

Experiences, Challenges, and Initiatives on Water Resource Management of a Small Island Community: The Case of Basco, Batanes, Philippines

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ABSTRACT

With the increasing water demand across different sectors: residential, commercial, agriculture, tourism, and energy, management of this finite resource is a major challenge in harnessing and sustaining its availability. The increasing demand for water from various stakeholders of Basco, Batanes puts pressure on the availability of water. These supply

constraints are rooted in the current management setup aside from its biophysical characteristics. The main objective of the study is to better understand the water-related issues and concerns and the operation and implementation of water resource strategies and programs in the case of the small island community in Basco, Batanes. Specifically, it aims to i) characterize the existing water supply systems in a small island community; and ii) assess the challenges, experiences, and efforts in water resources management. Guided with the Integrated Water Resource Management principles (IWRM), the

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experiences, issues, challenges, and opportunities in water resources management in the small island community were assessed. The available water sources and existing water systems were characterized, and challenges and initiatives toward effective resource management were also evaluated. The methods employed were secondary data collection; detailed household, commercial, and institutional sectors surveys; Focus Group Discussions (FGD) using Strengths, Weaknesses, Opportunities, and Threats (SWOT) matrix; Key Informant Interviews (KIIs) with key officials in the Local Government Unit (LGU) to capture data on the current operation and implementation of water-related programs. Results showed that Basco, the capital of Batanes, only has two major sources of water: *Racuaramum (upstream)* and *Miaga (downstream)* springs. It has no perennial or ephemeral streams. The intermittent streams only flow for a few minutes during heavy rainfall events. Their other sources of water are deep wells and rainwater for everyday use. With the limited budget and human resources of the small island community, localized integrated water resource management highlights the importance of institutional aspects towards its success. A framework on effective resource management emphasized the importance of institutional synergies in small island community setups, such as: joint implementation of watershed management plans, enhancement of technical and financial capabilities given a limited budget and human resources, improvement, and maintenance of water facilities, etc. The complexities of the issues surrounding water resources management could be best addressed by the consolidated efforts of government institutions, the private sector, and the local community within the small island, prioritizing environmental sustainability, economic efficiency, and social equity.

INTRODUCTION

Water is one of the main resources that humans depend on for survival. Our water dependency is not only limited to our biological needs but is also one of the key drivers of our social development, from household consumption to agriculture and industrial use and environmental sustainability. Water is considered a renewable resource yet finite (WWF 2020). Due to the intensified use of water caused by the increasing demand for economic development and lifestyle changes of the human population, its quality and quantity changed drastically (Marten 2001).

Changes in the quality and quantity of water are attributed to rampant issues of competing users, urbanization, and growing demand. According to Oviedo and Pastor (2020), water usage patterns, housing infrastructure, climate, pricing, and policies significantly drive water consumption and resource distribution. Thus, the perspective has been changed to look at these issues at a broader and more holistic level. To maximize the benefit of water while keeping in mind social and economic welfare and environmental sustainability, establishing water supply and demand management and policies is very important.

The United Nations (UN) aimed to prioritize development that balances social, economic, and environmental sustainability, especially in the least developed countries. One of the UN's Sustainable Development Goals (SDG 6) is to increase the efficiency of water utilization in all development sectors by ensuring sustainable supply and managing withdrawals of freshwater even in a small island setup. Moreover, SDG 6 aims to protect aquifers and freshwater sources like lakes and rivers to address water scarcity. Numerous approaches that observe the UN SDG 6 have been established to better understand water dynamics in communities, especially small island communities. Watershed scale analysis applied to small islands not only

focuses on the supply and demand side but also on the institutional concerns of water across sectors. For watershed management to work, the following are the considerations: a) relevant communities and the resource managers understand the interrelationships in an ecological system; b) a community that has a high level of social capital to support the watershed management initiatives; and c) adequate financial resource and legal and institutional support to undertake those watershed management initiatives (Francisco and Salas 2004).

