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Assessment of Water Quality Assurance for Communities in Mehara, Tutuala Administrative Post, Lautém Municipality

Juvencio Dos Santos*, Antonino Pedro Marsal, Francisco Ruas Hornai Oriental
University of Timor Lorosa'e (UNITAL), Timor Leste
Email: 420023008@students.itny.ac.id*

ABSTRACT

Access to safe and clean water is crucial for public health, sanitation, and overall well-being, yet the region faces challenges related to water quality due to various environmental and anthropogenic factors. Key parameters such as microbial contamination, chemical pollutants, and physical characteristics of water sources were assessed. The aim of this study is to investigate water quality assurance measures for communities in Mehara Village, Tutuala Administrative Post, Lautém Municipality, Timor-Leste. This study employed a mixed-method approach combining empirical field observations, laboratory analyses, and conceptual legal framework assessment. The findings revealed significant issues with water quality that could pose health risks to the local population. Factors contributing to these issues include inadequate sanitation facilities, agricultural runoff, and seasonal variations in water availability. In response, the study outlines recommendations for improving water quality, including the implementation of effective water management practices, community education on sanitation, and the establishment of regular monitoring systems for water quality assessment. By prioritizing these strategies, the study aims to enhance the safety and sustainability of water resources in Mehara District, ultimately ensuring the health and well-being of its residents.

Keywords: *Quality Water, Guaranty, Community.*

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INTRODUCTION

Timor-Leste gained independence on 20 May 2002, becoming a sovereign nation and receiving international recognition. Timor-Leste is part of the Asian continent, also known in English as East Timor. The territory consists of four regions: the mainland of Timor, the Oecusse enclave, Atauro Island, and Jaco Island. Timor-Leste is categorized as a small country with an area of about 15,000 square kilometers. Its territory is largely mountainous compared to flatlands, with Mount Ramelau being the highest peak, reaching nearly 3,000 meters (Eckstein et al., 2021; Organization & UNICEF, 2025; Programme), 2024).

The population of Timor-Leste is currently estimated at around 1.3 million, with approximately 300,000 concentrated in the capital, Dili. The majority of urban residents work as small-scale traders, while a small percentage are employed in the public and private sectors. Nearly 75% of the population, however, live across 13 districts, with agriculture as their main livelihood. The official languages of Timor-Leste are Tetum and Portuguese. According to United Nations (UN) data, only about 6% of the population can speak Portuguese, while nearly 90% speak Tetum. The dominant religion is Catholicism (90%), followed by Protestantism and Islam (Martins & Soares, 2024; Ribeiro & Bank, 2018; Sanchez-Triana et al., 2019).

Water consumption must come from safe and clean sources. Water provided to the community must undergo laboratory testing in accordance with Decree-Law No. 31/2020 of 26 August (Water Quality Control for Human Consumption), particularly Article 10, which mandates that the managing entity's laboratory conduct quality verification tests and collect water samples (Asbetsadik et al., 2025; Nepal et al., 2025; Pritchard et al., 2015). However, in

practice, the water provided to communities has not gone through laboratory testing. This situation indicates a violation of Article 10 of Decree-Law No. 31/2020 and poses risks of contamination and health impacts for communities.

Water is a vital human necessity. Clean water is essential for maintaining health and living in a healthy environment. Yet, in Timor-Leste, some communities still lack access to clean water, which is critical for sustaining families, particularly in rural areas. In Mehara Village, Tutuala Administrative Post, Lautém Municipality, local and central governments have not given this issue priority attention (Bayu et al., 2020; Cortés-Acosta et al., 2019; Quigley et al., 2019). As a result, the community consumes water that does not meet international public health standards, contrary to Article 10 of Decree-Law No. 31/2020 and WHO guidelines, which require that drinking water must pass laboratory tests. This ongoing phenomenon raises concern because the continued consumption of unsafe water threatens public health.

The Constitution of the Democratic Republic of Timor-Leste recognizes water as a natural resource under state control, intended to ensure the well-being of its citizens (Organization, 2022; Putri, 2022; Timor-Leste, 2016, 2020). Thus, central government decisions on water supply in Mehara Village must be integrated into the broader national water supply program, not limited to the capital, Dili. District governments must develop water provision programs for communities such as Mehara, supported by sufficient budget allocations from the central government, as water is a crucial factor for human survival (Foster & Hope, 2020; Lawrencia et al., 2023; Machado et al., 2022).

