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Assessment of Groundwater Potability of Barangay Actin, Basay and Its Associated Health Risks: Basis for WASH Program

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Abstract. Access to clean and safe drinking water is a universal human right and vital for overall health and well-being. Therefore, assessing water potability is crucial in avoiding waterborne diseases and strengthening Water, Sanitation, and Hygiene (WASH) practices. This study aimed to evaluate the potability of the groundwater in Barangay Actin, Basay, Negros Oriental, focusing on both microbiological and physicochemical parameters during the dry and rainy seasons. It also investigated the associated health risks, which served as the basis for implementing the WASH program. The researcher utilized experimental and descriptive methods in the study. Water samples were collected from a single groundwater source during rainy and dry periods. A third-party laboratory performed microbiological and physicochemical analyses. The respondents included 90 parents and senior high school students from Barangay Actin and Actin National High School, who were the primary consumers of the groundwater source. The study revealed that coliform bacteria and total suspended solids exceeded the limits set by the 2017 Philippine National Standards for Drinking Water (PNSDW), while pH, TSS, TDS, nitrate/nitrite, hardness, and turbidity met the standards. Parents' awareness of waterborne diseases was high for dysentery and moderately high for typhoid fever, amoebiasis, and cholera. Students demonstrated a high level of practice regarding access to safe drinking water and hygiene education at home, while other WASH standards were classified as moderately practiced. Based on the results, the groundwater is contaminated with coliform bacteria and suspended solids, posing health risks to consumers. Thus, monitoring of the untreated water source is recommended to ensure its quality. A strong implementation of the WASH program in schools is also encouraged to help students consistently practice hygiene standards and avoid health risks from water contaminants.

Keywords: Assessment of groundwater potability; WASH program; Waterborne diseases; Water contaminants.

1.0 Introduction

Clean and safe access to drinking water remains a pressing global issue, as contaminated water can endanger individuals' overall health and survival. Most of the residents in Barangay Actin still rely on deep wells and spring water for drinking and household needs. However, no formal water potability assessment has been conducted yet on these sources. Residents have reported waterborne diseases such as amoebic dysentery, diarrhea, and skin allergies, especially during the rainy season when surface runoff may contaminate their water sources. Despite

reporting these health concerns to the local health center, there is no concrete action yet from the local government to address the issue. According to Manetu and Karanja (2021), the development of waterborne diseases is due to the harmful microorganisms in drinking water. Globally, diarrheal illnesses linked to unsafe water rank among the leading causes of diseases and death, resulting in approximately 1.8 million deaths and nearly 4 billion cases of disease each year. In developing countries, groundwater is widely used for drinking, even though its quality poses a health threat. Hamdard et al. (2024) reported that 33.33% of sampled wells in Afghanistan had total coliform bacteria. Similarly, Mendoza et al. (2023) highlighted the importance of assessing groundwater potability, as contaminated water, when drunk, can cause consumers to suffer from diarrhea and other waterborne diseases. These findings reinforce the need for regular monitoring and systematic improvement of water sources to preserve public health. It aligns with the 2030 Sustainable Development Agenda, which advocates universal and equitable access to safe drinking water.

In the Philippines, half of the population depends on groundwater as their primary source of drinking water. Groundwater usage comprised 49% for household consumption, 32% for agricultural purposes, 15% for industrial use, and 4% for other sectors. In addition, recent data reveal that approximately 15.73 million Filipinos live in 212 waterless barangays in Metro Manila and 432 waterless municipalities without access to a safe and reliable water supply (Sumaria, 2024). Therefore, drinking water, particularly groundwater in rural areas, should be treated and regularly tested to prevent chemical and microbial contamination. This initiative is essential in rural communities, where there is limited awareness of water quality standards and minimal efforts to test or treat water for safety.

Despite the community's dependence on groundwater in Barangay Actin, Basay, including Actin National High School, no prior studies have assessed its potability in this area. Existing research conducted within the province of Negros Oriental has primarily focused on other locations, including the assessment of water and bottom sediment quality in the Pagatban River in Bayawan City (Guinoo-II et al., 2015), as well as isotopic assessment of long-term groundwater exploitation in Dumaguete City (Caranto et al., 2006). This lack of localized data presents a significant knowledge gap, particularly in light of increasing environmental and public health concerns associated with groundwater quality. As such, this study offers the first comprehensive evaluation of the physicochemical and microbiological safety of groundwater in Barangay Actin, contributing vital data in raising awareness and developing preventive measures among barangay health workers, local government officials, other agencies from the government such as Department of Environment and Natural Resources (DENR), Department of Science and Technology (DOST), Department of Health (DOH), private sectors and the rest of the community. This initiative seeks to prevent serious health problems among residents. It also aims to educate the students of Actin National High School on proper hygiene practices through the Water, Sanitation, and Hygiene (WASH) program. According to Pandey (2023), the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) developed the WASH program to improve the health and academic performance of school-aged children. Its standards can be applied at home, helping reduce the incidence of waterborne and water-related diseases. When effectively implemented in schools, WASH promotes healthier students who perform better and influence positive hygiene practices within their families and communities.

2.0 Methodology

2.1 Research Design

A groundwater sample from Barangay Actin in Basay was examined and analyzed for its physicochemical characteristics and the presence of microorganisms through laboratory tests. The study employed both experimental and descriptive research designs. It is experimental because the researcher collected water samples twice from the same source, once during the rainy season and once during the dry season, and submitted them for analysis at the Metro Dumaguete Water Laboratory (DOH-accredited laboratory), located at the Metro Dumaguete Water Office on Diego de la Viña Road, Barangay Daro, Dumaguete City, Negros Oriental. The variables were observed and manipulated during the microbiological and physicochemical analyses. The independent variables included the methods, treatments, water source, and storage time applied. On the contrary, the dependent variables are the following parameters: potential hydrogen (pH), total suspended solids (TSS), total dissolved solids (TDS), coliform bacteria, nitrate/nitrite, hardness, and turbidity. The water samples were analyzed to assess the potability and determine if their numerical values did not exceed the established standards. Additionally, the descriptive aspect of the study involved a survey using a self-made questionnaire validated by three medical experts from the Department of Health of Basay and Bayawan, Negros Oriental, Philippines. The main objective of the survey was to assess parents' awareness of waterborne diseases linked to groundwater consumption, as well as the extent to which students practiced the standards of the WASH education program at

home, specifically, access to safe drinking water, improved sanitation facilities, hygiene education, and proper waste disposal.

2.2 Research Environment

The conduct of the study was in Barangay Actin, Basay, Negros Oriental, Philippines, a municipality located in the southern part of Negros Oriental, approximately 119 kilometers from Dumaguete City. The water samples and survey data utilized in the study came from Zones 1, 2, and 6 of Barangay Actin. The inhabitants of the three selected places were consumers of the single groundwater source for a total population of 458. Given the presence of homes, local businesses, and public facilities in the vicinity, assessing water quality is vital to safeguard public health.

2.3 Research Participants

The respondents were 30 households of Zones 1, 2, and 6 and 60 randomly selected senior high school students from Actin National High School. These participants were suitable for the study because they are direct consumers of the groundwater source in Sitio Cutod, Actin, Basay, Negros Oriental, making their responses highly relevant to the objectives of the study. From the total population of 458 households in the three selected zones and 148 senior high school students enrolled in school, the researcher applied random sampling using the fishbowl draw method. The chosen technique is effective for small populations and ensures that each individual has an equal chance of being included. The sample size of 30 households and 60 students was a product of representativeness and manageability. The researcher ensured balanced representation across locations and age groups by selecting 10 household representatives from each zone and 30 students from grades 11 and 12, respectively. This sampling approach enhances the reliability of the findings, given the small population and the aim to understand community health behaviors related to water quality and sanitation.

