Analyzing the effectiveness of operational and administrative process of alternative wetting and drying program in Dumacaa River Irrigation System

Donna L. Ponce - Tamban

donna.tamban27@gmail.com
Laguna State Polytechnic University, Santa Cruz Campus, Laguna, Philippines 4009

Abstract

The Alternate Wetting and Drying (AWD) program is a well-established and scientifically endorsed water-saving irrigation technique designed to enhance rice production efficiency while significantly reducing water usage. As water scarcity becomes an increasing concern in agriculture, the AWD method offers a promising solution for achieving productivity and sustainability in rice farming systems. This study evaluates the effectiveness of the AWD program by examining its operational and administrative dimensions across diverse agricultural settings. The research specifically assesses the program's efficiency, sustainability, and overall impact, focusing on key factors such as stakeholder participation, policy implementation, and resource management. Utilizing a quantitative research design, data were collected through structured questionnaires administered to rice farmers participating in the program. The study analyzed critical performance indicators, including water-use efficiency, crop yield, economic viability, and farmer adoption rates. Findings indicate that the AWD program has been highly implemented in the Dumacaa River Irrigation System, leading to notable improvements in water conservation and crop productivity. However, several challenges persist, particularly in areas related to compliance monitoring, the provision of technical support, and the equitable distribution of resources to smallholder farmers. These barriers limit the scalability and uniform effectiveness of the program. The study underscores the need for enhanced administrative oversight, increased investment in farmer education and training, and the development of more robust support systems. These measures are essential to optimize the program's outcomes and facilitate its broader adoption. The insights generated from this research contribute to the growing body of knowledge on sustainable irrigation practices and provide practical recommendations for policymakers, development agencies, and agricultural stakeholders committed to promoting climate-resilient and resource-efficient farming.

Keywords: Agricultural policy; Alternate Wetting and Drying (AWD); irrigation efficiency; program implementation; sustainability; water management

1. Introduction

Among the nations worldwide, the Philippines is known as one of the leading producers of rice (Department of Agriculture, 2022). With the increasing population to feed, demands for rice production also increase. However, factors such as climate change, typhoons and other weather events, and water scarcity, which affect rice production, pose serious threats to rice-growing farmers and food security. Like any other plant, water is a basic requirement for rice production. Different interventions and water-saving techniques (WST) must be implemented to address water scarcity and maintain productivity.

Alternate Wetting and Drying (AWD) is a method developed and recommended by the International Rice Research Institute (IRRI) requiring less water in rice production without compromising the crops.

According to the Philippine Rice Institute (PhilRice), this method is attainable and improves water efficiency by drying rice fields intermittently, opposite to the traditional method of continuous rice paddy flooding.

Based on their study, IRRI claims that this method 1) lowers the water use in rice production by 30%, 2) reduces production expenses, and 3) reduces 30-70% of greenhouse gas (GHG), particularly methane gases emitted from rice agriculture.

The National Irrigation Administration (NIA) is mandated to play a vital role in supporting the country's agricultural sector by managing and developing irrigation systems. NIA plans, constructs, and maintains irrigation infrastructure to ensure water availability for farmers, especially during dry seasons, which enhances crop productivity and food security. It also provides farmers technical assistance, training, and financial support, promoting efficient and sustainable water use practices. NIA collaborates with various government agencies and local organizations to improve irrigation services and boost agricultural productivity, benefiting the nation’s farming communities and economy. NIA is essential for developing and managing irrigation systems, improving agricultural productivity, and supporting farmers in the Philippines.

The study for the implementation and effectiveness of the AWD program, the policy to adopt alternate wetting and drying (AWD) was approved by the NIA Board of Directors through Resolution No. 8323-16, Series of 2016, in their 914th Regular Board Meeting on 20 May 2016.

1.1. Background of the Study

According to Dietz et al., (2020) climate change is one of the twenty-first century’s greatest ecological and social challenges. Sociologists have made important contributions to our knowledge of the human drivers of contemporary climate change, including better understanding of the effects of social structure and political economy on national greenhouse gas emissions, the interplay of power and politics in the corporate sector and policy systems, and the factors that influence individual actions by citizens and consumers. Sociology is also poised to make important contributions to the study of climate justice across multiple lines of stratification, including race, class, gender, indigenous identity, sexuality and queerness, and disability, and to articulate the effects of climate change on our relationship to nonhuman species. To realize its potential to contribute to the societal discourse on climate change, sociology must become theoretically integrated, engage with other disciplines, and remain concerned with environmental and climate inequalities.

In agriculture, AWD has been associated with several other advantages in addition to water conservation. Intermittent drying may boost soil aeration, lower methane emissions, and improve root health, all of which positively affect plant growth and soil quality, according to studies. AWD also has significant financial ramifications because it enables farmers to reduce water-related expenses, which could boost their total profitability. Nevertheless, despite its potential, AWD has not been widely adopted in the Philippines, and to confirm its advantages and handle any potential drawbacks, thorough research on its impacts in the local environment is required (Pascual et al, 2023).

By investigating the effects of AWD on rice output, water conservation, and the financial results for smallholder farmers in the Philippines, this study aims to expand on previous studies. This study intends to enhance efforts to increase production, save water, and promote sustainable agriculture throughout the Philippines' rice-growing regions by providing data-driven insights into the potential benefits of AWD as a sustainable farming technique.

Establishing the framework plan and program on climate change, Republic Act 9729, also known as the *Climate Change Act*, is the cornerstone of the Philippines' approach to addressing climate change through a comprehensive legal and institutional framework. One of the most significant aspects of this law is its mandate to establish a framework plan and program on climate change, which integrates climate change into all levels of government policy, planning, and decision-making. This ensures that climate considerations are not treated as a peripheral issue but as a central governance component, affecting various sectors, including agriculture, infrastructure, health, and natural resources.

The law emphasizes the importance of mainstreaming climate change across all government sectors, encouraging a proactive stance in preparing for and mitigating the effects of climate risks Agard et al, 2014). By embedding climate change into the fabric of public policies, it ensures that national and local governments and private institutions consider the long-term impacts of climate change when planning for development and resource use. This shifts the traditional focus from reactive measures to a more anticipatory and preventive approach to climate risks (Dietz et al., 2020)

The precautionary principle suggests that, in the face of scientific uncertainty about the potential impacts of climate change, governments and other stakeholders should take preventative actions to avoid harm, even without conclusive proof (FAO, 2021). This principle guides the design of climate adaptation strategies, where policies and actions are structured to protect vulnerable communities, ecosystems, and resources from potential climate impacts, even if the exact outcomes of climate change are not fully predictable. It promotes an ethos of caution, focusing on minimizing risk and protecting future generations from environmental harm (Pandey, et al., 2020).

Moreover, the *Climate Change Act* envisions preserving the climate system as a collective responsibility. The law upholds the concept of climate justice, which recognizes that while the adverse effects of climate change are global, the responsibility for addressing and mitigating these impacts must be shared equitably among nations, with developed countries shouldering a greater burden due to their historical contribution to greenhouse gas emissions. In this context, the Philippines, though a relatively small emitter of greenhouse gases, acknowledges its vulnerability to climate change and asserts its right to participate in global climate discussions, advocating for fair and just solutions that consider the different nations' differentiated responsibilities.

The principle of shared but distinct duties means that while all nations must contribute to the global effort to combat climate change, the actions taken by each country must be aligned with their respective capabilities, resources, and historical responsibilities (Briones et al., 2020). For the Philippines, this translates into actively participating in international climate agreements, while also focusing on enhancing national resilience through adaptive measures and building the capacity of local communities to face the challenges posed by a changing climate.

As a participant in the United Nations Framework Convention on Climate Change, the state embraces the convention's ultimate goal, which must be accomplished in a timeframe that permits ecosystems to adjust to climate change naturally, ensures that food production is not jeopardized, and permits sustainable economic development.

To mitigate and reduce the impact of climate change, particularly on water scarcity, experts from the International Rice Research Institute (IRRI, 2020) developed a technology to save irrigation water, known as Alternate Wetting and Drying (AWD).

Farmers can utilize Alternate Wetting and Draining (AWD), a water-saving technique, to use less irrigation water in rice fields without sacrificing yield. AWD applies irrigation water a few days after the ponded water has subsided. As a result, the field alternates between being flooded and not. Depending on various circumstances, including crop development stage, weather, and soil type, the interval between irrigations can range from one to over ten days.

In support of the study for the implementation and effectiveness of the AWD program, the policy to adopt alternate wetting and drying (AWD) was approved by the NIA Board of Directors through Resolution No. 8323-16, Series of 2016, in their 914th Regular Board Meeting on 20 May 2016.

1.2. Theoretical Framework

To examine water management, agricultural productivity, and environmental sustainability, this study uses several theoretical frameworks to examine the application and efficacy of the Alternating Wetting and Drying (AWD) technique on rice production in the Philippines. AWD, a program designed to maximize water use in rice cultivation, is supported by the Water Use Efficiency (WUE) Theory. According to the WUE Theory, increasing water consumption efficiency without increasing total water intake can boost agricultural yield. The theory is supported by AWD, which promotes periodic drying and lessens the need for constant flooding, thus preserving or even increasing rice yield while consuming up to 30% less water overall. This study uses WUE Theory to investigate how AWD helps farmers sustainably manage their finite water resources and promotes efficient water use.

