Jurnal Teknik Indonesia

Volume 5 Nomor 4, October 2026
pp. 960-968
DOI: https://doi.org/ 10.58860/jti.v5i4.1004

Analysis of Clean Water Demand in Telawang District, East Kotawaringin Regency

Rakhmad Lastyanto, Laksono Djoko Nugroho, Esti Wulandari
Universitas 17 Agustus 1945 Surabaya, Indonesia
Email: rlastyanto@yahoo.com, laksonodjoko@untag-sby.ac.id,
wulandariesti@untagsby.ac.id

Keywords:
Population Growth; Clean Water Needs; Population Projections; Drinking Water Supply System; Telawang District.

This is an open access article under the CC BY-SA license.

Copyright © 2026 by Author. Published by Publica Scientific Solution

Abstract

Access to clean water is a fundamental community need that requires careful planning based on population growth and the capacity of existing water supply infrastructure. Telawang District, East Kotawaringin Regency, continues to face limitations in clean water services, as the existing non-PDAM water supply system serving the Ibu Kota Kecamatan (IKK, district administrative center) has a production capacity of only 10 L/s and serves 394 household connections, equivalent to approximately 1,576 people or 9.6% of the total population of 16,397. This study aimed to project population growth and estimate clean water demand to support the development of the Drinking Water Supply System (Sistem Penyediaan Air Minum, SPAM) within the Sebabi IKK service area, particularly Sebabi Village and Sumber Makmur Village. Data were collected through official documents and field surveys, while population projections were calculated using the geometric growth method in accordance with relevant water supply planning guidelines. The results indicated that the combined peak-hour water demand was projected to increase from 11.39 L/s in 2023 to 37.39 L/s in 2032 and 67.73 L/s in 2043. To meet the projected demand through 2032, the estimated raw water flow requirement was 35 L/s, which was increased to a design capacity of 40 L/s to account for pumping efficiency, while the proposed water treatment plant capacity was 35 L/s. The study concluded that projected population growth would substantially increase clean water demand, highlighting the need to expand SPAM infrastructure and align production and distribution capacities with future service requirements.

INTRODUCTION

Telawang District, East Kotawaringin Regency, comprises six villages: Sebabi, Tanah Putih, Sumber Makmur, Kenyala, Biru Maju, and Penyang. The district covers a total area of 317 km², with Sebabi being the largest village, occupying 158.50 km² or approximately 50% of the district's total area. In contrast, Biru Maju is the smallest village, covering 2.50 km² or approximately 0.79% of the total. Sumber Makmur is the closest village to the district administrative center, located approximately 3 km away, while Tanah Putih is the farthest, at a distance of 52 km. Situated in East Kotawaringin Regency, Telawang District has a tropical

climate, with average air temperatures in 2023 ranging from 26.30°C to 27.80°C. Its proximity to the equator contributes to generally warm climatic conditions, with average daily sunshine duration ranging from 3.7 to 7.4 hours. Variations in geographical, topographical, and geological conditions across East Kotawaringin Regency influence raw water availability and the accessibility of drinking water services in different areas (Stuhlmacher & Mathieu, 2020). Therefore, comprehensive water supply planning is essential to ensure reliable access to drinking water while accommodating the geographical characteristics and specific requirements of each service area (Deng et al., 2022). Currently, Telawang District is served by a non-PDAM water supply system for the district administrative center (Ibu Kota Kecamatan, IKK), managed by the East Kotawaringin Regency Public Works and Spatial Planning Agency (Dinas Pekerjaan Umum dan Penataan Ruang, PUPR). The system has a production capacity of 10 liters per second (L/s) and serves 394 active household connections, representing approximately 1,576 residents or 9.6% of the district's total population of 16,397. The existing distribution network operates through a branched configuration, making certain service areas vulnerable to interruptions when pipeline failures occur (Togneri et al., 2023). Furthermore, network expansion may result in inadequate water pressure if the existing hydraulic capacity is insufficient to accommodate additional demand (Rezaali et al., 2021; (Kavya et al., 2023).