Mehara Village is categorized as one of the most disadvantaged in terms of water supply, with a population of 3,213, most of whom are farmers (Sukandarrumidi et al., 2014). Agricultural activities require daily access to water for both household and farming needs. The community primarily relies on streams and rivers (Machona et al., 2025; Nguyen et al., 2023; Santos et al., 2023; String et al., 2020; Werku & Woldeamanuel, 2025).

The Constitution of the Democratic Republic of Timor-Leste, enshrined in Title II, Article 290, guarantees the right to life, meaning that no individual—including the government—may arbitrarily take life. This also obliges the state to adopt protective measures, including laws and regulations, to safeguard life when it is at risk. Article 2 of the Human Rights Act further strengthens this right. In contexts where the state's actions or omissions endanger life, there must be accountability and investigation. Despite this, communities in Mehara continue to lack a healthy environment due to inadequate water quality. The government has a moral obligation to ensure public health, and this issue should be a priority for the central government. However, attention has been limited and fragmented (Kumandhani, 2022).

Timor-Leste has cooperated with the Australian Government through the AUSAID program, which aids with water supply and sanitation through the Community Water Supply and Sanitation Project (CWSSP). This program, implemented by the Community Water and Sanitation Division (CWSD/WSS) under the Ministry of Transport, Communications, and Public Works of Timor-Leste, goes beyond water infrastructure. It emphasizes human development, community participation in planning, and public awareness regarding clean water and sanitation as key factors for the nation's future. The World Health Organization (WHO) establishes international standards for water quality and public health through the

Guidelines for Drinking Water Quality (GDWQ), which promote public health protection via risk-based management approaches such as Water Safety Plans, independent monitoring, and the adoption of national standards.

Despite growing recognition of water quality challenges in Timor-Leste, empirical research on specific community-level water safety issues remains limited. No previous studies have systematically examined water quality assurance in Mehara Village, representing a significant knowledge gap. This research addresses that gap by providing comprehensive data on microbiological and physicochemical water quality parameters, legal compliance assessment, and community perspectives.

Previous related research includes Kumandhani's (2022) examination of local government roles in environmental law enforcement within regional autonomy frameworks, applying environmental ethics theory, and Putri's (2022) analysis of hazardous waste regulation enforcement under Law No. 32/2009, utilizing civil liability theory. Both studies emphasize that effective environmental law enforcement is essential for achieving sustainable development and environmental protection. However, neither specifically addresses water quality in rural Timor-Leste contexts.

This research presents a new study that differs from previous works, as no research has specifically examined this issue in Mehara Village. The novelty of this research lies in its integrated approach combining empirical water quality data, legal analysis, and community perspectives within a previously unstudied geographic location. By documenting specific microbiological contamination levels and linking findings to legal compliance gaps, this study provides actionable evidence for policy intervention.

This study aims to: (1) assess current water quality conditions in Mehara Village through laboratory analysis and field observation; (2) evaluate compliance with Decree-Law No. 31/2020 and WHO standards; (3) identify factors contributing to water quality degradation; and (4) propose evidence-based recommendations for improving water quality assurance and community health protection. The implications extend beyond Mehara Village, offering insights applicable to similar rural communities in Timor-Leste and comparable developing-nation contexts. Findings can inform national water policy, resource allocation decisions, and community-based water safety programs, ultimately contributing to SDG 6 achievement and improved public health outcomes in rural Southeast Asian communities.

METHOD

The research applied an empirical approach, drawing directly on facts obtained from the field regarding water supply quality for the community in Mehara Village, Tutuala Administrative Post, Lautém Municipality. Findings were developed and examined in depth to reflect the conditions experienced by the community (Efendi, 2021; Efendi & Ibrahim, 2014; Ishaq, 2017).

A conceptual approach was employed, incorporating relevant theories, norms, and expert doctrines applicable to the analysis of water supply quality in the study area. A legal approach was also adopted, referring to legislation pertinent to the topic, including Decree-Law No. 31/2020 concerning community water supply. The research was conducted in Mehara Village, Tutuala Sub-District, Lautém District.

Primary data were obtained directly from the research site. Secondary sources included the WHO Guidelines for Drinking Water Quality (2022 edition), national water policy documents, and official statistical reports from ESTAE (Statistics Timor-Leste). Tertiary sources comprised recent peer-reviewed publications (2020–2024) on water quality in Southeast Asia, technical reports from international development agencies, and hydrogeological assessments of Timor-Leste.

