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ECOLOGICAL HYDROLOGY DYNAMICS: SUSTAINING HOUSEHOLD AND INDUSTRIAL WATER NEEDS IN BALARAJA DISTRICT, TANGERANG REGENCY, INDONESIA

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Abstract

The more rapid development of several areas in Balaraja which is triggered by the development of industrial and housing and settlement activities as well as supporting activities, the need for clean water supply will also increase where the majority of clean water supply is carried out by utilizing ground water even though the development of ground water resources is much more complicated. and more difficult than surface water development. This research aims to in-depth analysis of water needs in the Balaraja Detailed Spatial Planning Development Area (RDTR), separating the two main sectors of use, namely household and industrial. This research uses exploratory qualitative methods. This technique is a research approach that aims to explore and understand certain phenomena or events in depth. In this method, the main focus is the concept of ecogeohydrology through geoelectric estimation to obtain an overview of the characteristics of groundwater conditions in an area, especially in the RDTR Balaraja development area, analysis of water demand forecasts and the resulting impacts based on their interrelationships. The findings of this research in geological and hydrogeological analysis show that this area lacks groundwater, with dynamic system simulations providing a picture of the water deficit associated with changes in the area of green open space. This research is expected to provide a comprehensive view for policy makers in managing water resources in the Balaraja RDTR area in a sustainable manner.

Keywords: *Ground Water, Balaraja, Water Deficit, Eco-Hydrology, Water Exploitation*

INTRODUCTION

Groundwater is all water found below the surface of the land. The depth of groundwater is not the same in every place depending on the thickness of the surface layer above it and the position of the groundwater layer. The surface that is the upper part of a body of water is called the phreatic surface. The volume of water that seeps into the soil depends on the type of rock layer. There are two types of layers in the soil, namely the waterproof layer (im-permeable) and the non-waterproof layer (permeable). If groundwater can be economically developed and the amount is sufficient for human needs, the formation or condition is called a water-bearing layer or aquifer, whether in the form of soil, rock formations or both. The existence of groundwater is not necessarily easily accessible to the community. Adequate aquifer identification needs to be carried out in detail to provide the information needed for future exploration efforts. Planning for drilling wells requires information on the resistivity of subsurface rock layers, because from this information the thickness and depth of the aquifer layer can be estimated based on the underground resistivity value.

Eileen Poeter et al. (2020) stated that land use greatly influences the condition of the groundwater aquifer layer below the surface. Changes in the landscape, vegetation or use of groundwater for agricultural or construction activities will change the depth of the groundwater level in the groundwater layer (aquifer). Changes in spatial patterns with reduced open area and increased land cover greatly influence the amount of water that can be absorbed into the aquifer layer. Subagiyo et al. (in Hadimulyono, 2017) states that there are two important elements in planning that are interdependent, including water spatial planning and spatial planning that support each other for sustainable processes in urban areas.

This research aims to in-depth analysis of water needs in the Detailed Spatial Planning Development Area (RDTR) in Balaraja District, Tangerang Regency, West Java Province, Indonesia, separating the two main sectors of use, namely household and industrial. In addition, the research details land use planning in the Balaraja RDTR with a focus on two main zones, namely the environmental zone and the cultivation zone, providing a detailed understanding of spatial planning for sustainable regional development. Furthermore, hydrogeological analysis focuses on aquifer groups, geological conditions, and hydrogeological maps, provides critical information regarding the soil's ability to absorb water, and discusses the impact on groundwater availability through dynamic system simulations, geoelectric estimates, and analysis of groundwater zonation conditions. Through this approach, this research is expected to provide a comprehensive picture of the challenges and opportunities in managing water resources in the Balaraja RDTR and provide output for regional innovation. Regional innovation is all forms of innovation in regional administration(Suhendra et al., 2024).

Until now, sub-districts that already have detailed spatial planning documents (RDTR) have been approved in Tangerang Regent Regulation No. 75 of 2021 concerning detailed spatial planning plans for the Balaraja planning area for 2021-2041 with the arrangement of the Balaraja planning area aiming to realize the Balaraja planning area as an industrial urban area oriented towards sustainable development. Population growth and economic development require land as a place for activities that will later grow and develop in the RDTR Balaraja development area, however if this development is not controlled properly it can result in land conversion for activities that are not in accordance with its function. and the environmental carrying capacity which will have an impact on reducing the environmental carrying capacity is ground water resources.