The concepts and procedures required for setting up and running organizations are the main emphasis of administrative management theory. This theory describes how a society or organization might embrace new concepts, methods, or technology. Assessing AWD as a novel agricultural technique to better manage irrigation water and how farmers learn about, embrace, and apply it while taking into account elements like observability (observing favorable outcomes), compatibility (with current methods), and relative advantage (saving money and water).

Sustainable irrigation water utilization is a top priority in arid environments (Vanino et al., 2015). Consequently, a great deal of effort has been made over the years to implement policies that aim to encourage water efficiency in the face of shortage and climate change. These policies are based on the notion that more can be achieved with less water through improved management.

Improved irrigation water efficiency and/or water allocation are typically called better management. The former is directly tied to appropriate pricing, but the latter depends on the kind of irrigation equipment, the surrounding environment, and the water application schedule.

As previously said, irrigation systems can be maintained efficiently if people are motivated to perform operation and maintenance duties. Farmers' conduct and leadership abilities impact their motivation to complete chores. Because it considers the human aspect of work, the behavioral management theory is also called the human relations movement. The motivations and actions of employees are the main focus of behavioral management. In particular, behavioral management theory focuses on worker motivation, including expectations, demands, and interests, as well as group dynamics, to manage productivity (Behavioral Management Theories, 2022).

Nature, science, society, the economy, and information systems are all examples of systems. Systems theory is unique because it developed concurrently in several disciplines, with researchers from several fields expanding on common ideas and knowledge. For irrigation systems to be successful and sustainable over the long run, system management and behavioral theories must be applied. These theories offer a framework for comprehending the intricate relationships within irrigation systems and serve as a guide for wise decision-making to maximize water consumption, boost productivity, and resolve issues during irrigation management.

1.3. Conceptual Framework

The implementation and effectiveness of alternate wetting and drying programs involve AWD's operational and administrative processes in terms of capacity building, program monitoring, program implementation, risk mitigation and stakeholders' engagements. By carefully aligning these components and leveraging the strengths of community networks, policies, and infrastructure, the effectiveness of the AWD program can become a sustainable agricultural practice that significantly benefits both farmers and the environment.

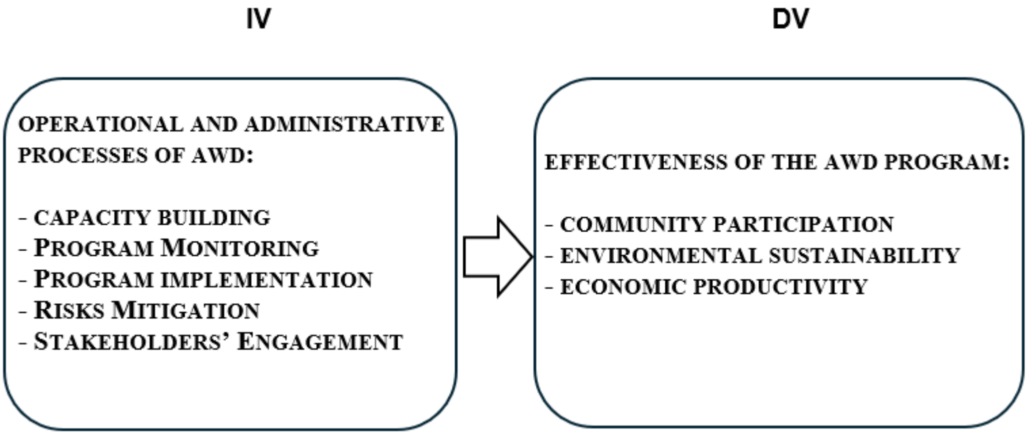

Figure 1. The Research Paradigm of the Study

1.4. Statement of the Problem

This study aimed to determine the effectiveness of the Alternate Wetting and Drying program about the administrative management theory:

Specifically, it sought to answer the following questions:

1. What is the Demographic Profile of the Farmers in terms of;
   1.1 Name;
   1.2 Age; and
   1.3 Sex?
2. What is the status of the operational and administrative processes of AWD in terms of:
   2.1 Capacity Building;
   2.2 Program Monitoring;
   2.3 Program Implementation;
   2.4 Risk Mitigation; and
   2.5 Stakeholders' Engagement?
3. What is the level of effectiveness of AWD implementation in terms of:
   3.1 Community Participation;
   3.2 Environmental Sustainability; and
   3.3 Economic Productivity?

4 Is there a significant relationship between operational and administrative processes of alternate wetting and drying and the effectiveness of the alternate wetting and drying program in the Dumacaa River Irrigation System in Quezon Province?

1.5. Research Hypothesis

There is no significant relationship between the operational administrative process and the effectiveness of the AWD program in the study.

1.6. Scope and Limitations of the Study

This study focuses on evaluating and assessing the implementation and effectiveness of the Alternate Wetting and Drying (AWD) Program on rice production in the Dumacaa River Irrigation System in Lucena

City, Quezon. This will be characterized as the result of the IA operational and administrative process in AWD. Performance indicators used were capacity building, program monitoring, program implementation, risk mitigation and stakeholders' engagement.

The adoption rate of AWD in the Philippines is low, despite its many benefits (IRRI, 2023) due to its tedious process, the lack of motivation to conserve water, and the challenge of ending the long-standing custom of leaving rice paddies soaked in water.

The use of participatory approaches in agricultural extension, implementation of the Free Irrigation Service Act (RA 10969), and an improvement in irrigation water governance to update and implement AWD are some of the suggested strategies to maximize the benefits of AWD.

Recognizing greater exposure and knowledge regarding AWD technology, researchers purposively selected respondents who had been practicing and implementing this technology. Their perception, though not representing the general membership, was viewed as significant in identifying the major points or flaws in the implementation of AWD technology. Furthermore, the perception of leaders reflected conditions prevalent during the interview.

The limitation study respondents are the farmers adopting the alternate wetting and drying program in the Dumacaa River Irrigation System in Lucena City.

1.7. Significance of the Study

Over the years, NIA has invested in implementing alternate wetting and drying technology and capability training for farmers to support the policy of adopting alternate wetting and drying (AWD), which the NIA Board approved through Resolution No. 8323-16, Series of 2016.

The researcher believes the study helps measure the effectiveness of the AWD technology that would contribute to the development of measures toward achieving the program, as well as irrigation system sustainability and viability through proper operation and maintenance, and full cooperation and participation of stakeholders, which is also improve the beneficiary's quality of life.

National Irrigation Administration. The study provides the agency with a detailed analysis assessing the effectiveness of the AWD technology in the implementation process. It is including a policy recommendation that the agency may use as a reference in its future project proposals.

Other agencies in the field of agriculture. They could use this research as a basis for the possible adaptation of an alternate wetting and drying program for future use.

Farmers/Irrigator's Association. The ultimate beneficiaries of the Alternate Wetting and Drying Program, and this study is critically important for farmers, especially those involved in rice cultivation. AWD is a water management strategy that alternates between periods of wetting and drying in rice fields, rather than keeping them continuously flooded. This practice offers a range of benefits that can enhance both agricultural productivity and environmental sustainability. Additionally, it can help other farmers make decisions about program adaptation.

Community. At the local level, integrating AWD into rice cultivation can enhance the community's social, environmental, and economic conditions. Implementing AWD may increase food security, strengthen resistance to the effects of climate change, and create a sustainable future for future generations. AWD's combined advantages go well beyond the advantages of individual farms and are essential to creating a more affluent, just, and sustainable community.

Future Researchers. Future researchers may use this study as a springboard for future study regarding the alternate wetting and drying program.