Several villages also rely on shallow drilled wells connected to public hydrants as alternative water sources to improve access to drinking water area (Salloom et al., 2021; Ghannam & Hussain, 2023). Access to clean water is a fundamental requirement for public health, household activities, quality of life, and regional development. Globally, the provision of clean water depends not only on the availability of water resources but also on the capacity of water supply systems to meet population demands in terms of quantity, quality, and service continuity (Mazzoni et al., 2023). Water demand planning has become increasingly important because of population growth, residential expansion, and increasing socioeconomic activities. From an engineering perspective, water supply systems require systematic planning that includes population projections, estimates of domestic and nondomestic water demand, and assessments of water treatment and distribution infrastructure capacities. (Al-Layla, 1978) emphasized that water supply planning should incorporate assessments of existing demand and future projections to ensure efficient and sustainable service provision. Similarly, (Peavy, 1985) highlighted the importance of comprehensive environmental engineering planning in developing water supply systems capable of meeting long-term community needs.

Water demand in a particular area is influenced by several interconnected factors. First, population growth increases domestic water consumption for drinking, cooking, bathing, washing, and other household activities. Second, settlement distribution and the geographical extent of service areas affect the accessibility and efficiency of water distribution networks (Abu-Bakar et al., 2021). Third, variations in geographical, topographical, and geological conditions influence raw water availability, infrastructure construction feasibility, and pipeline installation requirements. Fourth, the production capacity, physical condition, and operational efficiency of existing drinking water supply systems determine their ability to meet increasing demand. These factors are particularly relevant to Telawang District, where villages exhibit diverse spatial characteristics and existing water supply infrastructure does not serve the entire population. According to the Central Statistics Agency of Central Kalimantan (2023),

Telawang District covers approximately 317 km² and comprises six villages. Consequently, water supply challenges arise not only from population demand but also from the geographical distribution of settlements and the extent of the required service network. Linsley, Franzini, and Sasongko (1992) emphasized that population growth and regional characteristics are essential considerations in estimating water demand and planning water supply infrastructure (Sanchez et al., 2020).

Failure to anticipate these factors through appropriate infrastructure planning can adversely affect the reliability and accessibility of clean water services. Population growth without corresponding improvements in production and distribution capacity may widen the gap between water demand and available supply, potentially limiting household access to clean water (Jaskowiak, 2024; Cao et al., 2023; Abu Talib et al., 2023). Inadequate distribution networks can also contribute to low water pressure, intermittent service, and temporary supply interruptions following pipeline failures, particularly in branched distribution systems with limited network redundancy. Insufficient water supply coverage may encourage households to rely on alternative sources, including shallow wells and untreated surface water, which may not consistently meet applicable water quality standards. These conditions can increase potential health risks, reduce household comfort, and impose additional financial burdens associated with obtaining safe water. Masduqi and Assomadi (2012) emphasized that water supply management must address both water quantity and quality to ensure its suitability for community use. Furthermore, Regulation of the Minister of Public Works No. 18 of 2007 establishes requirements for developing drinking water supply systems, emphasizing the importance of water quantity, quality, service continuity, and affordability. Failure to adequately address these requirements may reduce the effectiveness and sustainability of public water supply services.

The primary variable examined in this study was clean water demand, which was estimated using population projections and the corresponding water flow requirements within the study area. Water demand represents the volume of water required to support domestic and nondomestic activities over a specified period. Its estimation generally considers projected population, planned service coverage, per capita water consumption, maximum-day demand factors, and peak-hour demand factors. Population projections therefore provide an essential basis for estimating future water requirements and determining the appropriate capacity of water supply infrastructure. The Guidelines for Planning Water Resources in River Areas (Directorate General of Water Resources, 2001) recommend the geometric growth method as one approach to estimating future population in water resources planning. In Telawang District, the existing non-PDAM water supply system has a production capacity of 10 L/s and serves only 394 household connections, representing approximately 1,576 residents or 9.6% of the district's total population of 16,397 (Central Kalimantan Statistics Agency, 2023). This limited service coverage indicates a substantial gap between the existing water supply infrastructure and the requirements for broader community access. Consequently, a systematic water demand assessment is necessary to determine the required raw water supply, water treatment plant capacity, and distribution network improvements needed to accommodate future demand.

