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MORALITY BEFORE KNOWLEDGE

Evaluation and development of the clean water distribution network

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ABSTRACT

Background: Rapid population growth and the large number of residential developments go hand in hand with the increasing need for clean water, especially drinking water. Basically, a city's development plan is closely related to the availability of clean water in the area, because clean water is a basic human need that is very important to fulfill. However, several consumers in certain villages which are part of the PDAM North Sebatik branch pipe network service area do not receive a clean water supply. With this research, it is hoped that it can provide alternatives/solutions in solving clean water problems, especially for the Pancang Village area, North Sebatik District. **Methods:** The data needed in this study is data on the population of Sei Pancang Village, North Sebatik District for the last 5 years, data on PDAM customers for the last 5 years, data on clean water needs, data on clean water sources and reservoir volume, as well as map data on the clean water distribution network. The evaluation technique used in this study uses the method with the largest correlation calculation, namely the arithmetic method. The clean water distribution network map will be evaluated using Epanet software. **Findings:** The results of this research are that the population of Sei Pancang Village, North Sebatik District in 2022 will be 5250 people and projections for the number of residents and customers for the next 10 years show that the population will increase to 7018 people. **Conclusion:** Water use in the development plan year, namely 2023, in the residential area of Sei Pancang Village, North Sebatik District, includes, among other things, an average daily need of 9,045 lt/s, a maximum daily need of 10,402 lt/s, and a peak hour need of 13,568 lt/s. Meanwhile, in 2032 water demand will increase, with an average daily demand of 11,697 lt/second, a maximum daily demand of 13,451 lt/second, and a peak hour demand of 20,177 lt/second. **Novelty/Originality of this article:** This study develops a predictive model integrating demographic, climate, and infrastructure data to project water demand and optimize distribution. This model can be applied across regions to improve water management efficiency.

KEYWORDS: arithmetic methods; clean water; Epanet software.

1. Introduction

Indonesia is a developing country that is vigorously pursuing development. As a developing nation, Indonesia possesses the fifth-largest water potential in the world, which the government largely utilizes for the prosperity of its people. However, water usage needs to be managed properly to avoid waste and to maintain its quality. The rapid population growth and the increasing number of residential developments are accompanied by a rising demand for clean water, especially drinking water. According to Government Regulation Number 122 of 2015 concerning the Drinking Water Supply System, raw water for

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household drinking water, hereinafter referred to as raw water, is water sourced from surface water, groundwater, rainwater, and seawater that meets certain quality standards as raw water for drinking water (Putra et al, 2020).

The provision of clean water from the source to the consumer is carried out in several ways. It can be directly collected from transmission pipes into the consumer network, or through reservoirs and then distributed through the distribution network according to its main function, which is to deliver clean water to all customers while maintaining factors of quality, quantity, and water pressure (Tafano et al, 2017). However, in reality, the water consumed by customers often decreases or does not flow at all. These problems arise when the distribution network cannot operate properly or when there is damage to some parts of the distribution network due to technical or non-technical factors (Rizki, 2022).

The development plan of a city is fundamentally closely related to the availability of clean water in the area, as clean water is a crucial basic human need that must be met. As the city grows and residential areas and other facilities expand, the demand for clean water increases proportionally with the rising population and the development of the area. Based on population growth data over the past five years, it is known that the population growth rate in Pancang Village, North Sebatik District, averages 5% per year. Considering the significant role of clean water services in the rapidly growing population, which implies an increase in the demand for clean water in Pancang Village, North Sebatik District, efforts need to be made to improve the distribution network system and provide adequate clean water in terms of both quality and quantity.

In Pancang Village, North Sebatik District, there is already a clean water supply system managed by PDAM North Sebatik branch, under the supervision of PERUMDA Tirta Taka, Nunukan Regency, with a source capacity of 20 liters/second. In its operation, the clean water distribution system is less effective due to issues as mentioned above. Some residents are already served, but several consumers who are part of the PDAM North Sebatik unit pipeline service area have not yet received a clean water supply. In the clean water distribution network in Pancang Village, North Sebatik District, many supporting facilities or network components are not adequately maintained, such as dirty or damaged distribution pipes, which hinder optimal operation. Given this background, an evaluation of the clean water supply system and improvement of the existing network system is needed to resolve issues related to clean water distribution.