Data collection involved gathering, inventorying, and classifying primary, secondary, and tertiary data before conducting analysis using the selected methodological approaches. The study examined objective facts and evaluated applicable legal frameworks. Comparative analysis was conducted between empirical findings, theoretical perspectives, and legal principles to assess the alignment of policy and practice with community needs.

RESULTS AND DISCUSSION

Government Policy on Guaranteeing Water Quality for the Community in Mehara Village

Provision of Water Supply and Distribution to the Community in Mehara Village

The village functions as an administrative unit that encompasses three or more hamlets, led by local authorities such as the village chief and hamlet heads, who operate under government directives. As stated by the Mehara village chief, local leadership carries a significant responsibility to implement government programs in compliance with applicable laws, including Village Law enshrined in Decree-Law No. 9/2016. This law affirms that villages play a crucial role in preserving cultural identity and mobilizing local communities to engage in collective efforts for national reconstruction. Mehara Village, located at the eastern tip of Timor, borders Chailoro Hamlet in the east, Malahara Hamlet in the south, and Somocho Hamlet in the north. Internally, it consists of three hamlets: Porlamano, Mehara, and Poros, with a total area of 150 km² (17,071.1 hectares).

The administrative post is considered periodically as a rotating authority (Coaldrake & Stedman, 1999). Nevertheless, there is no specific guidance on the necessity and utilization of electoral logistics. Tutuala Administrative Post, part of Lautém Municipality, coordinates villages and hamlets in accordance with national regulations. Access to safe water is a fundamental human right, and its absence constitutes a major human rights issue. When individuals, particularly children, have access to clean water, sanitation, and hygiene, they achieve healthier and more successful lives.

Water supply in Timor-Leste is managed by the public utility company Bee Timor-Leste, E.P. (BTL, E.P.), established under Decree-Law No. 41/2020. Its mission is to promote efficiency and sustainability through the implementation of government strategies in providing safe drinking water and improving sanitation services for the public. In 2022, the government initiated water channeling projects for communities in Mehara. However, water was still largely sourced from rivers and distributed through local pipelines. By 2023, the national and local governments jointly inaugurated new water systems currently in use.

a. The implementation of safe water solutions in communities includes: Installing filtration or water tank systems, at least once a week, with the addition of disinfectants to eliminate bacteria before community consumption. Water should be

integrated into holistic solutions within communities to strengthen human capacity in health, environment, economy, and public well-being.

b. A community-based approach that involves investment in people, solution implementation, long-term success, and the cultivation of hope for a healthier future. This includes providing education and training in health and hygiene, preparing local leaders, and developing entrepreneurial programs that empower residents to operate sustainable micro-businesses in water management.

Investment in people is considered the most powerful driver of sustainable change, creating not only transformation but also intergenerational impacts. Community-based safe water systems, combined with water safety plans, are key to protecting public health and ensuring equitable access. According to the U.S. Geological Survey (USGS), safe water is defined as "water that will not harm you if consumed." Similarly, the United Nations (UN) identifies five major reasons why safe drinking water is essential: (a) sustainable development, (b) socio-economic progress, (c) food and energy production, (d) health and survival, and (e) healthy ecosystems.

Communities require safe water to meet current needs without compromising future generations, aligning with the UN Sustainable Development Goals (SDGs) adopted in 2015. Goal 6 (Clean Water and Sanitation) emphasizes the importance of water access as a determinant of human well-being, poverty reduction, and environmental protection by 2030.

Factors that impede the local government in the village of Mehara

a. The Dry Season

Climate change impacts water crises. We feel these impacts through more severe floods, rising sea levels, shrinking glaciers, wildfires, droughts, and deforestation. However, water can fight climate change. Sustainable water management is central to building the resilience of societies and ecosystems and to reducing carbon emissions. Everyone has a role to play—actions at the individual and household levels are very important. The relationship between water and climate change is undeniable. Events that occur during this difficult time make water weaker, less predictable, more polluted, or frozen. These impacts on the water cycle threaten sustainable development, biodiversity, and people's access to water and sanitation. Glaciers and ice sheets are rapidly disappearing. Groundwater provides much of the flow for major rivers. Volatility in the cryosphere can affect the regulation of freshwater resources for many people in small land areas. Droughts and wildfires destabilize communities and cause civil disasters and migration in many areas. The destruction of forests and trees worsens soil erosion and reduces groundwater recharge, increasing water scarcity and food insecurity.