2.4 Research Instrument

The primary purpose of the laboratory tests was to analyze the physicochemical properties of groundwater and detect the presence of microorganisms. The water analysts from the Metro Dumaguete Water Laboratory analyzed the water samples using the following instruments: potentiometer, gravimeter, spectrophotometer, complexometric titration setup, nephelometer, and incubator. They provided sterilized bottles as containers for the water samples to prevent contamination. Then, the researcher prepared self-made questionnaires for the study. It comprised items that aimed to assess the parents' level of awareness regarding health risks associated with consuming groundwater and to evaluate the extent of students' practices related to the standards outlined in the WASH education program, which include access to safe drinking water, improved sanitation facilities, hygiene education, and proper waste disposal. Three health and sanitation education experts reviewed the questionnaires to ensure content validity. They provided written feedback on the clarity, relevance, and accuracy. Specifically, they recommended modifying the disease descriptions to align with current public health standards. Their suggestions were systematically integrated into the final version of the questionnaire, leading to clarity of the words, improved categorization of items, and better alignment with the study objectives. The researcher conducted a pilot test (dry run) on 60 selected respondents (parents and students) to test the reliability of the questionnaire. Then, the reliability of the items was followed using Cronbach's alpha, which is considered the most appropriate method for survey research involving items that are not scored as right or wrong and may have a range of possible responses (McMillan & Schumacher, 2001). The researcher employed it to verify the internal consistency and reliability of the items. It shows how closely related the items on a scale are, with values ranging from 0 to 1. A higher alpha value is more suitable, and an alpha value of 0.70 is deemed acceptable. The computed Cronbach's alpha value was 0.75, indicating a high level of internal consistency and confirming that the items reliably measured the intended constructs.

2.5 Data Gathering Procedure

Before conducting the study, the researcher incorporated all recommendations and corrections from the panel members. The Schools Division Superintendent of Bayawan City Division and the Barangay Chairman of Barangay Actin received a formal letter of request to carry out the research, following the endorsement from the Ethics Committee of the Foundation University Research Office. Upon approval, the letter was given to the school principal and the target respondents. The researcher clearly explained the purpose of the study to the participants and obtained their informed consent. The researcher also conducted a dry run with parents and students who were not part of the respondent pool to test and refine the research instruments. Then, the materials for the collection of water samples were prepared.

The researcher conducted water sampling twice, once during the rainy period and once during the dry period, to assess seasonal variations in water quality. The same procedures were strictly followed to ensure consistency across both sampling periods, including the sampling location, time of day, water collection technique, and handling protocols. The sampling was done at the groundwater source in Barangay Actin, adhering to the guidelines provided by Metro Dumaguete Water Laboratory. The water body was divided into three sections: left, middle, and right, to collect representative samples. From each section, two 100 mL-sterilized bottles (provided and labeled by the laboratory) were used to collect samples for coliform testing. The containers were submerged directly against the current of the water flow to avoid introducing external elements and to maintain sample purity. The bottles were immediately sealed, wrapped in clean paper for insulation, and stored in a cooler to maintain a stable temperature and prevent contamination during transport. The laboratory received all the samples within the prescribed holding time. Chain-of-custody procedures were followed to ensure the integrity and traceability of all samples the laboratory analysts took.

After the laboratory testing, the Actin National High School respondents and Zones 1, 2, and 6 households answered the validated questionnaires—the selection process employed random sampling through the fishbowl method. The activities, such as follow-ups through personal visits and reminders, ensured the return of all questionnaires, resulting in a 100% retrieval rate. Since the total sample was manageable, the researcher carefully tracked and collected responses, minimizing the possibility of non-response bias. The water test results and survey data were then analyzed and used as references in implementing the WASH education program at Actin National High School.

2.6 Data Analysis

The statistical tools used for data analysis were the weighted mean and the 5-point Likert scale. The weighted mean was applied to determine the level of awareness of parents and students regarding the health risks associated with the consumption of groundwater that can lead to dysentery, typhoid fever, amoebiasis, and cholera, and the extent to which students practice the standards set by the WASH education program, which include access to safe drinking water, improved sanitation facilities, hygiene education, and proper waste disposal. The responses were measured using a 5-point Likert scale and treated as ordinal data. The study presented the following cut-off values to interpret the results and categorize the levels of awareness and extent of practice.

- 4.21 – 5.00 = Strongly Aware (SA) / Strongly Practiced (SP)
- 3.41 – 4.20 = Aware (A) / Practiced (P)
- 2.61 – 3.40 = Moderately Aware (MA) / Moderately Practiced (MP)
- 1.81 – 2.60 = Unaware (U) / Less Practiced (LP)
- 1.00 – 1.80 = Strongly Unaware (SU) /Not Practiced (NP)

These categories helped quantify and interpret the perceptions of both parents and students regarding their awareness of health risks and their adherence to WASH program practices.

2.7 Ethical Considerations

Ethical standards were strictly adhered to throughout the study. Before data collection, the Ethics Committee of the Foundation University Research Office granted ethical clearance. All participants signed a consent form attached to the questionnaire, indicating their informed consent. The process ensured voluntary participation, with measures implemented to protect participants' confidentiality and anonymity. The participants were informed about the potential benefits and risks associated with their involvement in the study. Furthermore, the researcher disclosed the use of OpenAI's GPT-4 and Quillbot as language enhancement tools to improve the clarity and readability of the manuscript. All outputs generated by these tools were critically reviewed and revised by the researcher, who bears full responsibility for the integrity and accuracy of the final content.

3.0 Results and Discussion

3.1 Physicochemical and Microbiological Assessment of the Groundwater Potability in Actin Basay

Table 1 shows that the average pH level of the groundwater source based on the water test results from the three samples is 7.336 pH units. It did not exceed the maximum level of the said parameter.

Table 1. *Quality of the Groundwater as a Drinking Water Resource in Barangay Actin, Physicochemical Analysis: pH (potential hydrogen)*

Period	Method	Results			Average	Maximum Level or Characteristics*	Remarks
		Sample No. 1 *(Left side of the water body)*	Sample No. 2 *(Middle side of the water body)*	Sample No. 3 *(Right side of the water body)*			
Rainy Days	Potentiometry	6.98	7.11	7.02	7.036	6.5 – 8.5 pH units	Passed
Hot/Dry Period	Potentiometry	7.60	7.63	7.68	7.636	6.5 – 8.5 pH units	Passed
Average	**Potentiometry**	**7.29**	**7.37**	**7.35**	**7.336**	**6.5 – 8.5 pH units**	**Passed**

*Based on PNSDW2017

The result is in the normal range, which implies that it is not acidic but just slightly "basic" and could not harm the consumers. A research study by Saalidong et al. (2022) stated that pH is one of the most essential physicochemical factors influencing the behavior of various water quality parameters. Exposure to highly acidic or alkaline water, whether drinking or skin contact, can irritate the eyes, skin, and mucous membranes. As a result, municipal water providers monitor water pH regularly to detect potential contaminants, making it a valuable indicator of water pollution.

Table 2 reveals the water test results of the water source of Barangay Actin based on physicochemical analysis. The average level of TSS is 5.966 mg/L, which means TSS failed the Philippine National Standards for Drinking Water (PNSDW) of 2017 because the water has a high concentration of TSS. According to Kamal and Hashmi (2021), total suspended solids are significant pollutants in water because they offer surfaces for microbes and pathogens to attach to, thereby contributing to water contamination. Elevated levels of TSS and turbidity are associated with the spread of waterborne diseases like cryptosporidiosis, cholera, and giardiasis.