In this study, the distribution pipeline network is evaluated using software called Epanet version 2.0. The Epanet 2.0 program can help determine flow rates, velocities, head losses, and friction factors in clean water distribution networks. The analysis of the distribution pipeline network using the Epanet 2.0 program is conducted by inputting data obtained from tracking results and from the analysis of residents' water demand calculations. This will provide a simulation of the operation of the clean water network (Fitria, 2014). Therefore, the author uses this as a basis for the evaluation titled "Study of Clean Water Distribution Pipeline Network Development Planning in Pancang Village, North Sebatik District, Nunukan Regency.

1.1 Water

Water is a substance or element that is essential for all known forms of life on Earth, but not on other planets. Water covers nearly 71 percent of the Earth's surface. There are approximately 1.3-1.4 billion cubic kilometers of water on Earth, of which 97.5 percent is seawater, 1.75 percent is in the form of ice, and 0.73 percent is found on land as rivers, lakes, groundwater, and so on. Water on Earth continuously repeats a cycle of evaporation, precipitation, and outflow. Thus, it can be concluded that the water resources on Earth will not increase in quantity (Setia, 2015).

Clean water is a crucial material whose necessity is always intertwined with human life. Its utilization extends beyond household needs and encompasses facilities that provide economic and social services, as well as basic human necessities, where its demand is continually increasing. Generally, clean water is defined as water suitable for use as raw water for drinking. This suitability also includes being fit for bathing, washing, and sanitation purposes. The requirements referred to pertain to water quality aspects, including physical, chemical, biological, and radiological qualities, so that it does not cause side effects when consumed (General Provisions of the Ministry of Health Regulation No. 416/Menkes/PER/IX/1990). Clean water is water of a certain quality used for daily needs, which quality differs from drinking water (Ministry of Health Regulation No. 32 of 2017).

Drinking water is water sourced from households, whether it has undergone treatment or not, that meets specific health standards and is safe for direct consumption. The determination of drinking water quality standards is based on health and technical considerations, including the impact of each water quality parameter if it exceeds the established limits. Drinking water quality standards are defined as the operational limits of various water quality criteria, taking into account non-technical factors such as socio-economic conditions, production quality targets or levels, existing public health standards, and available technology. According to the Ministry of Health Regulation No. 416/Menkes/PER/IX/1990, the primary difference between the quality of clean water and drinking water lies in the maximum permissible quality standards for each physical, chemical, biological, and radiological parameter contained within.

1.2 Sources of clean water

A clean water source is one of the main components in a clean water supply system because, without a water source, a clean water supply system cannot function. A well-maintained and good-condition water source will produce high-quality clean water, even though it needs to be treated before consumption (Asmadi & Kasjono 2011). According to Sutrisno & Suciastuti (2010), "there are various sources of water that can be utilized as clean water sources. In its pure state, atmospheric water is very clean; however, due to air pollution caused by industrial pollutants, dust, etc., caution should be taken when collecting rainwater as a drinking water source. It is advised not to start collecting rainwater at the beginning of a rainfall because it still contains a lot of impurities.

Surface water is rainwater that flows on the earth's surface. Generally, surface water will contain many impurities while flowing over the surface. These impurities can come from soil, mud, dry leaves, and so on. Surface water is divided into two types, namely river water and swamp/lake water. River water used as clean and drinking water must undergo a thorough treatment process. This is because river water generally has a high content of impurities. Similarly, swamp/lake water must also undergo the same treatment process because it usually contains decayed organic substances that cause the water to turn yellow-brown.

1.3 Clean water requirements and factors influencing water usage

The requirement for water is the amount of water needed for basic needs or a specific unit of water consumption, where water loss and the need for firefighting are also taken into account. These basic needs and losses fluctuate over time, on an hourly, daily, weekly, and monthly basis throughout the year. The amount of water used for various types of usage is known as water consumption. The amount of water consumption is influenced by factors such as the availability of water in terms of quality, quantity, and continuity; local population habits; lifestyle patterns and standards; water prices; technical availability of water such as distribution facilities, waste disposal facilities that can affect clean water quality and ease of access, as well as the socio-economic conditions of the local population.

According to Imron Builcin, the amount of infrastructure and facilities needed is fundamentally influenced by three variables: the population served—the larger the population, the greater the infrastructure and facilities required; the area occupied by the population—the larger and more widespread the urban population, the greater the amount of infrastructure and facilities that need to be provided; and per capita income—the demand for public services is income elastic, meaning that as population income increases, there tends to be a higher demand for urban services both in quantity and quality.