The increasing need for water has heightened the need for energy-intensive freshwater transportation and treatment, and it has contributed to the degradation of freshwater-dependent carbon sinks like peatlands. Water-intensive agriculture for food production, especially meat, and for cultivating plants used as biofuels, can further increase water scarcity. Broad, rapid, and intensifying climate change plays a major role in freshwater quality. By scientifically exploring the interrelated mechanisms between climate change and freshwater quality, professionals can better adapt and optimize freshwater management and thus ensure freshwater security. Here, a new concept is proposed regarding water quality in the context of climate

change due to potential long-term and widespread impacts. This publication is licensed by the American Chemical Society for personal use. The recent Intergovernmental Panel on Climate Change (IPCC) report shows that climate change is widespread, rapid, and intensifying. When thinking about the impacts of climate change, the focus is often on rising temperatures, droughts, or rising sea levels and their direct consequences. According to the "2030 Agenda for Sustainable Development," water is considered an implicit but essential connecting factor for achieving various "Sustainable Development Goals" (SDGs) under normal circumstances. Therefore, the inability to adapt to climate change will not only threaten the achievement of SDG6 (The Water Goal) but also threaten the achievement of other sustainable development goals. With continued greenhouse gas emissions, freshwater quality will be inevitably influenced, but there is a lack of attention to the impacts of climate change on related freshwater quality, especially quantitative and potentially controllable conclusions. The focus here is on surface water, which is purified, distributed, and ultimately used as freshwater with traditional treatment processes (coagulation, filtration, disinfection, and distribution), and we will consider the consequences of climate change in the context of continuous and gradual changes, as well as the tendency for greater fluctuations. Coagulation has been successfully applied in freshwater treatment for more than 100 years. Due to the hydrolysis characteristics of coagulants (e.g., Al-based salts and Fe-based salts), coagulation efficiency will increase with an increase in water temperature. However, it should be noted that the quality of the freshwater will also worsen; it has been reported that the content of dissolved organic matter increased significantly in northern Europe, central Europe, and North America from 1980 to 2000, with climate change as a potential factor. We know that, based on the Arrhenius relationship, the rate of a chemical reaction will double when the temperature rises by 10 °C. However, the global average temperature will not rise by more than 2 °C if relevant policies are scientifically implemented, and therefore the average water temperature will only rise slightly. As a result, the benefits of better coagulation efficiency will be impacted. Sustainable water management helps society adapt to climate change by building resilience, protecting health, and saving lives. It also mitigates climate change by protecting ecosystems and reducing carbon emissions from water and sanitation transportation and treatment. Policymakers must work together across national borders to balance the freshwater needs of communities, industries, agriculture, and ecosystems. Innovative financing for water resource management will be needed to help attract investment, create jobs, and support governments in meeting their water and climate goals.

b. The Rainy Season

Acid rain forms when water droplets in clouds merge with contaminants in the air, such as sulfur dioxide and carbon dioxide. Acid rain can enter lakes and rivers after falling. This acidic water is corrosive, causing damage to waterways. The environment can generally adapt to some acid rain.

Often the soil is a bit basic (because of naturally occurring limestone, which has a pH greater than 7). Because bases neutralize acids, these soils tend to balance out some of the acid rain. But in areas like the Appalachian Mountains and some parts of the northwestern and southern United States, where there is no limestone, acid rain can damage the environment. Some fish and animals, like amphibians, have a difficult time adapting to and reproducing in an acidic environment. Many plants, such as evergreens, are damaged by acid rain and acidic soil. I have seen some of the damage to the dried-out forests in the German Black Forest. Much

of the black forest is really black because so many of the evergreens have been lost, leaving only the tree trunks and branches! You can also see how acid rain eats away at the stonework on some city buildings and statues.

Basic Components of Water (Hydrology)

Aquifers

An aquifer is a geological formation underground that stores, holds, and supports water. Aquifer formations require the presence of porous or permeable rocks to absorb rainwater, which infiltrates the ground and accumulates in the aquifer. Therefore, aquifers are the main medium for groundwater. Aquifers with the quality to store and support water are typically sedimentary rock types, with sandstones, conglomerates, and limestones. Other rocks, such as granite, quartzites, and amphibolites, can also form aquifers when there are many fractures.

Types of Aquifers in Timor-Leste

In Timor-Leste, aquifers are formations that store water in porous and permeable underground rocks, which are good for holding and supporting water. We can use the water from these reservoirs for our daily lives because of its good quality. The types of aquifers in Timor-Leste, according to Audley Charles (1968), who conducted a study throughout the country, are classified by various rock formations. However, this section aims to provide knowledge about the main type of aquifer in the country, which is the Baucau Formation. This formation has good porosity and permeability because of the presence of limestone, allowing it to absorb and support water in the subsurface. The movement of water can occur through porous, fissured, and karstic rocks.