The water sector focuses on rural development to harness individual and community systems through Community-Based Natural Resource Management (CBNRM). CBNRM focuses on motivating local communities, even on such small islands, to sustainably use and manage resources as a catalyst for rural development (Milupi et al. 2017). The Integrated Water Resource Management (IWRM) strategy is another flexible approach, widely established in numerous countries, that promotes a more interdependent development and management of water resources (UNESCO 2009). Such holistic approaches to managing resources benefit not only developed countries, where resources are overexploited, but also developing nations, where resources are commonly limited (Kurniawan et al 2016). Unlike other developing countries with limited natural land-based resources, the Philippines has abundant natural resources, particularly water. However, water access is limited due to the temporal and spatial distribution characteristics of the country's water resources (Zhou et al. 2015). Similarly, due to topographical and geographical location, small island ecosystems are vulnerable to disasters such as typhoons, floods, and droughts. Small islands are vulnerable to water shortages driven by physical scarcity in water sources. Water shortage in a small island setup is further exacerbated by limited capacity and conflict in management, tourism-centered economic development, water quality, and climate change concerns (Emmanuel and Clayton 2017).

Small island communities are perceived to be starters of climate change actions like eco-friendly energy sources and water-independent villages. Coupled with the indigenous knowledge, resilience, and independence of its people, small island communities can contribute to tailored actions in addressing hazards such as water scarcity (Añasco et al 2021).

Numerous management strategies have their pros and cons. Management strategies will dictate how to resolve or worsen the problem. Some constraints are the lack of policy consistency and ineffective governance. Policy schemes are crucial in ensuring that water is efficiently supplied, allocated, and used.

Ideas and aspirations on water resources management vary from people, groups, institutions, and places. Stakeholders' participation in watershed planning and management should be strengthened by providing public awareness of the importance of sustainable watersheds. The multi-stakeholder participation, synchronization, and coordination are important factors in successful watershed management (Narendra et al. 2021). Several water service providers in the country are small-scale or community-based. These include cooperatives, homeowner's associations, barangay water and sanitation associations (BWSA), Local Government Unit (LGU)-run, and rural waterworks and sanitation associations. One of the challenges in the country's water sector is that most of the mentioned institutions or groups are not registered with the National Water Resources Board (NWRB), the lead agency in policy formulation and resource and economic regulation of water (Asian Development Bank 2013).

This study focuses on documenting and understanding the operation, implementation of strategies and programs, and water

resources-related issues and concerns, including institutional set-up in the case of Basco, Batanes. Specifically, it sought to: i) characterize the existing water supply systems in a small island community; and ii) assess the challenges, experiences, and efforts in water resources management.

With the increased water demands caused by a tourism-centered development, especially with the limited water sources, this aimed to provide baseline information on the water dynamics, particularly in a small-island set-up. Guided by the Integrated Water Resource Management (IWRM) principles, this study aims to provide localized water resource management recommendations for the area.

MATERIALS AND METHOD

Location of the Study

The island province of Batanes is considered the smallest island in the Philippines but possesses abundant marine and terrestrial resources. It has well-preserved historical artifacts and cultural sites mirroring the unique culture and rich indigenous knowledge and practices of its people, called the Ivatans. The diverse terrestrial and marine resources provide ecosystem services such as water supply, land for production, biodiversity, etc. The major sources of livelihood of the small island community in the province are farming, fishing, and tourism-related activities. To regulate the utilization of resources, the province was declared as Batanes Protected Landscapes and Seascapes (BPLS) in accordance with Presidential Proclamation 335, consequently under Republic Act 8991 – Batanes Protected Area Act of 2000, pursuant to Republic Act 7586 – National Integrated Protected Areas System (NIPAS Act of 1992).

The small island province is governed under the provision of Republic Act No. 8371 – Indigenous People's Rights Act (IPRA), to protect the rights and culture of the Ivatan and the Batanes tribes. The island covers six (6) municipalities, with Basco as its capital. Basco, Batanes is a sanctuary and haven for the preserved Filipino cultural heritage of the Ivatan. It is a mix of old and new settings in an idyllic landscape at the northernmost part of the Philippine archipelago. Figure 1 shows a map of Basco, Batanes, as part of Region II. It is situated in 20°27' North 121°58' East, on the island of Batan. It is categorized as a 5th-class municipality with a total population of 8,579 (PSA 2015) and a total land area of 34,691,800 square meters.

Basco is also considered an agricultural and coastal municipality with six (6) barangays: Chanarian, Kaychanarianan, Kayvaluganan, Kayhuvokan, San Antonio, and San Joaquin. As a small island community, Basco was selected as the study site since it has been gaining an influx of tourists who compete with the growing water demand of the locals; thus, the need for a better water resource management scheme.