Table 2. *Quality of the Groundwater as a Drinking Water Resource in Barangay Actin: Physicochemical Analysis: TSS (Total Suspended Solids)*

Period	Method	Results			Average	Maximum Level or Characteristics*	Remarks
		Sample No. 1 *(Left side of the water body)*	Sample No. 2 *(Middle side of the water body)*	Sample No. 3 *(Right side of the water body)*			
Rainy Days	Gravimetry	1 mg/L	1.1 mg/L	0.9 mg/L	1 mg/L	-	Failed
Hot/Dry Period	Gravimetry	10.7 mg/L	11.7 mg/L	10.4 mg/L	10.933 mg/L	-	Failed
Average	**Gravimetry**	**5.85 mg/L**	**6.4 mg/L**	**5.65 mg/L**	**5.966 mg/L**	**-**	**Failed**

*Based on PNSDW2017

Humans might experience the said diseases if there is a high concentration of total suspended solids, especially when the percentage of coliform bacteria is also high. Likewise, turbid water, whether caused by organic or inorganic matter, is difficult to disinfect because suspended particles can shield microorganisms from treatment. In addition, an increase in TSS affects the optical clarity of the water and thus impacts the rate of photosynthesis of aquatic organisms (Adjovu et al., 2023). Hence, the water is unfit for drinking because of suspended solids such as silt, plankton, urban runoff, agricultural land, wastewater discharges, algal growth, and even coliform bacteria.

Table 3 shows that the average Total Dissolved Solids (TDS) level is 219 mg/L, which complies with the 2017 Philippine National Standards for Drinking Water (PNSDW) as it remains below the maximum allowable limit. TDS refers to the inorganic salts and trace amounts of organic matter dissolved in water. These comprise calcium, magnesium, sodium, potassium cations, carbonate, bicarbonate, chloride, sulfate, and nitrate anions.

Table 3. *Quality of the Groundwater as Drinking Water Resource in Barangay Actin, Physicochemical Analysis: TDS (Total Dissolved Solids)*

Period	Method	Results			Average	Maximum Level or Characteristics*	Remarks
		Sample No. 1 *(Left side of the water body)*	Sample No. 2 *(Middle side of the water body)*	Sample No. 3 *(Right side of the water body)*			
Rainy Days	Gravimetry	240 mg/L	241 mg/L	227 mg/L	236 mg/L	600 mg/L	Passed
Hot/Dry Period	Gravimetry	205 mg/L	201 mg/L	200 mg/L	202 mg/L	600 mg/L	Passed
Average	**Gravimetry**	**222.5 mg/L**	**221 mg/L**	**213.5 mg/L**	**219 mg/L**	**600 mg/L**	**Passed**

*Based on PNSDW2017

Despite meeting the 2017 PNSDW standards, Pushpalatha et al. (2022) stress the importance of regular TDS monitoring, as elevated levels can pose serious health and environmental risks. These include gastrointestinal, cardiovascular, genotoxic, respiratory, dermatological, and hepatic effects. Conversely, water with very low TDS levels may also be undesirable due to its flat taste and lack of palatability.

Table 4 exposes the water test results of the physicochemical analysis of the parameter nitrate/nitrite. The average of the three (3) samples during the rainy day and dry period is 0.855 mg/L, which means that it did not exceed the given maximum level or characteristics.

Table 4. *Quality of the Groundwater as Drinking Water Resource in Barangay Actin, Physicochemical Analysis: Nitrate/Nitrite*

Period	Method	Results			Average	Maximum Level or Characteristics*	Remarks
		Sample No. 1 *(Left side of the water body)*	Sample No. 2 *(Middle side of the water body)*	Sample No. 3 *(Right side of the water body)*			
Rainy Days	UV Spectrophotometric Screening Method	0.71 mg/L	0.70 mg/L	0.67 mg/L	0.69 mg/L	50 mg/L	Passed
Hot/Dry Period	UV Spectrophotometric Screening Method	1.05 mg/L	0.98 mg/L	1.04 mg/L	1.02 mg/L	50 mg/L	Passed
Average	**UV Spectrophotometric Screening Method**	**0.88 mg/L**	**0.84 mg/L**	**0.845 mg/L**	**0.855 mg/L**	**50 mg/L**	**Passed**

*Based on PNSDW2017

In this study, groundwater does not have higher levels of nitrate concentration; thus, it could not harm the community as consumers of the water source. Verma et al. (2023) noted that nitrate is a common groundwater contaminant from agricultural runoff and improper waste disposal. Prolonged exposure to elevated nitrate levels causes serious health issues such as methemoglobinemia (blue baby syndrome), thyroid dysfunction, and certain cancers. Additionally, nitrate-laden groundwater discharge can contribute to eutrophication, leading to algal blooms, aquatic ecosystem degradation, and adverse socio-economic impacts.

Table 5 illustrates the water test results based on physicochemical analysis. The average of the three (3) samples is 158.333 mg/L, which means it does not exceed the maximum level or characteristics of 300 mg/L. Therefore, the water source passed the 2017 PNSDW in terms of hardness.

Table 5. *Quality of the Groundwater as Drinking Water Resource in Barangay Actin, Physicochemical Analysis: Hardness*

Period	Method	Results			Average	Maximum Level or Characteristics*	Remarks
		Sample No. 1 *(Left side of the water body)*	Sample No. 2 *(Middle side of the water body)*	Sample No. 3 *(Right side of the water body)*			
Rainy Days	EDTA Titrimetry	108 mg/L	102 mg/L	100 mg/L	103.333 mg/L	300 as $CaCO_3$	Passed
Hot/Dry Period	EDTA Titrimetry	215 mg/L	214 mg/L	211 mg/L	213.333 mg/L	300 as $CaCO_3$	Passed
Average	**EDTA Titrimetry**	**161.5 mg/L**	**158 mg/L**	**155.5 mg/L**	**158.333mg/L**	**300 as $CaCO_3$**	**Passed**

*Based on PNSDW2017

The result relates to the study of Vohra et al. (2023), where they explained that total hardness in water is the combined concentration of calcium and magnesium. Elevated levels of total hardness in drinking groundwater may increase the risk of reproductive system disorders, impaired physical development, cardiovascular diseases, and other health issues. The study further emphasizes that excessive concentrations of various physicochemical parameters in groundwater can negatively impact public health. Therefore, regular potability assessments using standard test methods are essential to ensure that water quality parameters remain within acceptable limits.

Table 6 shows that the average of the three samples in terms of turbidity is 0.956 mg/L, which means that the turbidity passed the 2017 PNSDW since the results did not exceed the given maximum level or characteristic. Turbidity is due to suspended materials such as organic, clay, silt, and other inorganic matter in water.

Table 6. *Quality of the Groundwater as Drinking Water Resource in Barangay Actin, Physicochemical Analysis: Turbidity*

Period	Method	Results			Average	Maximum Level or Characteristics*	Remarks
		Sample No. 1 *(Left side of the water body)*	Sample No. 2 *(Middle side of the water body)*	Sample No. 3 *(Right side of the water body)*			
Rainy Days	Nephelometric	1.06 mg/L	0.59 mg/L	0.55 mg/L	0.733 mg/L	5 NTU	Passed
Hot/Dry Period	Nephelometric	0.04 mg/L	1.52 mg/L	1.98 mg/L	1.18 mg/L	5 NTU	Passed
Average	**Nephelometric**	**0.55 mg/L**	**1.055 mg/L**	**1.265 mg/L**	**0.956 mg/L**	**5 NTU**	**Passed**

*Based on PNSDW2017

In this study, the turbidity revealed a positive result, which means it possesses a desirable characteristic of potable water. On the other hand, Fahimah et al. (2023) stated that turbidity harms human health at higher concentrations. If the water is high in turbidity, it allows breeding for harmful microbes. They attach to suspended particles and cause gastrointestinal diseases. Thus, periodic water testing for turbidity, specifically after heavy rainfall or seasonal changes, is essential to ensure that a groundwater source consistently meets the required turbidity standards for drinking water.

