Analysis of clean water needs, quality and availability projections in 2032 (Case study: SMK Negeri 2 Manokwari)

Johra Johra[1], Ritnawati Ritnawati[1], Ismail Marzuki[2]

[1]Program Studi Magister Rekayasa Infrastruktur dan Lingkungan, Universitas Fajar Makassar, INDONESIA
[2]Program Studi Teknik Kimia, Universitas Fajar Makassar, INDONESIA

E-mail: johraidrus76@gmail.com

Received August 22, 2022 | Accepted October 22, 2022 | Published January 04, 2023

ABSTRACT

SMK Negeri 2 Manokwari West Papua Province is one of the vocational high schools that foster 12 competencies in the field of Technology and Engineering with 1,567 people active in 2022. To support daily activities at school, the availability of clean water in the school environment is necessary for washing hands, defecating, and urinating. The availability of clean water is at least balanced with the need for clean water, this is intended to ensure that school needs are fulfilled. This study aims to analyze the need for clean water and clean water quality by quality standards. Clean water needs are analyzed using a mathematical approach based on clean water planning criteria, while the clean water quality analysis is carried out by testing clean water samples through the Manokwari City BPOM laboratory. The results showed that the need for clean water in schools was 17,280 liters/day. Water distribution to bathrooms/toilets, sinks, and public face, uses a piping network sourced from 2 reservoirs with a capacity of 40,400 liters. The source of raw water used is groundwater and pumping systems. For the analysis of clean water quality, the data shows that the temperature parameter = 0.05 ºC, pH = 7.88, TDS = 0.3060 mg/L, and coliform number = 27.09 x 10^1 CFU/100 mL, so that the water quality microbiologically does not meet the requirements for sanitary hygiene. While the results of the study showed that the need for clean water in SMK Negeri 2 Manokwari until 2032 reached 33,276 L/day (47.21%). The results of this study are expected to be useful for the development of science for academics in universities, government and society. E, especially for students at SMK Negeri 2 Manokwari, hopefully, it will be interesting reading material in the school library.

Keywords: clean water; water demand; water quality; SMK Negeri 2 Manokwari.

INTRODUCTION

Manokwari Vocational High School (SMK) is a mountainous area located in Manokwari Regency, West Papua Province. The source of raw water used as clean water comes from deep ground water, namely water sources from excavation or drilling with a depth of more than 40 meters. The depth of the water source and the limited amount of water discharge that reaches the surface causes limited water in order to meet the needs of clean water for the benefit of all activities of educators, education staff and students of SMK Negeri 2 Manokwari. Clean water infrastructure and facilities at Vocational High School (SMK) Negeri 2 Manokwari are used to meet the daily needs of clean water in supporting activities at school. Currently, there are 2 units of reservoir tanks with reinforced concrete construction that are used to supply water needs in bathrooms, toilets, sinks and public faucets. The source of clean water in the school environment comes from drilled well water, this causes the availability of water to be insufficient to meet the water needs of teachers, students and staff at certain hours. Administrative data of SMK Negeri 2 Manokwari in 2022 shows that there are 91 teachers, 1,443 students, 6 administrative staff, 2 security guards and 2 janitors, all of which require sufficient water availability. In the clean water system at SMK Negeri 2 Manokwari, water supply must be able to reach all buildings within the school environment with sufficient quantity, pressure and water quality according to standards (Artayana & Indra, 2010, Noviyanti, 2014). Therefore, the provision of clean water must be able to meet sufficient quantities, hygienically, technically optimally and economically. The use of water as drinking water is the highest level in supporting human life (Wahyu Diana et al., 2020), this is based on the fact that the use of water as drinking water must be accompanied by very strict water quality requirements. This study was

pISSN 2302-4240
eISSN 2655-2086
Volume 12, Issue 1, February 2023, pp.128-135
DOI: http://dx.doi.org/10.32832/astonjadro.v12i1 http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO

conducted to analyze the need for clean water in the SMK Negeri 2 Manokwari environment, besides that the quality of clean water must be tested to ensure that the supply of clean water meets the specified quality standards.

