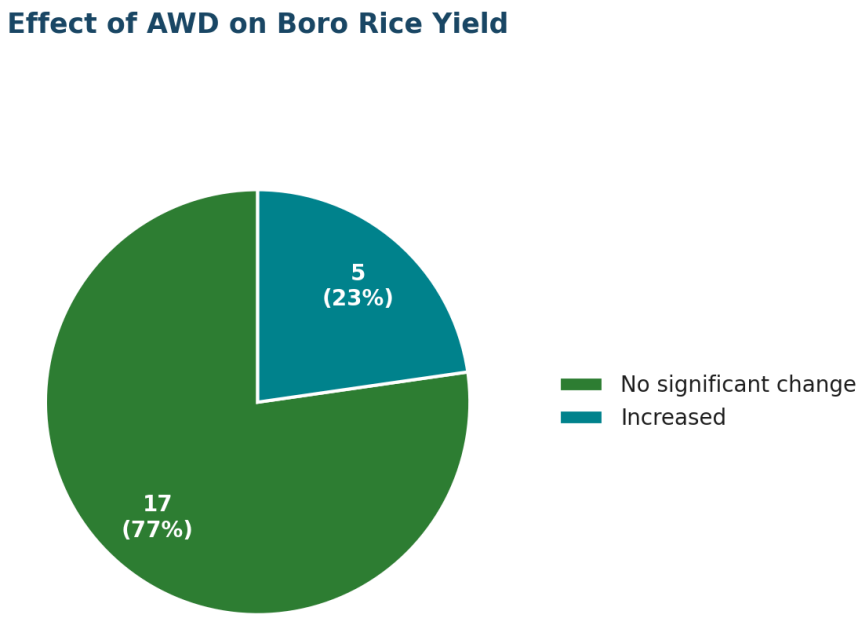

Figure 4.18: Effect of AWD on Boro rice yield

When asked about the main economic benefit received, responses were more mixed than the water and yield results: reduced irrigation cost and reduced water use were each cited by 32% of farmers, but a majority (68%) said they perceived no significant economic benefit (multiple responses were allowed). This is corroborated by the satisfaction data: 68% of farmers said they were "satisfied" and only 5% "very satisfied" with the economic benefits of AWD, while 27% were neutral and none were dissatisfied. Together, these results suggest that although AWD delivers clear water and irrigation-cost savings, farmers do not yet perceive a strong direct economic pay-off, an important gap between the technology's resource-saving performance and its felt financial benefit.

