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Drinking Water and Sanitation Challenges in the Island and Riverside Communities of Tillaberi, Niger

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Abstract

This study examines household access to drinking water and sanitation in the island and riverside areas of the rural communes of Ayorou and Dessa in the Tillabéri Region of Niger. The main objective is to evaluate the current state of accessibility to safe water and sanitation among local households. Data were collected through a household survey conducted over eleven days, from June 23 to July 3, 2025, using a quantitative approach involving 550 respondents. Findings indicate that 94.4% of island and 92.2% of riverside respondents are married. All island households (100%) depend entirely on the Niger River for their water supply, while 51.1%, 24%, and 19.6% of riverside households rely on standpipes, the river, and boreholes, respectively. The results also show that 82.8% of island residents and 68.7% of riverside residents face difficulties accessing potable water. Water treatment practices remain limited, with 52% of island households and only 10% of riverside households using "Pur" to purify drinking water. "Pur" is composed of ferric sulfate and chlorine, acts as a coagulant and disinfectant. Regarding sanitation, 84.5% of island households and 58.5% of riverside households lack latrines. Overall, the study highlights significant disparities in water access and sanitation conditions between island and riverside communities, underscoring the urgent need for targeted interventions to improve living standards in these vulnerable areas.

Subject Areas

Environmental Sciences

Keywords

Island and Riverside Communities, Drinking Water, Sanitation, Household, Pur

1. Introduction

In the 21st century, water, hygiene, and sanitation represent major global challenges [1]. Water is a precious and indispensable resource essential to all forms of life, constituting a key component of both the mineral and organic worlds. It plays a critical role in numerous physiological functions, including digestion, absorption, thermoregulation, and waste elimination [2].

Despite the legal framework established by the United Nations Committee on Economic, Social, and Cultural Rights, which recognizes the right to water as ensuring every human being access to sufficient, safe, acceptable, physically accessible, and affordable water for personal and domestic use [3], access to water and sanitation remains a fundamental human right that is far from universal. Although significant progress has been made toward achieving Sustainable Development Goal 6, these gains remain unequal and insufficient. Accelerated efforts and innovative solutions are required to ensure that no one is left behind [4].

It is estimated that 1.1 billion people lack adequate access to safe drinking water, while 2.6 billion people live without basic sanitation facilities worldwide [5]. United Nations data indicate that nearly 900 million individuals do not have access to an improved water source, including over 300 million in sub-Saharan Africa [1].

Disparities persist between countries, with the least developed nations lagging the most. Even within the same region, large differences exist. In 2020, nearly half of those without basic drinking water services lived in least developed countries, whereas most populations in Europe and North America generally had access to uncontaminated water. In East and Southeast Asia, access rates varied widely from 94% in Malaysia to 28% in Cambodia and 18% in the Lao People's Democratic Republic. In Latin America, access rates stood at 43% in Mexico, compared to 99% in Chile and 67% in Ecuador [4].

Across Africa, Asia, and Latin America, an average of 57% of people lack access to safe drinking water [6]. Inequalities also persist between urban and rural areas, with the problem being far more acute in rural regions. In these areas, drinking water is often sourced directly from springs or rivers, either untreated or subjected only to rudimentary chlorination [7].

During the 19th century, waterborne diseases caused large-scale epidemics of dysentery, typhoid fever, and cholera, among others [8]. The risks of spreading water-related diseases such as cholera, hepatitis, and dysentery, as well as vector-borne diseases transmitted by mosquitoes, remain significant [9]. Globally, between six and eight million people die each year because of water-related disasters and diseases, with children under five being the most affected. In sub-Saharan Africa alone, diarrheal diseases were responsible for approximately 600,000 deaths in 2017 [10].

Like other Sahelian countries, Niger faces severe water-related challenges in several regions. Although the country is traversed by the Niger River and contains significant groundwater reserves [11], its water resources are extremely fragile. Rapid population growth, agricultural expansion, and industrial and mining activities exert considerable pressure on both the quality and quantity of available water. Climate change further exacerbates these challenges [12].

In the Tillabéri region, the Niger River is the only permanent watercourse. The mean annual flow volume recorded at the Niamey station was 22.21 billion m^3 (1970-2002) and 21.5 billion m^3 at Kandadji (1975-2002). However, riverbed silting and the proliferation of aquatic plants have significantly reduced river flow in recent years. The most pronounced decline occurs during the low-water period (April-May), when daily discharge rates drop below 50 m^3/s [13].