1.8. Definition of Terms

The following terms are defined for a clearer understanding of this study:
Alternate Wetting and Drying – It is a water-saving technology that lowland (paddy) rice farmers can apply to reduce their water use in irrigated fields
Agricultural Productivity - It is the ratio of agricultural outputs to inputs
ASEAN – It means Association of Southeast Asian Nations, a political and economic union of 10 Southeast Asian countries
Capacity Building - It refers to enhancing the knowledge, skills, and resources of individuals, communities, and organizations to implement and sustain the practice effectively.
Community Participation – It refers to the active involvement of local communities, particularly farmers, in the planning, implementing, and monitoring AWD water management practices.
Continuous flooding – It is a traditional irrigation method that involves covering a field with water
Environmental Sustainability - It refers to the practice's ability to conserve natural resources, reduce environmental degradation, and maintain the health of ecosystems over time.
Economic Productivity – It refers to the economic benefits and improvements in agricultural output resulting from implementing AWD practices in rice farming.
Farmers - a person who cultivates land or crops or raises animals (such as livestock or fish)
Farmer's Adaptation – It refers to the adjustments, modifications, or changes farmers make in their agricultural practices to respond to new challenges, opportunities, or technologies.
Implementation Method (AWD) – It involves specific steps and guidelines to ensure its effectiveness in rice farming. This method relies on careful monitoring of water levels and coordinated irrigation practices to achieve the benefits of water conservation, reduced costs, and environmental sustainability.
IRRI – It means International Rice Research Institute, the world's premier research organization dedicated to reducing poverty and hunger through rice science; improving the health and welfare of rice farmers and consumers; and protecting the rice-growing environment for future generations.
NIA – It means National Irrigation Administration is responsible for planning, constructing, operating, and maintaining irrigation systems consistent with integrated water resource management principles to improve agricultural productivity and increase farmers' income.
Philippine Rice Research Institute (PhilRice) – It is a government corporate entity attached to the Department of Agriculture.
Rice Cultivation – It is the agricultural practice of growing rice, a staple food for many people around the world
Rice paddy – It is a field where rice is grown, usually by flooding or irrigating the land.
Operation and Maintenance – These are activities in NIA that comprise the operation of storage and diversion dams; running of pumps; operation of gates, turnouts, and drainage ditches; preparation and implementation of cropping and irrigation schedules; maintenance of the physical facilities, including services and access; and repairs on minor damages caused by floods and typhoons.
Operational and Administrative Process: This refers to the management and implementation aspects of this water-saving irrigation technique for rice farming. AWD aims to improve water use efficiency and minimize water wastage by periodically flooding and draining rice fields rather than continuously submerging them.
Program Implementation – It involves translating the strategic plans, objectives, and capacity-building efforts into practical actions that farmers, communities, and organizations can adopt. It requires careful planning, resource mobilization, stakeholder coordination, and ongoing support to ensure that AWD practices are effectively implemented and scaled.
Program Monitoring – It is process for ensuring the effectiveness, efficiency, and sustainability of the practice. It involves systematically collecting, analyzing, and using data to track the progress of AWD implementation and to assess whether it is meeting its goals, such as improving water efficiency, increasing

rice productivity, and reducing environmental impacts.
Risk Mitigation – It is to address the potential challenges and uncertainties while implementing this water management practice in rice farming.
Sustainability – It is a social goal that involves balancing the environment, economy, and equity to ensure that the earth can support life for future generations.
Stakeholder Engagement – It refers to involving and actively collaborating with various individuals, groups, and organizations that are affected by or are interested in the implementation and success of AWD water management practices in rice farming.
Technology Adoption – It refers to the process by which individuals, groups, or organizations start using and integrating a new technology or innovation into their practices, activities, or systems. It encompasses the journey from awareness to regular and sustained use of technology.

1.9. Review of Related Studies and Literature

1.9.1. Related Literature

Rice is a staple food for more than half of the world's population and a source of calories for billions of people. However, its production is highly water-intensive, consuming significantly more water than other major crops (Alauddin, 2020). Traditional rice cultivation methods rely on continuous flooding, which, while effective for weed control and pest management, leads to excessive water use and environmental degradation.

Given increasing concerns over water scarcity and sustainability, adopting more efficient irrigation techniques has become a priority for agricultural policymakers, researchers, and farmers. One such technique is Alternate Wetting and Drying (AWD), a water-saving irrigation method that allows fields to dry periodically before the next irrigation cycle. Studies have shown that AWD can reduce water consumption by up to 30% while maintaining or even improving rice yields in some cases (IRRI, 2022). AWD is a promising solution for achieving sustainable rice production, particularly in regions facing severe water shortages.

The significance of AWD has been recognized at both national and regional levels, particularly in Southeast Asia, where rice farming is a key economic sector. The Association of Southeast Asian Nations (ASEAN) and its member states have acknowledged AWD as an effective strategy for adapting to and mitigating the impacts of climate change (ASEAN Ministers of Agriculture and Food, 2015). Through national policies, ASEAN guidelines, and regional collaborations, governments have begun promoting AWD to reduce water usage while maintaining agricultural productivity. Various international organizations, including the International Rice Research Institute (IRRI) and the Food and Agriculture Organization (FAO), have launched pilot programs in multiple Southeast Asian countries to support the implementation of AWD. However, despite these initiatives, AWD has not yet been fully scaled up across the region, highlighting the need for more robust policy interventions, improved financial incentives for farmers, and expanded research efforts to enhance its adoption. Policymakers, researchers, and project implementers are crucial in refining AWD strategies and ensuring that farmers receive adequate support to implement this practice successfully (Briones et al., 2020).

Beyond water conservation, AWD is also regarded as a practical approach to climate change adaptation and mitigation, particularly in Southeast Asian countries where rice cultivation is deeply embedded in the economy and culture. As water resources become increasingly scarce, AWD provides a solution that improves irrigation efficiency and enables crop diversification, allowing farmers to maximize land productivity. Furthermore, AWD helps reduce input costs by lowering the need for excessive seed, fertilizer, and pesticide applications. This can improve farmers' profit margins, making them more financially resilient against external shocks such as droughts, unpredictable rainfall patterns, and fluctuating market prices (Celeridad, 2019). Consequently, AWD is an irrigation technique and a strategic tool for improving food security and rural livelihoods in rice-dependent economies.

Vietnam has taken significant steps to integrate AWD into its agricultural reforms as part of broader efforts to modernize rice production. In 2017, the Vietnamese government introduced Resolution 120, a policy aimed at promoting sustainable rice-growing methods to combat climate change and environmental degradation. This policy marked a significant shift in Vietnam's agricultural strategy, moving away from a focus on maximizing rice export volumes to emphasizing quality production, environmental sustainability, and resilience to climate change. In 2022, the government launched a comprehensive master plan for the Mekong Delta to enhance irrigation efficiency, reduce greenhouse gas (GHG) emissions, and diversify agricultural production. AWD has been one of the key strategies under this master plan, helping Vietnam achieve its targets of reducing water consumption while maintaining rice yields (Gupta, 2023).

In Thailand, AWD has also been recognized as an effective water-saving practice for rice cultivation. Research conducted in Northern Thailand suggests that AWD can significantly reduce irrigation water use while sustaining crop productivity. However, studies have revealed contrasting results in yield performance, with some regions experiencing slight declines in yield due to variations in soil type, weather conditions, and farmer practices. These findings underscore the need for further evaluation and site-specific adjustments to AWD protocols. Nevertheless, researchers recommend AWD as a simple and effective irrigation method that could benefit rice farmers, particularly in regions with growing water shortages and increasing competition for water resources (Kwanyuen, 2021).

Beyond its benefits in water conservation, AWD has also been studied for its potential to reduce greenhouse gas emissions, particularly methane (CH_4). A multi-year study in Central Vietnam provided comprehensive data on methane emissions from conventional rice farming, revealing that seasonal CH_4 emissions ranged from 500 to 644 kg CH_4 ha^{-1}, which is significantly higher than emissions reported in other rice-producing areas. The study attributed these high emissions to the extensive use of organic fertilizers, suggesting that proper AWD implementation and fertilizer management strategies could play a crucial role in mitigating methane emissions from rice paddies (Tran, 2017). Similarly, the International Rice Research Institute (IRRI) findings indicate that AWD significantly reduces methane emissions by limiting prolonged anaerobic conditions in rice fields. This has major implications for carbon credit markets, as emission reductions through AWD could be measured and monetized, providing additional financial incentives for farmers to adopt the practice (Pascual, 2016).

A study conducted in Central Java, Indonesia, further supports these findings. Over three years, researchers compared three irrigation systems: continuous flooding, standard AWD (with reflooding when water levels dropped 15 cm below the surface), and adaptive AWD (AWDS), where irrigation is tailored to site-specific conditions. The results showed that AWD and AWDS reduced methane emissions by 35–38% compared to continuous flooding, while maintaining rice yields across all test sites (Setyano et al., 2018). These findings reinforce AWD's role in sustainable rice farming, although further research is needed to determine the optimal irrigation schedule for different climatic and soil conditions.

Despite AWD's clear benefits, adoption rates among farmers remain relatively low, particularly in regions where irrigation water is subsidized or not properly regulated. Studies suggest that one of the major barriers to adoption is the lack of financial incentives for farmers to reduce their water usage. In many areas, irrigation water is supplied at a fixed rate, meaning that farmers do not directly benefit from water savings, reducing their motivation to switch to AWD. In some cases, farmers even overuse water to control weeds and minimize risks related to pump failures (Pandey et al., 2020). Additionally, small-scale farmers in tropical regions face greater challenges in adopting AWD due to their limited access to technology, financial resources, and agricultural extension services (Hellin et al., 2020).

One promising approach to enhancing AWD adoption is integrating it with subsurface drainage systems, which have been shown to improve water use efficiency and crop yields in rice paddies. A two-year study demonstrated that AWD, combined with subsurface drainage management, was highly effective in optimizing irrigation efficiency (Abdullah, 2017). Moreover, successful AWD implementation requires strong collaboration among stakeholders, including farmers, government agencies, researchers, and private sector partners. Studies highlight that early stakeholder engagement, transparent communication, and trust-building are key factors in ensuring the success of AWD initiatives (Holcomb, 2021).

AWD has proven to be a highly effective water-saving and climate-smart irrigation method that can help balance productivity, sustainability, and climate resilience in rice cultivation. However, achieving large-scale adoption requires strong policy support, financial incentives, and farmer training programs. As climate change and water scarcity continue to pose major challenges to global agriculture, AWD stands out as a viable and scalable solution for ensuring long-term food security and environmental sustainability in rice-producing regions.

