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Evaluation of Drilled Well Water Quality Based on Physical and Chemical Parameters at the Buyat Community Health Center (UPTD Puskesmas), East Bolaang Mongondow Regency

Hanief Prasetya Paputungan[1]
[1]Public Health, Ngudi Waluyo, Indonesia

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ABSTRAK

Air bersih merupakan komponen vital dalam layanan kesehatan yang mendukung sanitasi, pencegahan infeksi, dan kegiatan operasional fasilitas kesehatan. Penggunaan sumur bor sebagai sumber air utama masih umum dijumpai pada fasilitas kesehatan tingkat pertama, termasuk di Kabupaten Bolaang Mongondow Timur. Penelitian ini bertujuan untuk mengevaluasi kualitas air sumur bor berdasarkan parameter fisik dan kimia serta membandingkannya dengan standar mutu yang berlaku. Penelitian ini menggunakan desain observasional deskriptif yang dilaksanakan selama satu bulan di UPTD Puskesmas Buyat. Sampel penelitian berupa air minum yang diambil dari sumur bor utama. Parameter yang diperiksa meliputi pH, Total Dissolved Solids (TDS), dan konsentrasi besi (Fe). Hasil pengukuran menunjukkan nilai pH sebesar 7,5, nilai TDS sebesar 161 mg/L, dan konsentrasi besi (Fe) sebesar 0,04 mg/L. Seluruh parameter memenuhi standar mutu berdasarkan peraturan yang berlaku. Dengan demikian, kualitas air sumur bor di UPTD Puskesmas Buyat dinilai layak untuk mendukung layanan kesehatan dan kegiatan sanitasi

Keywords

Clean water; Primary healthcare facilities; Water quality; Borehole; TDS

ABSTRACT

Clean water is a vital component of healthcare services, supporting sanitation, infection prevention, and the operational activities of healthcare facilities. The use of boreholes as the primary water source remains common in primary healthcare facilities, including those in East Bolaang Mongondow Regency. This study aims to evaluate the quality of borehole water based on physical and chemical parameters and to compare it with applicable quality standards. The study employed a descriptive observational design conducted over one month at the Buyat Community Health Center (UPTD Puskesmas). The study sample consisted of drinking water collected from the main borehole. The parameters examined included pH, Total Dissolved Solids (TDS), and iron (Fe) concentration. The measurement results showed a pH valite of 7.5, a TDS value of 161 mg/L, and an iron (Fe) concentration of 0.04 mg/L. All parameters met the quality standards based on applicable regulations. Thus, the quality of borehole water at the Buyat

Community Health Center (UPTD Puskesmas) is deemed suitable for supporting health services and sanitation activities.

∗ Corresponding author : hanief.paputungan@gmail.com

Introduction

Clean water is a fundamental human necessity and an essential component of healthcare service delivery. Disease prevention efforts cannot be effective without adequate acces to clean water(Pitri & Wahyuni, 2026). Water that meets physical, chemical, and microbiological quality standars plays a critical role in preventing waterborne and environmentally related diseases. Consequently, primary healthcare facilities, including community health centers, require a safe and reliable water support medical service, infection prevention measure, and sanitation. (Odjegba et al., 2024).

In indonesia, groundwater and borehole wells continue to serve as important sources of clean water. According to data from the Central Statistic Agency (BPS), 17.28% of Indonesian households still rely on borehole or punp wells for clean water.(Central Bureau Of Statistic, 2018). Furthermore, the Ministry of Energy and Mineral Resources has developed 3,404 borehole wells in water-scarce regions throughout the country, with an additional 556 boreholes constructed across 177 districts in 2020 alone. (The Ministry of energy and Mineral Resources, 2021).

The quality of borehole water is influenced by various factors, including geological conditions, anthopogenic activities, and surrounding environmental characteristics. East Bolaang Mongondow Regency possesses distinctive regional characteristics, including coastal zones, wetland areas, and regions exhibition specific hydrogeological conditions. (Mokoagow et al., 2023). Swap conditions and proximity to coastal areas can influence the mineral composition as well as the physical and chemical properties of soil and water.(Directorate of Water Resource And irrigation, Ministry of National Development Planning/Bappenas, 2020).