Table 7 indicates the microbiological analysis of total coliform bacteria, which is >8.0 MPN/100 mL. It implies that coliform bacteria exceeded the value of their Recommended Contaminant Level (RCL), which is <1.1 MPN/100 mL. Thus, the DCWD laboratory stated that the samples they received failed the 2017 PNSDW. This finding supports the presence of total suspended solids (TSS) in the groundwater, which, as noted by Aram et al. (2021), can protect coliform bacteria. The suspended particles contain mineral precipitates, clay, and organic matter that can shield bacteria through absorption and sedimentation while supplying nutrients that support their survival.

Table 7. *Quality of the Groundwater as Drinking Water Resource in Barangay Actin Microbiological Analysis Result: Coliform Bacteria*

Period	Method	Results			Average	Maximum Level or Characteristics*	Remarks
		Sample No. 1 *(Left side of the water body)*	Sample No. 2 *(Middle side of the water body)*	Sample No. 3 *(Right side of the water body)*			
Rainy Days	Multiple Tube Fermentation Technique (MTFT)	>8.0	>8.0	>8.0	>8.0MPN/ 100mL	<1.1MPN/ 100 mL	Failed
Hot/Dry Period	Multiple Tube Fermentation Technique (MTFT)	>8.0	>8.0	>8.0	>8.0MPN/ 100mL	<1.1MPN/ 100 mL	Failed
Average	**Multiple Tube Fermentation Technique (MTFT)**	**>8.0**	**>8.0**	**>8.0**	**>8.0MPN/ 100 mL**	**<1.1MPN/ 100 mL**	**Failed**

*Based on PNSDW2017

Furthermore, Dey et al. (2022) emphasize that among various microorganisms, coliform bacteria in groundwater pose a significant threat to public health due to their potential to cause outbreaks of waterborne diseases. This issue is particularly critical in developing countries with residents lacking access to safe drinking water. As a result, two million people die annually from waterborne illnesses, with children under the age of five being the most affected due to diarrhea caused by coliform contamination.

Table 8 summarizes the results of the analyses of groundwater as drinking water from three zones in Barangay Actin based on the physicochemical and microbiological parameters of the water samples. The data show that total suspended solids, which have a value of 5.966 mg/L, and coliform bacteria, which have >8.0 MPN/100 mL, are the two essential parameters that exceeded the maximum characteristics and recommended contaminant level. Thus, the groundwater source is positive for microbial contaminants and suspended solids, making the water contaminated and unsafe to drink, especially over a prolonged period with no treatment.

Table 8. *Summary Table of the Quality of the Groundwater as Drinking Water Resource in Barangay Actin*

Physicochemical and Microbiological Analysis Results					
Parameter	**Method**	**Result**	**Units of Measurement**	**Maximum Level or Characteristic/ Recommended Contaminant Level***	**Remarks**
pH	Potentiometry	7.336	pH units	6.5-8.5	Passed
Total Suspended Solids	Gravimetry	5.966	mg/L	-	Failed
Total Dissolved Solids	Gravimetry	219	mg/L	600	Passed
Coliform Bacteria	Multiple Tube Fermentation Technique (MTFT)	>8.0	MPN/100 mL	<1.1	Failed
Nitrate/Nitrite	UV Spectrophotometric Screening Method	0.855	mg/L	50mg/L	Passed
Hardness as CaCO3/L	EDTA Titrimetric	158.333	mg/L	300$CaCO_3$	Passed
Turbidity	Nephelometric Method	0.956	NTU	5 NTU	Passed

*Based on PNSDW2017

Based on the research study of Haniifah et al. (2023), groundwater contamination is closely related to human activities. Rapid population growth and intensified land use contribute to the deterioration of groundwater quality. Various human actions often result in the intentional or unintentional release of chemical or organic waste, which can pollute groundwater sources. Consequently, increased human and industrial activities are factors in the decline of groundwater quality. In addition, contaminated groundwater can lead to outbreaks of infectious diseases, increasing the risk of illness and death. Olalemi et al. (2021) estimate that approximately 1.8 million people die annually from enteric diseases, with around 1,000 children under the age of five in low and middle-income countries dying each month from gastroenteritis or diarrhea. The majority of these cases are due to unsafe drinking water. In Barangay Actin, the Barangay Health Centre reported during the survey that five children aged 1 to 11 years from Zones 2 and 6 experienced episodes of diarrhea. According to the Metro Dumaguete Water Laboratory analyst, consuming water contaminated with coliform bacteria can adversely affect vulnerable individuals, particularly young children and older adults with weakened immune systems. Although water parameters such as potential hydrogen (pH), total dissolved solids, nitrate/nitrite, hardness, and turbidity were within standard limits, close monitoring is still needed, as the water source remains untreated.

3.2 Extent of Awareness of Parents of the Waterborne Diseases that Result in the Consumption of Groundwater

Table 9 shows the data about parents' awareness of dysentery. Indicator numbers 1, 2, 3, and 4 showed high awareness. The weighted means are 3.93, 3.90, 3.70, and 3.57, respectively, which means that the parents are aware that untreated groundwater is the source of microorganisms that can lead to outbreaks of diseases, especially when uncovered, it can be a risk for water contamination and waterborne diseases like dysentery. Statement number 5 has the lowest weighted mean of 3.07, which means that the parents are moderately aware of *Shigella dysenteriae* type 1, which is the cause of dysentery from drinking contaminated water or eating contaminated food.

Table 9. *Extent of Awareness of Parents of the Waterborne Disease (Dysentery) that Results in the Consumption of Groundwater (n = 30)*

The parents are aware that		$\bar{wx}$	**Verbal Description**	**Extent of Awareness**
1.	Untreated groundwater is the source of bacteria and other microorganisms that can lead to outbreaks of diseases.	3.93	Aware	High
2.	Uncovered water sources are at risk of water contamination that can lead to waterborne diseases.	3.90	Aware	High
3.	The symptoms of dysentery are abdominal pain, vomiting, nausea, fever, and dehydration, which can become life-threatening if left untreated.	3.70	Aware	High
4.	Dysentery is an intestinal infection that causes severe diarrhea with blood.	3.57	Aware	High
5.	Drinking water or eating food contaminated with *Shigella dysenteriae* type 1 can cause dysentery.	3.07	Mod. Aware	Moderate
	Composite	**3.63**	**Aware**	**High**

Legend:	**Scale**	**Verbal Description**	**Extent of Awareness**
	4.21 – 5.00	Strongly Aware	Very High
	3.41 – 4.20	Aware	High
	2.61 – 3.40	Moderately Aware	Moderate
	1.81 – 2.60	Unaware	Low
	1.00 – 1.80	Strongly Unaware	Very Low

Hence, as an overall result, the parents of Barangay Actin are aware of dysentery as a waterborne disease from groundwater. Based on the data, they are aware that dysentery, as a waterborne disease, is associated with drinking contaminated water; however, the residents continue to believe that their groundwater is free from microbial contaminants since they do not have the baseline data of the physiological and physicochemical characteristics of their water source. This finding aligns with a study conducted in Pakistan, where 67.5% of respondents were aware of the negative impact of poor water quality on human health, as they were directly experiencing water-related problems (Javaid et al., 2022).

Table 10 illustrates distinct levels of awareness of the parents from Zones 1, 2, and 6 about typhoid fever as one of the waterborne diseases due to groundwater. Indicators from items 2 to 5 have weighted means of 3.40, 3.27, 2.83, and 2.83, respectively. These results are under a moderate level of awareness, which means that the parents are moderately aware of the causes, origin, signs, and other symptoms of typhoid fever. Indicator number 1 reveals a higher level of awareness wherein the parents are aware of the symptoms of typhoid fever, abdominal pain, vomiting, headache, diarrhea, tiredness, rash, and flat, dry cough.