The novelty of this study lies in its location-specific assessment of clean water demand in Telawang District, particularly within the proposed Sebabi IKK service area, which encompasses Sebabi Village and Sumber Makmur Village. The study integrated population

projections with domestic and nondomestic water demand calculations to estimate future service requirements throughout the planning period. Rather than focusing exclusively on existing water supply conditions, the analysis quantified projected water demand and translated these estimates into technical requirements for drinking water supply system development (Sistem Penyediaan Air Minum, SPAM). Compared with broader water demand assessments, this study provides a localized evaluation that considers the geographical characteristics, existing infrastructure limitations, and projected service requirements of a relatively underserved district. Furthermore, the analysis establishes a direct relationship between projected water consumption and infrastructure planning parameters, including raw water availability, intake design flow, and water treatment plant capacity. This approach is consistent with (Al-Layla, 1978) and (Linsley et al., 1992), who emphasized the importance of medium- and long-term demand projections in water supply infrastructure planning. Accordingly, the study contributes a context-specific and quantitatively informed basis for developing water supply infrastructure in Telawang District.

The urgency of this research arises from the limited coverage of existing clean water services in Telawang District and the anticipated increase in water demand associated with population growth and regional development. Without reliable demand projections, infrastructure expansion may fail to accommodate future service requirements, resulting in inadequate production capacity, insufficient distribution coverage, or inefficient resource allocation. The availability of raw water from the Sebabi River presents an opportunity to expand the existing drinking water supply system. However, its utilization requires careful assessment of projected water demand, raw water availability, treatment requirements, system efficiency, source water quality protection, and long-term operational sustainability. Regulation of the Minister of Public Works and Public Housing No. 27 of 2016 provides a regulatory framework for drinking water supply system development, including technical planning and service requirements. In this context, a comprehensive assessment of clean water demand is necessary to support evidence-based infrastructure investment and ensure that proposed system improvements align with present and future community needs. Such planning can help local authorities adopt a proactive approach to water supply development rather than relying on reactive infrastructure expansion in response to service deficiencies.

This study aimed to estimate clean water demand in Telawang District, East Kotawaringin Regency, by integrating population projections with water consumption estimates over the designated planning period. Specifically, the study sought to (1) identify the geographical characteristics of the study area and assess the existing clean water supply system; (2) project population growth within the proposed service area as the basis for estimating future water demand; (3) calculate projected domestic, nondomestic, maximum-day, and peak-hour water requirements using relevant technical planning parameters; and (4) determine the required raw water intake flow and water treatment plant capacity to support the proposed expansion of the drinking water supply system. These objectives align with established water resources engineering principles, which emphasize the importance of population projections and service demand assessments in determining infrastructure design requirements (Linsley et al., 1992). The findings were intended to provide a quantitative basis for water supply infrastructure planning, support informed decision-making by relevant authorities, and

contribute to improving the accessibility, reliability, and sustainability of clean water services in Telawang District.

METHOD

Research Design and Strategy

This study employed a quantitative approach to assess clean water demand and support water supply infrastructure planning in the Sebabi IKK service area, Telawang District, East Kotawaringin Regency. The research focused on evaluating existing water supply conditions and estimating future service requirements. The analytical procedures included assessing the existing water supply system, collecting population data, projecting population growth, estimating future clean water demand, and determining the required raw water supply and water treatment plant capacity. Data were obtained from official documents and field surveys. This approach was adopted to address the limited capacity of the existing water supply system and anticipate increasing demand associated with population growth. The findings provided a quantitative basis for planning the development and expansion of the Drinking Water Supply System (Sistem Penyediaan Air Minum, SPAM).

Location and Scope of Research

The research was conducted in Telawang District, East Kotawaringin Regency, Central Kalimantan Province, with a focus on planning in the Sebabi IKK service area. Telawang District consists of six villages/sub-districts, namely Sebabi, Tanah Putih, Sumber Makmur, Kenyala, Biru Maju, and Penyang, with a total area of about 317 km². However, the technical analysis of system development in the study is focused on Sebabi Village and Sumber Makmur Village because the two villages are areas that are planned to receive services from the Sebabi IKK. The determination of this scope allows needs analysis to be carried out in a more targeted manner based on the population to be served and the capacity of the system that needs to be prepared. The geographical characteristics of the area are also considered because differences in geographical, topographic, and geological conditions can cause variations in the availability of raw water and drinking water service conditions. Thus, the research location is not only treated as an administrative boundary, but also an important part in determining the need and feasibility of developing a clean water supply system.