In the island and riverside villages of the rural communes of Ayorou and Dessa (Tillabéri Region), households primarily obtain water from the Niger River and a few boreholes. From a sanitation perspective, most households either lack latrines or rely on inadequate facilities. Against this backdrop, the present study aims to assess the current state of access to safe drinking water and sanitation among these households.

2. Materials and Methods

2.1. Study Area

This study was conducted in two rural communes of the Tillaberi region: Ayorou and Dessa.

Ayorou is located about 200 km northwest of Niamey, near the Malian border. Together with Inates, Ayorou forms the department of Ayorou, of which it is the chief town. The commune extends on both banks of the Niger River, with six of its twenty-seven administrative villages located on islands, one of which is being relocated as part of the Kandadji dam project. Ayorou covers 1132 km^2 and had an estimated population of 48,072 in 2022 (42.46 inhabitants/km^2), including 23,884 men and 24,188 women (INS/Tillaberi).

Dessa lies 53 km north of Tillaberi between longitudes 0˚52'30'' - 1˚15'00'' E and latitudes 14˚25'30'' - 14˚40'30'' N. It is bordered by Anzourou and Bibiyergou to the east, Mehana, Gorouol, and Bankilare to the west, Ayorou to the north, and Sakoira and Sinder to the south. Although its boundaries remain unofficial, Dessa spans approximately 472 km^2—9.72% of the Tillaberi department's 4853 km^2 and had a population of 40,194 in 2022 (86 inhabitants/km^2), including 19,985 men and 20,209 women across 6183 households. The main socio-ethnic groups are Sonrai-Zarma, Kado, Kourtey, Wogo, Tuareg, Fulani, and Hausa.

2.2. Methodological Approach

A structured questionnaire addressing three themes, respondent identification, access to drinking water, and access to sanitation and waste management, was administered to households in fifteen villages across both communes. Data were collected over eleven days (June 23-July 3, 2025) using a quantitative approach that surveyed 550 households, complemented by direct field observations of functional water supply sources. The responses gathered via KoboCollect were exported to Excel and analyzed using SPSS (version 25). Frequency distributions and means were computed for quantitative variables, while analysis of variance (ANOVA) at a 5% significance level was applied to quantitative data.

3. Results and Discussion

3.1. Results

3.1.1. Identification of Respondents

1) Marital Status of Respondents

The results in Table 1 show that 94.4% and 92.2% of respondents in the insular and riverside environments, respectively, are married. Table 1 also reveals that 5.2% and 4.5% of respondents are widows in the riverside and insular environments, respectively.

Table 1. Marital status of respondents according to environments.

Marital Status	Insular Environment	Riverside Environment
Married	94.4	92.2
Widow	4.5	5.2
Divorced	1.1	1.1
Single	0	1.5
Total	100%	100%

2) Household Size

The results in Table 2 show that the average household size of respondents is 7.62 ± 3.55 in the insular environment and 8.88 ± 4.64 in the riverside environment. The ANOVA analysis indicates that the difference in household size between the two environments is statistically significant ($P < 5\%$).

Table 2. Household size of respondents according to environments.

Household size	Mean ± Standard deviation
Insular Environment	7.62 ± 3.55
Riverside Environment	8.88 ± 4.638
ANOVA	ddl = 1; F = 5.979; P = 0.015

3.1.2. Access to Drinking Water

1) Sources of Water Supply

The analysis of Table 3 shows that all respondents in the insular environment obtain their water from the Niger River. In contrast, in the riverside environment, 51.1% and 24% of respondents obtain their water from public standpipes and the river, respectively. Furthermore, 19.6% of respondents in the riverside environment use human-powered boreholes as their main source of water supply.

Table 3. Different sources of water supply according to environments.

Sources of Water Supply	Insular Environment	Riverside Environment
River water	100	24
Public standpipes	0	51.1
Boreholes	0	19.6
Private taps	0	4.3
Wells	0	1
Total	100%	100%

2) Daily Household Water Needs

Table 4 shows that in the insular environment, the respondents' average daily water requirement is 167.64 ± 78.80 liters, compared to 179.09 ± 85.50 liters in the riverside environment. The ANOVA analysis indicates that the difference in daily household water consumption needs is not statistically significant (P > 5%) between the two environments.

Table 4. Daily household water consumption needs by environment.

