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Well Water Purification and Clean Water Distribution in the School Area of Yayasan Perguruan Serasan Muara Enim

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Abstract: Water is one of the natural resources that has a very important function. The existence of clean water in an area is very important, including in the school area. To support the availability of clean water in the school area at Yayasan Perguruan Serasan Muara Enim (YPS), namely by utilizing rainwater reservoirs, in addition to PDAM. However, the provision of clean water has not been able to meet water needs because the source of PDAM pipes is far away, and the distribution network pipes are not yet available. This often causes schools that are the furthest away not to get water flow so that they often must buy clean water which results in high school operational costs. There is one well to anticipate water needs, but the condition of the well water is cloudy yellowish and slightly smelly so it needs to be clarified first so that it can be used. The installation of a simple water purification device needs to be designed so that the water is suitable for use before being collected and distributed. The method used is to create a series of simple water purification devices consisting of an arrangement of adsorbents in the form of activated charcoal, sand, gravel, coral stone, and coconut fiber arranged in a tank. The result of this community service activity, the provision of clean water for school activities can be met, so that the academic community can enjoy clean water more easily and cheaper than before with better quality, quantity and continuity. The results of the analysis of well water after being clarified showed a reduction in the levels of Total Suspended Solid (TSS) which caused turbidity, with clean water quality that has met the requirements.

Keywords: Water purification; Water distribution; Clean water

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1. INTRODUCTION

Water is one of the natural resources that has a very vital function for the life of living things on earth (Ganoulis, 2024). Water has a very strategic role and must remain available so that it supports life both now and in the future. The existence of clean water in an area is very important (Mishra et al., 2021), one of which is in the Yayasan Perguruan Serasan Muara Enim (YPS) area. To support the availability of clean water in the school and campus area at YPS so far by utilizing natural resources in the form of rainwater reservoirs, in addition to the Muara Enim Regency Local water company (PDAM). However, the provision of clean water has not been able to meet water needs because the PDAM pipe source is far from the location of the three schools and the unavailability of distribution network pipes. This often causes schools that are the furthest away not to get water flow, so they often have to buy clean water to meet their needs. This results in high school operational costs. There is one well to anticipate water needs, but the condition of the well water is cloudy yellowish and slightly smelly so it needs to be processed/clarified first so that it can be used.

It can be said that the current condition of the availability of clean water is still inadequate, so clean water infrastructure is needed to support the smooth running of the teaching and learning process and all activities in the YPS area. With these problems, efforts need to be made to meet the need for clean water, namely by utilizing the water resources available in the YPS area and carrying out the stages of water purification and distribution of clean water to buildings and schools in the YPS area. In providing the need for clean water to meet the needs of schools, prayer rooms, halls, offices, and libraries in the YPSME school area, it is necessary to utilize existing water resources, but water purification needs to be carried out first before being used and distributed clean water. Therefore, the purpose of this community service activity is to solve the problem of providing clean water in the YPS area by using dug water that is purified with a simple water purifier as a source of clean water. Furthermore, creating a water distribution network from dug wells to support the availability of clean water needs, so that it can help reduce operational and maintenance costs that arise from meeting clean water needs by buying.

Water is the most important substance in life after air for human survival (Lin et al., 2022). About three-quarters of our body is made up of water and no one can survive more than 4-5 days without drinking water. In addition, water is also used for cooking, washing, bathing, and cleaning dirt around the house. Water is also used for industrial, agricultural, firefighting, recreational, transportation, educational purposes, and others. Diseases that attack humans can also be transmitted and spread through water. Water quality changes led to a rise in mortality rates (Dehkordi et al., 2024). This condition can certainly cause disease outbreaks everywhere. Releasing these pollutants into aquatic habitats without proper treatment can lead to water pollution (Chowdhary et al. 2020). Fulfillment of the need for clean water must meet two requirements, namely quantity and quality (Ministry of Health of the Republic of Indonesia, 2013). In addition to meeting the need for clean water, sanitation in the educational environment must also be considered. Around 1.1 billion people lack access to safe drinking water due to poor sanitation, leading to an increase in water-borne diseases (Ali et al., 2025).

Sanitation is a health effort by maintaining and protecting the cleanliness of the environment from its subjects, for example providing clean water for washing hands, providing trash bins so that they are not thrown carelessly. Sanitation is often also called environmental sanitation and environmental health, as an effort to control all factors in the human physical environment that are estimated to cause things that interfere with physical development, health or survival (Adisasmito, 2006). Environmental sanitation must be kept up, beginning with the roads, sewers, and yards (Dewi & Caesar, 2022). Meanwhile, according to WHO, environmental sanitation is supervision of the human physical environment that can have detrimental effects on physical health and survival. Therefore, water quality is very important in the physical environment and has a great influence on human health for sustaining life and ecosystems (Ejiohuo et al., 2025).