Degradation of water resources occurs simultaneously with degradation of land resources, this is because water in its cycle is very closely related to the condition of the soil on the surface of the earth, indicators of water resource degradation can be seen, among others: Related to groundwater is the deeper the groundwater level or the deeper The drying up of people's wells in certain high altitude areas indicates that the hydrological cycle which describes the relationship between water resources and land resources has been damaged (Nurhasan and Danhas, 2021).

The integration of detailed spatial plan documents for the 2021-2041 Balaraja planning area into the OSS system is a prospect for investment development in Balaraja District to grow more rapidly. The more rapid development of several areas in Balaraja which is triggered by the development of industrial and housing and settlement activities as well as supporting activities, the need for clean water supply will also increase where the majority of clean water supply is carried out by utilizing ground water even though the development of ground water resources is much more complicated. and more difficult than surface water development. Groundwater exploration in this research was carried out for geological mapping and geoelectrical investigations. This activity is the earliest stage in investigating groundwater conditions for planning the development of groundwater potential.

So far there has been quite a lot of research discussing this issue. The study of groundwater potential by geoelectric investigations has received great attention in recent years due to its relevance to hydrogeology, environmental monitoring and geology. for exampleZarif et al., (2022)Geoelectrical investigations have been used to assess diverse subsurface stratigraphic and hydrogeological settings of groundwater aquifers in various regions. Meanwhile, the vertical electrical sounding (VES) technique has been widely applied in groundwater studies, and has shown its efficiency in delineating groundwater potential zones.(A. Mohammed et al., 2023). In addition, geoelectric resistivity values have been used to characterize groundwater aquifers and evaluate groundwater quality in various regions.

There are also several other ideas, for example the geoelectric resistivity technique has been declared efficient and can be applied in various contexts such as groundwater exploration, engineering site investigations, and assessing soil hydrological properties.(Oyeyemi et al., 2020). WhereasRamzi & Al-Gburi, (2022)making research on the integration of geographic information systems (GIS) and remote sensing data that has been used to describe groundwater potential, creating groundwater potential maps based on various factors such as geology, geomorphology, altitude, and land use/cover. Additionally, researchers have utilized a combination of remote sensing and GIS approaches to evaluate groundwater potential(Haile, 2022). Determination of geoelectric collisions is considered important to improve the quality of interpretation of Magnetotelluric data, thereby contributing to the understanding of geological structures(Lestari et al., 2023). However, previous studies have provided an overview of the complexity of methods in groundwater potential studies, especially using geoelectric resistivity techniques, integration of GIS and remote sensing, as well as collaboration between methods to understand geological structure.

Different from several studies above, this research enriches our understanding of groundwater potential in the regional government, Tangerang Regency. By emphasizing the geoelectric approach as the main focus, this research tries to differentiate itself from previous research. The main focus of this research is on aquifer characterization and groundwater depth variability, as well as evaluating the direct impact of land use on aquifer conditions. This research also presents a new aspect by integrating the RDTR documents for the Balaraja planning area into the OSS system, providing insight into the prospects for investment development in the area. By mapping geology and conducting geoelectric investigations, this research aims to identify potential degradation of groundwater resources and explore the complex interactions between industrial growth, housing and supporting activities with clean water needs. With its details regarding the relationship between geology, hydrology and land use, it is hoped that this research will provide an important contribution in planning the development of sustainable groundwater potential in Balaraja District.

The existence of regulations, such as the Regulation of the Minister of Public Works and Public Housing of the Republic of Indonesia Number 27/PRT/M/2016, which regulates the implementation of drinking water supply systems, shows the government's seriousness in ensuring access to clean water for the community. Therefore, this research becomes increasingly urgent, as a response to the call for the human right to water as emphasized in international declarations and the Sustainable Development Goals (SDGs). Through an in-depth understanding of clean water needs, land use planning, and hydrogeological analysis in the Balaraja RDTR development area, this research makes a real contribution to sustainable water resources management and ensures the fulfillment of basic rights to water for communities. Thus, the results of this research can be a strong basis for supporting concrete policies and actions in providing sustainable drinking water at the local and national levels.