Data Collection and Analysis

The research was conducted through a qualitative research method. Primary data collection was employed through Key Informant Interviews (KIIs) with concerned groups and organizations and focus group discussions (FGDs) using several techniques such as Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis. Secondary data was gathered by collecting plans and programs from the Local Government Unit (LGU).

SWOT Analysis was used to gauge the historical, institutional, and community perspectives on managing water resources in the area. Through this method, various local stakeholders could recognize the strengths, weaknesses, opportunities, and threats

for effective water resources management, particularly in assessing the local needs and resources of the community.

Strengths	Weaknesses
Availability and abundance of water resources	Power interruption affecting water availability and distribution
Established waterworks system	Unmonitored groundwater extraction
Immediate response of LGU to water issues and problems	Unequal water distribution
	Limited available data
	Occurrence of water-related disease (i.e. dengue)
	Inadequate funds and equipment for the maintenance of water system
	Limited human and technical resources
Opportunities	Threats
Availability of financial assistance from national and provincial government for the improvement of water system	Natural calamities (e.g. typhoons, landslides)
Research and studies being conducted by various sectors concerning water	Tourist influx

Figure 1: SWOT Matrix on water resource management in the small island community of Basco, Batanes, Philippines.

Results from the SWOT Analysis can also serve as the basis of the Local Government Unit (LGU) of Basco in making their strategic plans and programs.

Community Resource Mapping was conducted to identify the physical aspects of the small island community related to its water sector. This includes infrastructures like roads, bridges, water sources, including settlement areas, public and private buildings, and institutions. A total of 19 representatives from different sectors attended the workshop: Local Government Units (LGUs), Basco Waterworks System (BWSS), private sectors, commercial/business owners, and People's Organizations (POs).

For the detailed survey, 354 respondents were from the residential/household sector. This was calculated using stratified random sampling in the six barangays using the Cochran method (Israel 1992). Table 1 shows the calculated sample size of the respondents per barangay.

Table 1: Calculated sample size of the respondents per barangay in Basco, Batanes, Philippines.

Barangay	Household Population	Household Sample Population
Kayhuvokan	473	72
Kayvaluganan	609	86
Kaychanarianan	513	73
San Antonio	523	75
Chanarian	101	21
San Joaquin	108	27
Total	2,327	354

Similarly, purposive surveys of selected local offices and commercial establishments such as hotels and resorts were also conducted to capture the water utilization status, practices, and

challenges of these water users on the existing management. A purposive survey was employed to encourage the active participation of direct stakeholders as respondents. With this, the water dynamics in the small island community can be easily captured and understood.

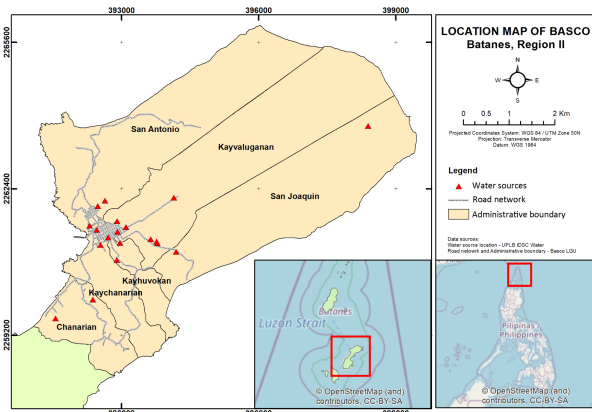


Figure 2: Location map of Basco, Batanes, Philippines with corresponding water sources.

Descriptive statistics were used to analyze the survey results of the respondents. Encoding, processing, and analysis of data were done using Statistical Program for Social Sciences (SPSS) version 21. Results from the KII and FGD were transcribed and presented through illustration, matrix, and qualitative discussion. The gathered qualitative data were further analyzed using the Integrated Water Resources Management (IWRM) principles. IWRM is a holistic approach that ensures the sustainable management of water to meet the present and future needs of society while considering the economic, social, and environmental factors. It emphasizes the need for collaboration and participation of various sectors and stakeholders to achieve an efficient, equitable, and sustainable water resource system (UNESCO, 2009).

The study included representatives of the population from various stakeholders and sectors affecting the water resource system of Basco. However, one limitation of the study is the relatively small representation of the FGD, which could limit the generalizability of the study and may not hold true to individuals/institutions with different characteristics and experiences. Also, water supply and demand projections rely only on a ten-year population projection based on the population size of the community during the conduct of the study. Further statistical study must be carried out to project population size closer to the actual.