Factors influencing water usage include (Linsley & Ray, 1995) climate—water needs for bathing, watering plants, air conditioning, etc., are higher in warm and dry climates compared to humid climates. In very cold climates, water might be wasted at faucets to prevent pipes from freezing. Population characteristics—water usage is influenced by the economic status of the customers. Per capita usage in poor areas is much lower than in wealthy areas. In areas without waste disposal, consumption can be as low as 10 gcpd (40 liters per capita per day). Environmental concerns—growing public attention to resource overuse has led to the development of tools that can be used to reduce water usage in residential areas. Socio-economic factors—population, city size, climate, living standards, education, and economic level. Per capita water usage in communities with waste networks tends to be higher in large cities than in small cities. Technical factors—system condition, pressure, price, and water meter usage. The influence of technical factors generally includes the malfunctioning of water meters.

1.4 Water usage fluctuations

In general, community water needs are not constant but fluctuate due to living habits and climate conditions in different parts of the world. In countries with four seasons, water usage significantly increases by 20% - 30% during the summer months of June, July, August, and September. In winter, water usage is usually 20% lower than the average annual usage. From a climate perspective, in tropical regions, including Indonesia, the difference between maximum daily factors tends to be smaller than in countries with four seasons. Water needs are divided into three groups, namely average water needs (Qr), maximum daily needs (Qm), and peak hour needs.

Knowing the maximum daily needs and peak hour needs is essential in calculating the raw water requirements. Maximum daily water needs and peak hour needs can be calculated through average daily water needs (Qr)—the water used to meet domestic, non-domestic needs, and water loss. Maximum daily water needs (Qhm) is the largest amount of water needed on a particular day in a year, based on Qr. Peak hour needs are the largest water requirements at a specific hour in a day.

1.5 Clean water requirement projections

Research on clean water provision in Indonesia shows various efforts to meet community needs. Fathony (2012) studied the clean water needs of PDAM customers and the increase in the number of customers and found that water loss and flow debit affect availability. Meanwhile, Makawimbang et al. (2017) planned a clean water supply system by considering data on energy loss and population. Furthermore, clean water needs can also be associated with the level of service (Salilama et al., 2018). Other studies have also found that conditions in the community indicate a shortage of water, requiring optimization of available water sources. In addition, another problem is the finding of an average water usage debit that does not meet the eligibility criteria (Zamzamia et al., 2018). However, conflicting findings were reported in other studies, where the need for clean water in the next 10 years showed that water production was sufficient (Salim, 2019). Finally, Hasanah (2021) and Noperissa & Waspodo (2018) analyzed the amount of clean water needs and availability in the community in the next few years, showing that the need for clean water can still be met.

To produce clean water, facilities for producing clean water are required, which include raw water, treatment buildings, transmission pipes, distribution pipe networks, and other equipment. Additionally, an organization and implementation personnel are needed to manage the clean water supply system. Considering the increasing demand for clean water year by year, the existing facilities/systems may not be able to meet future water needs.

Planning and constructing these clean water supply facilities also takes a considerable amount of time. Therefore, we need to estimate the future clean water needs so that we can prepare everything necessary to produce clean water according to future demands.

Furthermore, by knowing the future clean water needs, we can estimate the workforce and cost required to manage the clean water supply system in the future. The analysis of future clean water needs uses established calculation standards. The water needs for socio-economic facilities should be differentiated according to PDAM regulations, taking into account the production capacity of existing sources, leakage rates, and service levels. The main factor in the water needs analysis is the population in the study area. To analyze the 10-year projection, the Arithmetic, Geometric, and Linear methods are used. Based on these projections, the amount of water needed for the domestic and non-domestic sectors is calculated according to the criteria of the Directorate General of Human Settlements 1996. The target of this clean water needs analysis is to meet the clean water needs of the community with a service level of up to 100% of the population of Labuan Bajo in the future, using the latest population data from 2021 and projecting up to 10 years ahead, i.e., until 2031.

1.6 Clean water distribution system

The distribution system is directly related to consumers, with the main function of distributing water that meets the requirements to the entire service area. This system consists of reservoirs and distribution pipes. Two important aspects to consider in the distribution system are the availability of sufficient water and adequate pressure (continuity of service), and maintaining the safety of the water quality from the treatment installation.