Regional Hydrogeology of Timor-Leste

Based on the regional hydrogeology of Timor-Leste, the study area falls into the (low Confining Units aquifer). Aquifers with localized groundwater flow (fractured rocks—red and confining units brown) may require more precision to signal their potential for obtaining groundwater. Localized groundwater flow is divided into fractured rocks (red) and clay sediments (brown).

The Low Potential Production (light blue) reflects a small amount of water storage compared to the large alluvial plains (approximately 10-100 meters thick), which are classified as Intergranular Porosity, with a Higher Production Potential (dark blue). The age of the aquifers is more important for karstic fissured aquifers, where metamorphosed limestone of a younger age has fewer karstic fractures than older limestone.

The annexed hydrogeology map of Timor-Leste was developed in collaboration with UNESCO's International Consultation, which was adjusted with secondary data. The map shows geological information linked to hydrogeology, such as:

1. Intergranular Porosity: Shown in blue on the map. It has a high potential for groundwater accumulation and is divided into two parts: Intergranular porosity (alluvial part) shown in dark blue has a very high potential (high) and Intergranular porosity (alluvial part) shown in light blue has a low potential (low).
2. Karstic Fissured Aquifer (Karst): Shown in gray on the map, it has moderate potential for groundwater accumulation. This type of karstic aquifer is further divided into two

categories: a dark gray color on the map indicates high potential, and a light gray color on the map indicates low potential.

3. Fractured Aquifer (Localized aquifer/Fracture): Shown in light brown on the map, it has a low potential for groundwater accumulation because water only accumulates in the fractured parts (fracture porosity).
4. Confined Aquifer (confine units): Shown in brown on the map, it has the lowest potential for groundwater accumulation.

Analysis of Water Quality in Mehara Village

The permanent standardization of water quality is based on the results of each water source. The analysis of groundwater quality for drinking water is based on the results of laboratory analysis by the WHO regarding water quality standardization to meet drinking water needs. The decision from the laboratory is based on parameters that analyze the characteristics of groundwater, including physical, chemical, and biobacteriological parameters according to international standards. The surface runoff water that infiltrates the ground becomes the spring (Outlet). The spring's condition reflects the existing hydrogeological conditions in the research area. The spring is named Ira Veru (Ira Veru Spring) and is a perennial spring, meaning the water flows continuously until the end of the year.

The presence of calcareous and calcilutite rocks originating from limestone makes it a permeable rock layer capable of storing and supporting water. Its fragile, massive structure is easily dissolved and can undergo a karstic process when in contact with water, creating its own water flow and good water storage. Limestone can dissolve in water over a long period, and over millions of years, it can form caves, sinkholes, and uvalas. Limestone is a type of karstic aquifer.

The Limestone Unit is dominant in the study area, starting from the eastern, southern, and northern parts. According to Audley Charles (1968), the Baucau Limestone can reach a thickness of up to 500 meters, interpreting the Baucau Limestone as a second-thick layer with a topography known as a karstic aquifer.

The Ira Veru Spring

The spring is in the Mehara village area, along the NE coast in the study area, with the coordinates 08023’30’’S, 127010’57’’E, and an elevation of 522 meters above sea level. The observed water comes from calcilutite limestone. The physical characteristics of the water show a pH of 8.1, which is a good result according to international standards. Conductivity is 685 µs/cm, and the temperature is 24.8 °C. TDS has a result of 343, salinity is 0.3, and turbidity is 3.4. The total Coliform count is 17 Membrane Filtrations, indicating a high bacterial count when looking at the analysis of the water consumed by the community daily. With such microbes, the solution is for the community to boil the water to 100 °C before drinking or to add chemicals to kill the microbes before consumption. Total Coliform (TC) - In this method, TC are bacteria that produce fluorescent colonies when exposed to longwave ultraviolet light (366 nm) after primary cultivation in MI agar or broth (See Figure 1). These fluorescent colonies can be blue (TC not E. coli).

They can also appear blue-green (E. coli), and the color or fluorescence is surrounded by a blue hue. In September 2002, the Mehara community was using water with E. coli

colonies. A total of 5 E. coli colonies indicate that the water is contaminated with various microbes. Additionally, non-fluorescent blue colonies, which are less common, also add to the total count because the fluorescence is masked by the blue color from the breakdown of Escherichia coli.