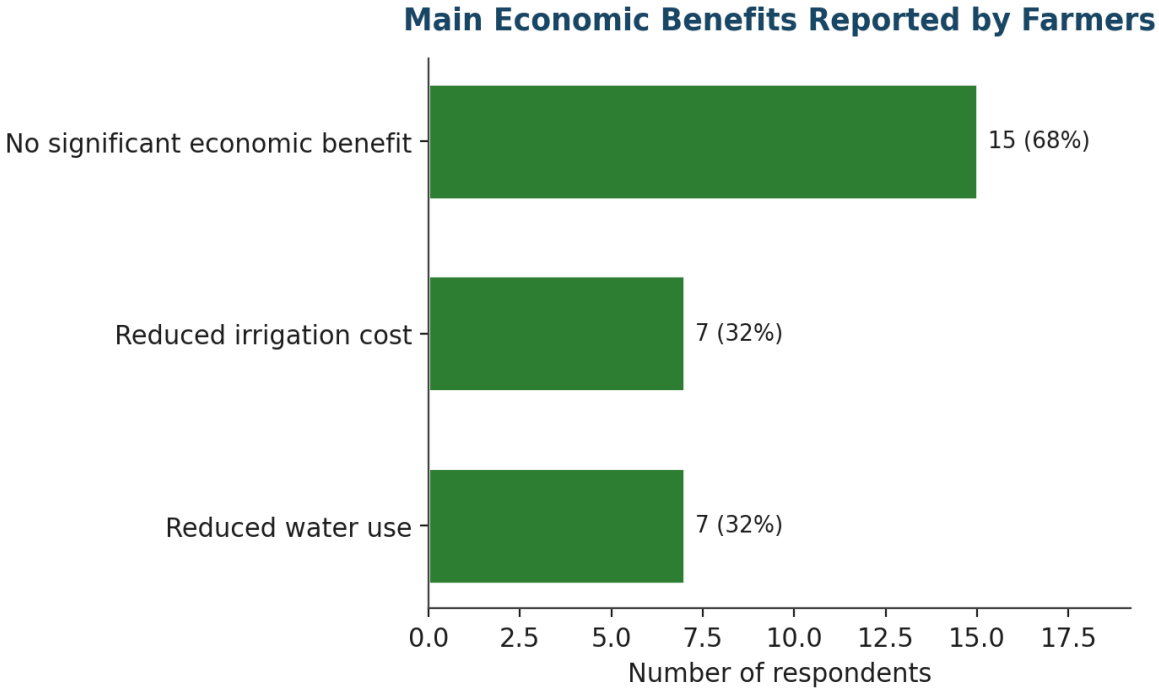

Figure 4.19: Main economic benefits reported by farmers

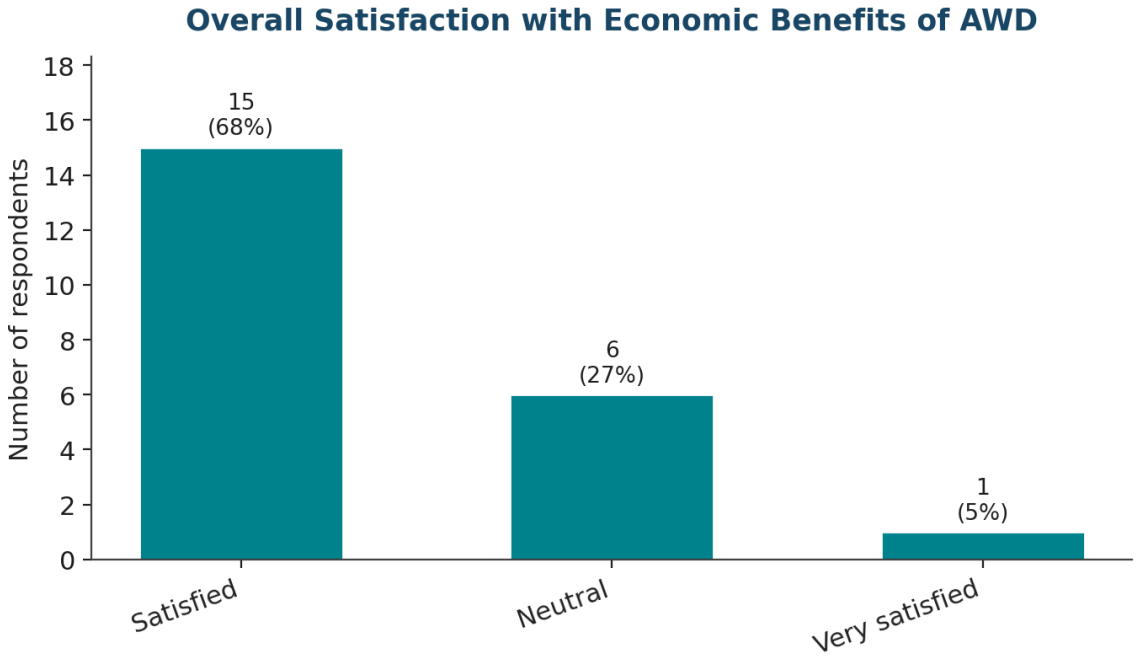

Figure 4.20: Overall satisfaction with the economic benefits of AWD

4.1.10. Challenges and Support Needed

Despite the positive water and yield outcomes, farmers reported substantial difficulties in adopting and using AWD. The most frequently cited difficulty was lack of knowledge (95%), closely followed by lack of training (91%) and fear of reduced yield (77%); lack of motivation (9%) and lack of irrigation facilities (5%) were mentioned by very few farmers, and cost of equipment, lack of technical support, and difficulty monitoring water levels were not cited at all. This shows that the main barrier to AWD adoption in this area is informational and technical rather than financial or infrastructural.

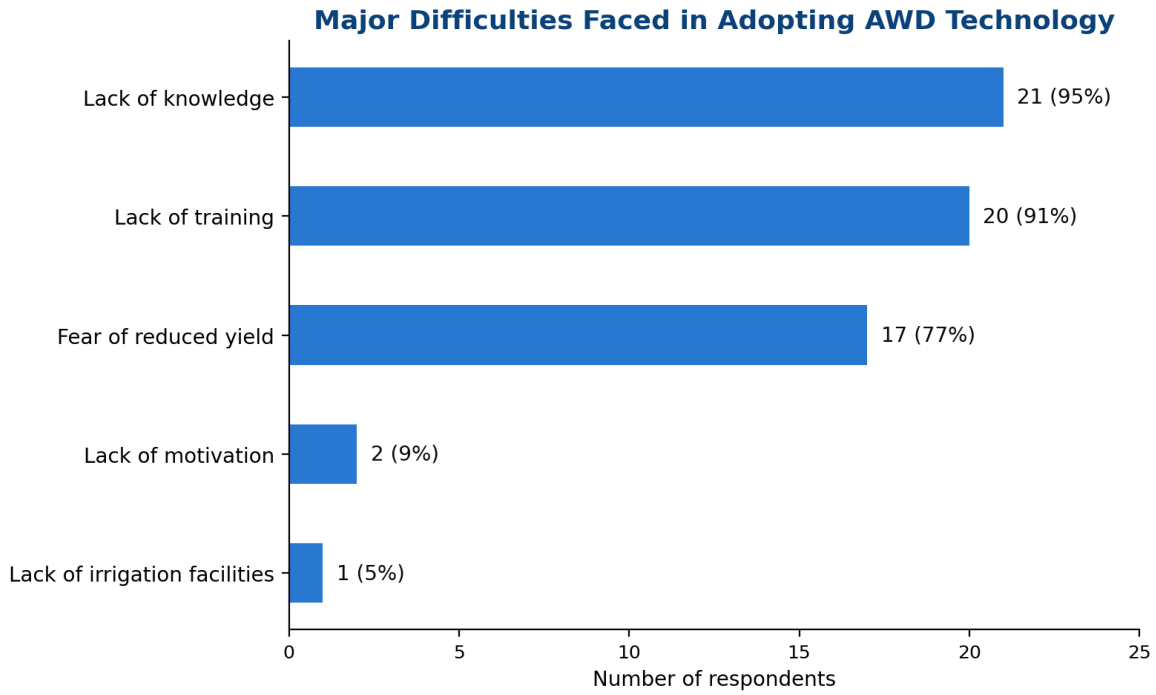

Figure 4.21: Major difficulties faced in adopting AWD technology

Consistent with this, only 18% of farmers felt that farmers in general have sufficient knowledge of AWD technology, while 50% said knowledge was insufficient and 32% said it was only partial. When asked what support would encourage wider adoption, more training (100%) and financial support (95%) were by far the most requested, with demonstration plots, free/low-cost equipment, technical support, government support, and NGO support each mentioned by a small minority of farmers.