The quality of clean water must be good, referring to water quality standards. Water quality is the condition and quality of water tested with certain parameters and methods based on applicable provisions. While water quality standards are a measure of the limits or levels of living things, substances, energy, or components that are or must be present or pollutants that are tolerated in water. The quality of raw water will determine the amount of investment in water purification installations and operating and maintenance costs. Worse water quality requires a higher price for clean water. The need for good water is reviewed in terms of water quality which includes physical, chemical, and microbiological quality so that when consumed it does not cause side effects (Minister of Health Regulation No. 32 of 2017). Water is a very important natural resource in the world. Water sustains life; without water, life would not be possible (Ahuja, 2017).

According to Asmadi et al. (2011), there are two types of water pollutants that come from domestic sources (households), villages, cities, markets, roads, and so on; and non-domestic sources such as factories, industries, agriculture, livestock, fisheries, and other sources. To obtain good quality water, prior processing is required if the water source used does not meet quality standards, including through an adsorption process using activated carbon (Sutrisno et al., 2015). Activated carbon is crucial for eliminating dangerous contaminants from both water and air (Tamanna et al., 2016). Primarily composed of carbon, activated carbon has a broad contact surface and is highly porous. It is used as a catalyst support and to cleanse gases and liquids via adsorption, which involves holding molecules, including heavy metals, in its surface pores (Alves et al., 2021). A microporous type of carbon activated carbon has a large internal surface area, a well-developed pore structure, a pore volume, and an adsorption capacity (Hao et al., 2021).

The principle of the activated carbon processing method is to adsorb impurities and pollutants using carbon media. The adsorption process depends on the surface area of the media used and is related to the total pore area in the media (Paputungan et al., 2023). In order for the adsorption process to be carried out effectively, sufficient contact time is required between the surface of the media and the water being treated so that later the pollutants can be removed (Jannati et al., 2009). The activated carbon is comercially marketed in two forms namely, powdered activated carbons (PACs) and granular activated carbons (GACs) (Jjagwe et al., 2021). Carbon filters are an activated carbon method with granular media (Granular Activated Carbon) which is a filtration process that functions to remove organic materials, disinfection, and eliminate odors and tastes caused by organic compounds. In addition, it is also used to separate organic compounds and separate dissolved particles. The target pollutant, pollutant concentration, flow rate, and adsorption capacity all impact the choice of GAC (Karelid et al., 2017).

One of the simple water purification devices that implements the adsorption process is using adsorbent media in the form of activated carbon or charcoal, combined with sand, stone, and coconut fiber. This system can be effectively applied for the clarification of well water. The adsorption process can be constructed using a layered filtration system consisting of activated carbon or charcoal as the primary adsorbent medium. This is typically combined with other filtration materials such as sand, gravel (stone), and coconut fiber to enhance the physical removal of suspended particles and improve water quality. Activated carbon or charcoal serves to adsorb organic compounds, chlorine, and various contaminants, while sand and gravel function as mechanical filters, removing turbidity and particulate matter. Coconut fiber contributes to additional filtration and offers some antimicrobial properties. This combination of materials provides a low-cost and accessible method for improving the clarity and safety of well water, making it suitable for use in rural or resource-limited areas.

2. METHODS

This community service activity was initiated through a problem identification process and the establishment of collaboration with the Yayasan Perguruan Serasan (YPS) Muara Enim. A preliminary survey was conducted to assess the availability and condition of local water sources within the school area. This assessment aimed to identify a suitable site for implementing a simple water purification system. The system utilizes adsorption-based filtration with locally available materials such as activated carbon, sand, gravel, and coconut fiber. These adsorbents were selected for their affordability, accessibility, and effectiveness in improving water quality. The design emphasizes simplicity, sustainability, and ease of operation for long-term use.

The target beneficiaries of this initiative are the academic community and employees of YPS Muara Enim. The ultimate goal is to provide clean water through well purification and an integrated distribution system. The distribution network includes the use of pumps, storage tanks, and gravity-fed pipelines to reach all buildings. This approach seeks to maximize the use of raw water sources available within the school environment. The program also aligns with public health goals by improving sanitation and hygiene conditions. Through this activity, local capacity in water management is strengthened for sustainable community impact.