RESULTS AND DISCUSSION

The Basco Experience: Profiling the existing water system of the small island community

Water Sources

Geographically, small island communities surrounded by seawater have a relatively scarce freshwater supply. Seventy-one percent of the Small Island Developing States (SIDS) are at risk of water scarcity (UNEP 2016). Freshwater in small islands usually comes from three natural sources - precipitation, surface, and groundwater. Rainfall is the common form of precipitation in most small islands. Small islands in higher elevation, like that of Batanes, have surface water in the form of streams, rivers, springs, and lakes. As for groundwater, small islands can have two types of aquifers - perched that run horizontally and/or vertically in volcanic dikes and basal aquifers that float or overlay a body of salt water (UNESCO 1991). However, on

most small islands, extraction of water from aquifers only occurs within small, thin, alluvial aquifers along the coastlines. This is because groundwater abstraction from perched aquifers poses numerous challenges (UNEP 2016).

Unlike other small island municipalities, Basco has relatively more resources and access to water to sustain the needs of its populace. It relies on springs as its main source of freshwater. Miaga and Mt. Iraya reservoirs were developed by the Japanese army deployed in Batanes during World War II in 1968. The biggest spring, Racuaranum (in the northern portion of Mt. Iraya), is the major source of water in the municipality. Water from the spring is captured in a concrete box (water box, capacity 45 cubic meters) constructed at the spring outlet. It flows by gravity down to the community through distribution pipes. The initial storage facility (a reservoir or dome located at Brgy. Kayvaluganan) to control water distribution is approximately 7.5 kilometers from the main spring. The water system started operation in 1960 with approximately 750 households serviced. Starting from 1968 to 1969, a new water system was established that currently provides 24-hour water service to more than 2,789 households covering five (5) barangays, namely Kayhuvokan, Kaychanarian, San Antonio, San Joaquin, and Kayvaluganan. Another utilized spring called *Miaga* also collects water in a water box-type reservoir. This water source services the community in the Southern part of Batan island.

As one of the Philippine provinces consisting of small islands, Batanes also relies on groundwater. Groundwater comprises ninety-nine percent of fresh liquid water sources worldwide. However, it can easily be irreversibly depleted without prior knowledge and proper management. The municipality of Basco relies on groundwater as its secondary water source. Groundwater extraction in Batanes started in early 2000 when an earthquake hit the province. The earthquake damaged the water pipes that distribute water to downtown Batanes, including Basco, from the spring source of Mt. Iraya. To provide water to the affected areas, the LGU of Batanes constructed production wells (Basilio *n.d.*).

Currently, the government owns 15 wells, while more than 216 unaccounted wells are owned by private individuals. The highest number of deep wells (6) are in the boundary of Barangay Kayvaluganan, followed by four (4) deep wells in Kayhuvokan, two (2) wells in Kaychanarian, two (2) in San Antonio, one (1) in San Joaquin and one (1) in Chanarian. Only the Chanarian deep well is under the management of the cooperative. This deep well is the only accessible water source of the Barangay that supplies drinking and domestic needs. Most of the wells are within commercial and residential zones and agricultural lands. Also, these have been constructed and operationalized since 2000 and 2016. A proper management scheme is needed for a small island community that depends on groundwater as its secondary source to ensure continuous groundwater sources.

The LGU, through its offices: Vice Mayor, Municipal Planning and Development Office (MPDO), Municipal Health Office (MHO), and Engineering Office are at the forefront of water supply and sanitation regulation. The MPDO is primarily responsible for developing plans and programs relevant to water resources management. The overall operations and maintenance are the main responsibility of the Engineering Office. Meanwhile, the Municipal Health Office, including hospitals in the area, oversees all health, water, and sanitation concerns. Basco Waterworks System (BWSS) is a Level III water system and a primary service provider. The BWSS supplies the domestic water demand of most households for kitchen use (75.28%), bathing (75.28%), laundry (75%), cleaning (72.44%), and gardening (60.23%). However, drinking water is sourced

from refilling stations (61.9%), mainly from deep wells. Rainwater is also used in cleaning and gardening (see Figure 3).