The main task of the clean water distribution system is to deliver clean water to the customers being served, while maintaining the quality, quantity, and pressure of the water according to the initial plan. The factor most desired by customers is the availability of water at all times. The clean water distribution system is divided into reservoirs and the distribution piping system. A reservoir is a tank located on or above the ground, serving as a water tower for gravity or pumping systems. It has three functions: storage to serve hourly usage fluctuations, water reserves for firefighting, and emergency services due to source disruption in transmission or damage or malfunction in a treatment facility. It also ensures flow and pressure equalization due to usage variations within the distribution area and serves as a central distributor or service source within the distribution area. The location of the reservoir depends on the topography source. The placement of the reservoir affects the distribution flow system, which can be gravity, pumping, or a combination of both. Meanwhile, Distribution Piping System is able to distribute water to each consumer in various ways, either through direct house connections or public taps. In ideal fluids, there is no loss of energy when flowing in pipes, but in ordinary fluids that have viscosity, friction occurs between the fluid and the pipe walls and/or between the fluid molecules themselves, causing energy loss (Fathony, 2012).

2. Methods

Research methodology is a set of activities, rules, and procedures used by researchers in a particular discipline. It also involves a theoretical analysis of a method or approach. Research is a systematic presentation with the aim of increasing the amount of knowledge. Methodology also encompasses the study of methods, philosophical and analytical considerations, as well as the logical appropriateness and limitations of various approaches and perspectives in the research itself (Lubis, 2018). The method used in this study is descriptive quantitative. The study was conducted to determine the need for clean water in Pancang Village, PDAM Unit of North Sebatik District, and to review the water distribution system in the area for the future.

2.1 Research location

Sei Pancang Village is one of the villages within the administrative area of North Sebatik District (established in 2011), located in the northern part of Kalimantan Island and the northern part of Sebatik Island, adjacent to Sabah – Northern Malaysia and directly bordering the Sulawesi Sea with a coastline of approximately 5 km. Sei Pancang Village covers an area of approximately 1,320 hectares, with 75% of its territory consisting of land used for agriculture and plantations, 15% used for residential settlements, and the remaining 10% for trade, government, and other public and social facilities. The administrative area of Sei Pancang Village in the north borders Seberang Village and North Sebatik Malaysia. In the south it borders Sei Nyamuk Village in East Sebatik District. In the east it borders the Sulawesi Sea, and in the west it borders Lapri Village (Figure 1).

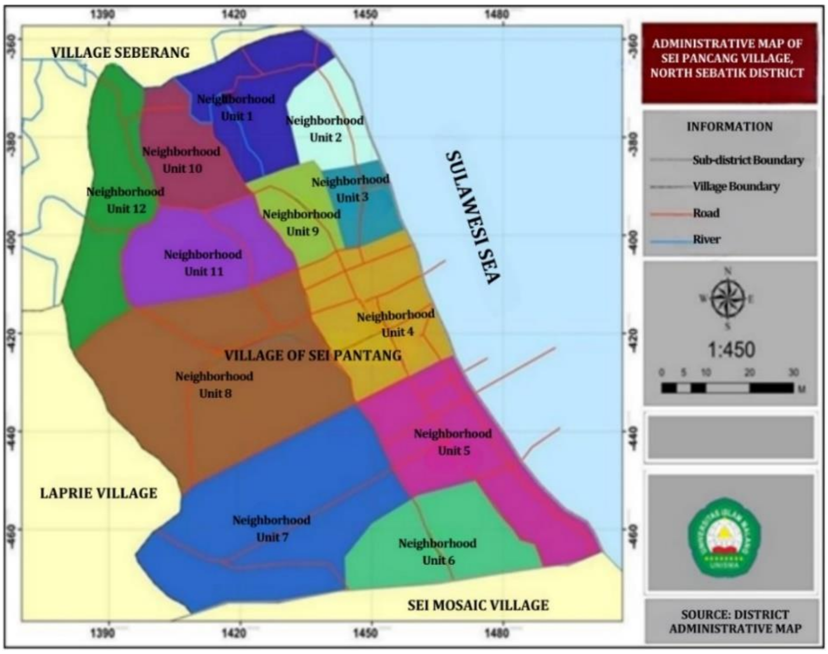

Fig. 1. Map of the Research Location

2.2 Research data

Data collection is conducted to obtain the information needed to achieve the research objectives. Primary data is usually obtained through field surveys that employ all original data collection methods (Hanke & Reitsch, 1998). Furthermore, primary data can be defined as data collected from original sources (Hamid & Susilo, 2011). The primary data in this study includes the identification of the conditions and potential of water sources, identification of the surrounding area and water needs of the vicinity.