Water utilized in healthcare facilities must comply with the standards established under the Regulation of the Minister of Health of the Republic of Indonesia No. 32 of 2017 concerning Environmental Health Quality Standards and Health Requirements for Hygiene and Sanitation Water, as well as Regulation of the Minister of Health No. 2 of 2023 concerning Drinking Water Quality Requirements. Therefore, routine monitoring of water quality is necessary to ensure compliance with regulatory standards and to safeguard public health.

Despite the widespread use of borehole wells in primary healthcare facilities, information regarding the physical and chemical quality of borehole water in East Bolaang Mongondow Regency remains limited. Accordingly, this study aims to evaluate the quality of borehole water at UPTD Puskesmas Buyat by assessing pH, Total Dissolved Solids (TDS), and iron (Fe) concentrations, and comparing the results with the applicable regulatory standards. The findings are expected to provide baseline data to support environmental health management and ongoing water quality monitoring efforts.

Research Methodology

Study Design, Location, and Duration

This study employed a descriptive observational design to assess the quality of borehole water based on selected physical

and chemical parameters. The research was conducted at UPTD Puskesmas Buyat, East Bolaang Mongondow Regency, North Sulawesi Province, over a period of one month.

Population and sample

The study population consisted of all clean water sources untilized witin UPTD Buyat community health center. The study sample comprised water collected from the facility's primary borehole wells, which serves as the main source of water for healthcare services and sanitation activities.

Definition of Operational Variables

The dependent variable in this study was borehole water quality. Water quality was operationally assessed through the measurement of pH, Total dissolved Solids (TDS), and iron (Fe) concentration. The measured values were evaluated against the quality standrads stipulated in the regulation of the Minister Of Health of the Republic of Indonesia No. 32 of 2017 and regulation No. 2 of 2023.

Data Collection Methods

water samples were collected direcly from the borehole well using standard sampling procedures. The pH value was measured using a calibrated pH meter, while Total Dissolved Solids (TDS)were determined using a TDS meter. Iron (Fe) concentration was analyzed using the colorimetric method in accordance with established water quality testing ptotocols.

Data Analysis

Data were analyszed descriptively by comparing the measured parameter values with the applicable regulatory standars. The findingsare presented in tabular form and supported by narrative interpretation to evaluated the level of compliance with the prescribed water quality requirements.

Result

This study was undertaken to assess the quality of clean water obtained from a drilled well that serves as the primary water source for the Technical Implementation Unit (UPTD) of the Buyat Community Health Center in East Bolaang Mongondow Regency. Water quality evaluation was conducted based on selected physical and chemical parameters, namely acidity (pH), Total Dissolved Solids (TDS), and iron (Fe) concentration. These parameters were chosen due to their significance as indicators of water suitability for hygiene, sanitation, and healthcare-related applications. The analytical results were subsequently compared with the water quality standards established under Minister of Health Regulation No. 32 of 2017 and Minister of Health Regulation No. 2 of 2023.

As presented in Table 1, all measured parameters complied with the applicable water quality standards. The pH value of the drilled well water was recorded at 7.5, indicating neutral to slightly alkaline conditions and falling within the permissible range specified by the relevant regulations. Maintaining an appropriate pH level is essential, as it contributes to the effectiveness of sanitation processes, supports the stability of water quality, and minimizes the risk of corrosion in water distribution systems and associated equipment.

The analysis of Total Dissolved Solids (TDS) yielded a concentration of 161 mg/L, which is substantially below the maximum allowable limit of 500 mg/L. This relatively low TDS value suggests that the concentration of dissolved substances in the water is minimal and is unlikely to adversely affect its physical characteristics. Furthermore, the dissolved solids content remaining within acceptable limits indicates that the water possesses adequate quality for various activities within healthcare facilities, including environmental sanitation, hygiene maintenance, and routine healthcare service operations.

Tabel 1. Result of Water Quality Measurements for Drillied Wells at the Buyat Community Health Center (UPTD)

Parameter	Quality Standard	Result	Compliance Status
pH	6.5-8.5	7.5	

Parameter	Quality Standard	Result	Compliance Status
TDS (mg/l)	≤ 500	161	Meet Requirements
Besi (Fe) (mg/l)	≤ 0,3	0.04	

The analysis of iron (Fe) concentration revealed a value of 0.04 mg/L, which is substantially lower than the maximum permissible limit of 0.3 mg/L established by applicable regulations. This result indicates favorable water quality, as elevated iron concentrations may cause undesirable aesthetic effects, including yellowish-brown discoloration, metallic taste, and the formation of deposits within water distribution systems. Although excessive iron levels are generally not associated with significant direct health risks, they may negatively affect the acceptability and usability of water for consumers.