METHODOLOGY

This research uses a qualitative approach. A qualitative approach is a research procedure that produces descriptive data in the form of written or spoken words from individuals and observable behavior, with an approach that focuses on the context and the individual as a whole.(Berg, 2001). The use of qualitative methods was chosen with the aim of achieving a comprehensive understanding of the reality investigated throughout the research process(N.K. Denzin & Lincoln, 2006). Qualitative methods use existing facts and information to formulate conclusions and explanations regarding the phenomena being investigated(Creswell, 2013).The type of research is part of qualitative exploratory(Neuman, 2014). This technique is a research approach that aims to explore and understand certain phenomena or events in depth(Archer, 2011). In this method, the main focus isecogeohydrology concept through geoelectrical estimation to obtain an overview of the characteristics of groundwater conditions in an area, especially in the RDTR Balaraja development area, analysis of forecasts of water needs and the resulting impacts based on their interrelationships. the need for water resources with the availability of groundwater where solutions are sought for the gaps that occur through the concept of ecogeohydrology so that the available groundwater potential can be sustainable. Overall, ecogeohydrology is an important field of science for understanding the complex interactions between groundwater based on geological conditions, its formation process based on geohydrology and ecology in the form of changes in spatial patterns as a basis for formulating strategies for conservation and sustainability management efforts. ground water resources.

RESULTS AND DISCUSSION

Water Needs in the Balaraja RDTR Development Area

This research provides comprehensive and in-depth detail regarding the need for clean water in the Balaraja Detailed Spatial Planning (RDTR) development area. The main focus of this research lies in separating two crucial water use sectors, namely the household and industrial sectors. By exploring data on water needs per person, estimated population, and estimated industrial needs, this research not only provides an in-depth understanding of water consumption levels, but also comprehensively describes the challenges and plans that may occur in the development of water needs in the region. In addition, an in-depth understanding of the estimated industrial water needs in the context of the Balaraja RDTR is important considering the role of this area as a developing industrial center. By detailing the calculation methods involved in previous research, this research provides an accurate picture of how big an impact industry has on water needs in the region. It is hoped that the results of this research will be able to provide a comprehensive view for policy makers, regional planners and related parties in managing water resources sustainably amidst the dynamics of growth and development of the Balaraja RDTR region.

The need for clean water in the Balaraja RDTR development area is divided into 2 utilization sectors, namely household water needs and industrial water needs. The need for clean water per person using SNI 19-6728.1-2002, the water requirement is 120 L/capita/day. The population will be 121,239 people in 2023, the total water requirement for the population will be 5,310,268,200 liters per year or 5,310,268 m3 per year. The needs of 122 industries in the Balaraja RDTR development area are estimated to be 300 m3 per day based on considerations of Purwanto's research results (1995), which determine the need for clean water for the agricultural industry which can be categorized into three. The respective types for large industry are around 151-350 m3/day, medium industry is around 51-150 m3/day, and small industry is around 5-50 m3/day. The total water requirement for industry is 12,264,000 m3 per year. The total amount of water demand based on these 2 utilization sectors results in a water demand of 17,574,268 m3 per year. The need for water will increase along with the increase in population and increase in industry every year. Land use planning in the Balaraja RDTR development area is divided into:

- The environmental zone includes: water body zone covering an area of 52.28 Ha; local protection zone 30.76 Ha; and an open space zone of 95.89 Ha
- Cultivation areas include: Road 113.85 Ha; Agriculture 0.10 Ha; Power plant 18.80 Ha; Industry 1,375.23 Ha; Housing 1,100.87 Ha; Public services 34.40 Ha; Mixed 424.38 Ha; Trade and services 71.90 Ha; Office 7.51 Ha; Other provisions 0.85 Ha; Transportation 5.53 Ha; and Defense and security 0.24 Ha.

Geologically, the condition of the Balaraja RDTR development area is dominated by alluvial deposits covering an area of 349.66 Ha; The upper Banten tufa deposits cover an area of 2,978.98 Ha and the tufa deposits cover an area of 0.006 Ha. These geological conditions greatly affect the soil's ability to absorb water. In alluvial deposits, water is more easily absorbed than in tuff deposits.