Clean water is a source of life. The construction of clean water installations is related to very diverse environmental conditions. A good environment will create good clean water too. In building clean water installations, many aspects must be considered (Ginanjar B, Hariati F, 2015; Alam MP, Lutfi M, 2016; Suhadi MZ, Namara I, 2016; Imamuddin M, Chayanto D, 2020). The most important aspect is that the condition of the structure and shape of the structure for the construction of clean water areas must comply with construction standards. Besides clean water, sewage disposal sites must be a priority (Barid B, Afanda BO, 2022; Atthar ADR et.al, 2022; Lutfi M et.al, 2022). In order to make dirty water development the main priority, it is necessary to divide clean water pipes and dirty water pipes that do not damage each other. This piping is really needed so that the completeness of clean water gets a good location (Amrullah A et.al, 2021; Prastowo I, 2020; Yarsono S et.al, 2020).

RESEARCH METHODS

Location of research object

The location of the object of this research is Manokwari Regency, West Papua Province. The research time starts from May 2022 to July 2022. The research location is located at SMK 2 Manokwari, West Papua Province, which is about 150 km west of Manokwari City. Geographically this area is located at 134°02'45"-134°03 '45" East Longitude and 0°51'00"- 0°52'00" North Latitude North Latitude.

Population and Sample

Population is a generalization area consisting of: objects/subjects that have certain qualities and characteristics determined by the researcher to be studied and then draw conclusions. The population in this study is SMK Negeri 2 Manokwari which includes teachers, students, administrative staff, security guards and cleaners. While the sample is part of the number and characteristics possessed by the population, the sample in this study is clean water.

Research variable

Research variables are everything in any form determined by the researcher to be studied so that information is obtained about it, then conclusions are drawn. The variables of this research are water demand, and water quality (standard parameters for clean water quality) including pH, TDS, and temperature.

Data Types and Sources

The data collected in this scientific research include; 1) Primary Data, primary data coverage is data obtained directly at the research location, namely water samples. 2) Secondary Data, secondary data to be collected in the form of data on the number of teachers, students, administrative staff, security guards, and cleaners. This data is sourced from the administrative data of SMK Negeri 2 Manokwari.

Data collection technique

Data collection can be done in various settings, various sources, and in various ways. When viewed from the source of the data, the data collection can use primary sources and secondary sources. For secondary data obtained by copying the administrative data file of SMK Negeri 2 Manokwari, while the primary data collection technique (water sample) is carried out in the following stages:

1. Prepare sample bottles;
2. Water sample bottles are sterilized from bacteria and dirt;
3. Taking 4 bottles of water directly from the faucet @ 1500 mL (6000 ml);
4. Water samples are delivered directly to BPOM Manokwari;
5. Laboratory tests of water samples are carried out by BPOM.

Research Instruments

The instrument used in this study was 4 water sample bottles, each with a capacity of 1500 ml.

Data analysis

Data on clean water needs at SMK Negeri 2 Manokwari were analyzed using a mathematical approach. The parameters used are based on the criteria for planning non-domestic water needs in the school sector. Meanwhile, for water quality analysis, a tool is used as part of the research tool, namely BPOM Manokwari.

RESULTS AND DISCUSSION

Water demand analysis

Water demand is the amount of water needed for daily needs at SMK Negeri 2 Manokwari. The categories of water needs in this study are grouped into 2, namely (1) domestic water needs, (2) non-domestic water needs. Domestic water needs are calculated to meet household needs for teachers and employees who live in the school complex, while non-domestic water needs are calculated based on the category of schools as public facilities. Water demand analysis is shown in Table 1.

Table 1. Water Demand Analysis

No.	Description	Number of people)	Water Needs (liters/person/day)	Total (liters/day)
A	Domestic			
1.	5 families in school	23	80	1.840
B	Non domestic			
1.	Teacher	91	10	910
2.	Students	1.443	10	14.430
3.	Administrative staff	6	10	60
4.	Security guard	2	10	20
5.	Janitor	2	10	20
			Total	17.280

The data analysis in Table 1 shows that the need for clean water in SMK Negeri 2 Manokwari is 17,280 liters/day, the average clean water requirement for each person is 11.03 L/day. The volume of water is used to meet the daily needs of the school. When compared with 2 units of reservoirs with a capacity of 40,400 liters, the existing building of the reservoirs has exceeded the daily water needs in schools.