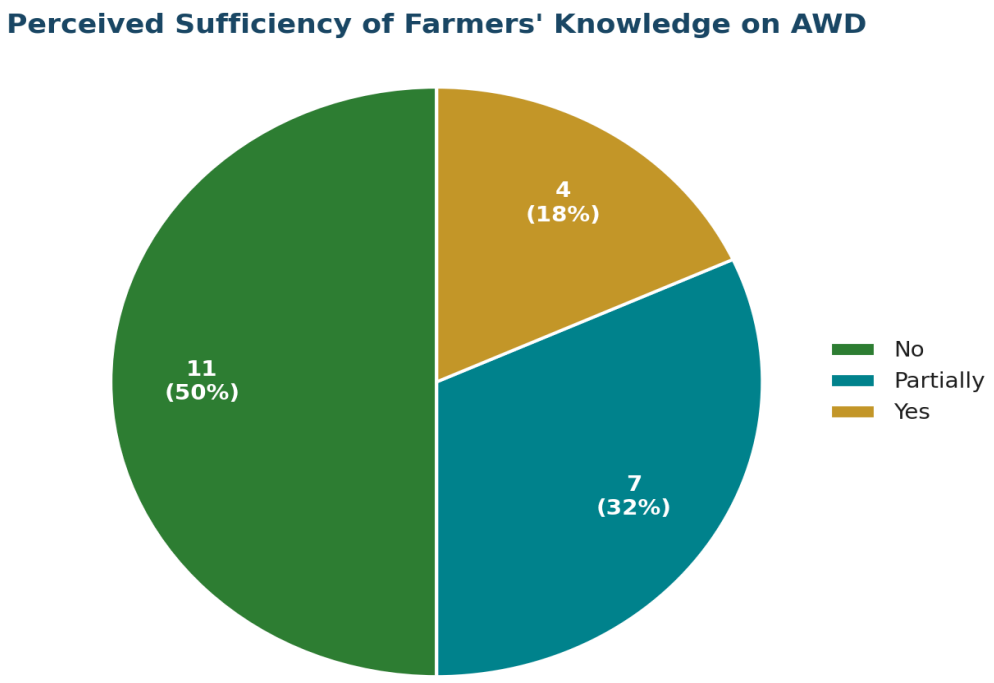

Figure 4.22: Perceived sufficiency of farmers' knowledge on AWD

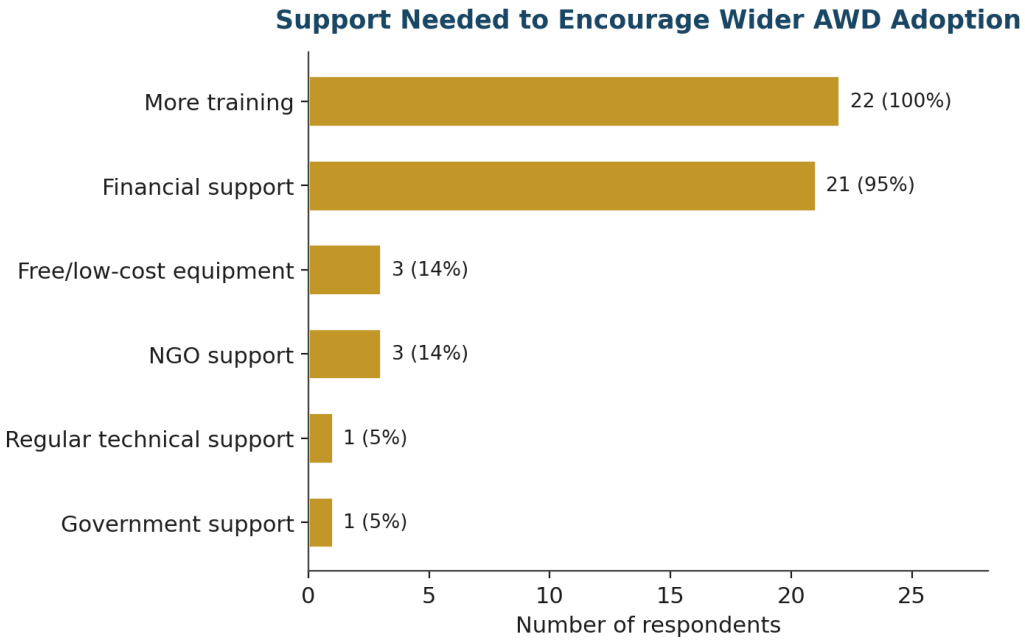

Figure 4.23: Support needed to encourage wider AWD adoption

4.1.11. Social Influence and Overall Recommendation

Social factors appear to play a substantial role in AWD adoption decisions: 82% of farmers said social factors (such as the influence of neighbours, community leaders, or peer farmers) influence the decision to adopt AWD, and a further 18% said they do so partially, meaning every respondent acknowledged some degree of social influence on adoption behaviour. This suggests that peer demonstration and community-level engagement could be an effective, low-cost complement to formal training..

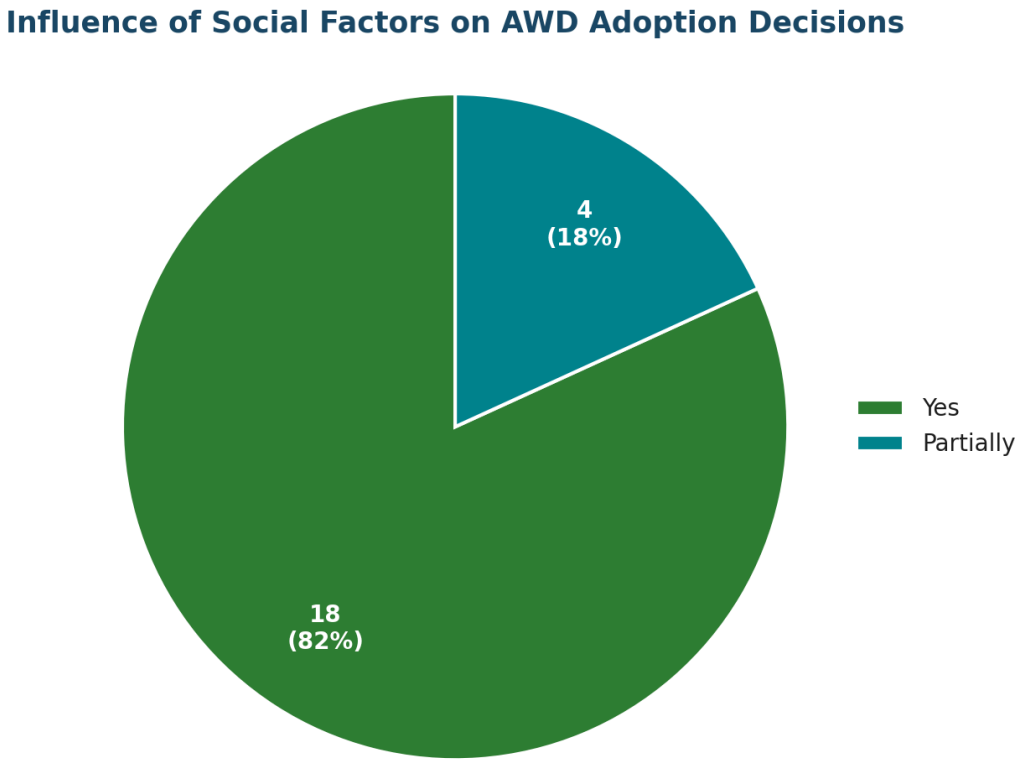

Figure 4.24: Influence of social factors on AWD adoption decisions

Most tellingly, all 22 farmers (100%) said they would recommend AWD technology to other Boro rice farmers, a unanimous endorsement that, taken together with the universal water savings and the absence of any reported yield decline, indicates strong overall farmer confidence in AWD despite the knowledge and training gaps identified above.

4.1.12 Summary of Key Findings

The table below consolidates the main quantitative results discussed in this chapter (n = 22).

Overall interpretation

1. AWD delivers on its core promise: every surveyed farmer achieves irrigation water savings, and no farmer experiences a yield loss, the technology's central water-yield trade-off objective is clearly being met in this drought-prone locality.
2. Economic benefits are perceived less strongly and less uniformly than water and yield benefits, with two-thirds of farmers reporting no significant direct economic gain despite lower irrigation cost and water use, pointing to a need for better cost-benefit communication or complementary support (e.g., input or credit support) to convert resource savings into felt income gains.
3. Knowledge and training, not cost, infrastructure, or motivation, are the dominant barriers to effective and wider AWD use, and are the most commonly requested forms of support.
4. Social influence and unanimous farmer endorsement (100% recommend AWD) suggest strong potential for peer-led, demonstration-based scaling once knowledge gaps are addressed.
5. The sample is entirely male, drawn from two neighbouring villages within a single upazila, and adoption is recent (≤ 2 years for all respondents), findings should be read as indicative of early-stage AWD experience in this specific part of the Barind tract rather than as generalisable to all Boro farmers in Bangladesh.

Theme	Key Result	Interpretation
Water use	100% reported reduced irrigation water use; 73% reported a significant reduction.	Strong evidence of perceived water-saving effectiveness.
Irrigation frequency	82% reported a 21–30% reduction; 18% reported a 10–20% reduction.	AWD reduced the frequency of irrigation events.
Yield	77% reported no significant change; 23% reported an increase; none reported a decline.	Water savings were achieved without reported yield loss.
Irrigation cost	77% reported some reduction; 23% reported no change.	Cost savings were present but not uniform.
Knowledge/training	95% cited lack of knowledge and 91% cited lack of training as difficulties.	Technical learning is the dominant adoption constraint.
Social influence	100% reported some degree of social influence on adoption decisions.	Peer and community influence are important for diffusion.
Recommendation	100% said they would recommend AWD to other Boro farmers.	Overall acceptance of AWD is very strong among current users.

Table 2: Summary of Quantitative Key Findings.