Table 10. *The Extent of Awareness of Parents of the Waterborne Disease (Typhoid Fever) that Results in the Consumption of Groundwater (n = 30)*

	The parents are aware that	$w\bar{x}$	Verbal Description	Extent of Awareness
1.	The symptoms of typhoid fever are high fever, abdominal pain, vomiting, headache, diarrhea, tiredness, rash, and a flat, dry cough.	3.77	Aware	High
2.	Typhoid fever spreads via contaminated water.	3.40	Mod. Aware	Moderate
3.	Another sign of typhoid fever is when it starts at a low temperature and increases daily, possibly reaching as high as 104.90°F (40.50 °C).	3.27	Mod. Aware	Moderate
4.	Contaminated water with *Salmonella typhi* bacteria can cause typhoid fever.	2.83	Mod. Aware	Moderate
5.	Remain still and fatigued, with eyes partially closed, in a condition referred to as the typhoid state.	2.83	Mod. Aware	Moderate
	Composite	**3.22**	**Mod. Aware**	**Moderate**

Legend:	Scale	Verbal Description	Extent of Awareness
	4.21 – 5.00	Strongly Aware	Very High
	3.41 – 4.20	Aware	High
	2.61 – 3.40	Moderately Aware	Moderate
	1.81 – 2.60	Unaware	Low
	1.00 – 1.80	Strongly Unaware	Very Low

In general, concerning this area, the level of awareness of people in Barangay Actin is moderate, as shown in its composite mean, which is 3.22. The result is opposite to the findings of Wagaja et al. (2023), where 80% of respondents were aware that contaminated water can lead to diseases such as typhoid fever, cholera, and diarrhea. Given the presence of microbial contaminants in various groundwater sources, the study recommended boiling and filtering water before consumption. In Barangay Actin, particularly in Zones 1, 2, and 6, residents rely on untreated groundwater from wells, which have not been checked for potability ever since.

Meanwhile, the data in Table 11 present the level of awareness of parents on amoebiasis due to contaminated water. Indicators from items 1 to 4 have a moderate awareness based on their weighted means of 3.37, 3.23, 3.17, and 3.00, respectively. The results imply that the parents of Zones 1, 2, and 6 are moderately aware of the symptoms, transmission, and causes of amoebiasis. However, indicator number 5 shows the lowest weighted mean of 2.57, which signifies that the parents are unaware of the cystic nuclei of *Entamoeba histolytica* transmitted through non-chlorinated drinking water sources contaminated with human feces. People in Zones 1, 2, and 6 are moderately aware of the existence of *Entamoeba histolytica,* its transmission, and its symptoms, as indicated in its composite mean of 3.07.

About *Entamoeba histolytica,* Xie et al. (2023) identified it as one of the most common pathogenic protozoa found in groundwater, along with *Cryptosporidium parvum* and *Giardia lamblia*. These protozoa are responsible for cryptosporidiosis, giardiasis, and amoebiasis, respectively. While infections caused by these parasites may be self-limiting in healthy individuals, they can lead to life-threatening conditions such as severe diarrhea, encephalitis, and dysentery in vulnerable populations. Therefore, proper hygiene, reliable sanitation, access to safe drinking water, and a clean environment are essential preventive measures against the spread of such waterborne diseases.

Table 11. *Extent of Awareness of Parents of the Waterborne Disease (Amoebiasis) that Results in the Consumption of Groundwater (n = 30)*

The parents are aware that	$w\bar{x}$	Verbal Description	Extent of Awareness
1. Diarrhea, abdominal cramps, and stomach pain are symptoms of amoebiasis.	3.37	Mod. Aware	Moderate
2. Amoebiasis can spread between people when hands are not washed well and contaminated objects are shared.	3.23	Mod. Aware	Moderate
3. Fecal-contaminated water transmits amoebiasis as a result of poor environmental and institutional sanitation.	3.17	Mod. Aware	Moderate
4. The presence of parasites like *Entamoeba histolytica* can result in disease outbreaks.	3.00	Mod. Aware	Moderate
5. Non-chlorinated drinking water contaminated with human feces transmits the cysts of *Entamoeba histolytica*.	2.57	Unaware	Low
Composite	**3.07**	**Mod. Aware**	**Moderate**

Legend:	Scale	Verbal Description	Extent of Awareness
	4.21 – 5.00	Strongly Aware	Very High
	3.41 – 4.20	Aware	High
	2.61 – 3.40	Moderately Aware	Moderate
	1.81 – 2.60	Unaware	Low
	1.00 – 1.80	Strongly Unaware	Very Low

Table 12 emphasizes the extent of awareness of parents of cholera, which is a result of consuming unprotected and untreated groundwater. The data specifies the value of weighted means for each indicator of the waterborne disease. Based on the table, indicators 1 and 2 have higher levels of awareness with weighted means of 3.60 and 3.43, respectively. This means that the parents are aware of the presence of bacteria and viruses from septic tank leakages that can contaminate the groundwater source, and even from drinking the contaminated water. On the other hand, indicators 3 to 6 have weighted means of 3.37, 3.23, 3.20, and 3.03, respectively. The value of the "composite mean" is 3.31. It suggests that the parents of Zones 1, 2, and 6 are moderately aware of cholera.

Table 12. *Extent of Awareness of Parents of the Waterborne Disease (Cholera) that Results in the Consumption of Groundwater (n = 30)*

The parents are aware that	$w\bar{x}$	Verbal Description	Extent of Awareness
1. Sewage and septic tank leakages can run into groundwater and contaminate it with microorganisms like bacteria and viruses.	3.60	Aware	High
2. One can become infected after eating food or drinking water that has the feces of an infected person	3.43	Aware	High
3. Cholera is an acute infection that begins with painless, watery diarrhea and vomiting.	3.37	Mod. Aware	Moderate
4. Severe, untreated cholera can lead to rapid dehydration and shock of death.	3.23	Mod. Aware	Moderate
5. Vegetables and fruits washed with contaminated water from sewage may also transmit the infection *V. cholerae*.	3.20	Mod. Aware	Moderate
6. Cholera is caused by *Vibrio cholerae* through drinking contaminated water or eating contaminated food.	3.03	Mod. Aware	Moderate
Composite	**3.31**	**Mod. Aware**	**Moderate**

Legend:	Scale	Verbal Description	Extent of Awareness
	4.21 – 5.00	Strongly Aware	Very High
	3.41 – 4.20	Aware	High
	2.61 – 3.40	Moderately Aware	Moderate
	1.81 – 2.60	Unaware	Low
	1.00 – 1.80	Strongly Unaware	Very Low

Martini et al. (2023) mentioned that cholera is an acute intestinal infection caused by consuming the bacterium *Vibrio cholerae*, which can be present in contaminated food or water. It can lead to severe diarrhea, dehydration, and even death. Clean water and proper hygiene are essential for prevention. To control cholera outbreaks and reduce mortality, it is crucial to carefully monitor hygiene conditions in communities, ensure access to clean drinking water, and strengthen and promote treatment and vaccines against cholera.

Table 13 presents the summary of the results of the survey on the extent of parents' awareness about waterborne diseases like dysentery, typhoid fever, amoebiasis, and cholera, in the consumption of groundwater. Based on the data, the awareness of dysentery has the highest composite mean of 3.63, which means that the parents of Zones

1, 2, and 6 are highly aware of the indicators of this disease. However, typhoid fever, amoebiasis, and cholera results have lower values than dysentery, with composite means of 3.22, 3.07, and 3.31, respectively.

