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Water treatment implementation in improving shallow ground water quality with a combination filter-aerator method

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Abstract

It is undeniable that humans are very dependent on water. The problem is, access to clean water evenly in the Bugis Village, Dumbo Raya District, Gorontalo City, North Sulawesi Province has not been fulfilled. In addition, the Clean and Healthy Living Movement Program initiated by the government since 2016 has not been felt by the whole community. The purpose of the Community Service activity is training in making water treatment equipment as a means of improving water quality. Meanwhile, the only affordable source of clean water that can be used is groundwater. One of the problem factors in coastal areas is the quality of clean water that does not meet health requirements (Physical parameters, namely water that is yellow and smells while the Chemical parameters, namely the average concentration of Iron (Fe) = 9.94 Mg/l and Manganese (Mn) average = 8.8 Mg/l so it also has a negative impact on human health Training and demonstration approaches but still accompanied by discussions and lectures to provide information are the methods used in programs that will be carried out to be more effective and efficient for improvement Community-Based Total Sanitation Then empowering the community will create water filtration technology Combination Water Treatment with the Filter-Aerator Method that is affordable and can be operated with minimal resources and resources using materials that are widely available in the area. The empowerment location is approximately 10 Km from Makassar City, namely Barombong Village, Ma City Kassar of South Sulawesi Province and in the Bugis Village, Kec. Dumbo Raya, City of Gorontalo, North Sulawesi Province

Keywords: Water Treatment; Filter-Arerator; Water quality checking; Indonesia

1. Introduction

It is undeniable that humans are very dependent on water. However, not only humans depend on water. Plants and nature also really need water. Unfortunately, access to clean water evenly throughout the year is still a problem in many places, including in Indonesia (1). Clean water problems arise because of the poor quality of groundwater and river water for daily consumption. Then, there are also weather factors, regional topography, to the lack of infrastructure which are factors in the difficulty of getting clean water. This is what needs to be addressed to deal with clean water problems.

In Indonesia, almost 119 million people do not have access to clean water. Only about 20 percent have access to clean water, and even then only in urban areas. Meanwhile, almost 80 percent are forced to consume inadequate water (2). If this unfit water continues to be consumed by humans, indirectly the body will function as a filter that will filter out toxins and pollutants consumed by the body. In the short term, consumption of unclean water will cause minor illnesses such as diarrhea (3). However, in the long term, the continuous use of dirty water will have a more severe impact, namely the emergence of disease epidemics (4).

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According to Dr. Neil Mcintyre (5), from Imperial College London, the earth consists of 98 percent salt water and 2 percent fresh water that is suitable for consumption. At that 2 percent figure, 70 percent is snow and ice, 30 percent is groundwater, less than 0.5 percent is water from rivers and lakes, and less than 0.05 percent is from the atmosphere. Meanwhile, the only affordable source of clean water that can be used is groundwater, because groundwater lies beneath shallow land (6).

Based on the data above, one can imagine how limited the available clean water commodity is. At the same time, the human population is increasing every day. Practically, the 20 percent figure earlier will become a bone of contention for more people. Ironically, population growth also increases the problem of water pollution. Water catchment areas continue to decrease, and cases caused by a low culture of caring for the environment continue to increase. The problem of clean water has developed into a frightening conflict in the future.

One of the problem factors above is water quality with Physical parameters, namely water that is yellow and smelly, while Chemical parameters, namely the average concentration of Iron (Fe) = 9.94 Mg/l and Manganese (Mn) average = 8.8 mg/l. This problem often occurs as a result of settlements and industries, or the use of less environmentally friendly technologies. Water is also contaminated by microorganisms, including mutagenic and carcinogenic micro-pollutants, thereby contributing to negative effects on living things. If polluted water is consumed by the public, even dangerous diseases will also lurk (7).

WHO research (World Health Organization, 2010)(8) shows that in the last decade, an average of 50,000 people die per day from diseases related to unclean water. This water is used by local residents for everything from drinking, cooking, bathing and washing. The adverse effects that occur on the people who use the water will be felt later if the people in the area continue to use the water for the long term. In this case, the government should monitor the existence of these water sources. Now the mainstay of drinking water for humans is spring water that is deep in the ground, which is not contaminated with pollution (9,10). Water is also a source of life, no living thing can survive without water because water is always needed by anyone (Altman, 2002).

In line with population growth, the need for water (especially clean water) tends to increase (11). This has not been achieved in the 2016 Clean and Healthy Living Movement Program. However, this increase in water demand has been accompanied by a reduction in existing water sources, both underground and surface water sources, and has been followed by pollution of this water. Pollution is caused by living things, waste or other components caused by human activities. With the presence of foreign objects in the water that cause sediment, the quality of the water decreases so that the water cannot be used according to its designation. This affects the availability of clean water for daily human needs (12).