1.9.2. Related Studies

The International Rice Research Institute (IRRI) created the Rice Knowledge Bank (RKB), a digital extension service that offers useful information solutions tailored for small-scale farmers in poor nations to close the knowledge gap between research and practice in rice production.

RKB highlights optimum farming practices, agricultural technology, and methods for producing rice based on IRRI's knowledge base of research findings, educational and media materials, and in-country programs. RKB states that irrigated rice in Asia typically requires between 1300 and 1500 mm of water. An estimated 34–43% of the world's irrigation water, or around 24–30% of all developed freshwater resources, are used for irrigated rice. When water is scarce, use water-saving techniques like Alternate Wetting and Drying (AWD). As the planting method, consider switching from puddled transplanting to dry-direct seeding or non-puddled transplanting (Lampayan, 2023).

Despite the possibility of prolonged droughts and water scarcity brought on by El Niño, the farmers' fortitude has held up well. Instead of giving in to hardship, they have welcomed the challenge as a chance to gain new skills and creative methods to counteract the consequences of the phenomenon while earning extra money. Farmers in Gabaldon, Science City of Muñoz, Nueva Ecija, are earning additional revenue from carbon credits by using a water-saving technique known as alternating wetting and drying (AWD) (Nicolas, 2023).

One of the biggest innovations brought about by El Niño was the use of alternate wetting and drying (AWD) technology. This method was developed in 2000 by the International Rice Research Institute (IRRI) and the DA-Philippine Rice Research Institute (PhilRice) to meet farmers' irrigation needs during times of water constraint.

The Department of Agriculture's Philippine Rice Research Institute (DA-PhilRice) plays a pivotal role in promoting innovative solutions to improve rice farming practices, especially in terms of resource efficiency. One of their key advocacies is the widespread adoption of water-saving technologies, particularly the *alternate wetting and drying* (AWD) method. AWD, a technique that alternates between wet and dry conditions in rice paddies, has been recognized as an effective approach to conserving water while maintaining or improving crop yields.

However, a recent issue of *Rice Science for Decision-Maker* reveals that certain aspects of the Free Irrigation Act need to be reviewed and adjusted to ensure better support for the adoption of this water-efficient technology. The article specifically addresses how the current policy framework could limit AWD's scalability and recommends several changes that could boost its implementation.

One of the primary suggestions is to allocate more financial support to irrigator groups that adopt AWD. These groups, which manage local irrigation systems, often face challenges regarding operations and maintenance, and providing them with increased funding could enable smoother, more efficient irrigation management. This, in turn, would make it easier for farmers to implement AWD practices and reap their benefits.

Furthermore, the publication advocates for the introduction of incentives for the National Irrigation Administration (NIA) irrigation management offices. These offices are crucial in managing the irrigation systems on the ground, and giving them additional incentives for implementing rotational irrigation systems would encourage more efficient water distribution. Rotational irrigation, which involves scheduling water distribution to ensure equitable access for all farmers, is seen as a key strategy for maximizing the benefits of AWD technology.

In essence, the suggestions presented in the article aim to address policy gaps hindering AWD's wider adoption. By enhancing financial support for irrigator groups and incentivizing district offices to adopt effective water management practices, the IRRI (2018) hopes to foster greater resilience in rice farming, reduce water waste, and improve the overall sustainability of Philippine rice production.

Water use, greenhouse gas emissions, and farm employment are all closely related to the Philippine agricultural sector. In addition to being a vital economic pillar, agriculture uses a lot of water—73 percent of the nation's total water consumption—and is the second-largest source of greenhouse gas emissions, contributing 53.7 MtCO2e to the total emissions nationwide (FAO, 2018).

According to Yuji (2021), scaling theory needs to be reframed to be more impact-oriented and pertinent to farmers' demands, such as increasing resistance to climate change and generating income. To solve the issue of irrigation water, strategies for guaranteeing farmers always have access to irrigation must be considered in addition to water efficiency. The ability of irrigation systems to effectively monitor and inform water management decisions and guarantee the availability and flexibility of irrigation water is a crucial change mechanism. This shifts the focus from farmer-level water management to the entire irrigation water provisioning system. Yuji (2021) has produced sufficient proof thus far about the influence of AWD at the field level and to save a lot of irrigation water and lessen the carbon footprint, it's necessary to take a broader look at the potential that will lead to widespread adoption at the irrigation system size.

The Philippine agricultural sector is closely related to water use, greenhouse gas emissions, farm jobs, and the economy. As the nation's second-largest source of greenhouse gas emissions, contributing 53.7 MtCO2e to the total emissions, and a major water user, accounting for 73% of the nation's total water consumption, agriculture is a vital economic pillar (FAO, 2018). According to the IPCC's 2018 Special Report, a 0.5°C increase over the 1.5°C warming scenario is expected to worsen the effects of climate change and the risks they pose to ecosystems by increasing temperature extremes, heavy precipitation, and drought frequency and intensity (IPCC, 2018).

Samoy-Pascual (2021) asserts that since conserving water (i.e., lowering fuel costs) is a direct advantage, knowledge of AWD may be important in pump irrigation systems. However, being "aware" of AWD may not always impact a farmer's decision to implement AWD technology in a gravity-irrigation system, since water is essentially free regardless of volume used. It should be mentioned that a number of capacity-building and participatory adaptation trials have already been carried out with a focus on safe AWD in the nation's irrigation system.

In most cases, farmers tend to revert to their usual practices after the end of pilot projects due to the absence of incentive and support. To persuade more farmers to implement AWD in a gravity irrigation system that the government oversees, a strong incentive structure must be established. For instance, water tariffs and carbon markets (via AWD's decrease of GHG emissions) could increase the desirability of AWD. Rejesus et al. recommended highlighting the "public good" (conservation benefits) features of AWD technology for sustainable water use. Furthermore, NIA can create incentive or reward plans for district offices that follow the safe AWD concept and conduct an appropriate rotational irrigation schedule (Pascual 2021).

Agricultural practices, such as soil management, fertilizer application, and disease and pest control, are related to sustainable water management in agriculture and the protection of the environment. Today, agricultural practice is characterized by the abuse of fertilizers. (Chartzoulakis, et.al., 2015)

Since the agriculture sector is both the most vulnerable to the devastating effects of climate variability and the rising frequency of extreme weather events and a key sector from the perspective of mitigating climate change, it is crucial to a nation's efforts to build resilience. Approximately 70% of the nation's total rice production comes from irrigated ecosystems, which account for 70% of the area harvested for paddy rice (Philippine Statistic Authority, 2020). Roughly 37 percent of the nation's total rice production comes from 3.26 million hectares of irrigated rice land. Agricultural efficiency is needed right now to guarantee food and water security.

Most farmers flood continuously during the cropping season, which means that rice cultivation uses the most water in the agricultural industry. Therefore, rice production must be optimized through novel management techniques that sustain rice yields with increased water productivity to guarantee the nation's food security and everyone's access to freshwater.

Since the logic of AWD technology's operation stands in sharp contrast to their custom of constant flooding, farmers are reluctant to take the risk of testing the technology. However, participatory field demonstrations have demonstrated that AWD has been successfully adopted in pump-irrigation systems where farmers experienced the input cost savings from fuel expenses. AWD can increase irrigation crop intensity and overall productivity, but it does not directly affect yield improvement, especially for gravity-based irrigation systems (Palis et al., 2017: Regalado et al., 2019).

The reluctance of farmers to adopt Alternate Wetting and Drying (AWD) technology can be attributed to the fundamental differences between AWD's operational logic and the traditional farming practices they are accustomed to. For many farmers, the standard practice involves constant flooding of rice fields, which has become ingrained in their daily operations (Chartzoulakis, et. al., 2015). AWD, by contrast, requires intermittent flooding, with periods of drying that go against this established habit. This shift introduces a sense of uncertainty, and the unfamiliarity with how the technology works leads to hesitation. As a result, many farmers are reluctant to risk switching from a practice they know well to one that is unproven in their context, even though the potential benefits are clear.

However, participatory field demonstrations have played a pivotal role in breaking down this resistance. These demonstrations, which involve local farmers working closely with experts to test the technology in real-world settings, have shown that AWD can be successfully adopted, especially in pump-irrigation systems. Farmers have observed tangible benefits in these cases, particularly in terms of reduced input costs, notably in fuel expenses. This cost reduction comes from AWD reducing the frequency and intensity of water pumping, resulting in significant fuel savings over time.

Moreover, the technology has been shown to increase crop intensity—meaning that more crops can be grown in a given area over time—by optimizing water use and enabling multiple cropping cycles in a season. This leads to a higher overall land productivity, making the practice more attractive from a resource-use perspective. However, it is important to note that while AWD can boost crop intensity and productivity, it does not necessarily lead to direct improvements in yield, especially in gravity-based irrigation systems. This is because gravity-fed systems rely on different water management methods, and the reduced water availability associated with AWD may not always be suitable for the specific needs of crops grown under these conditions. Therefore, while AWD offers economic and operational advantages, its impact on yield improvement may be limited in certain irrigation contexts.