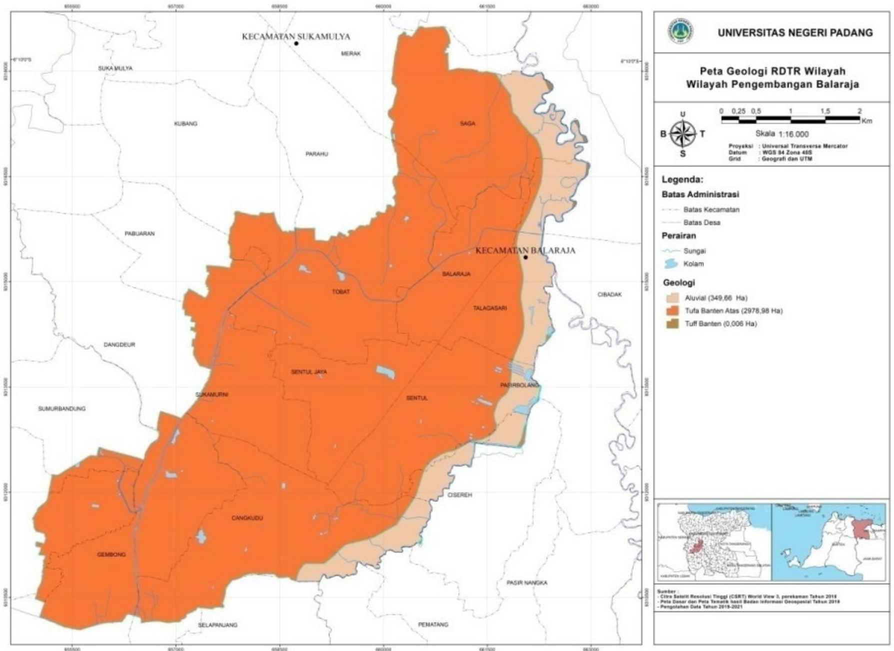


Figure 1. RDTR Geological Map of the Balaraja Development Area

Tangerang Regency DLHK Study Data for 2003-2004 shows the condition of the aquifer cluster in the Balaraja RDTR development area as follows:

Table 1. Aquifer groups in the Balaraja RDTR development area

Aquifer Group	Position Range	Thickness Range	Aquifer Building Materials
I	0-25m	2-4 m	Alluvial deposits (Qa) and Young volcanic deposits (Qav and Qpvb)

Aquifer Group	Position Range	Thickness Range	Aquifer Building Materials
II	25-90m	3-25m	Young volcanic deposits (Qav and Qpvb) as well as tuff sandstone, conglomerate and sandstone with mudstone as an impermeable layer (Tpss and Tpg)
III	90-210 m	5-20m	Tuffaceous sandstones, conglomerates and sandstones with claystone as an impermeable layer (Tpss and Tpg)

Data on geological conditions that influence the existence of the groundwater aquifer layer, based on the patent hydrogeological map of Tangerang Regency, the Balaraja RDTR development area is entirely in an area of groundwater shortage. This shows that the potential and availability of groundwater is very small. IWACO reported in the "Masterplan for the supply of drinking water for Tangerang Regency" that the RDTR in the Balaraja development area has a groundwater potential of 6.5 l/s/km2 with acceptable well discharge ranging from 2-10 l/s, the nature of which is that the aquifer is an aquifer. productive, which has a wide distribution and its characteristics are that it is not able to store groundwater but instead flows groundwater towards the sea in the North Tangerang area.

The results of resistivity measurements of the Balaraja area carried out by DLHK, 2003-2004, show that the dominant Balaraja area at the surface will have the typology of the Alluvial Sedimentary Aquifer System (Qa and Qbr) and Young Volcano (Qpvb/Qpb), but towards the subsurface it is estimated that there will be a System typology The aquifer (bore log – Balaraja) is in the form of fine sedimentary rock (Tmb). Balaraja District has 6-7 aquifer layers with a thickness of 2-25 meters. There may be three (3) aquifer groups, namely 0 – 25 meters, 25 – 90 meters, and 90 – 210 meters.