Water and health are two things that are interconnected. The quality of water consumed by the community can determine the degree of public health. Apart from being useful for humans, the human body is composed of millions of cells and almost all of these cells contain water compounds (13). According to research, almost 67% of the human body weight consists of water. The benefits of water for the human body are to help the digestive process, regulate metabolic processes, transport food substances, and maintain the balance of body temperature. Water can be contaminated by various kinds of pollutants such as micro-organisms, solid waste or liquid waste. Water is also a medium for nesting and transmission of dangerous diseases for humans. Dirty water is a comfortable place to breed various bacteria and viruses that cause disease. One of the germs of infectious diseases that reproduce through the medium of water is diarrhea (14–17).

The problem is high diarrheal disease as a result of environmental conditions that do not meet the need for clean water, low use of latrines, contamination of soil, water and air due to household waste, industrial waste, agricultural waste and transportation facilities as well as physical environmental conditions that allow the breeding of vectors. Main water quality in clean water supply facilities that does not meet the requirements is also a major problem that needs attention and is often found in the community and as a risk factor for diarrheal disease.

2. Material and methods

The method used is training. Training is an integrated process used by companies to ensure employees are working towards achieving organizational goals. By definition, training is the process of teaching skills needed by new and old employees to do their jobs (18). These processes can be grouped into the following stages; needs analysis, design, development, implementation, and evaluation. Methods of training delivery and implementation consist of the techniques and materials used by the trainer to structure the learning experience (19). Once the appropriate methods have been identified, they are implemented with a training plan in the development stage (20)The various methods of

training delivery and implementation can be divided into cognitive and behavioral approaches. Cognitive methods provide information orally or in writing, show relationships among concepts, or provide rules for how to do something (21).

2.1. Tools and materials

Tools and materials used to reduce levels of iron (Fe) and levels of manganese in dug well water

Tools used:

- Aerator Filter Series made of PVC
- Water Treatment Series
- Engine Water Pump and or Shallow Hand Pump.
- Water tank/drum/bucket (200 liters)
- Stop faucet Materials used:
- 6" diameter PVC pipe
- Ijuk (filtering)
- Pebbles, Silica Sand
- Activated Charcoal, Resin
- Pipe glue, water insulation, Piping fittings.

2.2. Implementation Procedure

The steps taken to implement this community service activity are as follows:

- Survey the types and numbers of users of water sources to determine the amount of clean water needed as a design basis.
- Survey of water discharge to determine the ability to supply clean water that can be used.
- Water quality testing to determine the suitability level of water for health which will be used as a determinant of the design for making water filter equipment.
- Procedure for making tools:

2.2.1. Aerator Filters

- Prepare the tools and materials to be used
- Measuring and cutting of angle iron for Filter Aerator series
- Making a series of Filter Aerators
- Making aerator plates and aerator holes
- Installation of plumbing systems and aerator plates
- Installation of shallow water pump/hand pump

2.2.2. Water Treatment

- Prepare the tools and materials to be used
- Cut PVC Ø 6 with a length of 1 meter
- Both ends of PVC Ø 6" are closed each with a Cap Ø 6" (using PVC glue), before being filled with quartz sand which is coated with palm fiber as a barrier to the sand.
- Both ends of the bottom PVC (10 cm from the bottom and the top) are perforated with a size of ¾" then attach the Sock Faucet DD both the bottom and the top.
- Faucet at the top as a flow of water to exit.

• While the hole at the bottom with the DD faucet sock as a place for water flow after the Aerator Filter process is connected to a ¾" water hose.

• Install a water faucet at the top. (with water insulation layer)

2.2.3. How to reduce levels of iron (Fe) and levels of manganese in dug well water:

• Prepare a bucket filled with 10 liters of raw water.

• Perform aeration with the Filter Aerator and immediately filter it with the available tools.

• Check the quality of Iron content (mg/l) and Manganese content after aeration and filtering.

• Compare with water quality standards according to Permenkes No. 32 of 2017 concerning Clean water quality.

- Outreach to stakeholders regarding the manufacture of water filtration devices and patterns for the use of clean water that are efficient and useful.

• Dissemination of how to make clean water filtering equipment to residents

• Dissemination of the operating system and maintenance of clean water filtering equipment to residents

- Implementation of the application of making clean water filtering equipment.
- Discussion with the residents after the implementation of making a clean water filter tool model for the residents to evaluate the effectiveness of the activity.

Service activities are divided into 3, namely:

- Clean water management group training
- The role of drinking water for pregnant women
- Technique of taking water to test water parameters in the field

3. Results and discussion

Program Implementation Transfer of technology and knowledge to the community for the development and preservation of natural resources by applying appropriate technology in the form of a simple water filter model (Implementation of Water Treatment in Improving Shallow Ground Water Quality with a Combination of Filter-Aerator Method) for rural clean water systems using materials that are easy to obtain, cheap and economical. Testing the performance of the simple water filter design model (Combination of the Filter-Aerator Method with Water Treatment) to obtain the physical quality of clean water according to the standards, which will later be used and made at each source community water.

The benefits expected from the results of this study are that the community's need for clean water for their daily needs can be fulfilled, so that it is hoped that it can improve the health status of the community. It saves people's time, because with the availability of clean water, the time that was previously spent looking for water can be used for other productive activities so that in the end it can improve the community's economy.