Table 13. *Summary Table of the Extent of Awareness of Parents on Waterborne Disease that Results in the Consumption of Groundwater (n = 30)*

Areas	$w\bar{x}$	Verbal Description	Extent of Awareness
1. Dysentery	3.63	Aware	High
2. Typhoid Fever	3.22	Mod. Aware	Moderate
3. Amoebiasis	3.07	Mod. Aware	Moderate
4. Cholera	3.31	Mod. Aware	Moderate

Legend:	Scale	Verbal Description	Extent of Awareness
	4.21 – 5.00	Strongly Aware	Very High
	3.41 – 4.20	Aware	High
	2.61 – 3.40	Moderately Aware	Moderate
	1.81 – 2.60	Unaware	Low
	1.00 – 1.80	Strongly Unaware	Very Low

The result implies that the parents are moderately aware of waterborne diseases' characteristics, causes, signs, and symptoms. People are not well informed that water contamination due to the presence of microbes will lead to serious diseases that may threaten lives. Since the inhabitants of Barangay Actin are not yet well-informed of the overall status of their drinking water, they are still using it today. Similarly, Javaid et al. (2022) emphasized that the majority of the population in Pakistan is aware of pathogen contamination; however, they still rely on untreated water sources due to limited access to clean and safe water. Therefore, the factors that can increase the chances of contamination are inadequate water supply, poor sanitary conditions, uncovered sources of drinking water, defecation in the open near drinking water sources, poor systems for human waste disposal, and lack of awareness among populations.

3.3 Extent of the Standards stipulated in the WASH Education Program Practiced by the Students in their Homes

Table 14 reflects the data gathered from the survey on the extent of practices under access to safe drinking water as one of the standards stipulated in Water, Sanitation, and Hygiene (WASH). Indicator one has the highest weighted mean of 4.33, which means that the senior high school students at Actin National High School "strongly practiced" the safe handling approach of drinking water. However, indicator five got the lowest weighted mean of 3.17, which means that boiling water for three minutes taken from an unprotected water source was "moderately practiced" by students. The data revealed that the extent of students' practice in this area is high, as shown in its composite mean of 3.72. Thus, the senior high school students at Actin National High School are doing the standards in their homes to a high level of practice.

Table 14. *The Extent to which Access to Safe Drinking Water is Practiced by Students in their Homes (n = 60)*

Students practiced the following:	$w\bar{x}$	Verbal Description	Extent of Practice
1. Safe handling of drinking water involves keeping water containers clean and free from potential contaminants.	4.33	Strongly Practiced	Very High
2. Safe disposal of human waste.	4.17	Practiced	High
3. Safe disposal of wastewater.	3.82	Practiced	High
4. Safe disposal of solid waste.	3.75	Practiced	High
5. Boiling water for three (3) minutes from an unprotected water source during the rainy season is essential.	3.17	Mod. Practiced	Moderate
Composite	**3.72**	**Practiced**	**High**

Legend:	Scale	Verbal Description	Extent of Awareness
	4.21 – 5.00	Strongly Practiced	Very High
	3.41 – 4.20	Practiced	High
	2.61 – 3.40	Moderately Practiced	Moderate
	1.81 – 2.60	Less Practiced	Low
	1.00 – 1.80	Not Practiced	Very Low

This result supports the statements made by Abegaz and Midekssa (2021) that having a safe and sufficient water supply is essential for protecting human health. Providing safe drinking water and sanitation for all is a priority in global development policy as promulgated in Goal 6 of the Sustainable Development Goals (SDGs).

Table 15 indicates the differences in the levels of practices on improved sanitation facilities of senior high students in their homes. Based on the table, washing hands after using the toilet is a standard "strongly practiced" by the students since it has a weighted mean of 4.42. The result implies that they practice hand washing regularly after

exposing themselves to areas vulnerable to microorganisms. Thus, effective management of water and sanitation facilities, supported by ongoing hygiene promotion, can help ensure safe hygiene practices in households, schools, and institutions. In the study by Jatrana et al. (2021), the authors emphasized that one of the most vital hygiene behaviors to promote among school children is proper hand washing with soap. Hand washing with soap offers potential health benefits, especially in developing countries. Therefore, schoolchildren must practice good sanitation habits, such as keeping toilets clean, carrying water, and managing solid waste properly.

Table 15. *The Extent to which Improved Sanitation Facilities are Practiced by Students in their Homes (n = 60)*

Students practiced the following:	$w\bar{x}$	Verbal Description	Extent of Practice
1. Wash your hands every time after using the toilet.	4.42	Strongly Practiced	Very High
2. An adequate water supply for flushing and hand washing must be available at home.	4.10	Practiced	High
3. Toilets are hygienic to use and easy to clean at home.	4.07	Practiced	High
4. Hand washing and cleaning materials like soap, a mug, and a brush must be available in the toilet at home.	4.02	Practiced	High
5. A cleaning and maintenance routine is in operation that ensures clean and functioning toilets are available at all times at home.	3.95	Practiced	High
6. The toilet has a leach pit for disposing of wastewater.	3.82	Practiced	High
7. Regularly cleaning out the storage container with soap or chlorine.	3.68	Practiced	High
8. Ensure functional hand-washing and tooth-brushing facilities.	3.62	Practiced	High
9. Disinfect water using household bleach.	2.75	Mod. Practiced	Moderate
10. Toilets have convenient hand-washing facilities close by at home.	2.73	Mod. Practiced	Moderate
Composite	**3.15**	**Mod. Practiced**	**Moderate**

Legend: Scale	Verbal Description	Extent of Awareness
4.21 – 5.00	Strongly Practiced	Very High
3.41 – 4.20	Practiced	High
2.61 – 3.40	Moderately Practiced	Moderate
1.81 – 2.60	Less Practiced	Low
1.00 – 1.80	Not Practiced	Very Low

Further, it can be observed from the data that items 9 and 10 have the lowest weighted means of 2.75 and 2.73, respectively, which provides an idea that there are students who moderately practiced disinfecting water using household bleach and have toilets and hand washing facilities that are convenient to use. The composite mean for improved sanitation facilities is 3.15, which means that the level of practice is moderate. Therefore, sanitation plays a significant role in community well-being as it safeguards public health, increases life expectancy, and contributes to economic benefits.

The data in Table 16 reveal that among the sixteen hygiene education practice standards, only items 1 to 4 show a remarkably high extent of practice, with weighted means of 4.65, 4.58, 4.35, and 4.22, respectively. The result suggests that senior high school students consistently practice personal cleanliness and self-discipline by wearing clean and appropriate clothing, washing their hands before handling ready-to-eat foods, and performing handwashing before and after food preparation.

According to Kumari (2021), maintaining clean hands through proper hand hygiene is one of the most effective ways to prevent illness and stop the spread of germs. Various diseases are transmitted due to the failure to wash hands with soap and clean running water, making this practice a vital component of hygiene education. However, hygiene practices such as removing watches and jewelry during food production, avoiding blowing air into plastic bags before use, wearing a mask and hairnet when cooking, and wearing a clean uniform during food preparation are moderately practiced at home. These practices received weighted means of 3.15, 3.12, 2.90, and 2.90, respectively, indicating a moderate level of practice. Teachers must emphasize these practices during classes, as bacteria and viruses are transmitted and present in affected environments. Students must understand that good hygiene supports overall health and well-being through cleanliness. Thus, promoting proper hygiene is essential for maintaining good health and upholding positive attitudes toward community sanitation.