Household Water Need	Mean ± Standard Deviation
Insular Environment	167.64 ± 78.80
Riverside Environment	179.09 ± 85.50
ANOVA	ddl = 1; F = 0.824; P = 0.365

3) Distances Traveled

The analysis of Figure 1 reveals that 100% of respondents in the insular environment and 91.8% in the riverside environment travel less than 500 meters to obtain drinking water. It is also evident from the analysis that in the riverside environment, 5.2% and 3% of respondents travel 500 meters or more than 500 meters, respectively, to fetch water.

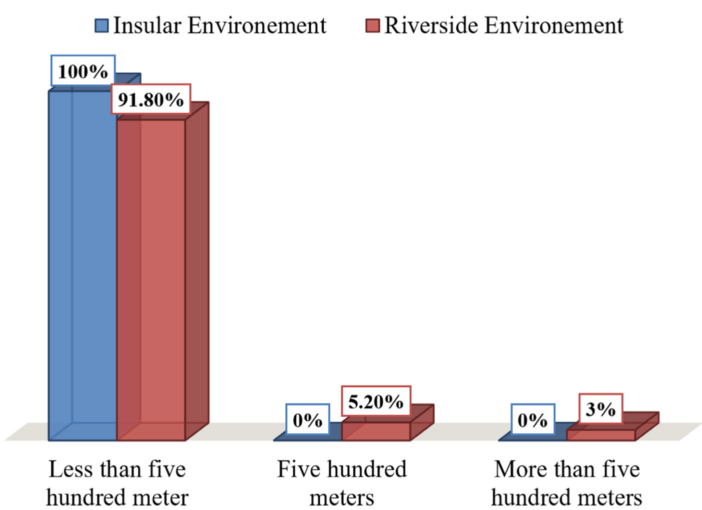

Figure 1. Distances Traveled to collect drinking water.

4) Means of Transportation

Table 5 summarizes the means of transportation used to collect drinking water. All respondents in the insular environment and 93.4% in the riverside environment go on foot, while 5.5% and 1.1% of respondents in the riverside environment use a donkey and a cart, respectively.

Table 5. Means of transportation used by respondents according to the environment.

Means of Transportation	Means of Transportation	Means of Transportation
On foot	100	93.4
On donkey	0	5.5
By cart	0	1.1
Wheelbarrow (Push-push)	0	0
Total	100%	100%

5) Time Spent Fetching Water

Table 6 shows that 100% of respondents in the insular environment and 92% in the riverside environment spend less than thirty minutes collecting water. The analysis also indicates that in the riverside environment, 5% and 0.8% of respondents spend thirty minutes or more than thirty minutes, respectively, fetching water.

Table 6. Time spent fetching drinking water.

Times spent	Insular Environment (%)	Riverside Environment (%)
Less than thirty minutes	100	92
Thirty minutes	0	5
More than thirty minutes	0	0.8
Don't know	0	2.2
Total	100%	100%

6) Access to Drinking Water

The results in Table 7 show respondents' statements regarding access to drinking water. The analysis reveals that 82.8% of respondents in the insular environment and 68.7% in the riverside environment report having problems accessing safe drinking water.

Table 7. Statements regarding access to drinking water by environment.

Access Problem	Insular Environment	Riverside Environment
Yes	82.8	68.7
No	18.2	31.3
Total	100%	100%

7) Quality of Drinking Water

Figure 2 presents respondents' assessments of drinking water quality. The analysis shows that 88.9% of respondents in the insular environment state that their drinking water is not of good quality, compared to 11.1% who believe it is. In the riverside environment, 36% of respondents also report that the quality of drinking water remains unsatisfactory.

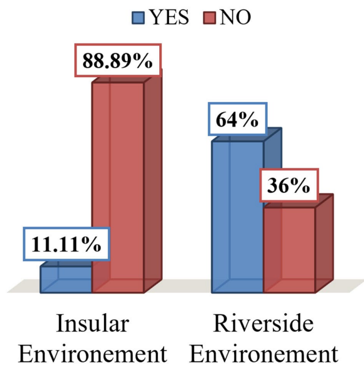

Figure 2. Respondents' statements on drinking water quality.

8) Drinking Water Treatment Methods

The results in Table 8 show the different methods used by respondents to treat their drinking water. The analysis reveals that 52% of respondents in the insular environment and 10% in the riverside environment use "Pur" to treat their drinking water. Filtration is practiced by 18% and 6% of respondents in the insular and riverside environments, respectively. However, 76% of households in the riverside environment do not apply any treatment method to their drinking water.

Table 8. Drinking water treatment methods by environment.