The results of this community service really need infrastructure for the development of community resources in order to improve water quality, especially the Iron (Fe) parameter by implementing the Combination of Filter-Aerator Methods with Water Treatment in realizing clean water in Coastal Areas. The goal is that people can use clean water for their daily needs and the quality meets the requirements in accordance with applicable laws and regulations and can be drunk when cooked. Water is an important factor in fulfilling vital needs for living things such as drinking water or other household needs. The water used must be free from disease germs and not contain toxic materials.

In terms of water quality, directly or indirectly pollution will affect water quality. In accordance with the basic considerations for determining the quality of drinking water, efforts to manage water used by humans as drinking water are guided by water quality standards, especially in evaluating the drinking water products they produce, as well as in planning the systems and processes that will be carried out on water resources. Water can be said to be clean water if it meets the requirements for clean water quality in accordance with Permenkes Number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitation Hygiene, Swimming Pools, Solus Per Aqua, and Public Baths.

The target audience for this activity were environmental and community sanitation cadres, heads of PPL and sub-district staff in the Barombong Sub-District, Makassar City, South Sulawesi and in the Bugis Sub-District, Kec. Dumbo Raya, City of Gorontalo, North Sulawesi Province. Realization of the implementation of the PPDS Community Service program, which was carried out from March to October 2022 both in the Barombong Village, Makassar City, South Sulawesi and in the Bugis Village, Kec. Dumbo Raya, City of Gorontalo, North Sulawesi Province.

Participants who attended were 20 community members consisting of sanitation cadres, Kelurahan staff and PPL members and attended by the heads of kelurahan Midwives from the Puskesmas both in Gorontalo and in Barombong and 6 students. in the Barombong Village, Makassar City, South Sulawesi and in the Bugis Village, Kec. Dumbo Raya, Gorontalo City, North Sulawesi Province, the method of implementation is training/demonstration on ways to solve clean water quality problems in the community, namely by providing 1 (one) unit of a combined filter-aerator method with water treatment and materials as examples of processing. simple water filter/water filter equipped with posters/banners (picture of a simple water filter), with a simulation of using a simple water filter for 10 heads of households both in the Barombong Village, Makassar City, South Sulawesi and in the Bugis Village, Kec. Dumbo Raya, City of Gorontalo, North Sulawesi Province.

Community service for the healthy village development program carried out by the Makassar Health Polytechnic and the Gorontalo Health Polytechnic with a team of lecturers consisting of the Environmental Sanitation study program in the National Featured category of the Healthy Village Development Program which is no less important is the practice of hygiene and sanitation. This is a combination of personal hygiene, household hygiene, to community hygiene as in the STBM (Community-Based Total Sanitation) program as a National program, the Nursing study program which of course synergizes with individual hygiene, while the medical laboratory technology program (Health analyst) works together in Health services regarding Environmental Health laboratory services related to physical, chemical and bacteriological examination of water quality.

The implementation of this activity by making efforts to manage water resources is carried out through various kinds of high-tech water filters and regulations. However, not all people know and can access these technologies and regulations due to a lack of access to information and limited knowledge about them. In the end, the community is burdened with meeting the needs of clean water for their lives. Thus, a simpler method is needed with the advantage of being able to produce water quality that meets health requirements according to the concentration of Iron (Fe) and fast filtering with appropriate technology using local materials and equipment efficiently. affordable by the community as well as ways to make tools that are easier/simpler that can be continued by the community and sanitation cadres who participate in carrying out community service activities who have previously been given knowledge through counseling and demonstrations to be able to respond to the process of making tools so that the community and the cadres can be more skilled as the Combination of Filter-Aerator Method with Water Treatment has been implemented in realizing clean water in the Coastal Area from two locations. The results of the evaluation that we have carried out economically are that the people who previously bought clean water and after having aeration and fast water filtration devices will be able to reduce the cost of buying clean water through POMAIR (Water User Groups) which have been formed by sanitation cadres, because the Kelurahan has collaborated with the PAMSIMAS organization (National Water Supply Program) with BUMDES (Village-Owned Enterprises) and the Midwife Group at the Barombong Health Center in Makassar City which was organized by the Sanitation cadres at the Kelurahan Office.

4. Conclusion

The combination of the Filter-Aerator Method with Water Treatment which has been made with a series of iron and zinc plates and a plumbing system and a quick sand filter using an electric water pump machine is made by coating a sand filter on top and gravel and activated charcoal on the bottom. Because the grains of sand and rock are very small, the potential for cleaning microorganisms and mineral particles is greater. there is a good relationship between cadres so as to facilitate communication with the community and the role of the government in carrying out the GERMAS program so that the active role of the community is needed. the results of this service are expected to have continued service and a team that collaborates with the drinking water procurement team and the existence of a village-owned business entity that always evaluates on an ongoing basis

Compliance with ethical standards

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Conflict of interest statement

The author declares that this article is free from conflicts of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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