Meanwhile, secondary data is data that has been collected by data collection institutions and published for public use. In brief, secondary data can be described as data that has been gathered by other parties. The secondary data in this study includes population statistics of the study area, geographical condition data or the area size, and existing location situation and topography maps.

2.3 Data collection dan data analysis

This research went through several stages of data collection. The preparation phase is intended to facilitate the research process, such as data collection, analysis, and report compilation. Literature studies aim to provide direction and insight to ease data collection, analysis, and the compilation of research results. Field observations are intended to identify the location/places for data collection necessary for compiling the research results.

Meanwhile, data collection can be obtained from related agencies, including data on the population of Pancang Village over the past five years, data on PDAM customers by customer type over the past five years, and data on the clean water needs for customers in Pancang Village.

In the analysis phase, calculations are performed on the existing data to determine the rate of change for each element and to identify the clean water needs. The necessary data in terms of quantity include the increase in PDAM customers according to their variables over the past five years. This data is then analyzed using formulas to estimate the clean water needs for the next ten years.

The data processing formulas that will be used include several important methods and analyses. For population estimation, three methods will be used, namely the geometric method, the arithmetic method, and the linear regression method. Clean water needs will be calculated based on the level of public service, home connection services, indirect connections or public tank connections, clean water consumption, and water loss analysis. In addition, an analysis of PDAM water needs, maximum daily needs, and water usage during peak hours will be carried out. Finally, the clean water distribution network will also be analyzed.

3. Result and Discussion

Calculations will be discussed with the aim of studying the evaluation of clean water distribution in the village of Sei Pancang. The first stage to be calculated is the projection of population growth in Sei Pancang, so that it will be known how many residents are in each house in the village of Sei Pancang up to the year 2032. The second stage involves the analysis of clean water needs, including average and peak hour needs, water availability, and the calculation of distribution pipe diameters. The next stage, which involves simulations using Epanet 2.2 software, can be carried out after the calculations and planning model data have been created. Evaluations can be conducted after the results of each simulation, including hydraulic aspects and others. Changes to system components are necessary if there are issues with the system, until the results are optimal and meet the planning criteria.

3.1 Population projection analysis

3.1.1 Population projection calculation using the arithmetic method

The population development of Sei Pancang Village in 2013-2022 based on population data from *Badan Pusat Statistik Kabupaten Nunukan/*Statistics of Nunukan Regency is numerically shown in Table 1. Population data from 2013 to 2022 shows a consistent increase in population from year to year.

Table 1. Data on the population of Sei Pancang Village over the past 10 years

No	Year	Population
1.	2013	3,903
2.	2014	3,961
3.	2015	4,196
4.	2016	4,224
5.	2017	4,402
6.	2018	4,693
7.	2019	4,887
8.	2020	5,060
9.	2021	5,164
10.	2022	5,250

(Badan Pusat Statistik, 2022)

In 2013, the population in the area was recorded at 3,903 people. This figure gradually increased to 3,961 in 2014 and continued to grow to 4,196 in 2015. This increasing trend continued, with the population increasing to 4,224 in 2016 and 4,402 in 2017. In 2018, the population increased more significantly to 4,693, followed by 4,887 in 2019. This growth continued until 2020, with the population reaching 5,060, and continued to increase to 5,164 in 2021. In 2022, the population reached 5,250, indicating a steady growth throughout the decade. Overall, these data reflect a positive demographic trend in the region.

The population projection of Sei Pancang Village from 2013 to 2022 is calculated using the arithmetic method with the Equation 1, where Pn equals Po multiplied by the result of adding one and multiplying r and n. In this formula, Pn is the population at the end of the projection period, Po is the population at the beginning of the projection, r is the average population growth rate, and n is the projection period.

$$Pn = Po \times (1 + r \times n) \qquad \text{(Eq. 1)}$$

Based on the available data, Po is 3,903, r is 0.03367, and n is for one year. The calculation results show that Pn, or the projected population in 2022, is 4,034 individuals. Similarly, the population growth projection using the Arithmetic method is fully presented in Figure 2.