Table 16. *The Extent to which Hygiene Education is Practiced by Students in their Homes (n = 60)*

Students practiced the following:		$w\bar{x}$	Verbal Description	Extent of Practice
1.	Maintain personal cleanliness and self-discipline.	4.65	Strongly Practiced	Very High
2.	Wear clean and appropriate clothes.	4.58	Strongly Practiced	Very High
3.	Wash hands before touching ready-to-eat foods.	4.35	Strongly Practiced	Very High
4.	Wash hands before and after handling food.	4.22	Strongly Practiced	Very High
5.	Wash hands after handling the garbage.	4.05	Practiced	High
6.	Hands must washed after cleaning tables.	4.05	Practiced	High
7.	Wash hands before touching raw or cooked foods.	3.97	Practiced	High
8.	Separate raw, cooked, and ready-to-eat foods.	3.93	Practiced	High
9.	Cover their mouth and nose when coughing or sneezing.	3.82	Practiced	High
10.	Foods are packed in sealed wrapping or must have proper serving utensils such as tongs or spoons.	3.68	Practiced	High
11.	Use a clean towel to wipe the hands after washing.	3.67	Practiced	High
12.	Ensure the nails are clean, short, and without polish or artificial nails.	3.55	Practiced	High
13.	Remove watches and jewelry during food production.	3.15	Mod. Practiced	Moderate
14.	Avoid blowing air into polythene bags before use.	3.12	Mod. Practiced	Moderate
15.	Wear a mask and hairnet when cooking food.	2.90	Mod. Practiced	Moderate
16.	Wear a clean uniform during the preparation of food.	2.90	Mod. Practiced	Moderate
	Composite	**3.79**	**Practiced**	**High**

Legend:	Scale	Verbal Description	Extent of Awareness
	4.21 – 5.00	Strongly Practiced	Very High
	3.41 – 4.20	Practiced	High
	2.61 – 3.40	Moderately Practiced	Moderate
	1.81 – 2.60	Less Practiced	Low
	1.00 – 1.80	Not Practiced	Very Low

The results in Table 17 indicate that proper disposal of wastewater away from groundwater sources and waste segregation are categorized as highly practiced by students in their homes, as reflected in the weighted mean of 3.83 and 3.57, respectively. The result justifies that students applied the good practices of Actin National High School regarding the solid waste management program. It includes the proper segregation of wastes and the reuse and recycling methods implemented by the school since the beginning of the school year. However, indicators from items 3 to 7 are those factors with lower weighted means, such as 3.38, 3.33, 3.32, 2.85, and 2.85, respectively. The data reveal that the utilization of compost pits, cleaning of garbage bins, employing recycling initiatives for school projects, proper collection of waste, and the use of cloth bags instead of plastic bags are "moderately practiced" by the students.

Table 17. *The Extent to which Proper Waste Disposal is Practiced by Students in their Homes (n = 60)*

Students practiced the following:		$w\bar{x}$	Verbal Description	Extent of Practice
1.	Wastewater must be safely disposed of and kept away from groundwater sources.	3.83	Practiced	High
2.	Segregation of waste is practiced in the classroom and applied at home.	3.57	Practiced	High
3.	Designate areas for compost pits away from groundwater sources.	3.38	Mod. Practiced	Moderate
4.	Ensure that the garbage bins are clean every day.	3.33	Mod. Practiced	Moderate
5.	Integrate recycling initiatives for school projects.	3.32	Mod. Practiced	Moderate
6.	Solid waste is collected from homes daily and safely disposed of to prevent contamination of groundwater sources.	2.85	Mod. Practiced	Moderate
7.	Use cloth bags instead of plastic bags.	2.85	Mod. Practiced	Moderate
	Composite	**3.30**	**Mod. Practiced**	**Moderate**

Legend:	Scale	Verbal Description	Extent of Awareness
	4.21 – 5.00	Strongly Practiced	Very High
	3.41 – 4.20	Practiced	High
	2.61 – 3.40	Moderately Practiced	Moderate
	1.81 – 2.60	Less Practiced	Low
	1.00 – 1.80	Not Practiced	Very Low

Overall, the composite mean is 3.30, indicating that proper waste disposal, one of the standards stipulated in WASH, has been moderately practiced by the learners in their respective homes. Based on the study of Raphela

et al. (2024), improper waste disposal can lead to breeding grounds for disease-carrying vectors like mosquitoes, flies, and rodents. It increases the risk of diseases such as malaria, dengue fever, and leptospirosis, which can become a problem to human health and well-being. Uncollected waste, for example, often clogs drains and stagnates water. The breeding of mosquitoes or the contamination of water bodies can spread waterborne diseases. Thus, the level of practice in proper waste disposal must improve to avoid those health risks.

The data in Table 18 highlight the summary of results on the extent of the standards stipulated in the WASH education program, which are practiced by senior high school students in their homes. Access to safe drinking water and hygiene education are the two significant WASH standards categorized as highly practiced by students. The weighted means are 3.72 and 3.79, respectively. The findings suggest that the students have exercised the right to access safe drinking water and employ good hygiene since they practice the standards at home 61 to 80% of the time. However, improved sanitation facilities and proper waste disposal are the key WASH standards that received a composite mean of 3.15 and 3.30, respectively.

Table 18. *The Summary of the Extent to which Standards Stipulated in the WASH Education Program are Practiced by Students in their Homes (n = 60)*

Areas	$\bar{wx}$	Verbal Description	Extent of Practice
1. Access to safe drinking water	3.72	Practiced	High
2. Improved sanitation facilities	3.15	Mod. Practiced	Moderate
3. Hygiene Education	3.79	Practiced	High
4. Proper waste disposal	3.30	Mod. Practiced	Moderate

Legend:	Scale	Verbal Description	Extent of Awareness
	4.21 – 5.00	Strongly Practiced	Very High
	3.41 – 4.20	Practiced	High
	2.61 – 3.40	Moderately Practices	Moderate
	1.81 – 2.60	Less Practiced	Low
	1.00 – 1.80	Not Practiced	Very Low

Thus, the students are not particular about proper waste disposal and maintaining good sanitation. They practiced the WASH standards only 40% to 60% of the time, highlighting the need to implement a WASH education program. This initiative aims to raise students' awareness and encourage consistent application of these standards at home, ultimately helping to protect their families and communities from contaminants that cause waterborne diseases.

4.0 Conclusion

Access to potable water is pivotal to public health, serving as a foundation for disease prevention and the promotion of overall well-being. Even in communities struggling to maintain water quality, providing safe drinking water is essential for preventing illnesses and protecting the health and safety of all residents. This study assessed the potability of groundwater in Barangay Actin, Basay, Negros Oriental. It also investigated the associated health risks, which served as the basis for implementing the WASH program. The groundwater in Barangay Actin met the 2017 Philippine National Standards for Drinking Water (PNSDW) for pH, total dissolved solids, nitrate/nitrite, hardness, and turbidity. However, it did not meet total suspended solids and coliform bacteria standards. Thus, there is a need for the local government unit, health workers of Barangay Actin, other agencies such as DENR, DOST, DOH, and private sectors to design appropriate activities for regular monitoring of the groundwater source to ensure its integrity and quality and to avoid chances for more bacteria to inhabit which may lead to certain health risks. Water potability tests may be conducted, and other priority water quality parameters such as arsenic, lead, salinity, and *E. coli* may be used to achieve more accurate and reliable results. Regular groundwater source cleaning and maintenance can ensure its quality and safety.

Furthermore, the extent of parents' awareness of the different waterborne diseases associated with groundwater consumption is high for dysentery and moderately high for typhoid fever, amoebiasis, and cholera. This result underscores the importance of conducting seminars for the residents and water consumers to raise awareness about the different waterborne pathogens and the health risks that may be experienced from using unprotected water sources. Moreover, the extent of practice by students of the WASH program at home is high on access to safe drinking water and hygiene education, and moderately high on improved sanitation facilities and proper waste disposal. Hence, a strong implementation of the WASH education program with its doable action plan can help improve students' consistency in the practices and standards and help them avoid the various health risks from water contaminants.