Table 2. Total Clean Water Needs in the Last 5 (five) Years at SMK 2 Manokwari

No	Years	Category Population/users					TOTAL
		KK	Teachers	Student	Tendic Power	Other	
1	2018	22	78	879	5	3	987
2	2019	22	85	1.117	5	3	1.232
3	2020	22	87	1.234	6	4	1.353
4	2021	23	90	1.335	6	4	1.458
5	2022	23	91	1.443	6	4	1.567

Based on the data from Table 2 above, it shows that if we assume the average individual daily water usage is 10.03 L/day, and for school use we assume half a day so that the clean water usage is 11.03 L/day (13.75% of the total). 80 L of normal needs per day), then the increase in the use of clean water per year is on average (145 individuals x 11.03 L) or equivalent to ± 1,600 L/day in the last five years. The volume of water use each year in the last 5 (five) years is presented in Table 3.

pISSN 2302-4240
eISSN 2655-2086
Volume 12, Issue 1, February 2023, pp.128-135
DOI: http://dx.doi.org/10.32832/astonjadro.v12i1 http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO

Table 3. The volume of increase in the use of clean water every year in the last 5 (five) years

No	Years	Population	Use of clean water (L/day)	Average increase in water use (L/day)	Percent increase (%)
1	2018	987	10.887	-	-
2	2019	1.232	13.589	2702,35	19,89
3	2020	1.353	14.924	1334,63	8,94
4	2021	1.458	16.082	1158,15	7,20
5	2022	1.567	17.284	1202,27	6,96
The average increase in the use of clean water/day in the current year				1.599	10,75

Source: Assume the use of clean water is 40 L/day.

Table 3 data, shows that there is an increase in the use of clean water every day reaching ± 1,600 L/day in the last 5 (five) years (2018-2022) or an increase of 10.75% per year. These data give the same results with the assumption of calculation based on the category of population of clean water users (Table 2) compared to the assumption of calculation based on the number of population. These results provide an overview of how the future needs for clean water will be, especially in the preparation of infrastructure, distribution facilities, water sources and costs for procurement, including sustainable management.

The provision of clean water at SMK 2 Manokwari in a sustainable manner for the next few years by following the trend of increasing population, it is possible to make predictions of the need for clean water at the school for the next 10 (ten) years based on the average population increase (students/I, teachers, technicians, other supporting staff) every year and an increase in the use of clean water in the last 5 (five) years with the assumption that the average population increase reaches 145 people per year and the average increase in clean water use reaches 3,480 L per year. ..

Table 4. Prediction of Clean Water Needs at SMK 2 Manokwari based on the estimated population increase in the next 10 years

No.	Years	Estimated population and demand for clean water			
		Population (soul)	Water needs (L)	The amount of water increase (L)	Percent growth
1	2022	1.567	17.567	±1.600 L/year	4.72 %/year
2	2023	1712	18.883		
3	2024	1857	20.483		
4	2025	2002	22.082		
5	2026	2147	23.681		
6	2027	2292	25.281		
7	2028	2437	26.880		
8	2029	2582	28.479		
9	2030	2727	30.079		
10	2031	2872	31.678		
11	2032	3017	33.276		
Amount per year		1.567	15.709		
Average		145	±1.600		47,21%/10 year

Table 4 above shows that the estimated need for clean water in SMK 2 Manokwari in the next 10 years (2032) is 33,267 L/day with the assumption that there is an increasing trend of population (number of students, teachers, technical staff and other supporting staff) reaching an average of an average of 145 people/year (8.47%), so that the increase is accompanied by an increase in water demand every year reaching 1,600 L/ (4.72%). If it is associated with the capacity and capacity of the water reservoir, which only reaches 40,400 L, this shows that in 2032 the need for clean water will only reach 33,276 L/day, so there is no need to build a new tub, nor do new sources of raw

water or construction of new bore wells. This is because the current capacity of clean water reaches a capacity of 40,400 L, so it is considered adequate to meet the needs of clean water at SMK 2 Manokwari in the next 10 years, thus the availability of clean water is sustainable and can meet the needs in line with population growth in SMK 2 in the next 10 years.