Water Treatment Method	Insular Environment (%)	Riverside Environment (%)
Boiling	0	1
Filtration	18	6
Sedimentation	14	5
Bleach (Chlorine water)	2	0
Aquatab	8	2
Pur	52	10
None	6	76
Total	100%	100%

3.1.3. Sanitation Accessibility and Waste Management

1) Latrine Ownership

The results of the survey on latrine ownership are presented in Table 9. It shows that 84.5% of respondents in the insular environment and 58.5% in the riverside environment do not have latrines in their households.

Table 9. Household latrine ownership by environment.

Latrine Ownership	Insular Environment (%)	Riverside Environment (%)	Total (%)
Yes	15.5	41.5	100
No	84.5	58.5	100

2) Latrine Typology

Figure 3 illustrates the types of latrines used by surveyed households. The analysis shows that among households with latrines, 100% in the insular environment and 94.2% in the riverside environment use pit latrines. Additionally, 5.8% of households in the riverside environment use water-sachet latrines without a reservoir.

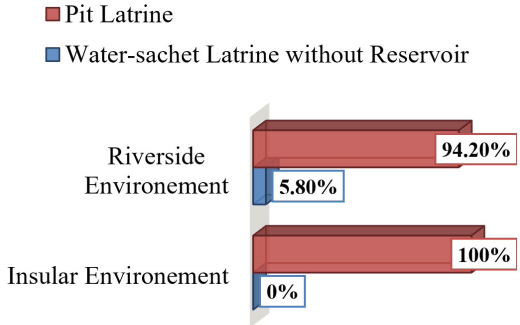

Figure 3. Typology of latrines.

3) Handwashing Facilities

Figure 4 illustrates the availability of handwashing facilities near household latrines. The analysis shows that in the riverside environment, 89% of respondents reported not having a handwashing facility, compared to 11% who said they did. Similarly, in the insular environment, all respondents (100%) reported having no handwashing facility near their latrines.

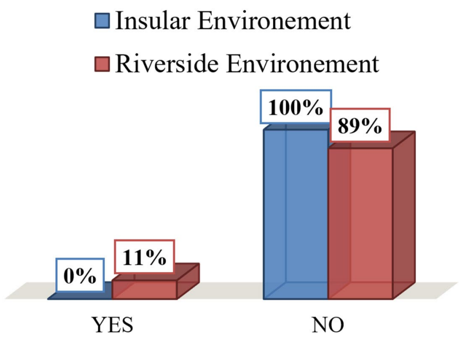

Figure 4. Handwashing facilities.

4) Solid Waste Management Techniques

Table 10 presents the different techniques used for managing household solid waste. The analysis shows that 59% of respondents in the insular environment and

54% in the riverside environment dispose of solid waste in the open air. Additionally, 23.3% and 32% of respondents burn their waste, while 17.7% and 14% bury it, respectively, in the insular and riverside environments.

Table 10. Household solid waste management techniques.

Solid Waste Management Technique	Insular Environment (%)	Riverside Environment (%)
Burning	23.3	32
Burying	17.7	14
Open dumping	59	54
Total	100%	100%

5) Liquid Waste Management Techniques

Figure 5 illustrates the different methods used for managing household liquid waste. The analysis shows that 80% of households in the riverside environment and 78% in the insular environment discharge their liquid waste into the open environment. Additionally, 15% and 22% of respondents in the riverside and insular environments, respectively, use soak pits for liquid waste management. In the riverside environment, 5% of respondents discharge wastewater into drainage channels.

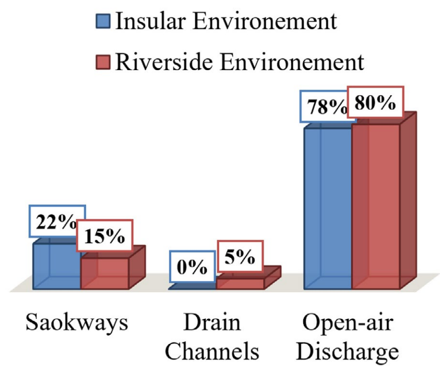

Figure 5. Different methods of household liquid waste management.

3.2. Discussion

3.2.1. Water Supply Sources

In the insular and riverside villages of the rural communes of Ayorou and Dessa, five (5) water supply sources were identified. These findings exceed those of [1], who, in a similar study conducted in the Didagou watershed (Dapaong, northern Togo), identified four (4) water sources. However, in that study, wells were classified as modern and traditional, river water was replaced by dam water, and private taps were not identified as a water source.