It is noteworthy, therefore, that the country's pump-irrigation system coverage is only 12% (Delos Reyes, 2017) and that the majority of farmers in irrigated ecosystems (75%) continue to use gravity-based systems (Inocencio et al., 2020). Adoption of AWD in gravity-based irrigation has been incredibly slow. Early on in the development of the technology, it was predicted that using AWD in a gravity-based system would save money on irrigation costs. The Free Irrigation Service Act (FISA), which was introduced in 2017, brought about revisions to the irrigation water pricing plan. The Free Irrigation Service Act took away NIA's income from irrigation fees because it now subsidizes irrigation fees for smallholder farmers with farms of 8 ha and less. This policy may have created a disincentivizing effect regarding the NIA's motivation to improve its rehabilitation and irrigation system quality and performance (Briones et al., 2019). The multiplicity and conflicting nature of the objectives beset the current mandate of NIA.

2. Methodology

Descriptive quantitative research is a method of research that involves collecting and analyzing numerical data to describe characteristics, trends, or patterns within a population or phenomenon.

According to Creswell (2014), descriptive research is used to describe the characteristics of a population or phenomenon being studied. It does not answer questions about how/when/why the characteristics occurred, which is done under analytic research.

Additionally, Nassaji (2015) explains that descriptive research seeks to provide an accurate representation of persons, events, or situations, often through quantitative methods when the goal is to generalize findings across a larger population.

The study involved a complete enumeration of respondent-farmers using a pre-tested interview schedule. Focus group discussions and participant observations were conducted. Data were organized into frequency distribution tables, and the overall conditions of each variable were calculated using an average weighted score. Interaction with the participants through surveys was carried out collectively to gather necessary information.

For this study, the researcher gathered data using self-administered questionnaires. The data gathered through these instruments provided reliable and valid statistics, contributing to achieving the study's objectives.

2.1. Research Design

The quantitative aspect of this research focused on collecting data to measure the effectiveness of the AWD program. This study used the descriptive-quantitative research methodology to gather necessary data from respondents using survey questionnaires. The data were presented in frequency distribution tables. The overall conditions of each variable were computed using Pearson R and descriptive statistics.

2.2. Respondents of the Study

The research was carried out on 80 farmers in the Dumacaa River Irrigation System, a total of two hundred forty (240) farmers as of December 2024 who have been practicing AWD technology.

2.3. Sampling Technique

The total number of farmers implementing the AWD Program in Dumacaa River Irrigation System is 240. For this study, a sample of 80 farmers was selected, representing approximately 33.33% of the total population. Furthermore, a purposive sampling technique was used to select the respondents. According to Palinkas et al. (2015), purposive sampling will allow for the deliberate selection of subjects that are most relevant to the study's objectives.

The farmers were chosen based on their practice of implementing the AWD program as a rice cultivation technique. This sampling technique ensured that the sample is aligned with the research goals. Etikan, Musa, and Alkassim (2016) support the use of purposive sampling, particularly for studies that require a focused population. The sample size will be sufficient to evaluate the perception and measure the effectiveness of the AWD Program in Dumacaa RIS in Lucena City.

2.4. Research Procedure

The study followed a descriptive quantitative research design. It began with the identification of the research problem, followed by a review of relevant literature to establish a strong theoretical foundation. A structured questionnaire was developed, validated by experts, and then administered to selected respondents within the Dumacaa River Irrigation System.

Data collection involved field surveys, after which the responses were encoded and statistically analyzed using descriptive and inferential tools. The results were interpreted to assess the implementation and effectiveness of the AWD program, leading to the formulation of conclusions and recommendations for future research and practice.

Upon approval by the faculty of Laguna State Polytechnic University—Sta. Cruz Main Campus, the researcher collected relevant information to address the research problem. Reading articles, journals, and previous studies helped conceptualize the study and design the questionnaires. The study commenced after the researcher obtained permission through a letter addressed to the Division Manager of NIA Quezon Irrigation Management Office and the Regional Manager of NIA Regional Office. The approved request was included with the questionnaire used for the interviews.

The researcher conducted the interview using the prepared questionnaire during scheduled coordination meetings with the Irrigators Association. Respondents were given sufficient time to answer the questions to ensure a better understanding and thorough responses. The completed research tools were collected after the required number of respondents was reached.

The responses were then tallied and organized in frequency distribution tables. The data was analyzed using various statistical methods, and the results were used to draw conclusions and formulate recommendations.

2.5. Research Instruments

The research instrument for this study was a self-assessment survey questionnaire. This questionnaire was designed to quantitatively measure the farmers' perceptions of the extent of effectiveness of the AWD Program implemented in Dumacaa RIS in Lucena City, in alignment with the study's objectives.

The questionnaire created by the researcher were submitted for approval and validation by the panel members and experts in public administration. The questionnaire was composed of three (3) parts. First part is the Demographic Profile of the respondents. Variables of the study are capacity building, program monitoring, program implementation, risk mitigation and stakeholder engagement to determine the status of the operational and administrative effectiveness of the alternate wetting and drying (AWD) program in the system.

Questionnaires were distributed to collect data from the selected Lucena City, Quezon farmers. The questionnaire employed Likert-scale items to gauge agreement or frequency and capture quantitative insights. Respondents were asked to rate their perceptions, practices, and experiences on a structured scale, providing quantitative data for analysis.

Table 1. ***The Five-Point Likert Scale to Measure the Respondents Response***

SCALE	NUMERICAL VALUE	DESCRIPTIVE VALUE
5	4.50 - 5.00	To a highly implemented
4	3.59 - 4.49	To a moderately implemented
3	2.50 - 3.49	To an implemented
2	1.50 - 2.49	To a less implemented
1	1.00 - 1.49	To a not implemented

Table 2. ***The Five-Point Likert Scale to Measure the Respondents Response***

SCALE	NUMERICAL VALUE	DESCRIPTIVE VALUE
5	4.50 - 5.00	To a extremely satisfied
4	3.59 - 4.49	To a very satisfied
3	2.50 - 3.49	To a moderate satisfied
2	1.50 - 2.49	To a slight satisfied
1	1.00 - 1.49	To a not satisfied

2.6. Statistical Treatment of Data

The collected data were tabulated and analyzed using descriptive, narrative, and statistical methods. The researcher also calculated the mean, which represents the average value used to determine the central tendency of the data. It is found by summing all the data points in the population and dividing the total by the number of points. The resulting value is referred to as the mean or average.

The Pearson correlation method was used to determine the relationship between the identified variables and the effectiveness of the Solar Pump Irrigation System, which answers the hypothesis. A Pearson Correlation is a number between -1 and 1 that indicates the extent to which two variables are linearly related.

Pearson Correlation Coefficient

Guilford developed the Pearson Correlation Coefficient "R" test in 1956 to quantify and analyze the linear relationship between two variables. It is used to determine whether a linear relationship exists and how strong it is (as indicated by the p-value and coefficient r, respectively). This test is only used when the underlying assumptions are true.

The Rule of Thumb, as presented by Guildford (1973), was adopted to interpret the strength of the relationship. Table 1 summarizes Guildford's (1973) Rule of Thumb for interpretation of the correlation coefficient (*r*)

Table 3. *Guildford's (1973) Rule of Thumb for Interpretation of Correlation Coefficient*

r	Interpretation
< .20	Slight, almost negligible relationship
.20 - .40	Low correlation, definite but small relationship
.40 - .70	Moderate correlation, substantial relationship
.70 - .90	High correlation, marked relationship
> .90	Very high correlation, very dependable relationship

3. Results and Discussion

This chapter focuses on the presentation, analysis, and interpretation of data according to the results and analysis formulated in the study.

Table 4. *Profile of Respondents in Terms of Age*

Age	*f*	%
18–28	0	0%
29–39	3	3.75%
40–50	37	46.3%
51 - above	40	50.0%
Total	80	100%

The demographic profile of the respondents includes key characteristics such as age, sex, and other relevant socio-economic factors. This information helps provide context for analyzing patterns in the implementation and effectiveness of the AWD program across different groups.

Most respondents (40 out of 80) are in the age range of 51 and above, making up 50% of the sample. This suggests that a significant portion of the respondents are likely to be older and more experienced. The second-largest group (37 respondents or 46.3%) falls within the 40–50 age range. Only a small proportion of respondents (3 or 3.75%) are in the 29–39 age group, and none fall in the 18–28 age range.

The statement about respondents being experienced and having a clearer sense of self in farming is more fitting for those in the 40–50 and 51+ age categories. These individuals will likely have accumulated substantial knowledge and experience in farming, contributing to their sense of self in this field. This could indicate that the population in the study is largely experienced in farming and may have a well-established understanding of their roles and practices.

Table 5 *Profile of Respondents in Terms of Sex*

Sex	*F*	%
Female	25	31.3%
Male	55	68.8%
Total	80	100%

The table 5 shows that 68.8% of the respondents are male, while 31.3% are female. This indicates a higher representation of male respondents in the study, suggesting that men comprise a larger portion of the population involved in the Dumacaa River Irrigation System. The gender imbalance (with males being almost twice as numerous as females) could reflect gender roles or patterns in farming practices, where men may have more direct involvement or leadership roles in agricultural activities within the area.