Water Quality Analysis

Testing the quality of clean water at SMK Negeri 2 Manokwari is carried out through the BPOM (Food and Drug Supervisory Agency) in Manokwari. Clean water quality testing must meet 3 (three) main requirements, namely fulfilling physical requirements, chemical requirements and biological requirements. There are 6 physical requirements in total, but only 3 parameters are carried out, while for chemical requirements according to the standard there should be 22 parameters, but only 2 parameters are carried out, assuming for groundwater with a depth of 30 m and above, then some physical and chemical parameters does not need to be done, because it is considered that the water is very unlikely to be contaminated with waste such as heavy metals. Laboratory test results data based on Test Result Certificate Number: LHU MKW/22.121.12.13.07.0015/PANGAN/2022, July 7 2022, are shown in Table 2.

Table 2. Results of the analysis of the quality of water on groundwater sources at SMK 2 Manokwari

No.	Test Parameters	Test results	Condition	Methods	Method Library
Chemical and Physical Test Parameters					
1.	Temperature	0,05 ºC	± 3 oC from room temperature (water for sanitary hygiene purposes)	Measurement with a thermometer	SNI 01-3553-2015
2.	pH	7,88	6.5-8.5 (water for sanitary hygiene purposes)	Measurement with a pH Meter	SNI 01-3553-2015
3.	Total Padatan Terlarut (TDS)	0,3060 mg/l	Maximum 1000 mg/l (water for sanitary hygiene purposes)	Gravimetry	SNI 01-3553-2015
Microbiological Test Parameters					
4.	Coliform Number	27,09 x 10^1 CFU/100 mL	50 CFU/100 mL	Filtering method	SNI 3554: 2015/84/MBM /MA-PPPMN/18

The data shows that for the chemical and physical test parameters, namely temperature and TDS all meet the requirements, as well as for biological requirements, the Coliform number does not meet the requirements and the Escherichia coli number meets the requirements. Coliform numbers that do not meet the requirements can be caused by several things, including: A dirty reservoir has never been washed, there was an error during sampling, for example there is an empty part in the sample holder, so that the space is filled with air which may be the air. contains bacterial cells that proliferate after sampling, there is a vacancy duration of more than 48 hours from the time of sampling until the biological requirements are tested. Based on table 2, a graph of the results of the physical and microbiological parameter tests of the research area is made in Figure 1.

ASTONJADRO

pISSN 2302-4240
eISSN 2655-2086

Volume 12, Issue 1, February 2023, pp.128-135
DOI: http://dx.doi.org/10.32832/astonjadro.v12i1 http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO

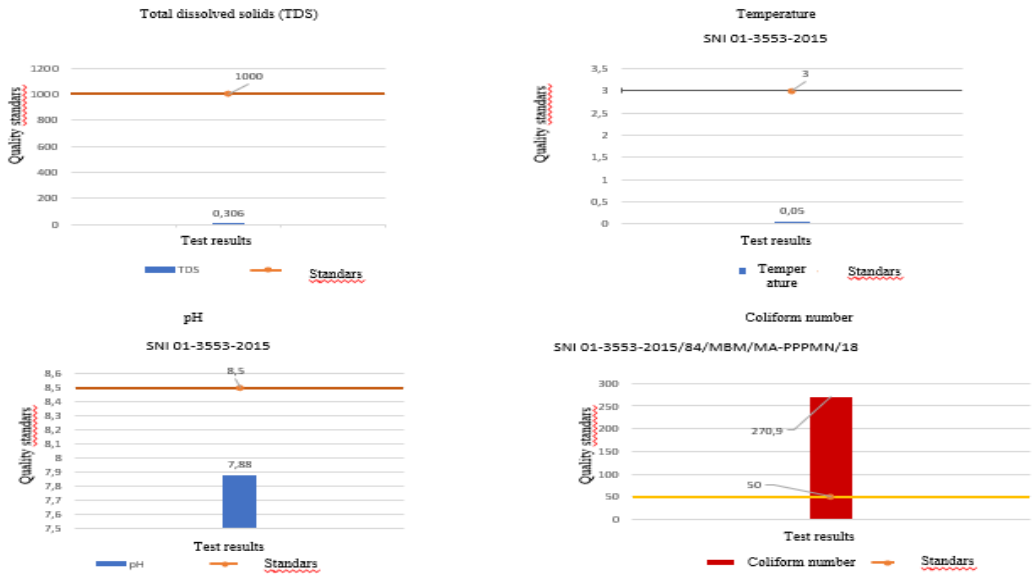

Figure 1. Lab analysis results. Water quality (BPOM Manokwari Laboratory, 2022)

1. Temperature

Good water must have the same temperature as air temperature (20-30oC). Polluted water has a temperature above or below air temperature. Water samples at both locations have a temperature of 0.05ºC. The results of this test indicate that the drilled well water from the research location meets the standard water requirements.

2. PH

pH is a measure of the level of acidity or alkalinity of water, a high pH is also called alkaline and a low pH is called acid. pH is used to describe the quality of clean water. Water with a low or high pH can be an indicator of chemical or heavy metal pollution, which is why knowing the pH is an important step, especially if the water is consumed or has direct contact with the human body. The degree of acidity (pH) of water which is less than 6.5 or an acidic pH increases the corrosiveness of metal objects, creates an unpleasant taste and can cause some chemicals to become toxic which can harm health. The pH value of clean water based on laboratory results is 7.88. This value is in the value interval of 6.50-8.50, so it can be stated that the pH value meets the requirements for clean water quality standards.

3. TDS

TDS usually consists of organic matter, inorganic salts and dissolved gases. TDS increases, the hardness will increase. The effect of TDS or hardness on health depends on the chemical species. TDS usually consists of organic substances, inorganic salts and dissolved gases. If the TDS increases, the hardness will increase. The effect of TDS or hardness on health depends on the chemical species that cause the problem. TDS (total dissolved solids) are dissolved solids such as minerals, salts, and metals dissolved in water. The standard TDS value for clean water is a maximum of 1000 mg/l, while the sample test results from the laboratory are 0.3060 mg/l. This value does not meet the standard requirements for clean water quality

4. Total *Coliform*

Coliform bacteria are indicators of pollution in water. This bacterium is a gram-negative rod-shaped bacterium, does not form spores and is able to ferment lactose at 37°C by forming acid and gas within 24-48 hours (Suriawiria, 2008). Total coliforms are bacteria that are usually found in water and soil environments which have been affected by surface water and waste that comes from human and animal waste. Coliform bacteria are a class of microorganisms used as indicators to determine

whether a clean water source has been contaminated with pathogens or not. Coliform bacteria can produce ethionine which causes cancer, besides that, these bacteria can produce poisons such as indole and skatol. The coliform value of the research sample based on laboratory results was 279 CFU/100 mL, while the coliform standard for clean water quality was 50 CFU/100 mL. This data shows that the coliform number does not meet the requirements, so it requires processing to reach quality standards.

CONCLUSION

The water demand at SMK Negeri 2 Manokwari in 2022 is 17,280 liters/day or an average of 11.03 L/day from a total population of 1,567 people. The use of clean water is still much smaller than the capacity of 2 units of storage tanks with a total volume of 40,400 liters. The results of the analysis show that for the quality of clean water at SMK Negeri 2 Manokwari, the parameters are temperature = 0.05 oC, pH = 7.88, TDS = 0.3060 mg/L, and coliform number = 27.09 x 10^1 CFU/ 100 mL. Based on microbiological requirements (coliform) the water quality does not meet the requirements for sanitation hygiene. It is predicted that the need for clean water in 2032 will reach 33,276 L/day or an increase of 47.21% from the current need for clean water, so there is no need for the construction of new tubs and sources of raw water.