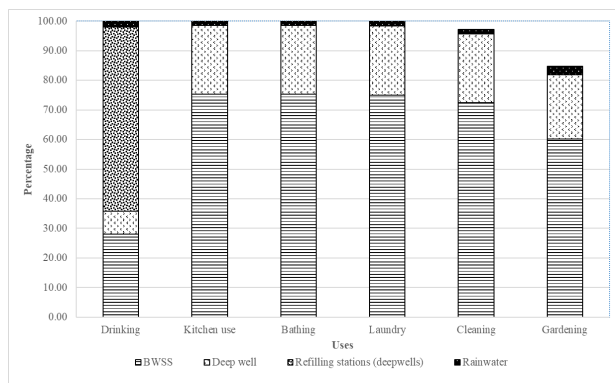


Figure 3: Household water uses across water sources in Basco, Batanes, Philippines.

Tourism-led industry of Basco

In general, small islands are more vulnerable to collapse and degradation due to their unique geographic features. This is further exacerbated by the changing climate and the prevalence of anthropogenic hazards brought about by economic development.

Small islands are endowed with beauty, rich biodiversity, natural habitats, and scenic coastal water, thus providing significant benefits to the tourism industry of the community. Basco is also economically dependent on its tourism potential. This makes establishing a resilient and water-independent community and tourism imperative to sustain the ever-growing water demand. Based on the Provincial data (2015), the Municipality of Basco has 973 commercial establishments, such as resorts, hotels, restaurants, transport, wholesale, and retail trade. Respondents covered the major water users from the business sector such as restaurants, accommodations, refilling stations, and other businesses, such as convenience stores/marts.

Most of the business establishments surveyed are engaged in wholesale and retail services that constitute 75% of the total number of establishments in the municipality based on the Comprehensive Land Use Plan (CLUP) 2017 data. Twenty-nine percent of the surveyed establishments are from hotel and resort accommodations and lodging establishments. It is followed by restaurants (20%) and water refilling stations (3%). As presented in Figure 4, 38 business establishments are being served by BWSS, while others are sourced from deep wells. Meanwhile, four (4) out of five (5) representatives from the institutional sector are being serviced by BWSS.

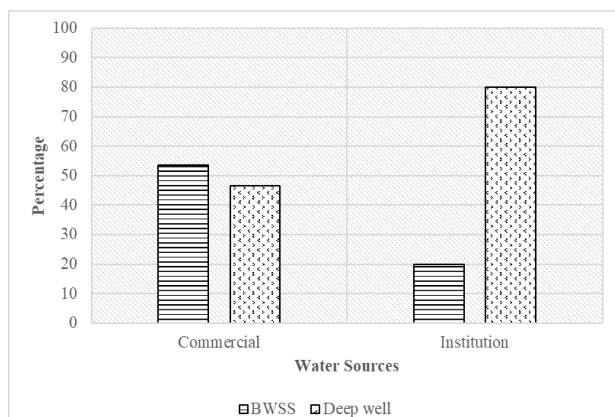


Figure 4: Water sources of commercial and institutional establishments in Basco, Batanes, Philippines.

As observed, commercial establishments cater to the needs of their tourism sector. This is consistent with the characteristics of most small islands that utilize tourism for economic development. These establishments can affect the quantity and quality of natural resources in the area including their water resources. Small islands have limited state capacity and smaller domestic markets (Herbert 2019). This is why there are smaller infrastructures here as compared to other communities in the country.

The Challenges: Assessing the Water Resources of Basco

Access to water in most developing countries depends on direct water sources like springs, ponds, and rivers. Without proper monitoring and quality control, danger to users, especially public health, is inevitable. Major challenges in water management include inadequate facilities, lack of technical capabilities or trained personnel, and limited financial resources (Goncalves et al. 2019). Exacerbated by high water demand, land use changes, climate variabilities impacts, deforestation, and overexploitation of water sources significantly affect most small island areas and communities. Thus, mainstreaming Integrated Water Resource Management (IWRM) dealing with the governance, policy setting, planning, institutional structures, financing, engagement of public and private sectors, and regular monitoring and reporting are recognized as best practices to achieve water security as well as preventing water-related diseases in Caribbean Islands (Dubrie, et al, 2022). Figure 1 summarizes the strengths, weaknesses, opportunities, and threats to water resources management in Basco.

Environmental factors

SIDS located in the Pacific largely depend on groundwater for anthropogenic needs (UNEP 2016). However, as coastal systems, small island communities are more prone to erosion and wave water wash events, degrading fresh groundwater resources (Coppola 2020). Small island communities are also highly exposed to natural hazards.

