

Optimizing clean water filtration through the application of science and technology: Reverse osmosis method

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ABSTRACT

Water is the fundamental basis for all biological and human activities. Water is believed to be a natural resource that will never run out and will always be available. Nonetheless, the availability of water as a natural resource is restrained due to its relatively constant hydrological cycle, thus making it limited in supply. The methods used during the activity were lectures and discussions. At the beginning of the activity, the team conducted counseling related to well water sanitation, its impact, and how to overcome it. The method of this counseling stage is carried out through 5 stages, namely: socialization stage and the implementation stage. This activity includes 3 sessions, among others: First stage: Pre-test, which is given through a questionnaire, lecture, question and answer, and discussion methods. Posttest and assessing the results of the posttest, the technology application stage, the monitoring and evaluation stage, and the program sustainability stage. The results of the service activities showed that the educational program on access to clean water, sanitation, and the effects of borehole water for health significantly increased the knowledge of the participants. The average score increased from 19.22 in the pre-test to 21.18 in the posttest, with a p-value of 0.001, indicating a significant difference. This result confirms the effectiveness of the clean water and sanitation education program.

Keywords: Clean Water; Filtration; Education; Socialization.



INTRODUCTION

Water is fundamental to all biological and human activities. Water is believed to be a natural resource that will never run out and will always be available. However, the availability of water as a natural resource is limited due to its relatively constant hydrological cycle, which limits its supply. Water abundance on Earth is uneven because there is no substantial addition over time [1] [2]. The issue of water scarcity in certain regions has caused serious problems for the health of the people living there [3] [4].

Therefore, it is very important to ensure the availability and management of clean water to support the community's livelihood. Controlling the quality and quantity of clean drinking water affects the standard of living of the population; therefore, providing access to fresh drinking water should be a human right that is granted fairly throughout society. Water treatment measures are necessary to meet the community's demand for drinkable water. Surface water consists of rainwater that does not seep into the ground; this can be further categorized as originating from rivers, lakes, or swamps. River surface water is one category often used as a raw material source if its quality remains good during its existence [5] [6] [7].

Access to clean water is a basic need that must be met. Sufficient development funds need to be allocated to promote safe drinking water access by 2030. Partner issues. Based on observations by the PKM team and students in Ta'bunga Village, out of 130 households, 126 households (96.6%) use dug wells as their daily source of clean water. Based on water quality tests of the dug wells, the pH level was found to be 6.4 (quality standard pH: 6.5-9.0), sulfate (SO_4) at 411.47 mg/l (quality standard for SO_4 : 400 mg/l), and organic matter (KMnO_4) at 10.11 mg/l (quality standard for organic matter: 10 mg/l). The results of the water quality inspection of the well in Julukanaya Village showed that the sulfate (SO_4) level exceeded the quality standard for clean water at 258 mg/l and for drinking water at 250 mg/liter. The iron content of dug wells was measured at 0–1.15 mg/l, while the iron content of wells was 1.3 mg/l. The quality standard for iron as a source of clean water is 1.0 mg/l, and for drinking water is 0.3 mg/l. Initial observations at the partner location showed that 20 wells exceeded the drinking water quality standard. All wells (100%) have iron and fluoride levels that do not meet the standards for clean water and drinking water [8] [9] [10].

One of the customs of the Ta'bunga Village community is to consume the water directly without prior treatment (only through sedimentation for one day). This is what causes the high incidence of diarrhea and parasitic infections. Based on data from the community health center, the incidence of diarrhea in toddlers has increased over the past three years by 33.5% (2022), 44.7% (2023), and 50.5% (2024). One of the causes is *E. coli*, resulting from contaminated water and inadequate treatment. Additionally, poor personal hygiene among children who are reluctant to wash their hands before eating is another contributing factor.

METHODS

The stages of community service include:

Socialization/activity survey stage

The forms of surveys conducted include:

- a. Community water quality survey (water sample collection and examination in the laboratory)
- b. Survey of potential water sources in terms of water discharge, adequacy of water quantity/discharge, especially in the dry season



Figure 1 Discussion with Partner Team and Students



Figure 2 Socialization and education for PKM Dikti partners

Training stage

Lecture method

In the lecture method, material related to clean water quality and the use of pomegranate plants is presented. 10-15 people attend this lecture method.

Demonstration plot method

In the Demonstration Method, guidance is provided on techniques for clarifying turbid water. We also offer guidance on the use and maintenance of the system so that the community can use and maintain it with full awareness.

Technology Implementation Phase

Implementation of appropriate technology

- Implementation of appropriate technology for well water using filtration methods.
- Measurement of the physical and chemical quality of well water before and after the application of the filtration method.
- Education on maintenance techniques for wells that have undergone filtration.

Mentoring and Evaluation Phase

Mentoring is conducted using the Demonstration Plot Method for water filtration techniques.