REFERENCES

Antariza, Rispiningtati, A. (2011). Simulasi dan Optimasi Harga Air Bersih pada Proyek Waduk Titab Kabupaten Buleleng Propinsi Bali. *Jurnal Teknik Pengairan*, *2*(2).

Artayana, B., & Indra, G. (2010). Perencanaan Instalasi Air Bersih dan Air Kotor Pada Bangunan Gedung dengan Menggunakan Sistem Pompa. *Jurnal Ilmiah Teknik Mesin*, *4*(1), 51–56.

Noviyanti, S. (2014). Penyediaan Air Bersih Pada Kawasan Rawan Air Bersih di Pesisir Utara Lamongan. *Tataloka*, *16*(2), 116–130.

Priyono, Yuliani, S. (2013). Studi Penentuan Status Mutu Air di Sungai Surabaya untuk Keperluan Bahan Baku Air Minum. *Jurnal Teknik Pengairan*, *4*(1), 53–60.

Wahyu Diana, E., Sholichin, M., & Haribowo, R. (2020). Kajian Pengembangan Jaringan Distribusi Air Bersih pada PDAM Tirta Barito Kota Buntok. *Jurnal Teknik Pengairan*, *11*(1), 8–17. https://doi.org/10.21776/ub.pengairan.2020.011.01.02.

B Ginanjar, F Hariati. 2015. ANALISIS KOEFISIEN DEBIT MODEL ALAT UKUR CELAH SEGIEMPAT DI LABORATORIUM HIDROLIKA TEKNIK SIPIL UNIVERSITAS IBN KHALDUN BOGOR. ASTONJADRO 4 (2), 18-24.

MP Alam, M Lutfi, 2016. ANALISIS TREND HIDROGRAF TERHADAP SIMULATOR HUJAN SATU MODEL DAS DENGAN METODE HSS GAMA I. ASTONJADRO 5 (2), 58-66.

MZ Suhadi, I Namara. 2016. PERENCANAAN TEKNIS PEMBANGUNAN PRASARANA SANITASI (STUDI KASUS PEMBANGUNAN PRASARANA SANITASI DI KAMPUNG CIKUKUL DESA NAGRAK SELATAN KABUPATEN SUKABUMI). ASTONJADRO 5 (2), 35-45.

M Imamuddin, D Cahyanto. 2020. ANALYSIS OF DRAINAGE CHANNEL CAPACITY AT SINDANG STREET IN SINDANG HOUSE PUMP AREA. ASTONJADRO 9 (2), 132-144.

B Barid, BO Afanda. 2022. Increasing peak flow of snyder synthetic hydrograph units in the serenan sub-watershed of Bengawan Solo Watershed. ASTONJADRO 11 (3), 616-626.

ADR Atthar, MM Sari, IWK Suryawan. 2022. Alternative medical waste treatment during COVID-19 case study in Hospital X Jakarta City. ASTONJADRO 11 (3), 569-575

M Lutfi, N Chayati, R Rulhendri, D Azhari. 2022. Assessment of building seismic risk in the environment of Ibn Khaldun University Bogor. ASTONJADRO 11 (3), 517-525.

pISSN 2302-4240
eISSN 2655-2086
Volume 12, Issue 1, February 2023, pp.128-135
DOI: http://dx.doi.org/10.32832/astonjadro.v12i1 http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO

A Amrullah, E Erniati, M Chaerul. 2021. BUILDING PROTECTION DESIGN IN FIRE HAZARD PREVENTION (Case Study: Fajar University Building (UNIFA) Makassar). ASTONJADRO 11 (1), 50-60.

I Prastowo. 2020. REVIEW OF BUILDING MAINTENANCE AND MAINTENANCE MANAGEMENT SYSTEM AT THE SUNAN HOTEL SOLO. ASTONJADRO 9 (2), 145-158.

S Yarsono, M Imamuddin, J Suwandi, LM TN, I Wulandari, B Al Hanif, 2020. PENGARUH PERUBAHAN DIMENSI TANGKI TERHADAP DESAIN PONDASI EKSISTING TANGKI REAKTOR PILOT PLANT BIOGAS POME. ASTONJADRO 9 (1), 24-29.