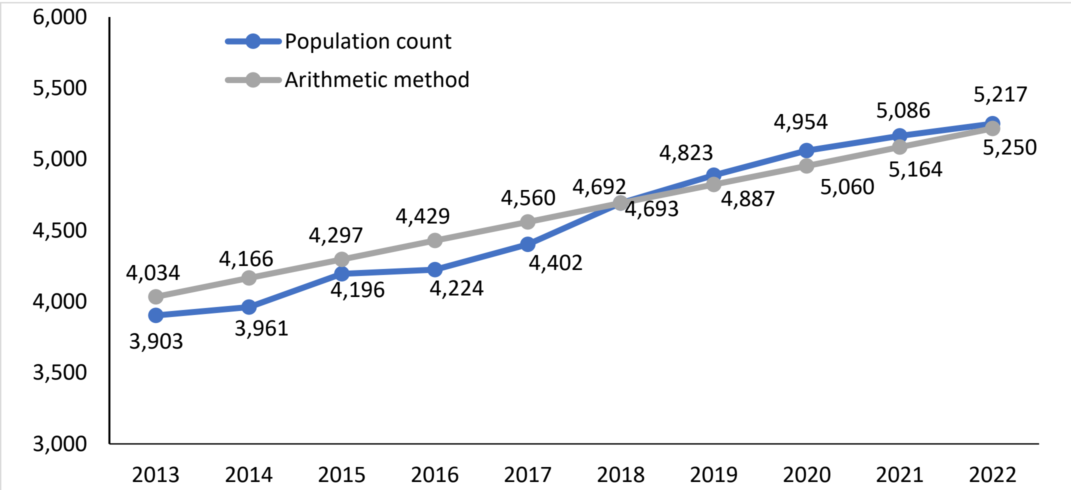

Fig. 2. Arithmetic method population growth projection graph

3.1.2 Population projection calculation using the geometric method

The calculation of the population projection for Sei Pancang Village for the years 2013-2022 using the Geometric Method is as follows Equation 1. Based on the calculation, the value of Po is 3,903, n is 1, and r is 0.03367. Using the arithmetic population projection formula, Pn is calculated as Po multiplied by the result of the addition of one and the multiplication of r and n. The result is Pn equals 3,903 multiplied by 1.03367, so that the projected population in 2022 is 4,034 individuals.

$$Pn = Po \times (1+r)n \qquad \text{(Eq. 1)}$$

The calculation of population projections using the Geometric Method is carried out in the same way for the following years. The results are presented in the form of a comparison between actual population data and projected data. This comparison is depicted in the graph shown in Figure 3.

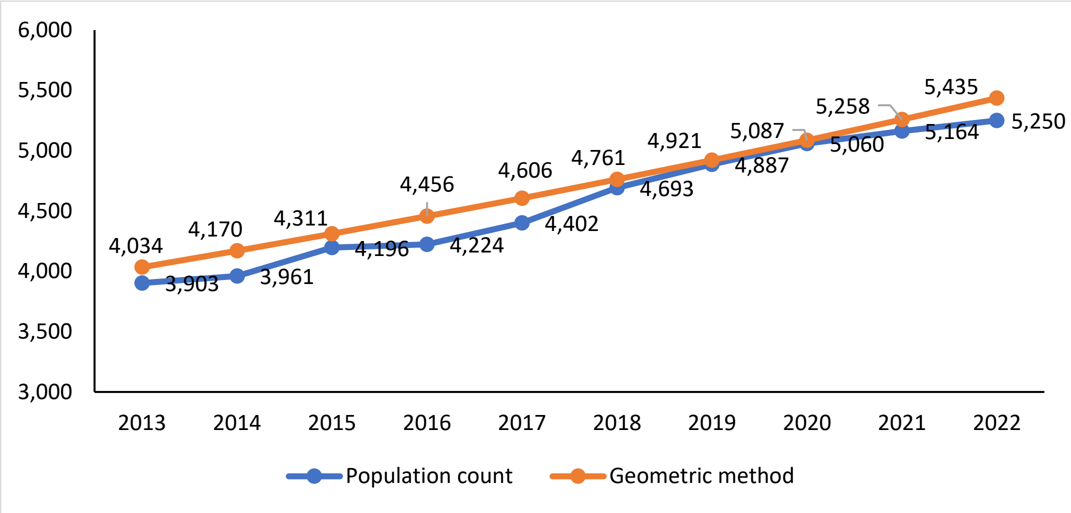

Fig. 3. Graph of population growth projection using the geometric method

3.1.3 Population projection calculation using the exponential method

The population projection calculation for the years 2013-2022 using the Linear Regression Method is as follows Equation 2. Based on the population projection calculation using the Geometric Method formula, it is known that Po is 3,903, the value of e as the base number of the natural logarithm system is 2.7182818, r is 0.03367, and n is 1 year. By entering these values into the formula, we get Pt equal to 3,903 multiplied by 2.7182818 to the power of the product of 0.03367 and 1. The results show that the projected population in 2022 is 4,037 individuals.

$$Pt = Po \times e^{rn} \qquad \text{(Eq. 2)}$$

Population projection calculation is done using Linear Regression Method for the following years. This projection is calculated by comparing actual population data with projected population data. The results of the comparison are displayed in graphical form, as shown in Figure 4.