4.2 FGD Findings(Qualitative)

To gain a deeper understanding of farmers' experiences, perceptions, and challenges regarding the adoption of Alternate Wetting and Drying (AWD) technology, two Focus Group Discussions (FGDs) were conducted with Boro rice farmers in Dhamoirhat Upazila. The first FGD was conducted in Lakshmitara village with 13 persons,while the second FGD was conducted in Chabbani village under Aranagar Union with 7 persons. The discussions lasted approximately 20-30 minutes,respectively. The participants had practical experience in Boro rice cultivation and provided information about irrigation practices, water use, production, irrigation costs, farmers' perceptions of AWD, adoption barriers, and the support required for sustainable use of the technology.

FGD- 1

Date:26.07.2026,

Location: Village: Lakshmitara, Upazila: Dhamoirhat, Naogaon .

Participants: 13 person

A total of 13 persons participated in the first FGD. The participants were experienced farmers with practical knowledge of Boro rice cultivation, irrigation practices, and AWD technology. The discussion focused on changes in irrigation practices after adopting AWD, water and irrigation cost savings, crop production, farmers' concerns, and the support required for wider adoption of the technology.

The participants reported that before adopting AWD, they generally irrigated their Boro rice fields approximately 10–12 times from the beginning of cultivation until harvesting. After adopting AWD, the number of irrigation events decreased to approximately 8–9 times. According to the farmers, conventional irrigation often involved maintaining standing water in the field and applying irrigation at relatively regular intervals. With AWD, however, they now make irrigation decisions based more on the *actual condition of the field and the water requirements of the crop. One farmer explained, "*আগে বোরো ধান উঠানো পর্যন্ত ১০–১২ বার সেচ দিতে হতো, এখন *AWD* করার পরে প্রায় ৮–৯ বার সেচ দিলেই হয়ে যায়।*"* The farmers considered this reduction in irrigation frequency one of the most important benefits of AWD, particularly because Boro cultivation in the Barind region is highly dependent on irrigation.

The participants also explained that AWD does not mean completely drying the field. They identified the first 15 days after transplanting as a particularly important period when adequate water is required for proper crop establishment. One participant stated, "প্রথম ১৫ দিন জমিতে পানি রাখতেই হয়। না হলে আগাছা হয় অনেক। After this initial stage, farmers reported that irrigation could be managed according to field conditions and crop requirements. This indicates that the farmers have developed a practical understanding of AWD in which water saving is combined with maintaining sufficient water during critical stages of crop growth.

A significant issue discussed by the farmers was the difference between the water-card and BMDA irrigation systems. Farmers using the water-card system explained that they directly pay for the irrigation water they use. Therefore, when AWD reduces the number of irrigation events, their irrigation expenditure also decreases. One participant stated, "কার্ডের পানিতে যতবার সেচ দিই, ততবারই আমাদের নিজের টাকা খরচ হয়। তাই *AWD* করে সেচ কমলে আমাদের খরচও সরাসরি কমে যায়।" The farmers considered this direct financial saving an important incentive for continuing AWD. In contrast, BMDA users explained that although AWD reduces the amount of water required, their irrigation expenditure does not necessarily decrease because the existing payment arrangement may remain unchanged. A farmer stated, "*BMDA*-তে *AWD* করার কারণে পানি কম লাগছে, কিন্তু খরচ কমছে না। পাঁচবার পানি নিলেও একই টাকা, দশবার নিলেও একই টাকা দিতে হয়।" Therefore, the FGD suggests that the economic benefits of AWD depend partly on the irrigation payment system through which farmers access water.

The participants generally expressed a positive perception of crop production under AWD. They did not identify a clear reduction in rice yield when AWD was properly implemented. One farmer reported cultivating BRRI dhan 88 and obtaining approximately 45 maunds of rice from 49 decimals of land, which he considered satisfactory production under reduced irrigation. Nevertheless, farmers remained cautious because Boro cultivation involves substantial financial investment. They expressed concern that improper irrigation management or excessive reduction of water could affect crop growth and yield. Thus, fear of crop loss remains an important psychological and economic barrier to wider adoption.

The farmers also emphasized the need for more practical and continuous training on AWD. They suggested that training should focus on irrigation timing, crop growth stages, field-water conditions, and proper implementation rather than being limited to theoretical information. Demonstration plots and repeated field-based training were considered useful for increasing farmers' confidence. In addition, some participants suggested financial assistance or a risk-protection mechanism for farmers who are hesitant to adopt AWD because of the fear of possible crop loss. Overall, the first FGD indicates that farmers recognize the water-saving and potential economic benefits of AWD, but continued technical guidance, practical demonstrations, and appropriate financial support are necessary to encourage wider and sustainable adoption.

FGD -2

Location: Village: Chokvhobani, Union: Aranagar, Upazila: Dhamoirhat,Naogaon.

Participants: 7 persons.

Date:26.07.2026

The second FGD was conducted with 7 people in Chokvhobani village.The discussion focused on farmers' practical experiences with AWD, particularly changes in irrigation frequency, water conservation, irrigation costs, production concerns, and the support required for continued adoption.

Similar to the first FGD, participants reported that conventional Boro cultivation generally required around 10–12 irrigation events, whereas AWD reduced the requirement to approximately 8–9 times. The farmers explained that AWD allows them to make irrigation decisions based on the actual condition of the field instead of maintaining continuous standing water. They considered this reduction in irrigation particularly important because of seasonal water scarcity and the high dependence of Boro cultivation on irrigation in the Barind region.

The participants again highlighted the difference between water-card and BMDA irrigation systems. Farmers using water-card systems considered AWD economically beneficial because they directly pay for irrigation water. Therefore, fewer irrigation events result in lower expenditure. In contrast, BMDA users reported that AWD reduces water requirements but does not provide the same direct financial benefit because their irrigation payment may remain unchanged. The farmers therefore felt that the existing irrigation payment system can influence their willingness to adopt and continue AWD.

Farmers' concerns about crop production were also discussed. Although participants recognized the benefits of reducing water use and irrigation costs, they remained cautious about adopting AWD if they believed that reduced irrigation might affect crop yield. One participant stated, "কৃষক পানি আর খরচ দুইটাই কমাতে চায়, কিন্তু ধানের ফলন কমার ভয় থাকলে সে নতুন পদ্ধতি নিতে চায় না।" This indicates that farmers' hesitation is mainly related to perceived production risk rather than rejection of the technology itself. The participants suggested that successful AWD

demonstrations within their own communities could help reduce this uncertainty and increase farmers' confidence.

The farmers also emphasized the need for stronger institutional and technical support. They recommended regular training, refresher sessions, field-level demonstrations, monitoring, and easily accessible technical guidance from NGOs, PKSF, agricultural officers, and project personnel. They also suggested that experienced AWD farmers could share their practical experiences with other farmers. In addition, participants considered financial assistance or a risk-protection mechanism useful for encouraging farmers who are concerned about possible crop loss. Overall, the FGD indicates that farmers recognize the water-saving potential of AWD, but wider adoption depends on continued technical support, practical demonstrations, appropriate economic incentives, and greater confidence in maintaining crop production.