With this method, E. coli are bacteria that produce blue colonies under ambient light after primary cultivation in MI agar or broth. These colonies can be fluorescent or non-fluorescent under longwave ultraviolet light (366 nm) (Reference 16.8).

This water supplies the entire community in Mehara Village and the surrounding areas. The spring is used by residents, schools, village administrative offices, and for various purposes such as cultivation in gardens, fields, and wetlands, as well as for animals and construction.

Water Quality Potential

The water quality of the identified spring varies after being tested in the laboratory. According to Thomas C. Winter et al. (1998), "water quality depends on the use and different types of sources, whether from a municipal community, industry, agriculture, or domestic use. This growth increases the concentration of water contamination." Thus, sub-surface water contamination will be divided as follows:

Water samples were collected from three different locations, including the Ira Veru Spring. The laboratory test results identified the water quality. The water quality from the Ira Veru Spring contains normal physical and chemical properties, but the bacteriological properties consist of 17 Coliform microbes and 5 E. coli microbes, indicating that the spring has a significant problem with other microbes.

These microbes come from powerful cellular or multicellular organisms originating from human and animal activities. The E. coli count is small, but according to international standards, the biobacteriological value should be zero (0) for safe drinking water. Therefore, the mentioned water has an impact on the health of the community when they consume it. In the area, if the community consumes this water, they need to apply some remedies to kill the microbes first before drinking to prevent implications for public health.

Government Plan for Clean Water Canalization in Mehara Village

Regarding the Government's Strategic Plan through the Ministry of Public Works, through Bee Timor-Leste, E.P., which is responsible for channeling water to the community in Mehara village, the implementers for this matter are as follows:

a. Bee Timor-Leste, E.P. (BTL)
b. National Village Development Program Plan (PNDS)
c. Uma Kbi'it Laek (UKL) or changed to Uma Naroman ba Povu (The House of Light for the People)
d. The creation of a New Neighborhood in Mehara Village.
e. Continuing to ensure the implementation of the Award for Healthy Villages and Environmental Development for Commercial, Industrial, and Private entities to Promote the Polluter-Pays Principle, conservation for carbon emission reduction, or measures aimed at improving the environment.

f. Implementation of a "Zero Plastic" policy throughout the territory and developing an effective program to combat plastic degradation, which affects rivers and has an impact on the quality of underground and surface water. It also includes how to develop a Plastic Recycling Industry.
g. Promoting and strengthening good cultural practices regarding environmental protection, nature conservation, and the protection of heritage and traditional sites, especially to protect water sources.
h. Promoting the environmental sector in Timor-Leste according to the "Blue Economy" policy of Timor-Leste, including Anthropogenic Pressure (Human Activities).

According to Decree-Law No. 9/2016 concerning Villages, the village has a decisive function in preserving our cultural identity and mobilizing our local communities to carry out collective efforts for National Reconstruction for peace and social stability, mediating disputes and conflicts between people, families, or hamlets, and contributing to improving the living conditions of the population and the socio-economic process of the country according to Article 3, which defines the Village based on the following:

1. A village is a public collective entity with an associative nature, established based on historical, cultural, and traditional circumstances, and its members are connected through family or traditional ties in a defined place.
2. The villages that exist in the city are collective entities of a public nature with an associative nature, established based on social and historical processes marked by the migration of various ethnicities during the colonial period, which arise from the family nature of the old ties in a defined place.

Because the State is preparing to establish Local Power, with material, human, and financial means from Democratic Legitimation, it is necessary to proceed with the definition of the role of villages through the clarification of the legal framework for adequate administrative responsibilities and capacities, and the reinforcement of its legitimacy and authority through the alteration of the designation procedure of the members of community bodies and the introduction of transparent guarantees in the activities developed for the common good of the communities based on Article 4 on Legal Nature, which states that the village is a Public Association.

According to the research findings, the population in Mehara Village, along with its three hamlets, is as follows:

1. Porlamanu Hamlet: Total of 253 families, with 572 females and 606 males. 5 disabled males and 3 disabled females, for a total of 1178 people in the 2022 academic year.
2. Loikeru Hamlet: Total of 239 families, with 559 females and 516 males. 5 disabled males and 2 disabled females, for a total of 1075 people in the 2022 academic year.
3. Poros Hamlet: Total of 216 families, with 467 females and 493 males. 6 disabled males and 3 disabled females, for a total of 906 people in the 2022 academic year.