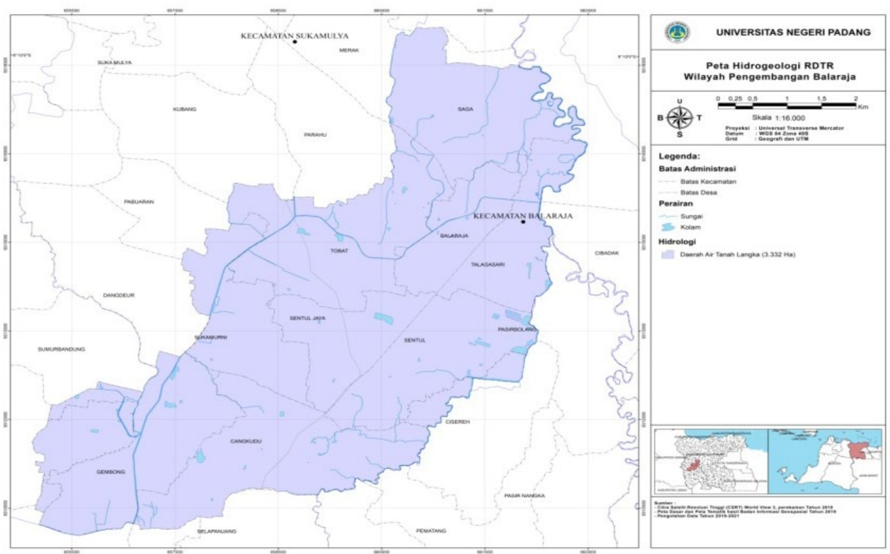
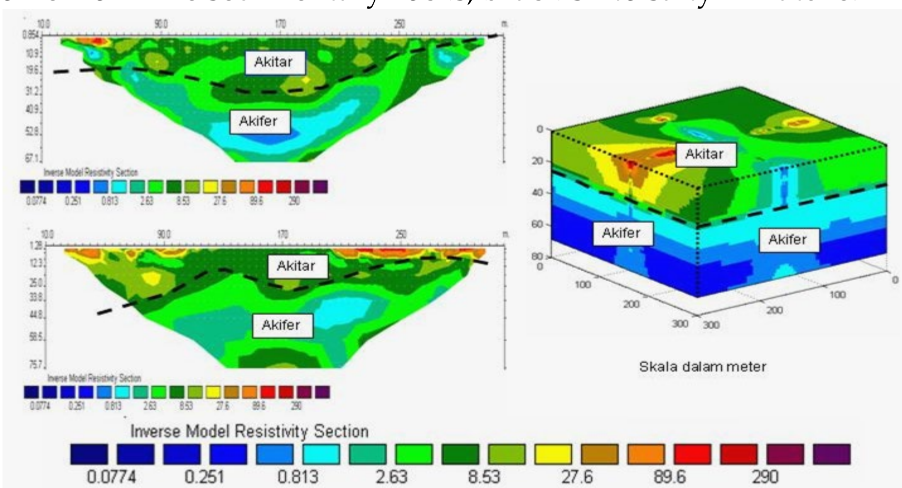


Figure 2. RDTR Hydrological Map of the Balaraja Development Area

- 0-25 meters: There is 1 (one) aquifer layer with a thickness of 2-4 meters originating from Surface/Alluvial (Qa) or Young Volcano deposits, with fresh to brackish groundwater.
- 25-90 meters; There are 3 (three) aquifer layers with a thickness of between 3 and 25 meters originating from Young Volcanic Sediment/Coarse Sedimentary Rock, with fresh to brackish groundwater.
- 90-210 meters; Aquifer layers range from 2 – 3 with a thickness of between 5-20 meters which come from fine sedimentary rocks, brackish to salty in nature.



Groundwater is considered a renewable natural resource if the filling process takes around 10-100 years, but if the filling process takes hundreds of years then groundwater is said to be a non-renewable natural resource (Hendrayana, 2007). Kodoatie (2012) explains that the existence of water resources is influenced by the presence of rocks that form aquifer layers. One effort to determine the condition and existence of rocks that form aquifer layers is by geoelectric estimation.