Overall FGD Findings

The findings from both FGDs demonstrate that AWD has contributed to a reduction in irrigation frequency and water use among participating Boro rice farmers. Farmers reported that while they previously required approximately 10–12 irrigation events during the Boro cultivation period, AWD reduced the requirement to approximately 8–9 events. However, the farmers emphasized that adequate water must be maintained during the first 15 days after transplanting, which they considered a critical period for crop establishment.

A particularly important finding is the difference in economic benefits between the water-card and BMDA irrigation systems. Farmers using the water-card system directly benefit financially from AWD because they pay for their own irrigation water; therefore, a reduction in irrigation frequency leads directly to lower irrigation expenditure. In contrast, BMDA users reported that although AWD reduces water requirements, their irrigation costs remain largely unchanged because of the existing payment arrangement. Thus, AWD provides a stronger direct financial incentive for water-card users, while BMDA users primarily experience the benefit of water conservation.

The FGDs also suggest that AWD does not necessarily reduce crop production when implemented properly. The reported production of 45 maunds of BRRI dhan 88 from 49 decimals of land by one AWD-using farmer provides a local example of satisfactory production

under reduced irrigation. Nevertheless, the fear of crop loss remains an important barrier to wider adoption.

Finally, farmers identified adequate training, practical demonstrations, regular technical guidance, and financial support as important requirements for increasing AWD adoption. In particular, a financial risk-protection or assistance mechanism could reduce farmers' fear of potential crop loss and increase their willingness to adopt AWD. Therefore, the findings indicate that promoting AWD requires not only technical awareness but also an enabling economic and institutional support system.

4.3 Key Informant Interview (KII) Findings

	Name of the key Informant	**Designation**	**Organization**
Key Informant Interviews	Ahmadullah Zaman	Project co-ordinator ECCCP-Drought	JRDM
	Farhad Hossain	Accountant cum MIS Officer	JAKAS
	Manjurul Islam	Agricultural officer	JAKAS

Table 03: Personnel for KIIs

To obtain institutional and expert-level insights into the adoption and effectiveness of Alternate Wetting and Drying (AWD) technology, three Key Informant Interviews (KIIs) were conducted with individuals directly involved in agricultural development, project implementation, field-level activities, and monitoring. The key informants included an Agricultural Officer of JAKAS NGO, the Project Coordinator of ECCCP–Drought at JRDM, and an Accountant cum MIS Officer of JAKAS. Their responses provided important insights into the current irrigation situation, groundwater scarcity, effectiveness of AWD, economic implications, farmers' perceptions, training and institutional support, as well as the major challenges affecting wider adoption of AWD in the Barind region.

The Agricultural Officer of JAKAS NGO highlighted the increasing pressure on groundwater resources in the Barind region, particularly due to the high dependence of Boro rice cultivation on irrigation during the dry season. According to him, declining groundwater levels, drought conditions, and changing climatic patterns are making efficient irrigation management increasingly important. He explained that AWD can help farmers reduce unnecessary irrigation by allowing water to be applied according to the actual requirement of the crop rather than maintaining continuous standing water. Based on his field-level experience, AWD can reduce irrigation water use by approximately 20–30%, although the actual level of saving may vary depending on soil conditions, crop growth stages, and the proper implementation of the technology. He also emphasized that AWD does not mean completely stopping irrigation; rather, it is a controlled irrigation practice that ensures adequate water availability for the crop while avoiding unnecessary water use. He further mentioned that farmers often hesitate to reduce irrigation because of their fear that insufficient water may negatively affect crop yield. Therefore, practical demonstrations and continuous technical support are necessary to increase farmers' confidence in AWD.

The Project Coordinator of ECCCP–Drought at JRDM provided further insights into the programme-level implementation of AWD and its relationship with climate adaptation. He explained that the ECCCP–Drought programme focuses on strengthening the resilience of communities in drought-prone areas and that efficient water management is an important part of this process. According to him, AWD is particularly relevant to the Barind region because it can reduce groundwater extraction while maintaining rice production when properly implemented. He also emphasized that farmers' adoption decisions are influenced not only by technical knowledge but also by economic considerations. Farmers using a water-card system can receive a more direct financial benefit from AWD because reduced irrigation frequency can lower their irrigation expenditure. In contrast, farmers using the BMDA irrigation system may save water without experiencing a similar reduction in payment where irrigation charges are not directly based on the number of irrigation events. He therefore considered the irrigation payment system an important factor influencing farmers' motivation to adopt AWD. He also stressed the importance of demonstration plots, repeated training, field-level follow-up, and awareness activities so that farmers can observe the practical benefits of AWD and overcome their concerns about possible crop loss.

The Accountant cum MIS Officer of JAKAS also emphasized the importance of monitoring, farmer awareness, and continuous institutional support for the successful implementation of AWD. From his perspective, field-level monitoring and information management are necessary to understand whether farmers are applying AWD correctly and to identify the difficulties they face during cultivation. He mentioned that project activities include training and awareness programmes on water conservation, rainwater harvesting, and sustainable management of water resources. He noted that farmers often have limited practical knowledge even when they have received general information about AWD. Therefore, training should not be limited to theoretical explanations but should include practical guidance on irrigation timing, crop growth stages, and field-water conditions. He also emphasized that one-time training may not be sufficient because farmers may return to traditional irrigation practices when they face uncertainty or difficulties. Regular communication, technical assistance, and follow-up are therefore necessary for sustaining adoption.

Across the three interviews, a common concern was farmers' fear of crop loss and the lack of sufficient practical knowledge about AWD. The informants indicated that farmers are generally more willing to adopt the technology when they can observe successful results from other farmers and receive continuous guidance from project personnel. They also highlighted the importance of coordination among PKSF, Partner Organizations, NGOs, agricultural officers, project staff, and local institutions in providing technical support and monitoring. The informants suggested that expanding practical training and demonstration activities, strengthening appropriate water-card systems, and developing suitable incentives or risk-support mechanisms could encourage hesitant farmers to adopt AWD. Overall, the KII findings suggest that AWD has considerable potential to reduce irrigation water use and contribute to groundwater conservation in the drought-prone Barind region. However, wider and sustainable adoption depends not only on the technical effectiveness of AWD but also on farmers' confidence, economic incentives, practical knowledge, continuous technical support, and effective institutional coordination.

Chapter 5: Discussion of Findings

5.1 AWD Effectiveness in Reducing Irrigation Water Use

The quantitative and qualitative findings consistently indicate that AWD has been effective in reducing irrigation water use among the surveyed Boro rice farmers in Dhamoirhat Upazila. All 22 survey respondents reported a reduction in irrigation water use after adopting AWD, while 73% described the reduction as significant and 27% as moderate. In addition, 82% estimated that the number of irrigation events had declined by 21–30%, while the remaining 18% reported a reduction of 10–20%. These findings are consistent with previous research identifying AWD as a water-saving irrigation practice (Neogi et al., 2018; Oliver et al., 2008; Das et al., 2023).