Overall, the findings of this study indicate that the borehole water used at the Buyat community health center UPTD meets the required quality standards based on the assessed parameters. These results indicate that the water source remains compliant with environmental health requirements and is suitable to support health services and sanitation activities within the facility. Furthermore, the findings indicate that the surrounding environmental and hydrogeological conditions do not significantly contribute to elevated concentrations of dissolved solids or iron in the groundwater used by the community health center.

Discussion

The research results show that the quality of the borehole water used at the Buyat Community Health Center (UPTD) meets quality standards based on the physical and chemical parameters examined, namely pH, Total Dissolved Solids (TDS), and iron (Fe) content. All three parameters fall within the ranges specified by Ministry of Health Regulation No. 32 of 2017 and Ministry of Health Regulation No. 2 of 2023; therefore, the water can be classified as suitable for hygiene and sanitation purposes and for supporting health services at primary health care facilities

The measured pH value of 7.5 indicates neutral to slightly alkaline conditions, within the acceptable range of 6.5–8.5. pH is a key water quality parameter affecting water chemistry, disinfection efficiency, and pipeline integrity. According to the World Health Organization (WHO, 2022), pH within the recommended range generally poses no significant health risks, although deviations may reduce water acceptability and cause operational issues such as corrosion and scaling (Saalidong et al., 2022). Overall, the results indicate that the borehole water is suitable for sanitation and healthcare-related uses in terms of acid–base balance.

The findings of the present study are consistent with those reported by Jusriana et al. (2023), who investigated the quality of protected well water in West Aceh Regency and observed pH values ranging from 7.5 to 7.9, all of which complied with the established clean water quality standards. The similarity of these findings suggests that groundwater sources generally possess adequate natural buffering capacity, enabling them to maintain pH levels within the acceptable range. This buffering mechanism contributes to the stability of groundwater quality and supports its suitability for domestic and public health-related uses.

The TDS value was recorded at 161 mg/L, which is well below the maximum permissible limit of 500 mg/L. TDS reflects the concentration of dissolved substances in water, including minerals and inorganic compounds. The relatively low TDS observed indicates a low level of dissolved constituents, which does not adversely affect the physical quality of the water. Generally, low TDS water is associated with better taste, clarity, and user acceptability. Moreover, the low dissolved

solids content suggests that the groundwater source has not been significantly impacted by surrounding environmental contamination (Nirwana & Legasari, 2024).

The iron (Fe) concentration was measured at 0.04 mg/L, which is well below the permissible limit of 0.3 mg/L, indicating very good water quality. Iron levels in groundwater are generally influenced by geological conditions, rock composition, and mineral dissolution processes. Elevated iron concentrations may cause yellowish or brownish discoloration, metallic taste, sediment formation in pipelines, and reduced aesthetic water quality (Xia et al., 2022). Such conditions can also lead to technical issues and lower user acceptance of water resources. Therefore, the low Fe concentration observed in this study indicates that the borehole water at the Buyat Community Health Center has good quality and does not pose aesthetic or operational problems in the water distribution system.

The satisfactory water quality observed in this study is likely influenced by aquifer characteristics and groundwater sources that remain relatively protected from contamination. Although the health center is located in a swamp-dominated area, the results indicate that dissolved solids and iron concentrations remain within safe limits. These findings suggest that the water source is capable of providing adequate quality water to support healthcare services, environmental sanitation, and the operational needs of primary healthcare facilities (Budianto et al., 2020).

Although all examined parameters met the applicable standards, this study is limited by its focus on only three physicochemical parameters and a single sampling point. Water quality assessed through pH, TDS, and Fe alone does not fully represent overall water safety. Additional parameters such as manganese (Mn), nitrate, nitrite, hardness, and microbiological indicators (e.g., Total Coliform and *Escherichia coli*) are required for a more comprehensive evaluation. Therefore, regular monitoring and more extensive testing are recommended to ensure the long-term safety of water use in primary healthcare facilities.

Conclusion

Although all tested parameters met quality standards, periodic water quality monitoring is still necessary as part of environmental health surveillance efforts. This is important given that groundwater quality can change due to natural factors or human activities near water sources. Continuous monitoring will help ensure that water quality continues to meet health standards and is safe for use to optimally support primary health care services.

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