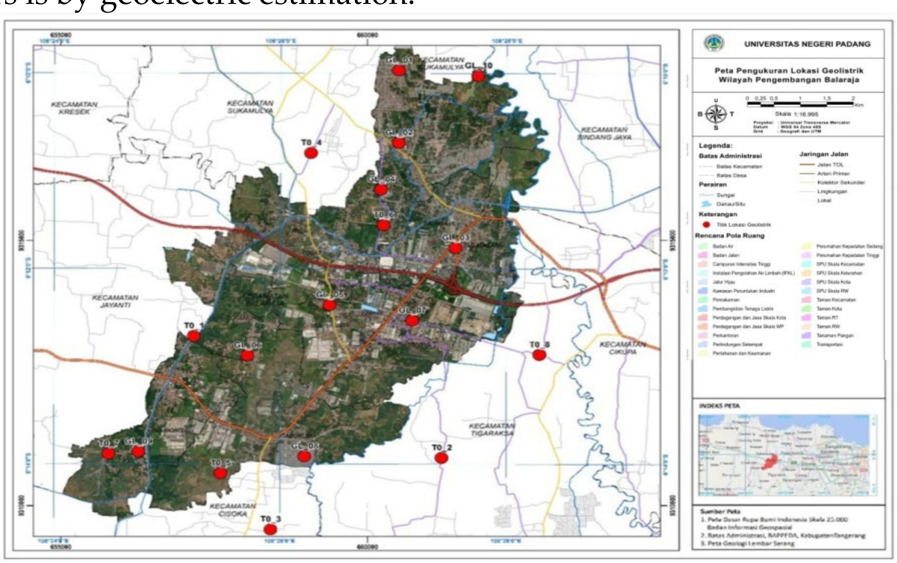


Figure 3. Geoelectric Location Measurement Map of the Balaraja Development Area

The in-depth analysis in this research leads to a comprehensive understanding of the need for clean water in the Balaraja Detailed Spatial Planning (RDTR) development area, with the main focus on the separation of two water use sectors, namely household and industrial. By exploring data on water needs per person, estimated population, and industrial needs, this research not only describes water consumption levels in depth, but also identifies challenges and plans for the development of water needs in the region in a comprehensive manner. Analysis of estimates of industrial water needs is crucial considering the role of the Balaraja RDTR as a developing industrial center. By detailing the calculation methods and impact of industry on water demand, this research provides an accurate picture of the extent to which industry influences water demand in the region. In addition, an in-depth understanding of land use planning, geological conditions and hydrogeological data adds an important dimension to managing water resources sustainably amidst the dynamic growth of the Balaraja RDTR region. It is hoped that the research results can provide a comprehensive view for policy makers and regional planners in their efforts to maintain the sustainability of water resources in the region.

Land Use Planning in the Balaraja RDTR

This section discusses in detail land use planning in the Balaraja RDTR, which is divided into two main zones. Environmental zones include areas such as water bodies, local protection, and open spaces, while cultivation zones involve sectors such as industry, housing, agriculture, and others. A detailed understanding of this spatial layout is important for designing sustainable regional development.

Geoelectric estimates to determine geological and hydrogeological conditions and characteristics, especially regarding the existence of aquifer layers in the RDTR in the Balaraja development area, were carried out at 18 scattered location points. The location of the estimation point which is outside the RDTR area of the Balaraja development area is a connecting reference in determining the extent and direction of distribution of rocks and layers that can be suspected to be aquifers.

Processing of geoelectric prediction data as a whole based on isoresivity in the RDTR of the Balaraja Development Area shows that the distribution of rocks in the central and eastern parts for a depth of 0-30 m is thought to be due to residual rock and volcanic deposits, the size of clay grains, including clay, is watertight, not can act as an aquifer. However, at a depth of 30 m – 150 meters, the distribution of rocks in the south and north is thought to be due to rock remains and volcanic deposits, sandy clay, sandy tuff, to clay sand, sand and tuff sand. These local rocks can act as aquifers which are indicated as aquifer zones.

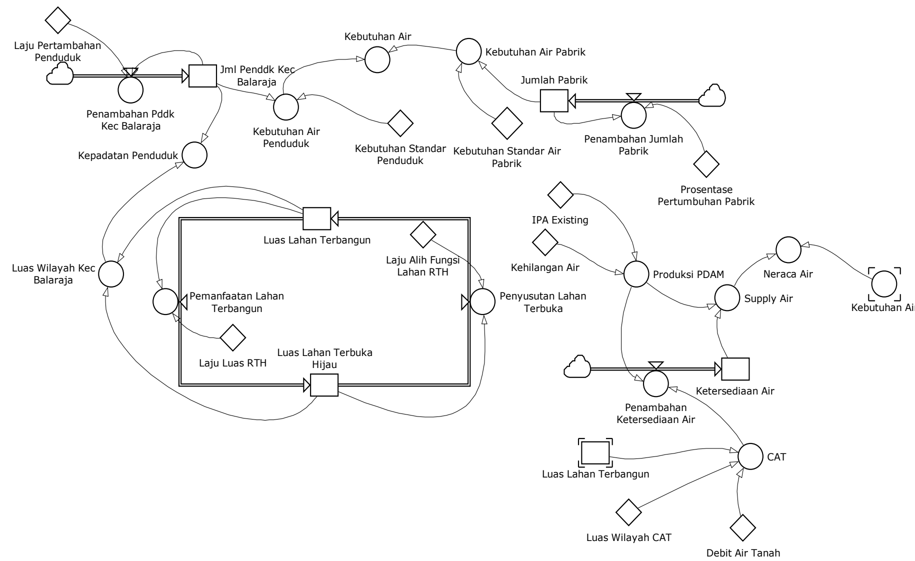


Figure 4. Location Pointgeological and hydrogeological conditions and characteristics