Time and Stages of Research Implementation

The attached research manuscript does not explicitly include the month or time range of data collection, so the research period cannot be stated specifically without adding information that is not contained in the source. However, the data on the condition of the area used refers to, among other things, information for 2023, while water needs planning is carried out for several projected years until 2043. The stages of analysis are arranged sequentially, starting from the collection of information on existing conditions, processing population data, projecting the number of population, calculating water needs, to determining the capacity of the necessary system. The years of water demand analysis shown in the manuscript include 2023, 2024, 2025, 2026, 2027, 2032, and 2043. The range is used to show the tendency to increase in needs so that service capacity is not only designed based on momentary conditions, but also considers future needs.

Population and Research Analysis Units

The population in this study is related to the community in the service area of the clean water supply system, especially the residents of Sebabi Village and Sumber Makmur Village as the target of the Sebabi IKK service. The manuscript shows that Telawang District as a whole has a population of around 16,397 people, while the existing IKK system only serves 394 house connections or around 1,576 people, equivalent to 9.6% of the overall sub-district population. This condition is the basis for seeing the gap between the scope of existing services

and the needs of the community. This study does not use the concept of a respondent sample as a social survey research, because the main unit of analysis is in the form of population data of the service area used in the calculation of water needs. The number of population is then projected to produce service needs in the specified years. The detailed basic population figures for each of Sebabi and Sumber Makmur Villages are not included in the available manuscript section, so they are not added in this methodology.

Data Collection Sources and Techniques

The research data was obtained through the use of official documents and field surveys. The documents were used to obtain information related to population, regional characteristics, clean water service conditions, and technical guidelines needed in the planning process. One of the sources listed in the research reference is the data on East Kotawaringin Regency in the 2023 Figures from the Central Statistics Agency of Central Kalimantan. In addition to documentary data, field surveys are used to obtain an overview of the actual condition of the service system and water sources that can be utilized. Data collection is directed to information that is really needed to answer planning problems, such as the scope of services, the capacity of the available system, raw water sources, distribution conditions, and regional characteristics. In this way, the data used does not stop at administrative information, but becomes the basis for determining the magnitude of the need and alternatives for the development of a clean water supply system.

Research Instruments and Parameters

The research instrument is not described in the manuscript as a questionnaire device or a specific measurement instrument. Therefore, the instrument in this study is more appropriately placed as a data collection and processing tool in the form of population documents, field survey results, calculation tables, and technical guidelines for water resource planning. The main parameters analyzed include the number of population to be served, projected population growth, clean water needs, water needs at peak hours, raw water discharge, and water treatment plant capacity. In addition to these main parameters, water source technical planning also considers the reliability of water collection buildings, water source protection from pollution, safety, and cost effectiveness of operation and maintenance. In further studies, aspects of water utilization rights, quantity, quality, continuity, climate conditions, water source fluctuations, flooding, and minimum water level are also important parameters that need to be considered.

Water Demand Projection and Analysis Techniques

Data processing is carried out by first projecting the number of population in the service area. The 2001 Water Resources Planning Guidelines for River Areas published by the Directorate General of Water Resources are used as a basis, with geometric methods recommended to estimate the development of the population. The results of the projection are then used as a basis for estimating the need for clean water. This strategy is necessary because the amount of discharge that must be provided by the system is directly related to the number of population served. Calculations are carried out in several planning periods so that the tendency to increase in needs from time to time can be known. The results of the processing show that the combined peak hour water demand in the Sebabi and Sumber Makmur regions increased from 11.39 liters/second in 2023 to 21.55 liters/second in 2027, 37.39 liters/second in 2032, and 67.73 liters/second in 2043. Thus, projections are used as a tool to translate population growth into technical needs of the system.

RESULTS AND DISCUSSION

The planned Sebabi IKK (Small-Town Water Supply System) is located within the Sebabi Village area. The system is designed to serve two villages: Sebabi Village and Sumber Makmur Village. Determining the system's requirements necessitates calculating the necessary flow rate (discharge), which is based on the size of the population to be served. Provided below are the current population figures and projected growth for the area to be served. Technical planning for the raw water intake structure must prioritize structural reliability, protection of the raw water source from contaminants, safety, and optimal operation and maintenance costs. Where necessary, further studies may be conducted such as assessments regarding raw water usage rights; water quantity, quality, and continuity; climatic conditions affecting raw water fluctuations (in both qualitative and quantitative terms); and flood and minimum water levels. The raw water source utilized for the Sebabi IKK system is surface water, specifically from the Sebabi River.

Table 1. Kebutuhan Air Jam Puncak

No	Kabupaten	Kebutuhan air (L/det)						
		2023	**2024**	**2025**	**2026**	**2027**	**2032**	**2043**
1	Sebabi	8,15	9,75	11,49	13,38	15,40	26,70	48,31
2	Sumber Makmur	3,23	3,88	4,57	5,33	6,14	10,69	19,42
	Jumah	**11,39**	**13,63**	**16,07**	**18,71**	**21,55**	**37,39**	**67,73**

Discussion

The Sebabi IKK Water Supply System (SPAM) project utilizes river water specifically from the Sebabi River as its raw water source. The required raw water flow rate is 35 L/sec; however, accounting for machinery efficiency factors, the required flow rate is set at 40 L/sec.

The Sebabi IKK SPAM is designed to provide service through the year 2032; based on calculations from the preceding chapter, the required Water Treatment Plant (IPA) capacity is 35 L/sec.

CONCLUSION

(Ghannam & Hussain, 2024) This study aimed to analyze and project clean water demand as a basis for developing the Drinking Water Supply System (Sistem Penyediaan Air Minum, SPAM) in Telawang District, particularly within the Sebabi district administrative center (Ibu Kota Kecamatan, IKK) service area, encompassing Sebabi Village and Sumber Makmur Village. The existing water supply system had a production capacity of only 10 L/s and served approximately 1,576 residents, representing 9.6% of Telawang District's total population, highlighting the need for infrastructure expansion (Timur, 2023). Based on population projections and water demand calculations, peak-hour water demand was projected to increase from 11.39 L/s in 2023 to 37.39 L/s in 2032 and 67.73 L/s in 2043. To support the planned service expansion through 2032, the Sebabi River was identified as the proposed raw water source, with an estimated flow requirement of 35 L/s. The proposed raw water intake design capacity was increased to 40 L/s to account for operational efficiency, while the required water treatment plant capacity was estimated at 35 L/s. These findings provided a quantitative basis for planning SPAM infrastructure expansion and demonstrated the applicability of population-based water demand projections in areas with limited water supply coverage. However, the study was restricted to demand projections for the Sebabi–Sumber Makmur service area and did not comprehensively assess water requirements across all villages in

Telawang District. Future research should incorporate detailed assessments of raw water availability, quality, and seasonal reliability; water abstraction rights; climatic variability; river flow fluctuations; flood conditions; minimum water levels; and distribution network hydraulic performance. Such assessments would support more accurate, adaptive, and sustainable planning and development of drinking water supply infrastructure.

FUNDING

The author states that no financial support has been received for the implementation of this research and/or the publication of this article.

CONFLICT OF INTEREST

The author states that this research was conducted without any commercial or financial relationship that can be interpreted as a potential conflict of interest.

AUTHOR CONTRIBUTION

If relevant, statements regarding the contributions of each author may be included in this section.

GENERATIVE ARTIFICIAL INTELLIGENCE USAGE STATEMENT

The authors state that generative artificial intelligence (AI) was used in the preparation of this manuscript. The authors acknowledge the use of generative AI to help improve language clarity and improve the grammatical structure of manuscripts. The use is carried out in compliance with applicable ethical guidelines regarding the use and disclosure of generative AI in scientific research. Each author has made substantial intellectual contributions to this work. The entire content of the manuscript has been carefully reviewed to ensure its accuracy, and the author is solely responsible for the integrity and final content of the manuscript.

REFERENCES

Abu Talib, M., Abdallah, M., Abdeljaber, A., & Abu Waraga, O. (2023). Influence of exogenous factors on water demand forecasting models during the COVID-19 period. *Engineering Applications of Artificial Intelligence*. https://doi.org/10.1016/j.engappai.2022.105617

Abu-Bakar, H., Williams, L., & Hallett, S. H. (2021). A review of household water demand management and consumption measurement. *Journal of Cleaner Production*. https://doi.org/10.1016/j.jclepro.2021.125872

Al-Layla, M. A. (1978). *Water Supply Engineering Design*. Ann Arbor Science Publishers.

Badan Pusat Statistik Kabupaten Kotawaringin Timur. (2023). *Kabupaten Kotawaringin Timur dalam angka 2023*. Badan Pusat Statistik.

Cao, L., Yuan, X., Tian, F., Xu, H., & Su, Z. (2023). Forecasting of water consumption by integrating spatial and temporal characteristics of short-term water use in cities. *Physics and Chemistry of the Earth*. https://doi.org/10.1016/j.pce.2023.103390

Deng, L., Chang, X., & Wang, P. (2022). Daily Water Demand Prediction Driven by Multi-source Data. *Procedia Computer Science*. https://doi.org/10.1016/j.procs.2022.10.020

Ghannam, S., & Hussain, F. (2023). Comparison of deep learning approaches for forecasting urban short-term water demand a Greater Sydney Region case study. *Knowledge-Based Systems*. https://doi.org/10.1016/j.knosys.2023.110660

Ghannam, S., & Hussain, F. (2024). Short-term water demand forecasting: a review. *Australasian Journal of Water Resources*. https://doi.org/10.1080/13241583.2024.2350102

Jaskowiak, P. A. (2024). Machine learning for water demand forecasting: Case study in a Brazilian coastal city. *Water Practice & Technology*. https://doi.org/10.2166/wpt.2024.096

Kavya, M., Mathew, A., Shekar, P. R., & P, S. (2023). Short term water demand forecast modelling using artificial intelligence for smart water management. *Sustainable Cities and Society*. https://doi.org/10.1016/j.scs.2023.104610

Linsley, R. K., Franzini, J. B., & Sasongko, D. (1992). *Teknik Sumber Daya Air*. Erlangga.

Masduqi, A., & Assomadi, A. F. (2012). *Operasi dan Proses Pengolahan Air*. ITS Press.

Mazzoni, F., Alvisi, S., Blokker, M., Buchberger, S. G., Castelletti, A., Cominola, A., Gross, M.-P., Jacobs, H. E., Mayer, P., Steffelbauer, D. B., Stewart, R. A., Stillwell, A. S., Tzatchkov, V., Alcocer Yamanaka, V.-H., & Franchini, M. (2023). Investigating the characteristics of residential end uses of water: A worldwide review. *Water Research*. https://doi.org/10.1016/j.watres.2022.119500

Peavy, H. S. (1985). *Environmental Engineering*. McGraw-Hill.

Rezaali, M., Quilty, J., & Karimi, A. (2021). Probabilistic urban water demand forecasting using wavelet-based machine learning models. *Journal of Hydrology*. https://doi.org/10.1016/j.jhydrol.2021.126358

Salloom, T., Kaynak, O., & He, W. (2021). A novel deep neural network architecture for real-time water demand forecasting. *Journal of Hydrology*. https://doi.org/10.1016/j.jhydrol.2021.126353

Sanchez, G. M., Terando, A. J., Smith, J. W., García, A. M., Wagner, C. R., & Meentemeyer, R. K. (2020). Forecasting water demand across a rapidly urbanizing region. *Science of the Total Environment*, *730*, 139050. https://doi.org/10.1016/j.scitotenv.2020.139050

Stuhlmacher, A., & Mathieu, J. L. (2020). Water distribution networks as flexible loads: A chance-constrained programming approach. *Electric Power Systems Research*. https://doi.org/10.1016/j.epsr.2020.106570

Timur, B. P. S. K. K. (2023). *Kabupaten Kotawaringin Timur Dalam Angka 2023*. Badan Pusat Statistik.

Togneri, R., Prati, R., Nagano, H., & Kamienski, C. (2023). Data-driven water need estimation for IoT-based smart irrigation: A survey. *Expert Systems with Applications*, *225*, 120194. https://doi.org/10.1016/j.eswa.2023.120194