Figure 1. Location of Community Service activities in the school area of Yayasan Perguruan Serasan Muara Enim

The technology used in this service involves an adsorption system that utilizes adsorbent media, which are easily obtainable and relatively inexpensive. This technology has been specifically designed to meet the clean water needs of school activities, ensuring that the school community can benefit from more accessible and affordable clean water compared to previous conditions. By using low-cost materials, this system is able to provide better quality, higher quantity, and continuous water supply, which significantly enhances the overall water availability in the school. This approach addresses the common challenges faced by many schools in providing safe and adequate drinking water for students and staff. Furthermore, it represents a sustainable solution that can be implemented with minimal investment, ensuring long-term benefits for the school community. The improved water quality also contributes to better health and hygiene standards within the school environment, making it an essential element for the well-being of the students and faculty.

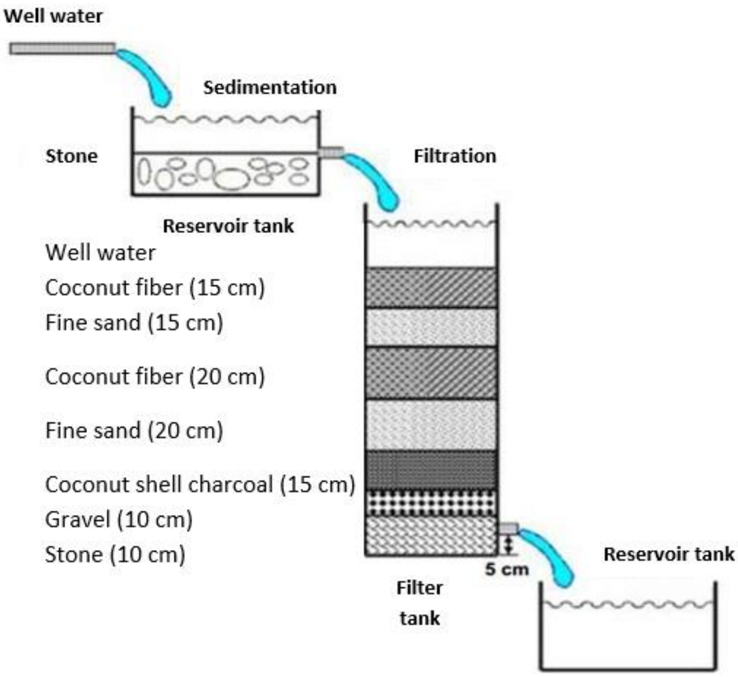

Figure 2. Water Purification Device Circuit

The water purification tool utilized in this system functions through an adsorption process, where adsorbent media such as activated carbon or charcoal are employed to remove impurities from the water. In addition to the carbon, the system integrates sand, stone, and coconut fibers to enhance the filtration process, as illustrated in the tool's circuit diagram shown in Figure 2. This combination of materials serves to improve the efficiency of the water purification system, ensuring that the water meets acceptable standards for consumption. The simplicity of this design makes it easy to construct and operate, while maintaining effectiveness in purifying the water. This low-cost yet efficient approach is particularly advantageous for schools with limited resources, as it allows them to provide a reliable source of clean water without the need for expensive or complex infrastructure. The use of locally available materials further increases the accessibility and affordability of the system, making it a viable solution for schools in various regions.

3. RESULT AND DISCUSSION

Clean water and proper sanitation are universally recognized as fundamental human needs. Access to these essential resources is vital for ensuring public health and well-being. However, many regions around the world are facing significant challenges in securing these basic necessities. One of the most pressing issues is water scarcity, which has emerged as a major threat to sustainable development, particularly as water demand approaches or even surpasses the total amount of renewable freshwater resources available (Kummu et al., 2016). As population growth and industrialization continue to put pressure on water resources, ensuring sustainable access to clean water becomes a critical goal for global development. The United Nations' Sustainable Development Goals (SDGs) emphasize the need to ensure universal access to clean water and sanitation as a core objective within the environmental sector (Weststrate et al., 2019).

In Indonesia, the provision of clean water remains a complex challenge. Despite ongoing efforts, various obstacles persist, including issues related to water quality, quantity, and availability. These problems are often compounded by difficulties in the management and distribution of water resources. As a result, the inadequate supply of clean water often leads to poor sanitation conditions. This situation has been exacerbated in many areas where water sources, such as wells, are the primary means of obtaining water. These water sources often fall short in terms of meeting the required quality standards, which further impedes the achievement of adequate sanitation (Huang et al., 2021). The human need for water drives individuals to seek out the most cost-effective solutions to access this vital resource. However, it is not enough to merely secure access to water; drinking water must also meet specific requirements related to its quality, quantity, and continuity.