To determine the relationship between water demand and population growth and spatial patterns, a dynamic systems approach was used, which was first introduced by Joy Forester in 1950 at MIT as a method for describing problems in a system (Sterman, 2000). Data analysis for dynamic systems includes: population prediction, population water demand prediction, industrial growth prediction and water demand. Apart from water needs, simulations were also carried out regarding water supply from water provided by PDAM and groundwater sources, including supporting factors for groundwater supply. To obtain the development of population water needs and industrial water needs compared with water supply with modifying factors that are mathematically related to the water supply and need parameters, then a simulation is carried out for 100 years.

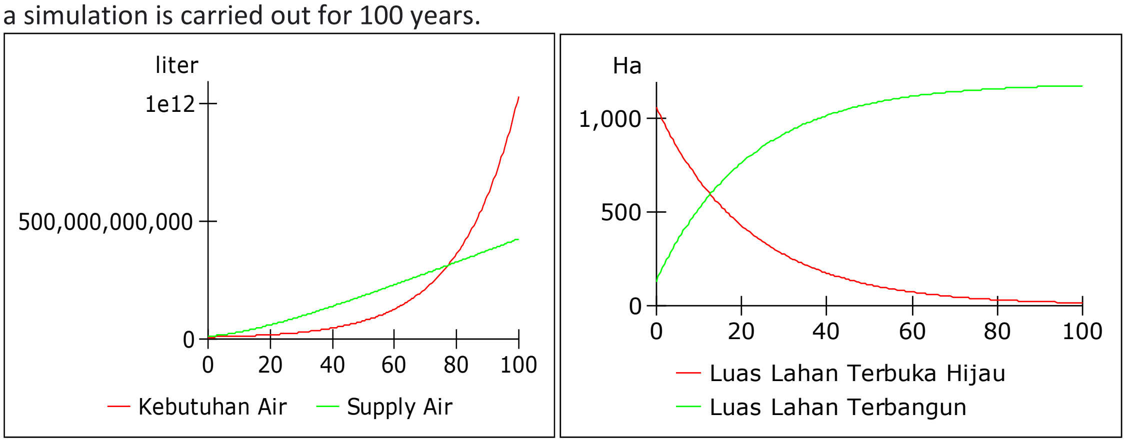


Figure 5. Dynamic system simulation related to the development of population water needs

Dynamic system simulations related to the development of population water needs, industrial water needs in the RDTR Development Area and the supply of water resources based on the simulation results show that the comparison between water needs and water supply occurs when the needs are much greater. If water supply occurs in the 55th (fifty-fifth) year, then in the 79th (seventy-ninth) year, water resources have experienced a deficit. Where in the 79th year there was a deficit of -2,958,196,217 liters or -2,958,196 m3.

If you look at the data in the previous chapter, this water deficit cannot be separated from the decreasing number of green open spaces as water catchment areas. The relationship between the availability of green open space and the area of built-up land shows balance in the 12th (twelfth) year, where after the 12th year the area of built-up land continues to increase. The area of the Balaraja RDTR Development Area is 1,190.26 Ha. Maintaining green open land is very necessary to ensure that water availability is always greater than utilization, so that green open land in the Balaraja RDTR Development Area can be maintained with an area of 84.52 Ha or 7.1 percent of the total and maximum building area. area 1,105. 74 Ha or 92 percent of the total area (55th year simulation results).

Hydrogeological Analysis and Its Impact on Ground Water Availability

In order to understand in depth the hydrogeological conditions in the Balaraja Detailed Spatial Planning Development (RDTR) Area, this research involves a number of key data, including information about aquifer groups, geological conditions, and hydrogeological maps. The main focus of the analysis is on the geological conditions which are dominantly characterized by alluvial and tuff deposits. By dissecting aquifer groups from the surface to a certain depth, this research provides critical understanding regarding the ability of soil to absorb and store groundwater.

The impact of geological conditions described in detail in this research also involves a series of holistic analyses. The results of dynamic system simulations are the basis for describing the water deficit that occurs, with an emphasis on changes in the area of green open space. The relationship between the availability of green open space and the area of built-up land is an important focus in analyzing the balance between water needs and land use.