The total community population according to statistics in the said village in 2021 was 694 families, with 1550 males and 1591 females. The data collection in the 2022 academic year increased to 708 families, with 1598 males and 1615 females, and a total of 16 disabled males and 8 disabled females, totaling 3113 people in the village. The village area is 150 km² and 1707.11 hectares. Therefore, BTL has been channeling clean water to each community's

household since 2021 and inaugurated it in 2022. The community can now access water, but it is not yet sufficient for their daily needs, as the quantity of water is small and is only supplied on alternate days for Loikero and Porlamo hamlets. Therefore, the community does not yet have good access to clean water to guarantee their needs for the future.

Sustainable, Accessible, and Scalable Water Solutions

- Improve carbon storage. Peatlands alone hold at least twice as much carbon as all forests on Earth. Coastal mangroves can store up to three or four times more carbon than terrestrial forests. Protecting and expanding these environments can have a significant impact on climate change.
- Protect natural buffers. Coastal mangroves and wetlands are effective and low-cost natural barriers to flooding, extreme climatic events, and erosion, as plants help regulate water flow and bind soil on plains, riverbanks, and coastlines.
- Harvest rainwater. Capturing rainwater is particularly useful in regions with uneven rainfall distribution to build resilience to shocks and ensure supply during dry periods. Techniques include small-scale surface capture for household use and runoff diversion to reduce soil erosion and increase groundwater recharge.
- Adopt smart agriculture. Use conservation techniques to improve organic matter to enhance soil retention; drip irrigation; reduce post-harvest loss and food waste; and transform waste into a source of nutrition or biofuel/biogas.
- Reuse wastewater. Non-conventional water resources, such as properly treated wastewater, can be used for irrigation, industrial, and municipal purposes. Safely managed wastewater is an accessible and sustainable source of freshwater, energy, nutrients, and other recoverable materials.
- Manage groundwater. In many places, groundwater is overused and polluted; in others, the quantity is unknown. Exploring, protecting, and sustainably using groundwater is central to adapting to climate change and responding to the needs of a growing population.

Demographics and Geography of Mehara Village

Demographics are the characteristics of a population categorized by different criteria such as age, gender, and income to study the attributes of each group. The study of demographic data is essential for companies, organizations, and governments to make decisions. Using this data, companies can create marketing strategies, and governments can implement public policies. In this section, we define demographics with examples, explain why they are important, and show how they are used to understand and support the general public.

To better understand the community, it is necessary to gather basic demographic information. Most of the required information will be available from the ESTAE Census Office or government agencies, and local authorities. Collecting and comparing data over recent years will allow the community to see short-term trends in the age and ethnic distribution of the community's population, as well as in the social and economic structures. It is also important that those working in the evaluation have an updated profile of their community. Often, changes occur in the population's composition and economic status in neighboring areas.

The village chief says that the number of community members is always increasing annually, and so are their needs, such as clean water, which is a very important basic necessity for the community. From 2020 to 2023, the total community population was 9241 people, spread across the three hamlets in Mehara village. This is based on Article 4 on the Legal Nature, which states that the village is a Public Association.

According to the research findings, the population in Mehara Village, along with its three hamlets, is as follows:

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a. Society in Mehara Village

A community is a social unit (a group of living things) with socially significant characteristics, such as location, a set of norms, culture, religion, values, customs, or identity. Communities can share a physical location in a geographical area (such as a nation, village, city, or neighborhood) or in a virtual space through communication platforms. Good relationships that can be built through immediate general relations also define a sense of community, which is important for their identity, practices, and roles in social institutions like family, home, work, government, television networks, society, or humanity in general. Although communities are typically small and related to personal social relationships, "community" can also refer to affiliation with large groups such as national communities, international communities, and virtual communities. The main article is "Sense of Community." In a 1986 seminal study, McMillan and Chavis identified four elements of "sense of community":

a. Membership: The feeling of belonging or sharing a sense of personal relationship.
b. Influence: A concern, making a difference to a group and the group being concerned about its members.
c. Reinforcement: Integration and fulfillment of needs.
d. Shared emotional connection.

As the Coordinating Minister for Social Affairs, the leader has the authority to coordinate the elaboration, execution, and control of policies defined by the Council of Ministers in social areas, to coordinate the preparation and organization of the work of government departments under his or her tutelage, to monitor and evaluate the work and service provision of the members of the Government mentioned in the previous number, to propose and develop public policies of a social nature that contribute to improving services for citizens, to coordinate the preparation and organization of government work in the social area, and to ensure coordination with relevant entities that contribute to social development.