These results are consistent with [14], who reported that wells and boreholes constitute the main sources of water supply for 24% of Africa's population. They also align with [15], who, in preparing the Local Water and Sanitation Plan (PLEA) for the rural commune of Dessa, recorded two (2) mini drinking water supply systems, three (3) autonomous water points (two functional), and 36 boreholes equipped with human-powered pumps (31 functional). Similarly, [16] recorded for the commune of Ayorou three (3) mini drinking water supply systems, four (4) autonomous water points, and 43 functional boreholes equipped with human-powered pumps.

These figures highlight the lack of adequate water infrastructure in both communes. This situation is particularly concerning in the insular villages, where the Niger River remains the primary source of drinking water. These results exceed those of [17], whose doctoral research on Lake Kivu in Bukavu (DRC) found that the public agency (REGIDESO) is the main provider of household drinking water, with access levels varying by socioeconomic status across communes.

3.2.2. Access to Drinking Water

Regarding access to potable water, 18.2% of respondents in insular villages and 31.3% in riverside villages reported having access to safe drinking water. These figures indicate that both populations face significant constraints in water accessibility.

The access rate in insular villages is lower than that reported by [5], whose doctoral study in the Ndé Department (Western Cameroon) found that 25.4% of households had access to potable water in 2018. These findings also align with [18], who observed that two out of five Africans lack access to safe drinking water, representing the lowest global access rate. According to [19], only 62% of the African population has access to improved water sources 47% in rural areas versus 85% in urban areas, making Africa the region with the weakest water supply coverage globally. This is consistent with the 2023 report of the Joint Monitoring Programme (WHO/UNICEF), which estimates that 2.2 billion people or one in four individuals worldwide do not have access to safely managed drinking water at home [20].

Similar trends are reflected in [15] and [16] from the Regional Directorate of Hydraulics of Tillabéri, which reported that in 2021 the commune of Dessa had a geographical coverage rate of 62.07% and a potable water access rate of 45.9%, while Ayorou had 53.73% coverage and 42.01% access. These figures are likely underestimated due to missing localities in the 2012 RENALOC database.

Nationally, according to the National Drinking Water and Sanitation Program (PN-AEPA 2011-2015), rural water coverage was expected to increase from 74.6% (2010) to 80% (2015), and potable water access from 48% to 58% over the same period. Despite these targets, the results show that inhabitants of the insular and riverside villages of Ayorou and Dessa still suffer from severe drinking water shortages, mainly because the Niger River, their primary water source, is threatened by silting, invasive aquatic species, and population pressure.

3.2.3. Means of Transportation

In the insular and riverside villages, three (3) means of transportation are used to collect water. These findings are lower than those of Yameogo, whose master's thesis on artisanal mining sites in Dossi and Kari (Tuy Province, Burkina Faso) reported that water transport mainly relied on bicycles, with a few carts, tricycles, and pushcarts [21].

3.2.4. Daily Household Water Needs

A degree of inequality exists between insular and riverside villages, as well as between households of different sizes. On average, households in insular villages consist of 7.62 persons, compared to 8.88 persons in riverside villages. The average daily water consumption is 167.64 liters in insular villages and 179.09 liters in riverside villages, equivalent to 22 liters per person per day in insular areas versus 20.16 liters in riverside areas. These values comply with the Nigerien standard (20 L/person/day) but fall below the Cameroonian standard (25 L/person/day).

These results are lower than those of Yameogo, who reported daily consumption averages of 29.6 liters and 31.2 liters per person at the Dossi and Kari sites, respectively [21]. They also align with Alex, who found disparities between urban centers and peripheral zones in Bukavu, DRC, where daily per capita consumption was 155, 100, 50, and 10 liters in residential, business, planned, and peripheral areas, respectively [17].

Similarly, [22] emphasized the uneven distribution of water resources across continents: in France, average consumption is 150 liters per person per day (≈600 liters per household of 4), whereas in Africa, it is about 10 liters per person per day (≈60 liters per household of 6).

Comparable results were observed by [23] in Ouagadougou, where 76% of the population had access to improved water sources, 23% through household connections, and 43% via public taps. These figures align with [24], which reported that in the Democratic Republic of Congo, average consumption is below 100 liters per person per day, compared to 150 L/person/day in Europe and 500 L/person/day in the United States.