This observation may point to a slight gender disparity in farming participation within this region. This disparity could be influenced by social, cultural, or economic factors that determine who typically engages in farming. However, the exact reasons for this disparity would need further exploration through additional qualitative or demographic research.

This study used a quantitative approach with a survey method conducted using a Likert scale questionnaire with five choices, namely, Highly Implemented (score=5), Moderately Implemented (score=4), Implemented (score=3), Less Implemented (score=2) and Not Implemented (score=1) and as a result for the effective implementation of Alternate Wetting and Drying Program, the choices are Extremely Satistied (score=5), Very Satisfied (score=4), Moderately Satisfied (score=3), Slightly Satisfied (score=2) and Not at all Satisfied (score=1).

Table 6. Status of the Operational and Administrative Processes of AWD in Terms of Capacity Building

Indicator	*M*	*SD*	*V.I.*
1. NIA provides training programs on new farming schemes and technology.	4.80	0.40	HI
2. Farmers willingly participate in various training programs conducted by NIA.	4.45	0.69	HI
3. Monitoring of the AWD Program implementation are done by NIA.	4.51	0.69	HI
4. Evaluation of the AWD Program implementation are done by NIA.	4.60	0.56	HI
Overall for Capacity Building	4.59	0.44	HI

Note. *N*=80. V.I.=Verbal interpretation. The mean is interpreted as follows: 4.21–5:00=Highly Implemented (HI), 3.41–4.20= Moderately Implemented (M), 2.61–3.40=Implemented (I), 1.81–2.60=Less Implemented (L), 1.00–1.80=Not Implemented (N).

The table 6 shows status of the operational and administrative processes of AWD in terms of Capacity Building.The overall mean score of 4.59, categorized as **Highly Implemented**, confirms that NIA Quezon Irrigation Management Office has been highly successful implemented capacity-building initiatives for the Dumacaa River Irrigation System. This indicates that the respondents (farmers) generally agree that the NIA has effectively carried out training, monitoring, and evaluation to improve their farming practices and the implementation of the AWD program.

The data suggests that the respondents consider NIA's capacity-building efforts, including training, farmer participation, and program monitoring and evaluation, highly effective. This positive assessment implies that NIA's initiatives have been well-received and have likely contributed to better knowledge, skills, and program outcomes for the farmers involved.

Table 7. Status of the Operational and Administrative Processes of AWD in Terms of Program Monitoring

Indicator	*M*	*SD*	*V.I.*
1. Water levels are checked for the proper execution of AWD Program.	4.79	0.41	HI
2. Water levels are regulated for the proper execution of AWD Program.	4.51	0.64	HI
3. The quality of rice production is good using AWD method than the traditional setting.	4.45	0.76	HI
4. Evaluation of the AWD Program implementation are done by NIA.	4.59	0.61	HI
Overall for Program Monitoring	4.58	0.47	HI

Note. *N*=80. V.I.=Verbal interpretation. The mean is interpreted as follows: 4.21–5:00=Highly Implemented (HI), 3.41–4.20= Moderately Implemented (M), 2.61–3.40=Implemented (I), 1.81–2.60=Less Implemented (L), 1.00–1.80=Not Implemented (N).

Table 7 provides details on an assessment of the implementation of the Alternate Wetting and Drying (AWD) Program, specifically in the context of rice production. All indicators related to the program's execution received a high level of implementation, as shown by their mean scores, which fall within the range of 4.21 to 5.00, corresponding to the "Highly Implemented" category.

The indicators received mean scores of 4.79, 4.51, 4.45, and 4.59, respectively. This indicates that it is strongly implemented, with standard deviations of 0.41 and 0.76 as the lowest and highest values.

Finally, the overall program monitoring was assessed with a mean score of 4.58 and a low standard deviation of 0.47, which also falls under the "Highly Implemented" category. This suggests that the overall monitoring of the AWD Program is effectively carried out with strong agreement among respondents. The low variation in responses across all indicators suggests that the program's implementation is consistent and well-regarded by participants.

Table 8. Status of the Operational and Administrative Processes of AWD in Terms of Program Implementation

Indicator	*M*	*SD*	*V.I.*
1. NIA provides the necessary resources to be utilized in the AWD Program Implementation.	4.75	0.54	HI
2. Water levels are equitable serve in rice field.	4.65	0.53	HI
3. Soil levels inside the pipe are properly maintained.	4.53	0.64	HI
4. The quality of rice production is good using AWD method than the traditional setting.	4.75	0.52	HI
Overall for Program Implementation	4.67	0.42	HI

Note. *N*=80. V.I.=Verbal interpretation. The mean is interpreted as follows: 4.21–5:00=Highly Implemented (HI), 3.41–4.20= Moderately Implemented (M), 2.61–3.40=Implemented (I), 1.81–2.60=Less Implemented (L), 1.00–1.80=Not Implemented (N).

In Table 8 outlines the status of the operational and administrative processes of the Alternate Wetting and Drying (AWD) program, specifically focusing on program implementation. All indicators show a high level of implementation, as evidenced by their mean scores, which fall within the "Highly Implemented" range (4.21–5.00).

The overall program implementation was assessed with a mean score of 4.67 and a standard deviation of 0.42, indicating that, in general, the AWD program is highly implemented, with low variation in the participants' responses.

In conclusion, the data indicate that the AWD program has been largely successful in resource provision, water management, soil maintenance, and rice production quality. Although the proper maintenance of soil levels inside the pipes received a slightly lower score, the program's overall implementation is still highly valued. The consistent performance across most indicators highlights the program's overall effectiveness.

Table 9. Status of the Operational and Administrative Processes of AWD in Terms of Risks Mitigation

Indicator	*M*	*SD*	*V.I.*
1. NIA encourage farmers to diversify their crop.	4.51	0.50	HI
2. NIA ensure that water delivery was utilized in the AWD practice area.	4.63	0.56	HI
3. Funding for AWD programs were provided by NIA.	4.49	0.50	HI
4. Engage farmers with NIA to ensure supportive policies for water management in AWD program.	4.61	0.56	HI
Overall for Risks Mitigation	4.56	0.35	HI

Note. *N*=80. V.I.=Verbal interpretation. The mean is interpreted as follows: 4.21–5:00=Highly Implemented (HI), 3.41–4.20= Moderately Implemented (M), 2.61–3.40=Implemented (I), 1.81–2.60=Less Implemented (L), 1.00–1.80=Not Implemented (N).

The results shown in Table 9 indicate the status of the AWD program's operational and administrative processes in terms of risk mitigation. All indicators show a high level of implementation, as reflected in the mean scores, which fall within the "Highly Implemented" range (4.21–5.00).

The indicator assessing whether NIA ensures that water delivery is utilized in the AWD practice area achieved the highest mean score of 4.63, which also received the verbal interpretation of "Highly Implemented." This suggests that NIA effectively monitors and manages water delivery, particularly in the Dumacaa River Irrigation System, ensuring that water resources are properly utilized for the AWD program.

Overall, the AWD program's risk mitigation efforts are reflected in its high mean score of 4.56 and low standard deviation of 0.35. This indicates that the program's risk

management strategies are effective and consistently implemented across all areas. The data confirms that NIA successfully manages risks within the AWD program by implementing strong measures in water delivery management, crop diversification, funding, and policy support. The consistent results across all indicators underscore the program's effectiveness in reducing potential risks.

Table 10. Status of the Operational and Administrative Processes of AWD in Terms of Stakeholders' Engagement

Indicator	*M*	*SD*	*V.I.*
1. NIA involve all relevant stakeholders in the planning processes.	4.50	0.64	HI
2. NIA involve all relevant stakeholders in the implementation processes.	4.58	0.61	HI
3. NIA ensure that the knowledge and experience of local farmers are valued and incorporated into AWD practices.	4.59	0.69	HI
4. Farmers attend training and capacity-building programs for AWD implementation.	4.50	0.68	HI
Overall for Stakeholders' Engagement	4.54	0.57	HI

Note. *N*=80. V.I.=Verbal interpretation. The mean is interpreted as follows: 4.21–5:00=Highly Implemented (HI), 3.41–4.20= Moderately Implemented (M), 2.61–3.40=Implemented (I), 1.81–2.60=Less Implemented (L), 1.00–1.80=Not Implemented (N).

The results presented in Table 9 highlight the strong engagement of stakeholders in the Alternate Wetting and Drying (AWD) program within the Dumacaa River Irrigation System. All indicators show a high level of implementation, as reflected by their mean scores, which fall within the "Highly Implemented" range (4.21–5.00).

The indicator assessing whether NIA ensures that the knowledge and experience of local farmers are valued and incorporated into AWD practices received the highest mean score of 4.59. This suggests that NIA places significant importance on integrating the expertise of local farmers into the program, fostering a more collaborative approach.

According to the Stakeholders' Engagement indicator, stakeholder involvement in the AWD program is consistently and successfully carried out. The indicator, which produced an overall mean score of 4.54 with a standard deviation of 0.57. According to the results, farmers in the Dumacaa River Irrigation System appear to be quite involved with the AWD initiative. The program's success depends on their contributions of local expertise and their active involvement in the planning, execution, and training phases. The continuously high scores for every indicator amply demonstrate these efforts.