The Philippines, for one, is susceptible to typhoons and earthquakes due to its geographic location. In the case of Batanes, being the Philippines' extreme north, the island is commonly in the path of numerous typhoons (can 2023). Following destructive disasters like typhoons and earthquakes, freshwater contamination and shortage issues will immediately arise (Travis 2013).

One of the major challenges of tropical islands is irregular seasons which is one of the characteristics of Batanes. Most islands have small catchments with high surface water flow draining to the sea and limited groundwater recharge rate (Tatas et al. 2015). There are also issues on forest cover destruction, land use change, and high groundwater utilization. Hence, water is considered a factor hampering the development of the area.

Though Basco has abundant freshwater resources due to its numerous groundwater sources and spring, its water supply is threatened by several factors. The Province of Batanes is known as one of the most hardly hit typhoon areas in the country. This has implications for the water supply provision resulting in an inadequate water supply, flooding in some areas, and degradation of water quality caused by storm over wash events. Also, as the country is in the ring of fire, Batanes is also susceptible to earthquakes. Water distribution from Mt. Iraja was once disrupted in early 2000 due to earthquake damage.

Social and Institutional factors

Another concern in the water supply system is the availability of financial resources. Due to its remoteness, state services cost

more, coupled with lower economic capacity (Herbert 2019). Accordingly, the municipality is classified as a 5th-class municipality. This is one of the factors driving the limited allocation of annual investment to improve the water system and expand the services in the municipality. This concern is reflected in the fact that LGU-run water utilities, though available, are experiencing weak or inadequate institutional and technical capacity. Investment in structural equipment and infrastructure for maintenance and improvement of the water system is very limited (Asian Development Bank 2013).

At the institutional and management level, several issues were also identified. These include irregular repair and maintenance activities, leakages, groundwater abstraction, and deep wells near coastal areas resulting in low supply and degradation of the quality of water.

Economic factors

The influx of tourists was also perceived as the cause of competition for water resources during the summer or dry season. Based on the study of Kurniawan et al. (2016), tourism can contribute to the environmental stress of small island communities, like the case of Gili Matra Islands, Indonesia, where it became too crowded. Competing water users, particularly for residential, commercial, and tourism-related uses, is one of the developing concerns in the area. A large percentage of water users come from the household sectors. As per projection, the increasing trend of water demand from households, commercial establishments, and tourism-related activities will surpass the potential available water by 2023 (Figure 5). With this scenario, proper management, and allocation of sufficient resources from the collaborative efforts of government and public-private partners are important in water sector development to ensure that the basic needs of the population are met.

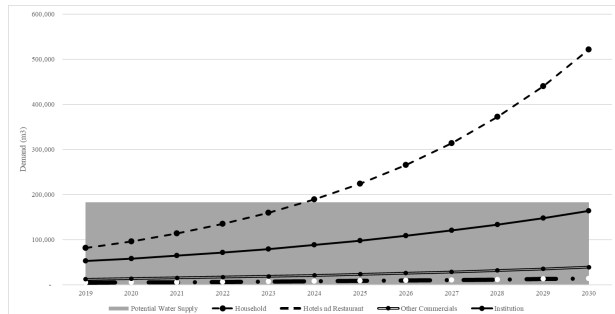


Figure 5: Water use projection of different sectors in Basco, Batanes, Philippines.

The Initiatives: Current Measures and Future Directions

Current strategies and efforts

The government institution through the BWSS (Batanes Water Service Works) has the responsibility of ensuring water supply to both the private sector (commercial and tourism) and households (water resources provision). At the local level, a community-based management approach is being practiced. However, there are also issues associated with water resource management: 1) water being utilized as a “common good,” 2) the population and its demand, 3) the limited number of people involved, 4) inadequate technical capability, 5) financial constraints, and sometimes even 6) cultural beliefs (Aquino and Rebanos 2019). Numerous water research studies by various sectors are paving the way for opportunities to improve the water management of Basco. Assistance by national and local authorities in improving the existing water system is also an avenue for developing a more sustainable water supply system in the municipality.

Water supply provision is primarily managed by the Office of the Municipal Vice Mayor, with the collective initiatives of other LGU offices, including the Municipal Planning and Development Office, Municipal Health Office, and Engineering. Despite experiencing weak or inadequate institutional and technical capacity, BWSS continuously supplies the domestic water demand of Basco. Decades ago, the municipality had a limited distribution of water. The LGU found that obsolete water distribution systems and inefficient water use cause insufficient water supply. Numerous efforts have been implemented to improve the water distribution system, the water sources, and the locals’ practices.