Program Sustainability Phase

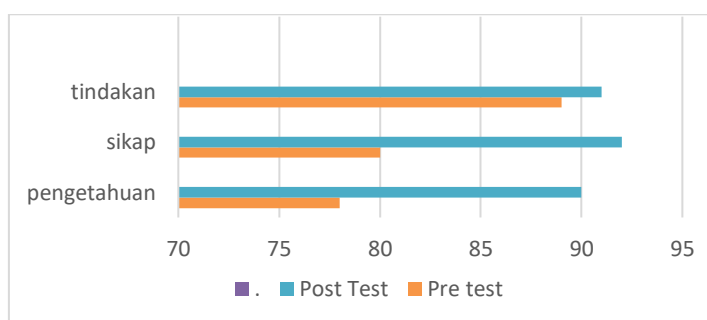
- The location of this PKM activity is the field experience learning practice site (PBL for FKM UMI students).
- The PKM activity is located in a village partnered with UMI, making long-term monitoring easier.
- Direct communication (field visits) and telephone communication with the partner are conducted.

RESULT

Table 1 Education on the Effects of Well Water Quality on Health in Tabanga

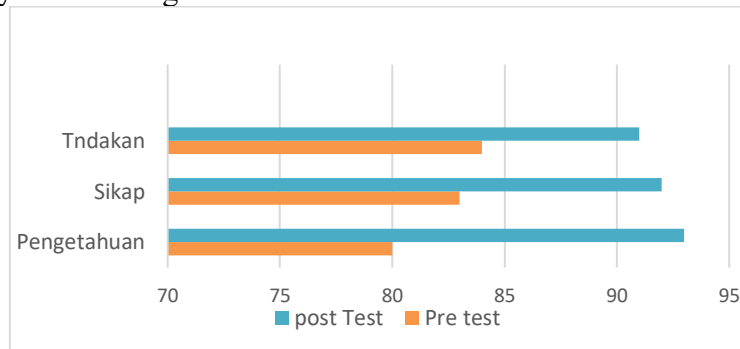
Result	Lowest Value	Highest Value	Makximum value	Average values	Standar deviasi	P-value
Pre test	18	22	27	19,22	3,27	0,001
Post test	26	26	27	21,18	5,40	

Table 1 shows the results of the well water sanitation education program for the community. This program was measured through pre-tests and post-tests conducted before and after the education was implemented. The pre-test results showed the lowest score of 18 and the highest score of 26, with an average of 21.18. The standard deviation of the pre-test was 3.27, indicating variation in scores among participants.



Graph 1: Education on the Benefits of Clean Water for Health

Based on graph 1, the pre-test results for knowledge (78%), attitude (80%), and action (87%) were compared to the post-test results for knowledge (90%), attitude (92%), and action (91%). This shows that there has been an improvement in the behavior of the partner community in educating others about the health benefits of clean water.



Graph 2: Education related to waterborne diseases

Based on graph 2, the pre-test results for knowledge (80%), attitude (83%), and action (84%) were compared to the post-test results for knowledge (93%), attitude (92%), and action (91%). This shows that there was an improvement in the behavior of the partner community in terms of education about water-related diseases.

DISCUSSION

The implementation of the Community Service Program (PKM) was conducted on Sunday, July 6, 2025, at the residence of the village head of Tabanga, Pallangga Sub-district, Gowa District, which is one of the villages under the guidance of the University of Muslim Indonesia. This training and educational outreach activity was attended by 15

participants, who are health environment cadres. The results of this activity showed enthusiastic responses from participants eager to learn about clean water management using clean water filtration methods. This was evident from several participants who asked questions about the process, the tools used, and the ratio of materials employed. During the implementation of the Community Partnership Program (PKM), the UMI PKM team carried out a community service program in the form of training/mentoring on clean water filtration. Among the achievements of the team were:

1. The residents of Tabanga Village have gained knowledge on proper clean water management.
2. The implementation of the PKM activity in the form of training on water purification techniques for community partners in the Ta'bunga, Palangga sub-district, Gowa district, has been published in the online media Fajar.

In this activity, partners actively participate and support the entire series of PKM activities. For each dissemination and demonstration plot activity, partners prepare a location for the implementation of PKM activities. The partner also prepares the location and introduces appropriate technology for water purification techniques. The partner's participation is required in a series of activities, especially in the educational sessions [11] [12].

The issue of limited water sources in certain areas has caused serious health problems for the residents living there. Therefore, it is crucial to ensure the availability and management of clean water to support community life. Controlling the quality and quantity of clean drinking water affects the standard of living of the population; therefore, providing access to fresh drinking water should be a human right granted fairly throughout society. Water treatment measures are necessary to meet the community's demand for drinkable water [13]. Surface water consists of rainwater that does not seep into the ground; this can be further categorized as originating from rivers, lakes, or swamps [14]. River surface water is one category often used as a raw material source if its quality remains good during its existence [15]. The health education activity began with the distribution of pretest evaluation materials to the residents in attendance [16]. The purpose of the pretest was to measure the participants' initial level of knowledge before receiving the educational materials. After the residents completed the pretest, the education team continued by providing education using the lecture method. This method was chosen to provide information directly and systematically to participants regarding water well sanitation education for the community [17]. After the education session was completed, the residents were then given a post-test containing a questionnaire. This posttest served to measure the residents' understanding after participating in the education session, so that the results of the pre-test and post-test could be compared to see the changes in knowledge that occurred [18].

CONCLUSION

Overall, the clean water education outreach activity aligns with the SDGs' objectives, as the clean water, sanitation access education program for the community significantly increased participants' knowledge. The average score increased from 19.22 in the pre-test to 21.18 in the post-test, with a p-value of 0.001 indicating a significant difference. These results confirm the effectiveness of the clean water and sanitation education program.

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