Table 11. Level of Effectiveness of AWD Implementation in Terms of Community Participation

Indicator	*M*	*SD*	*V.I.*
1. NIA hold community meetings to discuss progress, challenges, and solutions to adapt the AWD practice.	4.64	0.62	ES
2. Maintain an open line of communication between NIA and farmers involved or practice AWD.	4.64	0.56	ES
3. NIA recognize farmers who successfully adapt AWD.	4.55	0.55	ES
4. NIA offer practical, hands-on training sessions where can actively participate in AWD activities.	4.60	0.63	ES
Overall for Community Participation	4.61	0.48	ES

Note. *N*=80. V.I.=Verbal interpretation. The mean is interpreted as follows: 4.21–5:00= Extremely Satisfied (ES), 3.41–4.20= Very Satisfied (VS), 2.61–3.40= Moderately Satisfied (M), 1.81–2.60= Slightly Satisfied (S), 1.00–1.80= Not Satisfied (NS).

The data reflects the high level of community participation in implementing the Alternate Wetting and Drying (AWD) program in the Dumacaa River Irrigation System. All indicators related to community involvement received scores in the "Extremely Satisfied" (ES) range, indicating strong satisfaction from the respondents.

Farmers expressed high satisfaction with NIA's efforts to hold community meetings (mean = 4.64, SD = 0.62), maintain open communication with farmers (mean = 4.64, SD = 0.56), recognize successful AWD adopters (mean = 4.55, SD = 0.55), and offer practical, hands-on training (mean = 4.60, SD = 0.63). These scores demonstrate that the community is actively involved in the program and strongly satisfied with NIA's engagement and support.

The overall mean for community participation was 4.61 with a low standard deviation of 0.48, further indicating that the program is well-received and that community participation is consistently strong and effective.

In summary, the results suggest that the farmers in the Dumacaa River Irrigation System are highly engaged and satisfied with the AWD program, with their active participation and positive feedback contributing significantly to the program's effectiveness.

Table 12. ***Level of Effectiveness of AWD Implementation in Terms of Environmental Sustainability***

Indicator	*M*	*SD*	*V.I.*
1. Reduces amount of water required for rice cultivation by minimizing continuous flooding.	4.63	0.60	ES
2. Promotes more stable crop growth when implemented successfully.	4.65	0.55	ES
3. AWD minimizes surface runoff that helps reduce leaching and chemicals.	4.48	0.57	ES
4. Improved water quality in surrounding areas.	4.51	0.50	ES
Overall for Environmental Sustainability	4.57	0.39	ES

Note. *N*=80. V.I.=Verbal interpretation. The mean is interpreted as follows: 4.21–5:00= Extremely Satisfied (ES), 3.41–4.20= Very Satisfied (VS), 2.61–3.40= Moderately Satisfied (M), 1.81–2.60= Slightly Satisfied (S), 1.00–1.80= Not Satisfied (NS).

Information shown in Table 12 indicates a high level of satisfaction regarding the environmental sustainability of the Alternate Wetting and Drying (AWD) program. All indicators related to the environmental impact of AWD received scores within the "Extremely Satisfied" (ES) range, signifying strong positive feedback from the respondents.

The overall mean score for environmental sustainability was 4.57, with a low standard deviation of 0.39, indicating that the program is consistently highly effective in promoting environmental sustainability.

In conclusion, the results suggest that the AWD program is highly effective regarding environmental sustainability. Respondents are extremely satisfied with its impact on water conservation, crop stability, reduced chemical runoff, and improved water quality, demonstrating the program's positive environmental effects.

Table 13. Level of Effectiveness of AWD Implementation in Terms of Economic Productivity

Indicator	*M*	*SD*	*V.I.*
1. Reduce input costs such as water, fertilizers and pesticides.	4.59	0.50	ES
2. Increased rice yield that results in increased profits.	4.63	0.49	ES
3. Increased rice yield that results in increased productivity.	4.55	0.53	ES
4. Encourage crop diversification providing more options for income generation.	4.56	0.52	ES
Overall for Economic Productivity	4.58	0.34	ES

Note. *N*=80. V.I.=Verbal interpretation. The mean is interpreted as follows: 4.21–5:00= Extremely Satisfied (ES), 3.41–4.20= Very Satisfied (VS), 2.61–3.40= Moderately Satisfied (M), 1.81–2.60= Slightly Satisfied (S), 1.00–1.80= Not Satisfied (NS).

The data outlined in Table 13 reflect the high level of satisfaction regarding the economic productivity of the Alternate Wetting and Drying (AWD) program. All indicators related to economic productivity received scores within the "Extremely Satisfied" (ES) range, indicating strong positive feedback

IJRP.ORG
International Journal of Research Publications
ISSN: 2708-3578 (Online)

from the respondents.

Overall, the economic productivity aspect of the AWD program received a mean score of 4.58, with a low standard deviation of 0.34, suggesting consistent and widespread satisfaction with the program's economic benefits.

However, the lowest mean score was associated with the indicator assessing increased rice yield productivity (mean = 4.55, SD = 0.53). While still in the "Extremely Satisfied" range, this suggests that the increase in productivity may be somewhat minimal compared to other aspects, but it still contributes positively to overall economic productivity.

Therefore, the results indicate that the AWD program positively impacts economic productivity, with strong satisfaction regarding cost reduction, increased profitability, and opportunities for crop diversification. Although the increase in rice yield productivity was slightly lower in comparison, the program's overall impact on economic productivity remains highly regarded.

Table 14. Correlations Between Operational and Administrative Processes of AWD and its Program Effectiveness

Operational and Administrative Process	Effectiveness the Program		
	Community Participation	Environmental Sustainability	Economic Productivity
Capacity Buillding	.81 high corr. <.001	.60 moderate corr. <.001	.29 low corr. .009
Program Monitoring	.80 high corr. <.001	.58 moderate corr. <.001	.35 low corr. .002
Program Implementation	.79 high corr. <.001	.75 high corr. <.001	.47 moderate corr. <.001
Risks Mitigation	.63 moderate corr. <.001	.60 moderate corr. <.001	.26 low corr. .019
Stakeholders' Engagement	.77 high corr. <.001	.81 high corr. <.001	.40 moderate corr. <.001

Note. Cell contains Pearson correlation coefficient, interpretation of its strength, and its corresponding *p* value. Degree of freedom is 78. *p<.05. **p<.01. ***p<.001.

The table 14 project correlation between the operational and administrative processes of the AWD program and its effectiveness in three key areas: community participation, environmental sustainability, and economic productivity. Key processes like capacity building, program monitoring, and stakeholders' engagement show strong correlations, particularly with community participation and environmental sustainability. Program implementation also correlates positively, especially with environmental sustainability. However, risk mitigation shows a lower correlation with economic productivity.

The table confirms that all the correlations are statistically significant, with p-values less than 0.05 ($p < 0.05$), indicating that the relationships between the operational processes and the program's effectiveness are reliable and meaningful. This demonstrates that these processes are correlated and likely to have a genuine influence on the success of the AWD program.

In summary, the operational and administrative processes of the AWD program are strongly linked to its effectiveness, particularly in promoting community participation and environmental sustainability. The processes of capacity building, program monitoring, program implementation, stakeholders' engagement, and risk mitigation all play important roles, with varying degrees of influence on economic productivity. While some processes, such as capacity building and risk mitigation, show weaker correlations with economic outcomes, they are still crucial for the overall success and sustainability of the program. The consistently positive and statistically significant correlations suggest that these processes are integral to the AWD program's success in achieving its objectives.

4. Summary of Findings, Conclusion, and Recommendations

4.1. Summary of Findings

The effectiveness of the AWD program is strongly influenced by its operational and administrative processes, which support community participation and environmental sustainability. Core elements like capacity building, monitoring, implementation, stakeholder engagement, and risk mitigation play vital roles, despite varying impacts on economic outcomes.

The study yielded several salient findings. First, sex and age were found to have no significant effect on the implementation of the Alternate Wetting and Drying (AWD) program. Second, survey data gathered from respondents in the Dumacaa River Irrigation System indicated that the extent of AWD implementation is very high. Third, the results revealed positive and significant relationship between the effectiveness of the AWD program and the operational and administrative processes within the Dumacaa RIS. Lastly, the strength of these significant relationships ranges from moderately to highly implemented, with satisfaction levels among respondents ranging from very satisfied to extremely satisfied as a result of the program's effectiveness.

4.2. Conclusions

While sex and age have no significant effect on the implementation of the AWD itself, the age range of farmers will significantly impact agricultural sustainability (FAO 2018).

The results also emphasized a strong and positive correlation between the operational and administrative_aspects of the program and its overall effectiveness (Holcomb, et al., 2021). This suggests that the program's success is not just due to the technical implementation of AWD but also the efficient management and coordination of various program activities, from capacity building to monitoring and evaluating the program. M&E, along with learning and adaptive management, can contribute to achieving national climate change mitigation and adaptation goals (FAO, 2021).

Though there may be areas for further improvement, overall operational and administrative processes in the AWD Program is effectively functioning to augment water scarcity particularly in the lowland area of the Dumacaa River Irrigation System as shown in the collected results. This success could serve as a model for similar irrigation systems in other areas, showcasing the effectiveness of the AWD approach in sustainable water management.