The collective initiatives and efforts of Basco’s LGUs in managing water resources can be categorized as structural and non-structural measures. Structural measures are physical or infrastructural efforts aimed at delivering water from the sources to the populace. Small and large springs are found in the area but no records of river networks. The biggest spring, *Racuaranum*, is in the northern portion of Mt. Iraya. It is the major source of water in the municipality. The development of the Mt. Iraya water system is one of the lifelines of Basco since this will provide water supply to the people.

Non-structural measures are applied to improve water supply and reduce the impacts of water-related disasters such as flooding and landslides. These comprise policies and programs on Information, Education, and Communication (IEC) campaigns related to water conservation techniques and practices; before, during, and after calamities through radio and community roving; initiative and participation in tree planting and coastal clean-up drives; and the institutionalization and training of the Basco Emergency Action Team (TEAM), who is the overall entity responsible during calamities. All the water stakeholders collectively implement and participate in these efforts, indicating that the small island community has a high level of social, financial, and institutional capital to support water resource management initiatives.

Small island communities, despite having common ground, are still heterogeneous in nature. They require different needs, face varied challenges, and have their strengths and opportunities. The Organization for Economic Co-operation and Development or OECD (2018 as cited by Herbert 2019) recommends that management and development approaches be tailored to the community.

A holistic perspective towards an Integrated Water Resources Management for Basco

Small island communities are generally economically vulnerable. An exception to this is cited in a case study attributing the economic success of small island communities to the resourcefulness of its people and good governance of policymakers and implementers (Herbert 2019). The scientific, technical, institutional, legal, financial, managerial, and operational aspects of activities are required to properly manage water resources (Savenije and Hoekstra 2009). Social awareness of the interconnectedness of the environment and economy leads to a better realization of adaptation systems for successful resource conservation and provision of services (Kurniawan et al 2016). The interplay and complex relationships between the environment, social equity, and economic efficiency are the factors toward an integrated approach in managing water resources, especially in rural areas and small island communities (Figure 6).

Environmental Component. The environmental component investigates the natural landscapes of Basco, a small island with marine and terrestrial resource abundance, classified as a protected area. It taps into numerous springs and groundwater

within Mt Iraya's watershed for water utilized by households and commercial establishments for daily use.

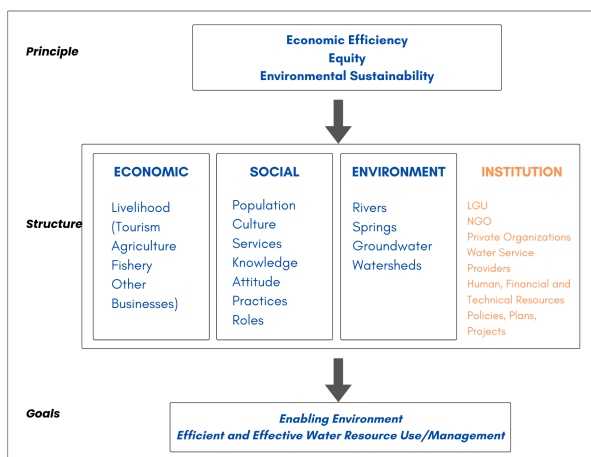


Figure 6: Localized Integrated Water Resource Management (IWRM) Framework in a small island community of Basco, Batanes, Philippines (Adapted and modified from UNESCO, 2009).

Economic Component. The economics in small islands focuses on the price, supply and demand, growth, production and consumption of water resources, and its contribution to employment. The local livelihood of the people relies on farming, fisheries, and tourism-related activities. These sectors are highly dependent on freshwater for continued operations. Tourism-related activities are also made possible due to the area's scenic and rich environment.

Social Component. Social determinants in water resource management emphasize the water users and the social outcomes of management and conflicts. In this case, stakeholders in the management of water resources include the locals that use water for household, commercial, and agricultural use. The tourist population is also a key player in managing water resources in the small island community since they also add pressure to water supply and distribution. Locals and tourists comprise Basco's human capital vital to the success of water management that could promote human welfare. Their knowledge, attitude, and practices (KAP) are important in optimizing effective water resource utilization. Key players must be socially aware of the interconnectedness of the environment and economy to successfully adapt systems on resource conservation.