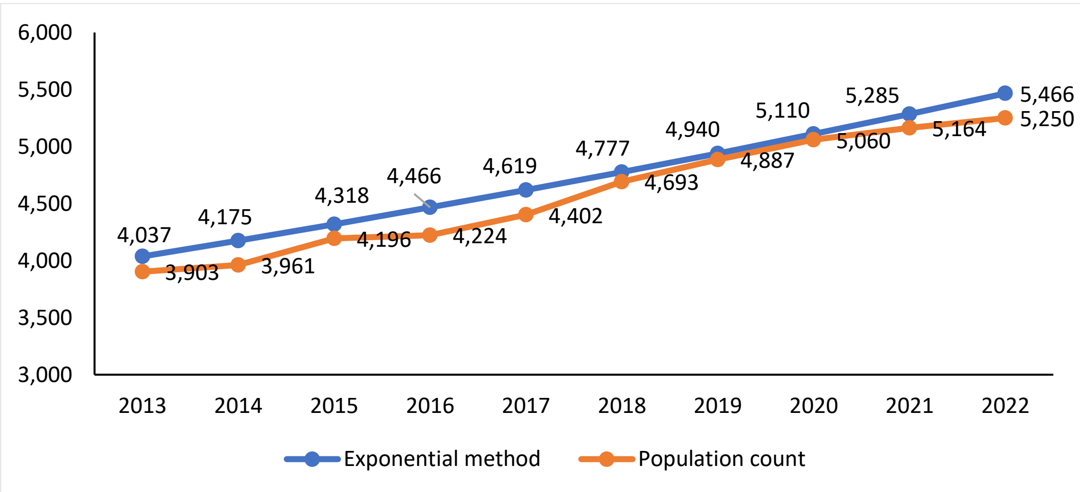

Fig. 4. Population growth projection graph using linear regression method

3.2 Selection of the projection method used and calculation of clean water needs

The results of the population count calculated annually using three different methods are used as a comparison for the current growth rate. The various methods can be compared in the graph shown in Figure 5. The criteria for calculating the projected water needs in Sei Pancang Village follow the standards established by Ministerial Regulation No. 18 of 2007 and field conditions. Domestic water needs include service coverage planned up to the year 2032 according to the needs of the development areas to be served. Each household connection is planned to serve five people, with a target service percentage of 100%, based on data from the PDAM Unit of Sebatik Utara District, which indicates that all households in the village are connected to the clean water service.

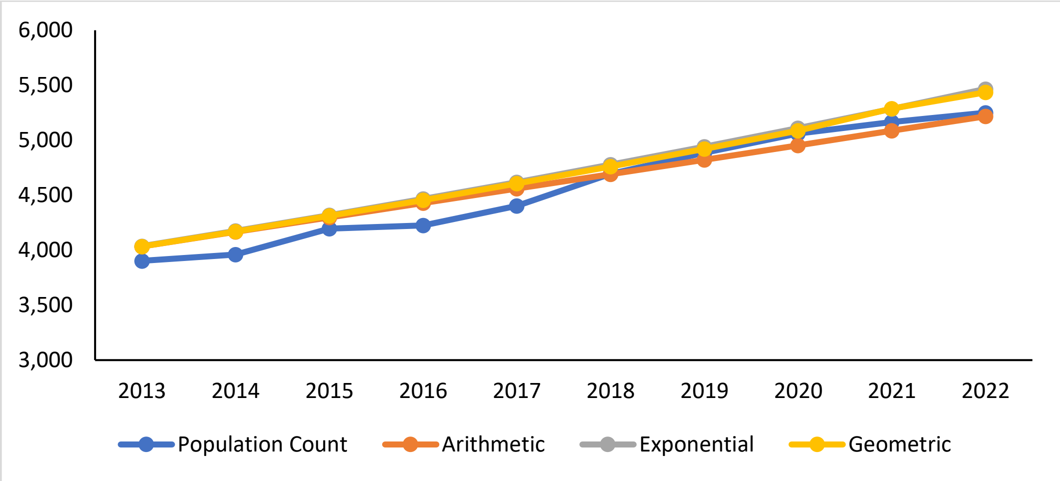

Fig. 5. Graph of population growth projection

The percentage of non-domestic service is planned to be between 20-30% (according to the Clean Water Planning Criteria based on SNI 1996) of the domestic needs. Non-domestic water needs are used to meet requirements for facilities such as educational institutions, healthcare facilities, places of worship, industrial facilities, trade facilities, public facilities, and others. Commercial water needs in an area tend to increase with the growth of the population and changes in land use.