The schools in the Yayasan Perguruan Serasan (YPS) Muara Enim area serve as an example of the difficulties faced by communities in accessing clean water. The lack of clean water available for daily use in these schools has led to suboptimal sanitation conditions, which are detrimental to the health and well-being of students and staff. In response to this issue, the installation of simple water purification systems has been proposed. These systems, which consist of an arrangement of adsorbents such as activated charcoal, sand, gravel, coral stone, and coconut fiber, are designed to improve the quality of well water. The purification process involves passing the collected well water through these materials, which help to filter out impurities and contaminants. The treated water is then distributed to the nearest buildings, ensuring that clean water is accessible to those who need it most. For more distant buildings, a pump and a large storage tank are used to ensure that the purified water reaches its destination by gravity, ensuring full utilization of the system across the school environment.

Table 1. Results of Well Water Analysis After Purification

No.	Parameter	Unit	Value	Maximum Level (Regulation of the Minister of Health of the Republic of Indonesia No. 32 of 2017)
1	pH	-	6.07	6.5-8.5
2	TSS	mg/1	3.3	-
3	Iron (Fe)	mg/1	0.03	1.0
4	Manganese (Mn)	mg/1	0.09	0.5
5	Zinc (Zn)	mg/1	0.77	15
6	Lead (Pb)	mg/1	0.03	0.05
7	Copper (Cu)	mg/1	0.02	-
8	COD	mg/1	22.39	-

A key component of this solution is the effectiveness of the water purification process. The results of water analysis after purification have shown significant improvements in water quality. For example, the levels of Total Suspended Solids (TSS), which contribute to turbidity, were notably reduced, demonstrating the efficacy of the filtration process. Additionally, the purified water meets the quality standards set by the Regulation of the Minister of Health No. 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Hygiene and Sanitation purposes. Table 1 provides a detailed breakdown of the well water analysis after purification, which highlights that the water now falls within acceptable limits for various parameters, such as pH, TSS, and the presence of metals like iron, manganese, zinc, and lead.

The quality parameters of the purified well water indicate a significant improvement in water safety and suitability for consumption. For instance, the pH level of the treated water was measured at 6.07, which is within the acceptable range of 6.5 to 8.5 as outlined in the regulation. The levels of other contaminants, such as iron, manganese, and lead, were also found to be within safe limits, with concentrations of 0.03 mg/l, 0.09 mg/l, and 0.03 mg/l, respectively. These findings are critical, as excessive levels of these substances can pose serious health risks. Furthermore, the results demonstrate that the water purification system is capable of reducing potentially harmful contaminants, thereby ensuring that the water is safe for consumption and aligns with national health standards.

In terms of the distribution network for clean water, the system is designed to be simple, cost-effective, and easy to maintain. Given the limitations of resources in many areas, it is crucial that the clean water distribution network be both affordable and practical to implement. The system uses pumps, storage tanks, and piping made from PVC, all of which are durable and easy to install. The use of PVC pipes, along with valves for controlling the flow of water, ensures that the distribution system is both efficient and manageable. The simplicity of this setup, combined with its low maintenance and operational costs, makes it an ideal solution for schools and other institutions that face financial constraints while still needing to meet the clean water demands of their communities.

The clean water distribution system outlined above offers a sustainable and scalable solution to the challenges faced by schools in the YPS Muara Enim area. By utilizing locally available materials and simple technologies, the system provides an affordable and effective means of improving water quality and ensuring access to clean water. In addition, the ability to expand and adapt the system to other schools or communities with similar challenges makes it a promising model for addressing water scarcity and sanitation issues in rural and underserved areas. Ultimately, this approach not only provides a practical solution to the immediate water needs of the school but also contributes to long-term improvements in public health and environmental sustainability.

4. CONCLUSION

The implementation of community service programs through simple technology for well water purification is expected to help solve the problem of clean water supply in the YPS school area. The quality of the well water from the purification has met the water quality according to Regulation of the Minister of Health of the Republic of Indonesia No. 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Hygiene Sanitation purposes. By creating a water distribution network from dug wells to buildings and infrastructure such as prayer rooms, libraries, laboratories, it has supported the availability of clean water needs. Thus, it also helps reduce operational and maintenance costs that arise from meeting clean water needs by purchasing, so that existing funds can be used to develop other school facilities. The filter tank for water purification containing an adsorbent column should be checked periodically for cleaning or replacing the adsorbent to avoid saturation, especially due to the possibility of accumulation of Total Suspended Solid (TSS).

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