The FGD findings provide important contextual support for these quantitative results. Farmers reported that conventional Boro cultivation generally required around 10–12 irrigation events, whereas AWD reduced this to approximately 8–9 events. They also described a shift from routine irrigation towards irrigation based on field condition. This suggests that the main contribution of AWD in the study area is not the elimination of irrigation, but more efficient timing and application of irrigation water. The convergence of survey and FGD evidence strengthens the conclusion that water saving is the clearest and most consistently experienced benefit of AWD in the study area.

The findings are particularly significant in the Barind context because groundwater was the dominant irrigation source before AWD adoption, with 82% of farmers reporting groundwater use and 18% reporting combined groundwater and surface-water use. All respondents also perceived a reduction in groundwater use after adopting AWD. Although the study did not directly measure groundwater extraction, the farmers' consistent reports suggest that AWD has the potential to reduce pressure on groundwater resources when properly implemented.

5.2 Yield Stability and the Water–Yield Relationship

A major concern surrounding water-saving irrigation is whether reducing irrigation will negatively affect rice yield. The present findings provide a positive indication in this regard. None of the 22 surveyed farmers reported a decline in Boro rice yield after adopting AWD, while 77% reported no significant change and 23% reported an increase. This result is broadly consistent with the literature suggesting that AWD can reduce water use without necessarily

compromising rice production (Neogi et al., 2018; Oliver et al., 2008).

The qualitative findings, however, add an important qualification. Farmers and key informants emphasized that AWD must be implemented correctly and that sufficient water should be maintained during critical stages of crop development. FGD participants specifically identified the first 15 days after transplanting as an important period when adequate water is required for crop establishment. They also expressed concern that excessive or poorly timed drying could create a risk of crop loss. Therefore, the observed yield stability should not be interpreted as evidence that irrigation can simply be reduced without monitoring. Rather, the findings suggest that AWD can maintain production when farmers understand the appropriate timing and conditions for irrigation.

This distinction is important for farmer confidence. Since Boro cultivation involves substantial investment, farmers are understandably cautious about practices that they believe may threaten yield. Demonstrating that water savings can occur without yield loss, while simultaneously providing clear technical guidance, is therefore central to sustainable AWD adoption.

5.3 Irrigation Cost Savings and the Perceived Economic Benefit

The economic findings reveal a more complex picture than the water-saving results. Although 77% of farmers reported some reduction in irrigation cost, none reported a significant reduction and 23% reported no change. When asked about total Boro production costs, only 36% believed that AWD had reduced their overall production cost, while 23% reported no reduction and 41% were unable to say. Moreover, 68% reported that they perceived no significant direct economic benefit from AWD.The FGDs help explain this apparent difference. Farmers clearly distinguished between irrigation-related savings and total production costs. AWD can reduce the number of irrigation events, but it does not directly reduce expenditure on other major inputs such as fertiliser, labour, seed, and other cultivation costs. Consequently, a reduction in irrigation expenditure does not necessarily produce a large enough change in total production cost for farmers to perceive a substantial overall financial benefit.

The irrigation payment system is also important. Water-card users reported that reduced irrigation frequency directly lowers their personal expenditure because they pay according to water use. In contrast, farmers using the BMDA system may experience reduced water consumption without a proportional reduction in the amount they pay under the existing payment

arrangement. This indicates that the economic attractiveness of AWD is shaped not only by the technology itself but also by the institutional arrangement through which irrigation water is accessed and paid for.

Therefore, AWD's strongest immediate economic benefit in this study appears to be the reduction of irrigation expenditure for farmers whose payment system allows water savings to be converted directly into monetary savings. Clearer communication about the scope of these savings may help farmers develop more realistic expectations about the economic benefits of AWD.

5.4 Knowledge and Training as the Main Adoption Constraint

Across all three sources of evidence—the survey, FGDs, and KIIs—knowledge and training emerged as the most important constraints on confident and wider use of AWD. In the survey, lack of knowledge was reported by 95% of farmers and lack of training by 91%. Fear of reduced yield was also common, reported by 77% of respondents. By contrast, equipment cost, lack of technical support, and difficulty monitoring water levels were not identified as major barriers in the survey.The qualitative findings explain why knowledge remains important even though all surveyed farmers had received AWD training. While 100% reported receiving training and rated it as useful, 9% still did not fully understand how to apply AWD. Farmers in both FGDs requested repeated and practical training, particularly on irrigation timing, crop growth stages, and field-water conditions. The KIIs similarly emphasized that one-time training is insufficient and that farmers need follow-up guidance during cultivation.

This suggests that the main challenge is not simply whether farmers have been exposed to AWD information, but whether they have developed enough practical confidence to apply the technology correctly. Training should therefore move beyond introductory information towards repeated field-based learning, demonstrations, monitoring, and problem-solving support.

5.5 Social Influence, Peer Learning, and Farmer Confidence

The findings also demonstrate that AWD adoption is socially embedded. All 22 farmers acknowledged that social factors influence their adoption decisions: 82% reported direct influence and 18% reported partial influence. The FGDs further showed that farmers value practical examples from other farmers and are more likely to develop confidence when they observe successful AWD practices in their own communities.

This finding is important from a sociological perspective because technology adoption is not an entirely individual decision. Farmers operate within networks of neighbours, fellow farmers, community members, development workers, and agricultural institutions. These relationships influence how information is shared, how risk is interpreted, and whether a new agricultural practice is viewed as trustworthy.

The unanimous finding that all 22 respondents would recommend AWD to other Boro rice farmers further indicates strong positive acceptance among current users. Peer farmers who have successfully used AWD could therefore play an important role as local resource persons or peer educators. Demonstration-based farmer-to-farmer learning may be particularly useful for reducing the fear of yield loss and making the technology more understandable in practical terms.

5.6 Institutional Support and Sustainability of Adoption

The study indicates that institutional support has played a central role in introducing AWD in the study area. NGOs and Partner Organisations were the main source through which most farmers first learned about the technology, while formal learning from agricultural officers and informal farmer networks was comparatively limited. This demonstrates the effectiveness of project-based extension in reaching targeted farmers, but it also raises questions about how adoption will be sustained after project-supported activities become less intensive.

Both FGDs and KIIs emphasized the need for continued technical assistance, refresher training, field demonstrations, and monitoring. The KIIs also highlighted the importance of coordination among PKSF, Partner Organisations, NGOs, agricultural officers, project personnel, and local institutions. Such coordination can help ensure that farmers receive consistent messages and support rather than isolated or one-time interventions.

The findings therefore suggest that institutional support should gradually move from simply introducing AWD towards building local capacity for continued use. Strengthening government–NGO coordination and developing farmer-based support mechanisms could help sustain adoption beyond the initial project period.

5.7 Gender Dimensions of AWD Adoption

Gender is an important limitation and social dimension of the present study. All 22 survey respondents and both FGD groups were male. As a result, the quantitative and group-discussion

findings do not adequately capture the perspectives of women who may contribute to agricultural labour, household decision-making, or farm management.

The male composition of the sample should not be interpreted as evidence that women have no role in AWD-related agricultural activities. Rather, it indicates that current farmer outreach and formal training in the study setting have been concentrated primarily on male farmers. Future AWD programmes should therefore consider including women farmers and relevant household members in awareness activities, training, and demonstrations. A more inclusive extension approach would provide a fuller understanding of household-level decision-making and access to agricultural information.