Water loss is projected to reach 20% by the end of the development planning year, based on information from the PDAM Unit of Sebatik Utara District. This projection reflects the estimated level of loss that is expected to occur within the water distribution system. The calculation of water needs is not static but fluctuates. Generally, water needs are divided into three main categories: average water needs, which include both domestic and non-domestic needs; maximum water needs, calculated as 1.15 times the average water needs; and peak hour water needs, calculated as 1.50 times the average water needs. All calculations adhere to the guidelines outlined in Ministerial Regulation No. 18 of 2007. The results of the water requirement calculations are as follows (Table 2).

Thus, the need for clean water in Sei Pancang Village in 2023 with an average daily requirement of 9,045 lt/sec, a maximum daily requirement of 10,402 lt/sec, and a peak hour requirement of 13,568 lt/sec. Meanwhile, for 2032 the need for water will increase, for an average daily requirement of 11,697 lt/sec, a maximum daily requirement of 13,451 lt/sec, and a peak hour requirement of 20,177 lt/sec.

For the analysis of clean water availability until 2032, it is done by comparing the potential discharge of the water source that is currently being utilized with the discharge needed until 2032 according to the calculation results. Based on data obtained from the field, Sei Pancang Village uses a water source from the Lapri IPA with a discharge of 20 liters/second, the maximum water requirement is 13.51 liters/second and the peak hour water discharge needed for Sei Pancang Village is 21 liters/second. By comparing the existing needs and availability, it can be seen that the amount of raw water or waste water from the reservoir that can be utilized for the needs of the current population is not yet able to meet the needs of the Sei Pancang Village area until 2032.

Tabel 2. Projection of clean water needs in Sei Pancang Village 2022-2032

Description	Unit	Year										
		2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Number of people	People	5250	5427	5604	5780	5957	6134	6311	6487	6664	6841	7018
Number of people/ house connection	People	6	6	6	6	6	6	6	6	6	6	6
Number of residents served	%	100	100	100	100	100	100	100	100	100	100	100
House connection	Unit	875	905	934	963	993	1022	1052	1081	1111	1140	1170
Per-capita water requirement	L/ Person /day	100	100	100	100	100	100	100	100	100	100	100
Domestic water requirement	L/sec	6076	6281	6486	6690	6895	7100	7304	7508	7713	7918	8123
Non-domestic water requirement	L/sec	1215	1256	1297	1338	1379	1420	1461	1502	1543	1584	1625
Total water requirement	L/sec	7292	7538	7783	8028	8274	8519	8765	9010	9256	9501	9747
Leakage losses	%	20	20	20	20	20	20	20	20	20	20	20
	L/sec	1458	1508	1557	1606	1655	1704	1753	1802	1851	1900	1949
Average water requirement	L/sec	8750	9045	9340	9633	9928	10223	10518	10812	11107	11402	11697
Maximum daily water requirement	L/sec	10063	10402	10741	11078	11418	11757	12096	12433	12773	13112	13451
Peak hour water requirement	L/sec	13125	12568	14010	14450	14893	15335	15778	16218	16660	17103	20177
Production capacity of Regional Drinking Water Company	L/sec	20	20	20	20	20	20	20	20	20	20	20

4. Conclusion

The population projection for Sei Pancang Village, North Sebatik Subdistrict, in 2032 is 7,018 people. The clean water needs for Sei Pancang Village in 2023 are as follows the average daily requirement is 9.045 liters per second, the maximum daily requirement is 10.402 liters per second, and the peak hour requirement is 13.568 liters per second. By 2032, the water demand is expected to increase, with an average daily requirement of 11.697 liters per second, a maximum daily requirement of 13.451 liters per second, and a peak hour requirement of 20.177 liters per second.

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Informed Consent Statement

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Data Availability Statement

Not available.

Conflicts of Interest

The authors declare no conflict of interest.

Reference

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