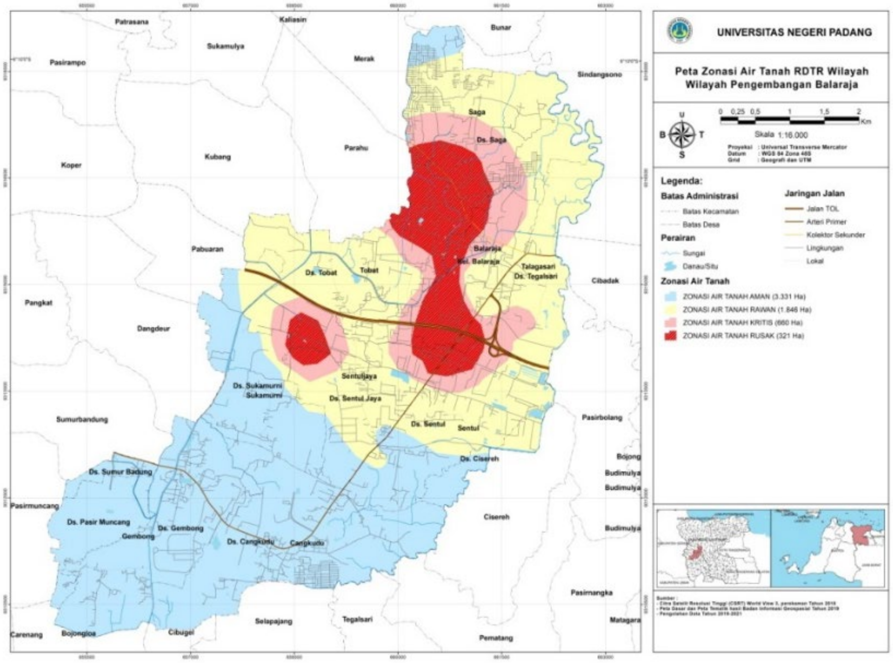


Figure 6. RDTR Groundwater Zoning Map of the Balaraja Development Area

Conditions and characteristics of the groundwater space based on geological and hydrogeological conditions, by referring to the groundwater zoning map issued by the Tangerang Regency Industry and Trade Service in 2015, it can be described that the RDTR for the Balaraja development area is based on the groundwater zoning map, data on the existence of safe groundwater zoning covering an area of 3,331 Ha is obtained. ; vulnerable groundwater zoning covering an area of 1,846 Ha; critical groundwater zoning covering an area of 680 Ha; damaged groundwater zoning covering an area of 321 Ha.

Interpretation of the groundwater zoning map of the Balaraja RDTR development area and the spatial pattern of the Balaraja RDTR Development Area shows that most of the locations of industrial and residential space utilization areas in the north are in groundwater-prone zones. damaged groundwater zone where exploitation of groundwater in the RDTR of the Balaraja development area will have an impact on expanding the vulnerable groundwater zoning into damaged groundwater zoning which will further reduce the area of safe groundwater zoning.

In connection with the above, hydrological ecological dynamics plays an important role in supporting household and industrial water needs in Balaraja District, Tangerang Regency, Indonesia. Hydrological dynamics are influenced by various factors such as climate, soil, vegetation, and anthropogenic impacts(Rodriguez-Iturbe, 2000). These factors influence spatial heterogeneity and connectivity in river floodplains, alter natural flow, and reduce hydrological dynamics(Amoros & Bornette, 2002). Vegetation dynamics in riparian corridors are strongly influenced by hydrological disturbance regimes, highlighting the complex relationship between vegetation and hydrology(Tabacchi et al., 1998). In addition, interactions between rivers and floodplains are critical for a variety of hydrological, ecological, and geomorphic processes(Stone et al., 2017). Connectivity and hydrological dynamics in the study area are critical for maintaining ecological services(Siev et al., 2019).

Understanding hydrological dynamics is critical to managing water resources sustainably. Hydrological dynamics are influenced by factors such as rainfall patterns, river networks, and connectivity of water bodies in river floodplains(Garbin et al., 2019; Rinaldo et al., 2018; Ruhiat, 2022). In addition, hydrological dynamics have a significant impact on the physical organization and ecology of river landscapes, which ultimately influence the structure of fish communities and the ecosystem as a whole.(Thoms & