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Assessment of Water Resource Management and Development Programs in Virac, Catanduanes

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Abstract

This paper focuses on the management of water resources in Virac, Catanduanes, Philippines. More specifically, through the analysis of existing policies, programs, and practices concerning the environmental, social, and economic dimensions of water resource management. The research methodology involved the collection of primary data primarily through in-depth interviews with key informants, supplemented by secondary data review. This qualitative approach was vital to gain a deep, contextual understanding of the water resource program within Virac, Catanduanes. The study's design was specifically tailored to tackle complex research questions, seeking detailed insights into the program's status, its implications for the community, the challenges faced, and stakeholder-informed recommendations for future management. Findings indicate that the integrated water resources management in Virac, Catanduanes is practiced in different forms. Major strategies employed included devising ways of protecting and developing water sources, ensuring people's access to water supply and fair distribution, safeguarding public health and the environment, promotion of climate change responsiveness, and adopting an integrated water resources management approach. However, insufficient resources, aging infrastructure and climate change continue to serve as development challenges. In order to maximize the effective management of water resources, the paper offers different approaches that can be employed. These include increased investment in finance and technology, improvement of the infrastructure, climate change adaptation planning, policy compliance improvement, stakeholder active participatory approaches and water resource safeguarding. By adopting these suggestions, water services in Virac, Catanduanes will be more sustainable and effective in the future.

Keywords: water resource management, sustainable practices, community engagement, climate resilience, policy development

INTRODUCTION

Concerns over the quantity and quality of domestic water supply in Virac, Catanduanes are becoming a relevant issue and requires the attention of all stakeholders. This can be observed especially during dry season when the supply of domestic water becomes scarce and during rainy season in which water quality deteriorates.

These issues of scarcity and declining quality inevitably influenced how much water residents can safely and practically use in their daily lives. Understanding water consumption both locally and globally provides context for evaluating whether currents usage levels in Virac meet basic human needs or fall short due to supply constraints. Per capita water usage varies significantly around the world. In developed regions, the average consumption is approximately 200 liters per person per day. Conversely, the internationally recognized standard for basic human water needs is around 50 liters per person per day (Gleick & Palaniappan, 2010).

In Catanduanes, water resource management efforts encompass objectives such as sustainable water sourcing, equitable distribution, environmental conservation, climate resilience, and integrated management. These objectives align with the provisions of PD 1067 and RA 9275 (the Clean Water Act), under which the DENR's Environmental Management Bureau (EMB) plays a central role in enforcing

water quality standards and monitoring compliance to control water pollution. This alignment reflects an integrated water resource management (IWRM) approach, which adheres to global best practices and emphasizes the interconnected nature of water resources across different sectors and regions.

Given the nature of the identified problems and objectives, a comprehensive and suitable conceptual paradigm that is used in this study is the Integrated Water Resources Management (IWRM) framework. The IWRM framework is a holistic approach that takes into account the interconnectedness of various components involved in water resources management, including social, economic, and environmental factors. It emphasizes sustainability, stakeholder participation, and adaptive management. The following figure depicts the conceptual paradigm of the study:

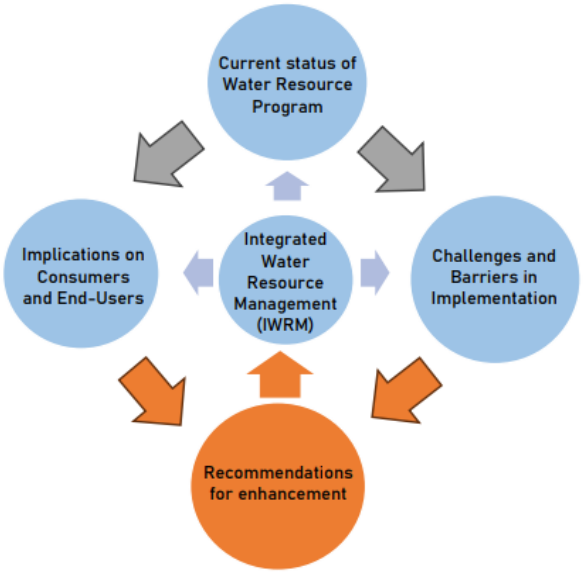

Figure 1
The Integrated Water Resources Management (IWRM) framework.

This study investigates water resource management in Virac, Catanduanes, addressing pressing local concerns about seasonal water scarcity and declining rainy-season water quality. It aims to evaluate the effectiveness of current programs and policies by examining their implementation status, identifying inherent challenges (particularly those unique to an island setting), assessing their implications for residents, and proposing enhancement strategies. Employing a multi-method approach, the research utilizes document analysis, and key informant interviews. This comprehensive strategy involves engaging with policymakers, implementers, community leaders, and consumers to capture diverse perspectives, from institutional operations to lived experiences regarding water access, quality, and satisfaction. Findings will inform collaboratively developed recommendations, refined through participatory stakeholder workshops, ensuring contextually relevant and actionable outcomes for improving water resource management in Virac.

LITERATURES

The Local Government Code (LGC) of 1991 delegates the responsibility for providing local water services to Local Government Units (LGUs). Water services function under at least eight legal frameworks, with the Water Code of the Philippines serving as the foundational law (Presidential Decree [PD] 1067, series of 1976). Several regulatory agencies oversee water service delivery across the country. The two primary entities are: (1) the National Water Regulatory Board (NWRB), which is responsible for establishing, administering, and enforcing all regulations concerning water, including the "control, conservation, and protection of waters, watersheds, and related land resources" (Rola et al. 2015, p. 200); and (2) the Local Water Utilities Administration (LWUA), which acts as a "specialized lending institution for the promotion, development, and financing of local water utilities" (PD 768, Section 22).

The current global concern revolves around the looming prospect of water scarcity, driven primarily by the increasing demands associated with a growing population, and the potential ramifications on energy and food production (Cosgrove & Loucks, 2015). A noteworthy insight from the World Economic Forum's Insight Report (2015) underscores this apprehension. The report, derived from a Global Risk Perception Survey involving 900 recognized experts, reveals a consensus that water crises

are anticipated to exert the most significant societal impact over the next decade. This recognition highlights the urgency of addressing water-related challenges to ensure the sustainability of crucial resources.

According to Florini, and Pauli (2018) a "multi-dimensional framework of governance" refers to a comprehensive and intricate structure or system that encompasses various dimensions or aspects of governance. In the context of water resource management, a multi-dimensional framework would consider and integrate different factors, perspectives, and elements to ensure effective and holistic governance. In essence, a multi-dimensional framework of governance acknowledges the complexity of managing water resources and strives to create an inclusive, sustainable, and resilient system that considers the diverse aspects of governance. It seeks to balance competing interests while ensuring the overall well-being of communities and the environment.

Donnelly and Cooley (2015) underscore that prevailing trends in water usage are unsustainable, especially considering the challenges posed by population growth and climate change. The significance of water as a policy priority has escalated on the global stage, as highlighted by the third United Nations World Water Development Report (United Nations World Water Assessment Programme, 2009). This report issues an unprecedented warning about the potentially severe consequences arising from the present inequitable and unsustainable water utilization practices. It emphasizes the perilous implications for both economic development and security, underscoring the critical role that effective water management plays in mitigating these risks.

According to Grayman, Loucks, and Saito (2012), the challenges related to water resources are anticipated to intensify due to both the impacts of climate change on water availability and an anticipated 50% increase in the global population by 2050. Simultaneously, urbanization is projected to double during this timeframe, compounding the strain on future water resources. The combined effects of climate-induced water stresses and substantial population growth, particularly in urban areas, underscore the escalating pressures on water resources that need to be addressed proactively.

Water supplies in parts of the Philippines are frequently scarce and, as a consequence, supplies are frequently shut down to preserve capacity (Barkwith, 2021). Current climate projections through 2050 indicate that the Philippines will experience rising temperatures, along with reduced rainfall during the dry season and more intense rainfall events during the wet season. These changes will likely worsen water availability during drought periods and increase the severity of flooding during heavy rainfall events. The province of Catanduanes, particularly the service area of the Virac Water District (VIWAD), is not immune to this issue. This situation is the impetus for the development of this research proposal.

METHODS

Research Design. This research employed a comprehensive descriptive qualitative approach to provide an in-depth understanding of the water resource program in Virac, Catanduanes. The study addressed complex research questions that require contextual insights into the current status, implications, challenges, and recommendations for water resource management in the province.

Participants. The participants include key stakeholders with direct involvement in water resource management, policy implementation, and the local community's experiences with water availability and quality. VIWAD (Virac Water District) officials including the General Manager, Board of Directors, a representative from the Construction and Production Division, and the Project Planning and Development Officer. These officials are directly responsible for managing water resources, infrastructure development, and policy enforcement in Virac. Their insights provided valuable information on

operational challenges, strategic priorities, and the practical aspects of water distribution in the municipality. Additionally, national and local government representatives were included to discuss the role of government agencies in supporting and enforcing water management policies. Key participants include the Municipal Planning and Development Officer, Municipal Planning and Development staff, Project Monitoring Member, Municipal Environmental and Natural Resources Officer, Provincial Planning and Development Coordinator, Assistant Provincial Planning and Development Coordinator, Project Development Officer, Planning Officer, Provincial Environment and Natural Resources Officer, and 10 DENR Forester. These individuals contributed in understanding the policy gaps, resource allocation issues, and inter-agency coordination efforts in water resource management. Community leaders, specifically 15 Barangay Captains, were selected to offer insights into community-level water issues and the engagement of local leadership in water management. Their perspectives are crucial for understanding how water policies and practices impact communities on the ground. Lastly, 15 community members were interviewed to capture firsthand experiences and perceptions of water availability, quality, and management. These participants provide essential feedback on how the water programs and policies affect their daily lives, helping to highlight both successes and areas needing improvement from the perspective of the end-users.

Research Instrument. The study employed a carefully constructed research interview guide as its primary instrument. Developed by the researchers, this guide featured clear and focused questions meticulously framed to align directly with the identified research problems and objectives. The design of these questions was strategic, aiming to capture a comprehensive understanding of stakeholder perspectives. Specifically, the questions were crafted to elicit views on the current status of water resource programs, delve into specific challenges encountered during implementation, explore the implications of these programs for the community, identify opportunities for future improvement, and ultimately, guide discussions on potential collaborative interventions from the stakeholders' point of view.

Data Collection. Data of the study was collected from multiple sources to ensure a comprehensive understanding of water resource management in Virac. The qualitative data component includes survey and in-depth interviews with key stakeholders, including representatives from VIWAD, local government officials, relevant government offices and agencies, community leaders, and consumer - residents. This phase aimed to capture stakeholder perspectives, uncover nuanced challenges, and understand local experiences with water resource programs. Additionally, documentary analysis of government publications and online resources from national agencies further contextualized the research within existing policy and legal frameworks.

Ethical Considerations. In adherence to rigorous ethical standards, this study ensured that all participants and respondents received a clear and thorough understanding of the study's objectives, purpose, and methods. Special attention was given to maintaining confidentiality and anonymity for participants interview respondents, with an emphasis on the assurance that individual responses would remain unidentifiable throughout the research process.

Ensuring ethical conduct was paramount throughout this study. Prior to participation, the researchers introduced themselves and provided a comprehensive overview, clearly outlining the study's objectives, procedures, and anticipated outcomes. Emphasis was placed on the voluntary nature of participation; individuals were explicitly informed that they could choose not to participate or withdraw at any point during the research without any negative consequences.

To facilitate genuine informed understanding, all information was presented in clear, accessible language, avoiding technical jargon, and participants were actively encouraged to ask questions until they felt fully informed. A

transparent discussion covered any potential minimal risks or discomforts associated with participation, alongside the potential benefits, both direct (if any) and indirect, such as contributing valuable insights into water resource management in Virac.

Participants were also made aware of the expected time commitment and the specific activities involved in their participation. Crucially, assurances of confidentiality and anonymity were given, with detailed explanations of protective measures like the use of pseudonyms and the de-identification of collected data. Only after confirming participants' understanding of all these elements was their formal informed consent obtained. Finally, contact information for the research team was provided should any questions or concerns arise later, and all records of informed consent were securely documented and maintained.

Qualitative Data Analysis. The qualitative component includes in-depth interviews and focus group discussions with key stakeholders, such as community leaders, community members, and representatives from relevant government offices and agencies. This phase undergone a thematic analysis with the aim to capture stakeholder perspectives, uncover nuanced challenges, and understand local experiences with water resource programs. This involves identifying recurring themes, patterns, and insights within the qualitative responses. These themes were categorized and coded to capture the diverse perspectives of stakeholders regarding the implications, challenges, and recommendations related to the water resource programs in Virac. Additionally, documentary analysis of government publications and online resources from national agencies further contextualizes the research within existing policy and legal frameworks.

RESULTS

In the assessment of objectives, activities, and policies related to water resource management in the island province of Catanduanes, the researchers adopted a comprehensive and integrated approach.

Current Status of Water Resource Program in Virac, Catanduanes. The current status geared towards the implementation of water resource programs objectives are systematically presented in Table 1.

Table 1

Status of the Implementation of Water Resource Programs in Virac, Catanduanes

Water Resource Program Objectives	Activity	Policies	Status of Implementation
Sustainability	Water Conservation and Efficiency Program, including water recycling initiatives.	Policy on Water Conservation and Sustainable Use (e.g., VIWAD annual plan)	86% Implemented
Access & Equity	Installation of water systems with elevated water tanks and solar pump for underserved barangays.	Equitable Access Policy for water services	Ongoing (scheduled for 2024) for implementation of LGU
Ecosystem Health	Protection and reforestation of watershed areas (e.g., National Greening Program).	Watershed Management and Biodiversity Conservation Policies	Ongoing (Community-based programs)
Climate Resilience	Construction of resilient water infrastructure to withstand extreme weather conditions.	Climate Adaptation Policy and Disaster Risk Reduction	For Implementation
Integrated Management	Development of Integrated Water Resource Management (IWRM) plans involving multiple stakeholders.	Policy for Inter-agency Collaboration in Water Resource Management	Fragmented (Needs enhancement)

The implementation of water resource programs in Virac, Catanduanes reveals a multi-faceted approach guided by key objectives, though with varying degrees of progress and challenges.

Focusing first on sustainability, the findings indicate that water conservation programs are notably underway, with a substantial 86% reported as partially implemented. Local Government Units (LGUs) play a critical role, demonstrating robust regulatory oversight to not only ensure compliance but also actively work towards enhancing water quality. This commitment by the LGUs aligns well with broader policies promoting sustainable water use. However, the findings also suggest that while progress is being made, there remains a need to further strengthen some of these programs to achieve their full potential.

In terms of access and equity, significant efforts are being directed towards improving vital water infrastructure. A key focus is on reaching underserved areas, highlighting a commitment to equitable distribution. LGUs are at the forefront of this objective, taking responsibility for the construction and maintenance of essential facilities, including water treatment plants and the intricate networks required for

water distribution. Furthermore, their management of sanitation systems is integral to both environmental protection and the promotion of community health within Virac.

Addressing ecosystem health, the study points to ongoing reforestation activities as positive contribution. These efforts, encompassing the preservation of crucial watersheds, are directly linked to maintaining the integrity of water resource in the area. Such initiative is not isolated but are aligned with national policies, and importantly, they benefit from the active participation of the local community, suggesting shared understanding of the importance of environmental stewardship.

Regarding climate resilience, there is a clear recognition among LGUs of the need to develop infrastructure capable of adapting to the impact of climate change, such as increasingly extreme weather events and the threat of sea-level rise. While many of these projects are still in their nascent stages, the inherent susceptibility of the region to climate-related vulnerabilities is a significant factor driving current planning. Echoing observations from studies elsewhere, such as Rola (2011), the findings underscore that LGUs in Catanduanes are particularly attuned to this risk, given the region's high exposure to extreme weather.

Finally, concerning integrated management, the study highlights the existence of efforts aimed at developing comprehensive water management plans. However, a significant challenge identified is the fragmented collaboration among various agencies involved. While national bodies like the National Water Resources Board (NWRB), Department of Environment and Natural Resources (DENR), and Department of Public Works and Highways (DPWH) do engage with LGUs, findings suggest that achieving truly effective integrated management necessitates improved inter-agency coordination and reinforcement of existing policies.

In essence, the picture that emerges from Virac, Catanduanes, is one of a community and its local government actively working towards better water resource management across multiple critical fronts. While progress is evident in areas like regulatory oversight, infrastructure development, and environmental preservation, challenges remain, particularly in ensuring the complete implementation of conservation programs and fostering seamless integration among the various stakeholders involved in managing this vital resource.

Overall, this study highlighted the multifaceted approach to water resource management in Virac, Catanduanes. These results offer practical insights for similar regions facing challenges related to water access, climate resilience, and resource sustainability.

Implications of the Water Resource Programs on the Consumers and End-Users. Water resource programs, activities, and policies implemented by concerned national line agencies and local government units in Virac, Catanduanes have direct and indirect implications on consumers and end-users. The effects differ depending on the nature of the initiatives, the local context, and the efficiency of implementation. Table 2 below outlines the consequences of water resource programs.

Table 2
Implications of Water Resource Programs on the Consumer and End-Users

Water Resource Program/Regulatory Framework	Implications/Expected Measurable Results	Inadequate Observable Outcome
Clean Water Act (RA 9275) Philippine Water Code (PD 1067) Water Quality Management	Access to Clean Water ✓ Well-implemented programs which lead to improved access to clean and safe water for consumers, enhancing public health and reducing waterborne diseases. ✓ Inadequate programs or mismanagement resulted in water scarcity, contamination, and reduced access, negatively affecting the health and well-being of consumers.	✓ Water quality is not maintained especially during heavy downpour ✓ Scarcity of supply (quantity) happens during summer seasons ✓ VIWAD as distributor of potable water does not have a program that will ensure the sustainability of water source.
Local Government Code (RA 7160)	Cost of Water Services ✓ Efficient programs that contribute to stable or reduced costs for water services, benefiting consumers economically. ✓ Poorly managed programs or inadequate infrastructure that led to increased costs, impacting the affordability of water services for end-users.	✓ There is no existing policy that promotes this objective ✓ Based on the annual PPAs of VIWAD for the past five years, it has lined-up projects that will provide solution to its technical operations, mainly on the maintenance of dilapidated and old pipelines
Integrated Water Resources Management (IWRM) Watershed Protection and Rehabilitation Biodiversity Conservation	Environmental Impact ✓ Sustainable water policies that lead to positive environmental outcomes, preserving ecosystems and biodiversity for the benefit of present and future generations. ✓ Poorly planned activities which contribute to environmental degradation, impacting ecosystems and wildlife, with potential repercussions for consumers.	✓ There is laxity in the implementation of this policy. Implementing IWRM principles involves considering the interconnectedness of water resources, ecosystems, and various water uses. This holistic approach seeks to balance competing demands while ensuring the sustainability of water sources. ✓ Policies focusing on the protection and rehabilitation of watersheds are essential. This includes measures such as reforestation, erosion control, and the establishment of protected areas to maintain the health of ecosystems and ensure a sustainable supply of water. Even with the policies in-placed, implementation and enforcement are still a question.
Community-Based Resource Management	Community Engagement ✓ Inclusive programs that involve communities in decision-making which empower consumers, fostering a sense of ownership and responsibility for water resources. ✓ Lack of community engagement that result in dissatisfaction, resistance to water-related policies, and challenges in implementation.	✓ Engaging local communities in decision-making processes and sustainable practices is vital. ✓ Policies that promote community involvement in water resource management foster a sense of ownership and responsibility, leading to positive environmental outcomes.
Climate Change Adaptation Strategies	Resilience to Climate Change ✓ Climate-resilient policies and programs that enhance the resilience of water resources, ensuring continued availability in the face of climate variability. ✓ Inadequate adaptation measures that lead to vulnerabilities, affecting water supply reliability during extreme weather events.	✓ Given the impact of climate change on water resources, policies that incorporate climate adaptation strategies are crucial. This may involve infrastructure resilience, water storage, and adaptive measures to address changing precipitation patterns. These are yet to be observed.
Philippine Water Code Presidential Decree No. 1067,	Equitable Distribution ✓ Well-designed policies that promote equitable distribution of water resources, preventing disparities among different consumer groups. ✓ Poorly implemented policies may result in unequal access, creating social and economic disparities among end-users.	✓ In accordance with the business plan of the local water district and the established organizational policies, the equitable distribution of water services is implemented within the municipality of Virac.
Republic Act No. 9275 (Philippine Clean Water Act)	Educational and Awareness Impact ✓ Educational programs accompanying water initiatives raise awareness about water conservation, hygiene, and the importance of sustainable water use. ✓ Lack of awareness and education that hinder the adoption of responsible water practices among consumers.	✓ There is a necessity to develop information, education, and public awareness programs focused on safeguarding water quality, particularly in the barangays from which the local water district draws its water sources.

The findings in Table 2 highlighted several crucial areas in water resource management, particularly concerning supply sustainability, policy implementation, community engagement, and climate resilience. An analysis of each key result is presented below, with comparisons to related studies, emphasizing areas of alignment and divergence:

1. *Water Scarcity During Dry Seasons.* The study emphasizes the issue of water scarcity during the dry season, highlighting the need for long-term water management planning. VIWAD lacks a sustainable program, and there is a gap in its approach to using alternative water sources and drought-resistant infrastructure, which are essential for preventing shortages. Research on sustainable water supply systems supports the idea that integrated, year-round water resource management is crucial to avoid shortages during dry periods (Falkenmark, 2013). Effective strategies, as noted by other studies, include utilizing alternative water sources and implementing drought-resistant infrastructure—areas where VIWAD's current approach appears to be lacking.

2. *Absence of Integrated Water Resource Management (IWRM) Principles.* The study finds that there is no strong policy framework supporting Integrated Water Resource Management (IWRM), which is crucial for addressing interconnected water challenges across sectors. VIWAD's focus is mainly on pipeline maintenance, missing a more holistic approach to water resource management, which could leave gaps in addressing community needs. Research by Mitchell (2014) suggests that effective water resource management requires policies that address all interconnected areas, implying that VIWAD's narrow focus may result in missed opportunities to meet the diverse needs of the community.

3. *Effectiveness of Watershed Protection Policies.* While policies focusing on watershed protection are in place, their effectiveness appears limited due to challenges in implementation and enforcement. Studies like those by Pereira et al. (2016) argue that watershed protection requires both policy support and active, community-based enforcement to safeguard critical ecosystems effectively. Although VIWAD has policies aimed at conserving biodiversity, their impact is reduced by the lack of consistent enforcement. Improved implementation strategies, as recommended by related studies, could lead to more effective conservation of water resources and biodiversity.

4. *Community Engagement in Water Resource Management.* Recognizing the value of community engagement is a positive aspect of VIWAD's strategy, as local involvement is key to sustainable resource management. However, the study suggests that current policies lack the strength needed to fully engage communities in decision-making processes, which could lead to a disconnect between policy intentions and on-the-ground realities. Research by Reed (2008) supports the need for genuine community participation, showing that engaged communities are more likely to contribute to and support water management efforts. Strengthening policies to formalize community roles could enhance their sense of ownership and accountability.

5. *Climate Change Adaptation and Resilience.* Despite acknowledging the impact of climate change, the study finds no observable climate adaptation strategies in VIWAD's approach. Policies addressing infrastructure resilience and adaptive measures are essential for handling climate variability, a point emphasized in studies by Adger et al. (2018) on the benefits of climate adaptation in resource management. Implementing adaptive strategies can protect water resources against climate-induced challenges, highlighting an area where VIWAD's planning could improve.

6. *Equitable Distribution and Community Awareness*. The study confirms that VIWAD ensures equitable distribution of water within the municipality, which aligns with the

goals outlined in its business plan. However, there is a significant need for enhanced information, education, and public awareness programs, especially in barangays that serve as water sources. This finding is consistent with research on the role of community education in water conservation (Pahl-Wostl, 2015). Increasing awareness among residents, particularly those in areas directly impacting water quality, can encourage more responsible water use and foster a community culture of conservation.

7. *Need for Comprehensive and Enforced Policies.* The cumulative findings in Table 2 suggest that VIWAD's policies lack a comprehensive, integrated framework that addresses the complex challenges of water resource management. The need for more rigorously enforced policies and strategies aligns with global best practices, which recommend cohesive, multi-sector approaches to water resource management (World Bank, 2015). The results suggest that VIWAD's current policy framework could benefit from adopting a more comprehensive approach that integrates sustainable practices, inclusive stakeholder engagement, and stringent enforcement mechanisms.

The analysis presented in Table 2 underscored the importance of adopting a holistic integrated approach to water resource management in Virac, with a focus on stronger policies, community engagement, and climate resilience to ensure long-term sustainability. VIWAD's policies would benefit from incorporating IWRM principles and enhancing enforcement to address the region's water management challenges effectively.

Challenges and Barriers Encountered in the Implementation of Water Resource Management Programs and Policies. This section highlights the challenges and barriers encountered in the implementation of water resource program and policies in Virac, Catanduanes. Table 3 delineates these challenges and barriers, providing insights derived from the perspectives of policy implementers, the Local Government Unit, and consumers of water services, along with accompanying descriptions.

Table 3
Challenges and Barriers Encountered in the Implementation of Water Resource Programs and Policies

Challenges and Barriers Encountered	Description
Limited Resources and Infrastructure Deficiency	Insufficient financial and technical resources hinder effective implementation. Many programs put forward by the local water district and the LGU alike, lack the necessary funding and expertise to address complex water management issues adequately. Outdated or inadequate water infrastructure, such as aging pipelines and treatment facilities, poses a challenge. These insufficient infrastructure and facilities result in water losses, poor service delivery, and an inability to meet growing demand.
Climate Change and Weather Impact	The province of Catanduanes is vulnerable to climate change, leading to irregular weather patterns, extreme events, and changes in precipitation. Infrastructure facilities, watershed areas, and other important resources towards the delivery of efficient water services are usually damaged by these weather disturbances. Adapting water resource management strategies to these challenges is crucial.
Policy Implementation and Enforcement of Data and Monitoring	In the conduct of the study, the researchers can hardly find data that are organized and linked with water resource programs of the different stakeholders of water resources. Inadequate data collection, monitoring, and assessment systems hinder evidence-based decision-making. A lack of reliable data makes it challenging to understand the dynamics of water resources effectively. Despite having comprehensive policies, the effective enforcement and implementation of these regulations can be lacking. Inconsistent enforcement undermines the impact of existing policies.
Population Growth and Urbanization	The threat of rapid population growth and urbanization within the municipality of Virac may strain water resources, leading to increased demand. Based on the data from the Virac Water District, demand in water consumption has steadily manifested an increasing linear trend for the past 10 years. Balancing the needs of a growing population with sustainable water management practices is a significant challenge.
Water Quality Issues	Inadequate water treatment facilities and the inefficient protection of watershed areas in the province of Catanduanes impact water quality. Agricultural runoff, and inadequate solid waste management facility for the municipality of Virac contribute to water quality degradation. Ensuring and enforcing water quality standards are persistent challenges.
Community Awareness and Education	Findings of the study revealed a very limited public awareness and education programs on water conservation and responsible water use which contribute to wasteful practices. Educating the public about the importance of water conservation is crucial. Involving local communities in decision-making processes and encouraging sustainable practices can be challenging.
Interagency Coordination and Political Will	Collaboration among various government agencies in the island province of Catanduanes responsible for water management has been observed to be fragmented. Improved coordination is essential for integrated and holistic water resource management. Political will provides the necessary leadership and commitment to overcome challenges, allocate resources, and enforce policies, contributing significantly to the effective implementation of water resource management.
Land Use Practices	Inappropriate land use practices, such as settlement in protected areas, deforestation and improper agricultural practices have been observed by the researchers to contribute to soil erosion and negatively impact watersheds. Integrating land use planning with water resource management is essential and an existing policy. However, the implementation of this policy is another issue
Legal and Institutional Framework	Despite having relevant laws and policies, gaps in the legal and institutional framework impede effective implementation. Strengthening these frameworks is essential for successful water resource management.

The challenges and barriers affecting water resource management in Virac, Catanduanes reveal critical issues impeding sustainable water resource programs and policies. Each major challenge is discussed below, with connections drawn to similar issues found in related studies, to interpret the findings and underscore the implications for effective water management in the area:

1. *Lack of Financial and Technical Resources, Outdated or Insufficient Water Infrastructure.* Limited financial and technical resources are significant barriers to implementing effective water resource programs. Without adequate funding and expertise, addressing issues such as infrastructure upgrades, maintenance, and

innovation becomes challenging. This aligns with findings by Biswas and Tortajada (2020), who note that underfunded water management programs in developing regions often face technical capacity limitations. The study suggests that increased funding and capacity-building efforts are necessary for effective management. Outdated infrastructure leads to frequent water losses, reduced service quality, and an inability to meet growing demand, as highlighted by McDonald et al. (2014), whose research in Southeast Asia shows that aging systems contribute to high non-revenue water (NRW), causing economic losses and service challenges. Upgrading infrastructure is essential to reduce water loss and improve service efficiency.

2. *Impact of Climate Change on Water Resources.* Climate change has introduced irregular weather patterns and extreme events that strain water infrastructure and resources in Catanduanes. This finding mirrors broader research on climate vulnerability in island regions, which are particularly susceptible to changing precipitation patterns and storm intensification (Adger et al., 2018). Climate adaptation strategies, such as resilient infrastructure and climate-responsive water management policies, are therefore crucial to mitigate climate impacts on water availability and quality.

3. *Inconsistent Enforcement of Policies and Inadequate Data Collection and Monitoring.* Although comprehensive water policies exist, their inconsistent enforcement weakens their effectiveness. This challenge is common in local government settings (Grafton et al., 2019) and strengthening enforcement mechanisms is essential to ensure policies result in tangible outcomes. Additionally, the lack of robust data collection and monitoring hinders evidence-based decision-making. Research by Pahl-Wostl (2015) underscores the importance of data for tracking resource availability and usage. Establishing strong data management systems is critical for informed planning and responsive water management.

4. *Population Growth and Increased Demand for Water.* Rapid population growth in Virac places additional pressure on already limited water resources, as demand outpaces supply. Population growth is a significant driver of water scarcity globally, as documented by the United Nations (2021). To manage increasing demand, policies must integrate water-saving measures, efficient distribution, and possibly alternative water sources, such as rainwater harvesting.

5. *Inadequate Treatment Facilities and Watershed Protection.* Poor water quality, caused by inadequate treatment facilities and weak watershed protection, poses a public health risk. Similar challenges are highlighted by Tularam and Marchis (2016), who emphasize the need for effective watershed management and modern treatment plants to ensure safe water. Strengthening watershed protection and investing in upgraded treatment facilities would improve water quality in Virac.

6. *Challenges in Community Involvement and Public Awareness on Water Conservation.* The study identifies difficulties in engaging local communities, which hinders the success of water management programs. Research by Reed (2008) supports the idea that inclusive community participation is essential for sustainable resource management. The lack of public awareness about water conservation leads to wasteful practices, undermining conservation efforts. Studies by Cook and Bakker (2012) show that awareness campaigns can significantly improve conservation behaviors, suggesting that increasing public education will foster more responsible water use and support for conservation policies.

7. *Fragmented Collaboration Among Government Agencies and Political Will.* Fragmented collaboration among government agencies impedes integrated water resource management, leading to

uncoordinated and inefficient efforts. Research by Ostrom (2010) highlights the importance of cohesive collaboration and aligned goals among agencies. A centralized framework for water management could improve coordination and resource sharing. Political will is also critical to overcoming challenges in resource allocation, policy enforcement, and community engagement. Strong political leadership is necessary for securing funding, initiating programs, and ensuring the long-term success of water management initiatives (Ghosh et al., 2018).

8. *Inappropriate Land Use Practices.* Unsustainable land use practices contribute to soil erosion, degrading watersheds and ultimately affecting water resources. Studies on land use and watershed health by Pereira et al. (2016) emphasize that inappropriate agricultural or urban practices exacerbate erosion and sedimentation in waterways. Land-use policies that promote sustainable practices are essential for watershed protection.

9. *Gaps in the Legal and Institutional Framework.* Despite relevant laws and policies, gaps in the legal and institutional frameworks hinder effective implementation. Research by Tortajada (2019) argues that clear, enforceable regulations and institutional coherence are crucial for policy success. Streamlining legal frameworks and enhancing institutional accountability can strengthen water resource management efforts.

Recommendations to Enhance the Effectiveness of Water Resource Programs, Activities, and Policies. Discussed in this section are several recommendations to enhance the effectiveness of water resource programs, activities, and policies in the island province of Catanduanes. These recommendations aim to create a more resilient, sustainable, and community-centered approach to water resource management in Catanduanes. Continuous evaluation, adaptation, and collaboration are key to addressing the diverse challenges identified in the research findings.

Table 4 outlines the proposed strategies along with their corresponding actions for effective implementation.

Table 4
Recommended Strategies and Actions for Effective Implementation of Water Resource Programs, Activities, and Policies

Recommended Strategies	Action for Effective Implementation
Financial, Technical, Infrastructure Upgrade Resource Allocation	Advocate for increased budget allocation and seek external partnerships for technical support. Allocate sufficient financial and technical resources to ensure the effective implementation of water management programs. Seek partnerships with government agencies, non-governmental organizations, and the private sector for additional support. Prioritize upgrading and maintaining water infrastructure to address issues of outdated and inadequate facilities. This includes addressing aging pipelines, treatment facilities, and improving distribution systems to reduce water losses.
Climate-Resilient Strategies	Develop and implement climate-resilient water resource management strategies to adapt to irregular weather patterns, extreme events, and changes in precipitation. Invest in resilient infrastructure and protection measures for watershed areas.
Consistent Policy Enforcement and Data Collection and Monitoring	Strengthen enforcement mechanisms to ensure the consistent implementation of existing policies. Address gaps in enforcement to enhance the impact of regulations related to water quality, discharges, and pollution sources. Strengthen data collection, monitoring, and assessment systems for water resources. Implement evidence-based decision-making by ensuring reliable and organized data related to water resource programs.
Population Growth Planning	Plan for the impacts of rapid population growth and urbanization on water resources. Implement sustainable water management practices that balance the needs of a growing population with resource conservation.
Water Quality Protection	Improve water quality protection measures by addressing inadequate water treatment facilities and enhancing solid waste management. Enforce water quality standards and implement measures to prevent agricultural runoff.
Community Engagement and Awareness Program	Increase efforts to involve local communities in decision-making processes and raise awareness about water conservation. Foster community engagement and ownership to ensure the success of water resource programs. Develop and implement comprehensive public awareness and education programs on water conservation and responsible water use. Educate the public about the importance of water conservation to reduce wasteful practices.
Inter-Agency Coordination, Political Will and Leadership	Enhance coordination among government agencies responsible for water management. Improve collaboration to create an integrated and holistic approach to water resource management. Harness political will and leadership to overcome challenges, allocate resources, and enforce policies. Ensure commitment from local leaders to drive the effective implementation of water resource management initiatives.
Land Use Planning Integration	Integrate land use planning with water resource management to address inappropriate land use practices. Enforce policies that discourage settlement in protected areas, deforestation, and improper agricultural practices.
Legal and Institutional Framework Strengthening	Address gaps in the legal and institutional framework that impede effective implementation. Strengthen existing laws and policies to create a more robust framework for successful water resource management.

DISCUSSION

In the assessment of objectives, activities, and policies related to water resource management and development in the island province of Catanduanes, the researchers adopted a comprehensive and integrated approach. This study examines the complex interplay of policies, practices, and governance in water resource management in Virac, Catanduanes, within the broader context of the Philippines. It aims to understand how national policies intersect with local government initiatives to foster water resource resilience, ensure equitable access, and protect water ecosystems. Archipelagic countries like the Philippines face unique challenges in managing water resources, as diverse ecosystems and communities are dependent on sustainable water usage and conservation efforts. Given the critical role of water in life, economic development, and environmental health, the Philippines has developed a policy framework

empowering Local Government Units (LGUs) to participate actively in water resource governance, as established by Sandhu (2021).

The results indicate that while national laws such as the Philippine Water Code (Presidential Decree No. 1067) provide a general legal structure for water conservation and use, the actual implementation at the local level is mediated through LGUs and supported by various government agencies, including the National Water Resource Board (NWRB) and the Department of Environment and Natural Resources (DENR). Consistent with Rola et al. (2015), the findings emphasize the Philippines' integrated approach to water management, which highlights the importance of local governance and participatory practices.

In conclusion, the research findings provide a comprehensive overview of water resource management programs in Virac, Catanduanes. The initiatives outlined in Table 1 demonstrate a multifaceted approach, addressing sustainability, access, equity, ecosystem preservation, public health, and climate resilience. The complex interplay of decision-makers at various levels, as highlighted by Rola (2011), underscores the challenges of water governance in the local area. The research underscores the importance of a comprehensive and integrated approach to water resource management, combining conservation, infrastructure development, community engagement, and research and innovation.

The legislative framework governing water resources in the Philippines, particularly the Philippine Water Code, plays a crucial role in shaping policies and actions related to water management in Catanduanes. The research findings indicate that the program excels in ensuring water quantity through conservation efforts and efficient infrastructure management. The positive feedback from the recipient stakeholder emphasizes the impact on community well-being and aligns with the goals of water resource management programs.

The statements from VIWAD, the water utility, and recipient stakeholders highlight the importance of awareness programs, education, individual responsibility, and efficient infrastructure in achieving water use efficiency. The positive outcomes related to water bills, affordability, healthcare savings, and community well-being indicate progress in meeting diverse water needs.

The challenges and barriers identified in the research, ranging from financial and technical limitations to climate change impacts and inadequate enforcement, emphasize the need for a comprehensive and coordinated approach. Addressing these challenges requires stakeholder involvement, enhanced public awareness, and strengthened legal and institutional frameworks to ensure sustainable water resource management in Catanduanes. The research findings collectively underscore the importance of continued efforts and strategic planning to overcome the multifaceted challenges in water resource management within the study area.

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