3.2.5. Access to Sanitation and Household Waste Management

In insular and riverside villages, 15.5% and 41.5% of surveyed households, respectively, have latrines. These findings indicate that hygiene and sanitation remain inadequate, particularly in insular areas.

These results surpass those of [21], who found that all respondents in Dossi had no latrines, and 88% in Kari practiced open defecation. They also resemble those of Nya (2020) [5], who observed that rudimentary latrines dominate in both urban (47.6% in Bangangté, 30.1% in Bazou, 68.4% in Tonga) and rural areas (17.6% - 27.9% across Bangangté, Bazou, Tonga, and Bassamba).

These findings are consistent with [20], which reported that 4.2 billion people (55% of the global population) lack safely managed sanitation services, far below the Sustainable Development Goal 6 (SDG 6) target to achieve equitable access to water, sanitation, and hygiene for all by 2030 [25]. According to [4], if current trends continue, by 2030, only 81% of the world's population will have safely managed water services, and 67% will have sanitation services.

In sub-Saharan Africa, as noted by [18] and [26], roughly 30% of people still practice open defecation, and traditional latrines remain the most common sanitation system. Similar disparities are observed in the European region, where 48 million people lack piped water and over 300,000 still practice open defecation, mainly in rural areas [20].

According to the National Drinking Water and Sanitation Program (PN-AEPA 2011-2015) in Niger, the proportion of the population with basic sanitation facilities was expected to rise from 7% (2009) to 25% (2015). However, survey results show that a large proportion of residents in insular and riverside villages still practice open defecation.

Regarding solid waste management, 59% and 54% of households in the insular and riverside environments, respectively, dispose of waste in the open air. These rates are higher than those found by [3] in Abéché, Chad (26.79%) and by [5] in Ndé, Cameroon (20%).

For island communities, interventions should prioritize the development of fundamental and resilient infrastructure from the foundational level. This includes strategies such as rainwater harvesting, the implementation of dependable water purification solutions (such as "Pur" sachets), and the encouragement of cost-effective, flood-resistant latrines.

For Riverside Communities, efforts should be directed toward upgrading and sustaining existing infrastructure, such as standpipes and boreholes, as well as implementing comprehensive hygiene promotion initiatives to enhance water treatment and latrine utilization, considering that many households already have access to improved sources but do not utilize them safely. For both, it is essential to empower women in water management. Ultimately, policies must be tailored to the specific context to effectively resolve the distinct barriers encountered by each community.

3.2.6. Limitation

There are certain constraints associated with this research. It primarily depends on self-reported survey data, which may introduce memory bias (in which respondents inaccurately recall past events or behaviors) or social desirability bias, which can impact the accuracy of topics such as water treatment or sanitation practices. The geographic scope is restricted to island and riverside communities in the Ayorou and Dessa communes (Tillaberi Region, Niger), which limits its generalizability to other regions. There is a possibility that potential sampling biases exist, as the 550 households were surveyed in accessible villages over a brief period (June 23-July 3, 2025), potentially excluding isolated groups. Furthermore, water quality assessments are subjective and do not include objective laboratory tests. To enhance the robustness of future research, it is recommended that blended methods, broader sampling, and scientific analyses be implemented.

4. Conclusion

The study on accessibility to drinking water and sanitation in the insular and riverside areas of the rural communes of Ayorou and Dessa (Tillaberi region) is based on field surveys and direct observations. The findings reveal the presence of five (5) main water supply sources. According to the United Nations (UN), access to safe and clean drinking water is a fundamental human right. Yet, the study shows that 88.9% of respondents in insular areas and 36% in riverside areas are deprived of good-quality water. From a sanitation perspective, 84.5% of households in insular areas and 58.5% in riverside areas do not have latrines. This situation underscores the urgent need for a comprehensive water, hygiene, and sanitation development program aimed at improving access rates in both environments. Moreover, awareness campaigns targeting key water resource users, particularly women and children, are essential to minimize the risk of contamination and to promote responsible management of water sources. A two-pronged strategy is suggested to fill crucial water and sanitation gaps: first, in island communities that have very few facilities, build flood-resistant latrines. Second, distribute water purification products. Restoring existing water points and initiating community-led behavior change programs to promote water purification and hygiene should be the priority in riverside areas where infrastructure is lacking. Educational programs aimed at women and children should supplement these efforts to decrease pollution and promote safe water management.

AI-Assisted Technologies Statement

AI tools, including ChatGPT, were employed solely for language refinement. The author retains full responsibility for the content and conclusions of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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