5.8 Integrated Interpretation of the Findings

Taken together, the quantitative and qualitative evidence presents a consistent picture of AWD as a technically promising irrigation practice in the study area. The strongest finding is its water-saving effect: all surveyed farmers reported reduced irrigation water use, and the FGDs confirmed a reduction in irrigation events from approximately 10–12 to 8–9 per Boro season. This water-saving outcome occurred without any reported yield decline, suggesting that AWD can improve irrigation efficiency while maintaining production when it is correctly implemented.

At the same time, the study demonstrates that technical effectiveness alone is not sufficient for sustained adoption. The major constraints are knowledge gaps, insufficient practical training, fear of yield loss, and differences in the financial incentives created by local irrigation payment systems. Social influence and positive farmer experiences provide an important foundation for further diffusion, while institutional support remains necessary to maintain confidence and correct implementation.

The overall interpretation is therefore that AWD should be promoted as a combined technological and social intervention rather than simply as an irrigation technique. Its long-term contribution to climate-resilient agriculture in the Barind region will depend on sustained farmer learning, peer demonstration, appropriate economic incentives, inclusive extension, and coordinated institutional support. Given the small, purposive, male-only sample and the reliance on self-reported data, these findings should be understood as strong local evidence of early AWD experience rather than as statistically generalisable evidence for all farmers in the Barind region.

Chapter 06: Limitations of the Study

1. The sample size is small (n = 22) and confined to two villages (Lokkhitara and Chokvhobani) in Dhamoirhat Upazila, Naogaon District, which limits the statistical generalisability of the findings to the wider Barind region.
2. All respondents were male, so the survey does not reflect the views or labour contributions of women engaged in Boro rice farming and AWD-related field tasks.
3. Most findings are based on farmers' self-reported perceptions (e.g., of water savings, cost changes, and yield effects) rather than on measured field data such as metered irrigation volumes, input expenditure records, or plot-level yield measurements; perception-based data can be subject to recall bias or a tendency to respond favourably about a technology introduced by a trusted NGO.
4. Because AWD adoption in the study area is recent (one to two years for all respondents), the results reflect short-term experience and may not capture longer-term effects on soil, groundwater tables, or economic returns.
5. Several questions permitted multiple responses (e.g., difficulties faced, learning sources, support needed), so percentages for those items sum to more than 100% and should be read as the share of farmers citing each option, not as mutually exclusive categories.

Chapter 07: Recommendations

7.1 Recommendations for NGOs, Partner Organisations,and Government Agricultural Agencies

1. Expand training beyond a single session: introduce structured refresher training and repeated field-level guidance throughout at least one full Boro season, so that the 9 percent of farmers who did not fully understand AWD application after initial training, and future adopters, can consolidate their technical understanding.
2. Invest in demonstration plots in both study villages and neighbouring communities, since farmers in both FGDs and all five KIIs identified direct field observation as the most persuasive form of learning.

3. Improve communication about the specific economic scope of AWD, clearly distinguishing irrigation-cost savings from total production-cost effects, to close the gap between farmers' recognition of water and irrigation-cost savings and their more muted perception of overall economic benefit.
4. Strengthen coordination between NGOs, PKSF and Partner Organisations, and government agricultural offices to avoid fragmented, one-off interventions and to ensure consistent, sustained follow-up support for farmers after initial training.
5. Deliberately include women farmers and household members in AWD awareness campaigns, training sessions, and demonstrations, given the entirely male composition of current training reach identified in this study.

7.2 Recommendations for Policy

1. Support the development of low-cost monitoring tools (such as the perforated field water tube already in use) and ensure their availability and correct use is part of standard training, since correct technical application, not equipment cost, was identified as the binding constraint.
2. Consider complementary financial or input support, since farmers most frequently requested financial support (95%) alongside training (100%) as measures that would encourage wider adoption.

7.3 Recommendations for Future Research

1. Complement farmers' self-reported perceptions with objective field measurements, including metered irrigation volumes, input expenditure records, and plot-level yield data, to validate and refine the perception-based findings of this study.
2. Extend the study to a larger, gender-inclusive sample across multiple upazilas within the Barind region to improve the generalisability of findings beyond the two villages studied here.
3. Conduct longitudinal research following the same farmers over multiple Boro seasons to assess whether the strong short-term outcomes reported here (all respondents having used AWD for two years or less) persist, strengthen, or diminish as adoption matures.

Chapter 08: Conclusion

This study examined the effectiveness of Alternate Wetting and Drying (AWD) technology for Boro paddy cultivation in the drought-prone Barind region of Bangladesh, combining a structured survey of 22 AWD-practising farmers with two focus group discussions and five key informant interviews in Dhamoirhat Upazila, Naogaon District. The findings demonstrate that AWD is a technically effective water-management practice in this context: every surveyed farmer achieved a reduction in irrigation water use and groundwater dependence, and no farmer experienced a yield decline. These outcomes directly address the central problem motivating the study, namely the challenge of achieving sustainable Boro rice production in a drought-prone region where irrigation water is increasingly scarce.

At the same time, the study shows that technical effectiveness alone does not guarantee complete or confident adoption. Farmers' knowledge and training, rather than cost or infrastructure, remain the dominant constraint on wider and more confident use of AWD, and farmers' perceived economic benefit lags behind the measurable reductions in irrigation cost and frequency that the technology delivers. Social influence, peer demonstration, and sustained institutional support emerge as important, currently under-leveraged, levers for deepening and sustaining adoption as AWD moves beyond its present early diffusion stage in these villages.

The study therefore concludes that AWD represents a genuinely promising climate-resilient adaptation strategy for drought-prone Boro rice farming communities, but that realising its full potential, economic as well as agronomic, requires continued and expanded investment in farmer training, field-level demonstration, and coordinated institutional support, alongside more inclusive engagement of women farmers in extension activities.

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10. Appendices

10.1 Consent Form

Research Title: Barriers to Adoption of Alternate Wetting and Drying (AWD) Technology among Boro Rice Farmers in the Barind Region of Bangladesh

Researcher: Sidhratul Muntaha

Organization: Palli Karma-Sahayak Foundation (PKSF)

Research Objectives:

This study aims to explore the barriers to the adoption of Alternate Wetting and Drying (AWD) technology among Boro rice farmers and to understand farmers' experiences, perceptions, benefits, and challenges related to AWD.

Your Participation:

- Your participation is voluntary and confidential.
- You will be asked to answer some questions, which may take approximately 20 minutes.
- The information provided will be used for academic and research purposes only.

Risks and Benefits:

- There are no expected physical or mental risks from participating in this study.
- The findings may help improve future agricultural and climate adaptation programs related to AWD technology.

Privacy:

- Your information will be kept confidential.
- Your identity will not be disclosed in any report or publication.

Contact:

Researcher: Sidhratul Muntaha
Phone:01302535218

- I understand the purpose of the research and agree to participate voluntarily.

Participant Name: _____

Signature/Thumbprint: _____

Date: ____ / ____ / _____

10.2 Research Questionnaire

Study on the Effectiveness of Alternate Wetting and Drying (AWD) Technology for Boro Paddy Cultivation in Barind Areas, Bangladesh.

Instructions: Please tick (✓) the appropriate box or write your answer in the space provided. All information given will be kept confidential and used only for research/project evaluation purposes.

Name of Respondents	
Date of Interview	/ / 2026
District	
Upazila	
Union / Ward	
Village	

A. Household Survey Questionnaire

Section 1: Respondents Information

1. What is your age?

☐ Below 30 ☐ 30–40 ☐ 41–50 ☐ 51–60 ☐ Above 60

2. What is your gender?

☐ Male ☐ Female

3. What is your educational qualification?

☐ No formal education ☐ Primary ☐ Secondary ☐ Higher Secondary ☐Above

4. Number of family members:_____

5. What is your main occupation?

☐ Farming ☐ Business ☐ Service

☐ Day labor ☐ Other: _____

Section 2: Farming and Boro Rice Cultivation Information

1. How many years have you been involved in Boro rice cultivation?

☐ Less than 5 years ☐ 5–10 years ☐11–20 years ☐ More than 20 years

2. What is the total area of land you cultivate for Boro rice?

_____bigha

3. What is your main source of irrigation water for Boro rice cultivation?

☐ Groundwater ☐ Surface water ☐ Both groundwater and surface water

☐ Other: _____

4. Before adopting AWD, which irrigation method did you mainly use?

☐ Continuous flooding ☐ Conventional irrigation ☐ Other: _____

5. Before adopting AWD, how frequently did you irrigate your Boro rice field?

☐ Daily ☐ Every 2–3 days ☐ Every 4–5 days

☐ Based on field condition ☐ Other: _____

Section 3: AWD Adoption and Knowledge

1. How long have you been using AWD technology?

☐ Less than 1 year ☐ 1–2 years ☐ 3–4 years ☐ More than 4 years

2. How did you first learn about AWD technology?

☐ NGO/Partner Organization ☐ Agriculture Officer/DAE ☐ Other farmers

☐ Training/workshop ☐ Family/friends ☐ Other: _____

3. Did you receive any training on AWD technology?

☐ Yes ☐ No

4. If yes, how useful was the training for understanding and implementing AWD?

☐ Very useful ☐ Useful ☐ Moderately useful ☐ Slightly useful ☐ Not useful

5. Do you fully understand how to apply AWD technology in Boro rice cultivation?

☐ Yes ☐ No ☐ Partially

Section 4: Effectiveness of AWD and Water Use

1. Compared with your previous irrigation method, has AWD reduced your irrigation water use?

☐ Yes, significantly ☐ Yes, somewhat ☐ No significant change ☐ No ☐Cannot say

2. How much do you think AWD reduces irrigation frequency compared with your previous practice?

☐ Less than 10% ☐ 10–20% ☐ 21–30% ☐ More than 30% ☐ Cannot estimate

3. Has AWD reduced your groundwater use during Boro cultivation?

☐ Yes ☐ No ☐ Cannot say

4. What changes have you observed in water availability after using AWD?

☐ Water is available for longer ☐ Less pressure on groundwater

☐ No noticeable change ☐ Other: _____

5. In your opinion, is AWD suitable for drought-prone areas such as the Barind region?

☐ Yes ☐ No ☐ Partially

6. Why? (Reason)

Section 5: Production Cost and Economic Benefits

1. Compared with your previous irrigation practice, has AWD reduced your irrigation cost?

☐ Yes, significantly ☐ Yes, somewhat ☐ No change ☐ Cost has increased

2. Has AWD reduced your total Boro rice production cost?

☐ Yes ☐ No ☐ Cannot say

3. Has AWD affected your Boro rice yield?

☐ Increased ☐ Decreased ☐ No significant change ☐ Cannot say

4. What is the main economic benefit you receive from using AWD?

☐ Reduced irrigation cost ☐ Reduced water use ☐ Reduced labor cost

☐ Increased income ☐ No significant economic benefit ☐ Other: _____

5. Overall, how satisfied are you with the economic benefits of AWD?

☐ Very satisfied ☐ Satisfied ☐ Neutral

☐ Dissatisfied ☐ Very dissatisfied

Section 6: Social, Economic and Institutional Barriers to AWD Adoption

1. What are the major difficulties you face in adopting or using AWD technology?

(Multiple answers possible)

☐ Lack of knowledge ☐ Lack of training ☐ Fear of reduced yield

☐ Difficulty in monitoring water levels ☐ Lack of irrigation facilities

☐ Lack of technical support ☐ Cost of AWD equipment

☐ Lack of motivation ☐ Other: _____

2. Do you think farmers have sufficient knowledge about AWD technology?

☐ Yes ☐ No ☐ Partially

3. What type of support would encourage more farmers to adopt AWD?

☐ More training ☐ Regular technical support ☐ Free/low-cost equipment

☐ Financial support ☐ Demonstration plots ☐ Government support

☐ NGO support ☐ Other: _____

4. Do social factors influence farmers' decisions to adopt AWD?

☐ Yes ☐ No ☐ Partially

5. If yes, how?

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6. Overall, would you recommend AWD technology to other Boro rice farmers?

☐ Yes ☐ No ☐ Maybe

7. Why or why not? (Reason)

10.3 FGD Questionnaire

1. What do farmers in your community know about AWD technology, and how did they first learn about it?
2. What changes have you observed in irrigation water use and groundwater dependency after adopting AWD?
3. What changes have you experienced in Boro rice production, irrigation costs, and overall farming expenses after using AWD?
4. What are the major benefits of AWD for farmers in drought-prone areas of the Barind region?
5. What major challenges or barriers do farmers face while adopting and implementing AWD technology?
6. How do social factors, farmers' attitudes, knowledge, family/community influence, and economic conditions affect AWD adoption?
7. What support from NGOs, PKSF, agriculture officers, government, or other institutions could help more farmers adopt AWD successfully?

10.4 KIIs Questionnaire

1. What is the current situation of Boro rice cultivation, irrigation, and water scarcity in the study area, particularly in the context of drought and climate change?
2. How effective is AWD technology in reducing irrigation water use and groundwater extraction compared with conventional irrigation practices?
3. What impacts have you observed of AWD on Boro rice yield, production costs, irrigation costs, and farmers' economic conditions?
4. What are the main social, economic, technical, and institutional barriers that prevent farmers from adopting AWD technology?
5. To what extent do farmers have adequate knowledge, training, and technical support to implement AWD properly?
6. What roles do government agencies, NGOs, PKSF, Partner Organizations, and local institutions play in promoting AWD adoption among farmers?

7. What recommendations would you suggest to increase the adoption and sustainable use of AWD technology among Boro rice farmers in the Barind region?

10.5 Photo Gallery



Plate 01: FGD Discussion on Aranagar Village.



Plate 02: FGD Discussion on Lokkhitara Village.



Plate 03: AWD Water Level Observation Tube(Perforated PVC Tube).



Plate 04: Key Informant Interview



Plate 05: Interview with a Boro Rice Farmer.



Plate 06: Field Visit and Interaction with Farmeration Tube Used in AWD Practice.