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The researcher solely authored this research.

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7.0 Conflict of Interests

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9.0 References

Abegaz, M. T., & Midekssa, M. J. (2021). Quality and safety of rural community drinking water sources in Guto Gida District, Oromia, Ethiopia. Journal of Environmental and Public Health, 2021(1), 5568375. https://doi.org/10.1155/2021/5568375

Adjovu, G. E., Stephen, H., James, D., & Ahmad, S. (2023). Measurement of total dissolved solids and total suspended solids in water systems: A review of the issues, conventional, and remote sensing techniques. Remote Sensing, 15(14), 3534. https://doi.org/10.3390/rs15143534

Aram, S. A., Saalidong, B. M., & Lartey, P. O. (2021). Comparative assessment of the relationship between coliform bacteria and water geochemistry in surface and groundwater systems. PLOS One, 16(9), e0257715. https://doi.org/10.1371/journal.pone.0257715

Caranto, J. A., Pamatian, P. I., & Ogena, M. S. (2006). Chemical and isotopic trends in the Southern Negros geothermal field and the shallow groundwater aquifer in Dumaguete City due to long-term exploitation. International Atomic Energy Agency, 213. https://tinyurl.com/5xfvpt23

Dey, U., Sarkar, S., Duttagupta, S., Bhattacharya, A., Das, K., Saha, S., & Mukherjee, A. (2022). Influence of hydrology and sanitation on groundwater coliform contamination in parts of Western Bengal basin: Implication to safe drinking water. Frontiers in Water, 4, 875624. https://doi.org/10.3389/frwa.2022.875624

Fahimah, N., Salami, I. R. S., Oginawati, K., & Thaher, Y. N. (2023). Variations of groundwater turbidity in the Bandung Regency, Indonesia: From community-used water quality monitoring data. Hydro Research, 6, 216-227. https://doi.org/10.1016/j.hydres.2023.06.001

Guino-o II, R. S., Alcala, M. L. R., & Basa-Inocencio, J. E. P. (2015). Water and bottom sediment quality of Pagatban River in Negros Oriental, Philippines: 30 years after mining closure. Silliman Journal, 56(1) https://tinyurl.com/ttw8u5kp

Hamdard, M. H., Rahmani, S. R., Shnizai, Z., & Kløve, B. (2024). Groundwater quality assessment in Upper Kabul basin and Paghman Aquifer. Journal of Environmental Science and Health, Part A, 59(7), 321–333. https://doi.org/10.1080/10934529.2024.2384803

Haniifah, D., Soesilo, T. E. B., & Martono, D. N. (2023). Evaluation of factors and biological parameters of the groundwater in Makasar Subdistrict, East Jakarta. Journal of Environmental Health, 15(1). https://doi.org/10.20473/jkl.v15i1.2023.46-55

Jatrana, S., Hasan, M. M., Mamun, A. A., & Fatima, Y. (2021). Global variation in hand hygiene practices among adolescents: The role of family and school-level factors. International Journal of Environmental Research and Public Health, 18(9), 4984. https://doi.org/10.3390/ijerph18094984

Javaid, M., Qasim, H., Zia, H.Z., Bashir, M.A., Hameed, A., Samiullah, K., Hashem, M., Morsy, K., Dajem, S.B., Muhammad, T., Shaheen, M., Muhammad, Y.A., Saeed, M., Alasmari, A., & Alshehri, M. A. (2022). Bacteriological composition of groundwater and its role in human health. Journal of King Saud University-Science, 34(6), 102128. https://doi.org/10.1016/j.jksus.2022.102128

Kamal, H., & Hashmi, I. (2021). Water quality assessment of raw and chlorinated drinking water of a residential university. NUST Journal of Engineering Sciences. 14. 12–19. https://doi.org/10.24949/njes.v14i1.633

Kumari, I. L. (2021). Effectiveness of educational intervention on knowledge, attitude, and practice regarding hand washing among primary school children. International Journal of Applied Social Science, 8 (3-6) https://tinyurl.com/2kwwbk8u

Manetu, W. M., & Karanja, A. M. (2021). Waterborne disease risk factors and intervention practices: A review. Open Access Library Journal, 8(5), 1-11. https://doi.org/10.4236/oalib.1107401

Martini, M., Minet, C., & Orsini, D. (2023). The specter of cholera in Libya and North Africa: Natural disasters and anthropization threaten human health during recent years. Journal of Preventive Medicine and Hygiene, 64(3), E340. https://doi.org/10.15167/2421-4248/jpmh2023.64.3.3102

McMillan, J. H., & Schumacher, S. (2001). Research in education: A conceptual introduction. Longman.

Mendoza, K., Ortiz, B., Rivera, L., Peña, T., Chirinos-Escobar, M., Enríquez, L., Maldonado, V., & Fontecha, G. (2023). Monitoring of microbial contamination of groundwater in the Upper Choluteca River Basin, Honduras. Water, 15(11), 2116. https://doi.org/10.3390/w15112116

Olalemi, A. O., Ige, O. M., James, G. A., Obasoro, F. I., Okoko, F. O., & Ogunleye, C. O. (2021). Detection of enteric bacteria in two groundwater sources and microbial health risks. Journal of Water and Health, 19(2), 322-335. https://doi.org/10.2166/wh.2021.212

Pandey, J. (2023). Water, Sanitation, and Hygiene (WASH): Pillars of global health and sustainable development. International Journal of Academic Research & Development, 10(2) https://tinyurl.com/5ap2as66

Pushpalatha, N., Sreeja, V., Karthik, R., & Saravanan, G. (2022). Total dissolved solids and their removal techniques. International Journal, 2(2). https://tinyurl.com/578w33yw

Raphela, T., Manqele, N., & Erasmus, M. (2024). The impact of improper waste disposal on human health and the environment: A case of uMgungundlovu District in KwaZulu Natal Province, South Africa. Frontiers In Sustainability, 5, 1386047. https://doi.org/10.3389/frsus.2024.1386047

Saalidong, B. M., Aram, S. A., Otu, S., & Lartey, P. O. (2022). Examining the dynamics of the relationship between water pH and other water quality parameters in ground and surface water systems. PLOS One, 17(1), e0262117. https://doi.org/10.1371/journal.pone.0262117

Sumaria, M. G. (2024). Assessment of the quality of groundwater wells in the island municipality of Panglao, Bohol, Philippines. Annals of Tropical Research, 46(1), 120–139. https://doi.org/10.32945/atr4619.2024

Verma, A., Sharma, A., Kumar, R., & Sharma, P. (2023). Nitrate contamination in groundwater and associated health risk assessment for Indo-Gangetic Plain, India. Groundwater for Sustainable Development, 23, 100978. https://doi.org/10.1016/j.gsd.2023.100978

Vohra, P., Kakodia, A. K., Lal, S., & Tanwar, K. (2023). Review on physicochemical characteristics of groundwater and their health effects. Journal of Mechanical Construction Engineering, 3(1), 1–8. https://doi.org/10.54060/jmce.v3i1.30

Wagaja, K. S., Hassan, M., & Abdullahi, J. (2023).Examination of people's perception of the quality of groundwater and health implications in Suleimanti Area, Maiduguri, Borno State, Nigeria. Journal of Water Resources and Pollution Studies, 8(3), 28-33. https://tinyurl.com/bmre6766

Xie, X., Shi, J., Pi, K., Deng, Y., Yan, B., Tong, L., Yao, L., Dong, Y., Li, J., Ma, L., Zheng, C., & Jiang, G. (2023). Groundwater quality and public health. Annual Review of Environment and Resources, 48(1), 395–418. https://doi.org/10.1146/annurev-environ-112321-114701