As the Minister of Rural Development and Community Housing, he is responsible for the conception, execution, coordination, and evaluation of policies defined and approved by the Council of Ministers for areas relevant to improving living conditions, opportunities, and accessibility in rural areas, from the Mehara village chief, the development of promotional

initiatives for diversifying activities, creating jobs in rural areas, with the objective of consolidating its productive structure.

Community development is often linked to community service or community planning and may involve stakeholders, foundations, governments, or contracting entities, including non-governmental organizations, universities, or government agencies, to make progress toward local, regional, and sometimes national social well-being. Many more efforts, called community building or community organization, seek to empower individuals and groups of people by providing them with the skills they need to effect change in their own communities.

These capacities often help build political power by forming large social groups that work for a common agenda. Community development practice must understand how to work with individuals and how to affect the position of communities in the context of larger social institutions. Public administrators, on the contrary, need to understand community development in the context of rural and urban development, housing and economic development, and community, organizational, and entrepreneurial development.

b. Analysis Technique for Legal Materials to Ensure Clean Water

From a legal perspective, water is a very important factor for the community's daily life; everyone has the right to access clean water for a prosperous life. The need for investment in the water and sanitation sector has become a transversal concern. For all governments and people to consider, this is a long-term government program. In this regard, the VIII Constitutional Government Program considers that a clear reinforcement of investment in access to clean water and basic sanitation is urgent. Investment in this area constitutes a simultaneous investment in health and improving the quality of life of the population, the environment, education, and, as a direct consequence, in economic growth.

This is enshrined in DECREE-LAW NO. 31/2020 of August 26, ON THE CONTROL OF WATER QUALITY FOR HUMAN CONSUMPTION. Based on interviews with community members, they said that five years ago, the water we drank often caused coughing, was dirty, and had a brownish color. After the VIII government supplied and channeled the water to individual households in 2022, we used the water which was still clean. But now the water is still dirty, and in the rainy season, the water becomes brownish and smells bad because the water is drawn from the river. Hence, the researcher analyzed this information, concluding that our local authorities and municipalities have not yet paid proper attention to the needs of the community, especially basic needs like clean water.

c. Water Consumption According to Law

Drinking water for human consumption is very important for life, therefore, before completion, a laboratory control of its quality must be carried out. The parameters used in this control through physical-chemical and bacteriological analysis are only included in the guidelines published by the United Nations in 2000 and more recently by the Ministry of Health in December 2016. The analyzes carried out by the current National Water Services Directorate laboratory have long followed these parameters. However, there is no legal document that supports them.

Based on the questionnaire that the researcher distributed to 50 community members, they filled it out according to their point of view, indicating that the preparation of clean water or the supply of water to the community is not yet sufficient for their needs and the water

quality is not very good. When it rains, the water shows dirty characteristics, like a brownish color, and our ministries do not implement the law.

In this area, it is the responsibility of the Ministry of Public Works, through direct or indirect state administration, to ensure and implement universal, regular, and continuous water distribution for public consumption in safe and hygienic conditions, and to carry out laboratory tests on water and prepare and develop technical rules for water treatment to ensure the quality of drinking water.

The government describes, according to paragraph a) of paragraph 1 of Article 115 and paragraph d) of article 116 of the Constitution of the Republic, which is in force. But community members say, after the researcher sampled 50 people to get information, that local authorities often do not provide information about water quality. The relevant ministries and BTL do not provide information about the quality of clean water according to international standards and according to our legal code. Based on Article 6, Control of Compliance, in point 1. Verification of water quality has been carried out, according to the provisions of the Water Control Program, Water quality, prepared annually and in the format provided in Annex III to this diploma.

CONCLUSION

The study in Mehara Village, Tutuala Administrative Post, Lautém Municipality, Timor-Leste, found that while the Ira Veru and Ira Masi Springs exhibited normal physical and chemical water quality parameters, both contained bacteriological contamination, including *E. coli*, with Ira Veru showing higher levels than Ira Masi. These findings highlight significant challenges in ensuring safe potable water, especially given the legal mandate under Decree-Law No. 31/2020 to provide clean water free from microbial pollution. Future research should investigate effective, locally adaptable water treatment and purification methods to reduce microbial contamination, alongside community-based monitoring initiatives to maintain long-term water safety.

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