Therefore, the null hypothesis is rejected since the results show a significant relationship between AWD's Operational and Administrative processes and the AWD program's effectiveness.

4.3. Recommendations

Based on the findings of the study, several recommendations are proposed to guide future research and improve the implementation and impact of the Alternate Wetting and Drying (AWD) program. These suggestions aim to address observed gaps, enhance program effectiveness, and support sustainable agricultural practices.

1. For other agencies related to agriculture, given that most respondents are aged 51 and above, it is essential to focus on engaging younger farmers and stakeholders to ensure the long-term sustainability of the Dumacaa River Irrigation System. By prioritizing the training and involvement of the younger generation, the program can build a strong foundation for future growth and continuity (Holcomb et. al., 2021)
2. To IA/Farmers and National Irrigation Administration, since the AWD program has shown remarkable implementation and effectiveness, it is crucial to maintain and strengthen the practices that have contributed to its success. To ensure continued progress, regular monitoring and evaluation should be carried out to assess the program's ongoing effectiveness and identify potential areas for enhancement (Palis, et al., 2017). This proactive approach will help safeguard the program's positive outcomes and facilitate timely adjustments.
3. For National Irrigation Administration; The strong connection between the operational and administrative processes and the overall success of the AWD program highlights the importance of focusing on these aspects. Regular surveys and feedback mechanisms should be implemented to capture stakeholders' concerns, suggestions, and needs, allowing for ongoing improvements and a more responsive program (Department of Agriculture—Bureau of Soils and Water Management, DA-BSWM, 2021). By staying attuned to stakeholder input, the program can evolve and better meet the community's needs, ultimately improving satisfaction and overall effectiveness.
4. For Future Researchers, considering the success of the AWD program in the Dumacaa River Irrigation System, there is significant potential to expand this initiative to other regions with similar irrigation systems. Doing so would extend the program's benefits, particularly in terms of agricultural productivity and water conservation, thus creating a broader positive impact in the region (DA-BSWMM, 2021). Scaling up AWD to more farmers led to long-term water conservation benefits and increased agricultural resilience (Pascual et al., 2022).

Acknowledgement

The researcher would like to express her profound gratitude to those who helped her and shared ideas that made this study successful.

Laguna State Polytechnic University – Sta Cruz Main Campus, the researcher's Alma Mater, for the competent faculty and staff who untiringly nurtured the researcher and obtained professional growth.

Hon. MARIO R. BRIONES, EdD, University President, for strengthening the pillars of this university and promoting an academic institution that provides quality education;

ENGR. MANUEL LUIS, R. ALVAREZ, Campus Director for untiring support in providing quality education;

DR. MARY JANE D. FUENTES, Dean of the Graduate School, for her excellent leadership that made the school globally competitive;

The researcher's deepest gratitude and appreciation go to **VPAA ATTY. RUSHID JAY S. SANCON** for his invaluable guidance, patience, and continuous support throughout the development of this thesis. The adviser's expertise and encouragement have been instrumental in shaping the research and enhancing the researcher's academic growth.

Prof. EDEN C. CALLO, EdD, her internal statistician, for helping the researcher in computing her data and interpretation;

DR. IMEE P. SANCHEZ, her subject specialist for the valuable comments, suggestions, and useful comments that helped in the development of this piece of work.

VICTOR A. ESTALILLA JR., her external statistician, for being capable and sharing his expertise in interpreting the results of this research.

LSPU employees, secretaries of CBAA for their patience and support.

Above all, the researcher gives all the glory to **Almighty God,** who bestows strength and directs the path of blessedness and wisdom. A heartfelt thank you to my family for their unwavering love, patience, and encouragement throughout this journey. His belief in the researcher has been my greatest motivation. To Ma'am Danna Dael, Ate Romeleen Largueza, my friends and colleagues, their support, camaraderie, and words of encouragement have made this academic endeavor more meaningful and fulfilling.

Lastly, the researcher acknowledges all those who contributed, directly or indirectly, to the success of this thesis. Their kindness and support are deeply appreciated.

Sincerely Yours,

The Researcher

References

Alauddin, M., Sarker, M. A. R., Islam, Z., & Tisdell, C. (2020). Adoption of alternate wetting and drying (AWD) as a water-saving technology in Bangladesh: Economic and environmental considerations. Land Use Policy, 91.

Asian Development Bank (ADB). (2018). Technical and vocational education and training in the Philippines: Challenges and opportunities. https://www.adb.org

Briones, R. M., Clemente, R. S., Inocencio, A. B., Luyun, R. A., & Rola, A. C. (2020). Assessment of the Free Irrigation Service Act. Philippine Institute for Development Studies. https://pidswebs.pids.gov.ph/CDN/PUBLICATIONS/pidsrp2005.pdf

Chartzoulakis, K., & Bertaki, M. (2015). Agriculture and Agricultural Science Procedia, 4, 88–98. https://doi.org/10.1016/j.aaspro.2015.03.011

Dietz, T., Shwom, R. L., & Whitley, C. T. (2020). Climate change and society. Annual Review of Sociology, 46(1), 135–158. https://doi.org/10.1146/annurev-soc-121919-054614

Enriquez, Y., Yadav, S., Evangelista, G. K., Villanueva, D., Burac, M. A., & Pede, V. (2021). Disentangling challenges to scaling alternate wetting and drying technology for rice cultivation: Distilling lessons from 20 years of experience in the Philippines. Frontiers in Sustainable Food Systems. https://doi.org/10.3389/fsufs.2021.675818

FAOSTAT Database. (2018). Food and Agriculture Organization, Rome. http://www.fao.org/faostat/en/#data

Food and Agriculture Organization (FAO). (2021). Building capacity for sustainable rice production: The role of alternate wetting and drying (AWD). https://www.fao.org

Gupta, S., Mann, V., Mazzucotelli, J., Gomez, M., & Maqsood, H. (2023). Vietnamese rice farmers go high-tech to anticipate a low-water future [Video]. YouTube. https://youtu.be/fpOcBgOOBXM

Holcomb, J., Ferguson, G. M., Sun, J., Walton, G. H., & Highfield, L. (2021). Stakeholder engagement in adoption, implementation, and sustainment of an evidence-based intervention to increase mammography adherence among low-income women. Journal of Cancer Education, 37(5), 1486–1495. https://doi.org/10.1007/s13187-021-01988-2

Intergovernmental Panel on Climate Change (IPCC). (2014). IPCC Fifth Assessment Report: Climate change 2014: Impacts, adaptation, and vulnerability. https://www.ipcc.ch/report/ar5/wg2/

Kwanyuen, B., Punyawansiri, S., & Chaengpui, K. (2021). Effects of alternate wetting and drying techniques on grain yield and water use efficiency in irrigated rice. Journal of Sustainability Science and Management, 16(2), 3–10. https://doi.org/10.46754/jssm.2021.02.002

Lampayan, R. M., Rejesus, R. M., Singleton, G. R., & Bouman, B. A. M. (2015). Adoption and economics of alternate wetting and drying water management for irrigated lowland rice. Field Crops Research, 170, 95–108. https://doi.org/10.xxxx

Nassaji, H. (2015). Qualitative and descriptive research: Data type versus data analysis. Language Teaching Research, 19(2), 129–132. https://doi.org/10.1177/1362168815572747

Vanino, S., Nino, P., De Michele, C., Bolognesi, S. F., & Pulighe, G. (2015). Earth Observation for Improving Irrigation Water Management: A Case-study from Apulia Region in Italy. *Agriculture and Agricultural Science Procedia*, *4*, 99–107. https://doi.org/10.1016/j.aaspro.2015.03.012

Palis, F. G., Lampayan, R. M., Flor, R. J., & Sibayan, E. (2017). A multistakeholder partnership for the dissemination of alternate wetting and drying water-saving technology for rice farmers in the Philippines. Agriculture and Food, 2(3), 290–309.

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. Administration and Policy in Mental Health and Mental Health Services Research, 42(5), 533–544. https://doi.org/10.1007/s10488-013-0528-y

Pandey, S., Yadav, S., Hellin, J., Balié, J., Bhandari, H., Kumar, A., & Mondal, M. K. (2020). Why technologies often fail to scale: Policy and market failures behind limited scaling of alternate wetting and drying in rice in Bangladesh. Water, 12(5), 1510. https://doi.org/10.3390/w12051510

Pascual, K. S., Yadav, S., Evangelista, G., Burac, M. A., Rafael, M., Cabangon, R., Tokida, T., Mizoguchi, M., & Regalado, M. J. (2022). Determinants in the adoption of alternate wetting and drying technique for rice production in a gravity surface irrigation system in the Philippines. Water, 14(5). https://doi.org/10.3390/w14010005

Philippine Rice Research Institute (PhilRice). (2020). Empowering young farmers through digital innovations. https://www.philrice.gov.ph

Tran, D. H., Hoang, T. N., Tokida, T., Tirol-Padre, A., & Minamikawa, K. (2017). Impacts of alternate wetting and drying on greenhouse gas emissions from paddy fields in Central Vietnam. Soil Science & Plant Nutrition, 64(1), 14–22. https://doi.org/10.1080/00380768.2017.1409601