Environmental, economic, and social factors are interdependent and interconnected, so the deterioration of one could also lead to the decline of the other. These are part of a system to create an enabling environment for efficient water resources management. To integrate environmental, economic, and social factors in achieving the goal, a unifying body must manage these factors through institutional factors. The institutional approach reinforces technical, financial, managerial, and legal capabilities in managing water resources (Emmanuel and Clayton 2017).

Institutional Component. Despite the current efforts to manage the water resources, gaps in the implementation still hinder the dynamic balance toward Integrated Water Resource Management. A sound institutional set-up for effective water resources management at the local level, particularly in the case of Basco, Batanes, requires actors to be strengthened. These institutions would include service providers, local authorities, and civil society. Service providers are those public and private companies and organizations responsible for providing financial, managerial, and technical aspects to ensure water service supply in the municipality. With capacity-building efforts, institutions

can better formulate and implement an integrated watershed management plan that will develop tools for monitoring and decision-making.

The regulatory and enforcement bodies are the LGUs who oversee and ensure the implementation of plans and programs. The local government is responsible for seeking financial and technical support and other relevant water resources management regulations and initiatives within the scope of their jurisdiction. Civil society groups, including non-government organizations, and community-based organizations are the main actors in advocating and communicating water-related policies and programs and strengthening community engagement in water resource management. The social components will also be reinforced by strengthening the institutional factors of the water resources management structures. Aside from capacitating key actors, improvement of water resource management will also ensure the welfare of the stakeholders in terms of water availability.

In addition to enhancing institutional and social factors, the environmental structure must be properly managed. To do this, environmental variables and risks must be further studied. Research can be made on the carrying capacity and water pollution in relation to tourism. With proper knowledge of this, integrated with hydrological studies, the LGU can make scientific and sound decisions on IWRM. Also, intensive study on the environment can boost the economy, capitalizing on the endowed beauty of the islands.

Moreover, tapping indigenous knowledge, culture, and practices in creating policies on water management in this kind of small island setup will encourage social inclusion, thus, social awareness for more successful resource conservation.

CONCLUSIONS

This paper describes the characteristics of water sources in Basco Batanes. It focuses on the experiences, challenges, and current initiatives to address water-related issues in the municipality.

The main source of water is the *Racuaranum* and *Miaga* springs. These water sources are being tapped by the Basco Water Works System, the primary water service provider in the municipality. Most residential, commercial, and institutional sectors have access to Level III or piped water systems. Other sources of water (private wells) are government-owned and private deep wells and rainwater.

The challenges faced for its water resources are partly due to the biophysical limitations of the small island's water sources. The municipality is a typhoon-prone area with a high risk of water unavailability caused by its small island characteristics. The quality and quantity of water are being hampered because of human-induced activities like the increase of competing water users for residential, commercial, and tourism-related use.

Issues on the provision of water supply can also be attributed to the limited institutional arrangements available and financial, human, and technical resources typical of small island communities. The Local Government Unit (LGU) is exerting efforts to manage the Mt. Iraya watershed sustainably. These include improving the current water system, IEC for resource protection and management, community brigades, and disaster response planning. These efforts are made collectively by all water stakeholders in the municipality. However, the current structural and non-structural strategies still need to be

strengthened. An IWRM framework for small island communities, specific to the case of Basco, shows where more effective institutional arrangements could augment limitations in resources.

Given the limited budget and human resources of this small island community, a development framework for water resource management should highlight the importance of institutional aspects towards effective water resource management. This includes setting up a joint-office institution from various expertise yet with defined roles and responsibilities; formulation and implementation of the watershed management plan; development tool for monitoring and decision-making; enhancement of technical, operational, and financial capabilities of BWSS personnel through training and capacity-building; and allotment of the financial budget for improved water service and sanitation facilities. The specific steps in linking the water service provision to water resources management should always be addressed holistically, collectively, and at the basin level.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest. The authors have examined and agree with the contents of the paper and do not have any financial interest to report. We hereby certify that this paper is an original work and is not under review and/or published at any other scientific journals.

CONTRIBUTIONS OF INDIVIDUAL AUTHORS

Conceptualization and overall writing, Ms. Jessa O. Aquino; Layout of map and other figures, contribution to introduction, references, Ms. Unice Faith Roa; Supervision, Dr. Maria Helen F. Dayo; Supervision, Dr. Patricia Ann J. Sanchez; and Data provision, Ms. Catherine B. Gigantone. All authors have read and agreed to the published version of the manuscript.

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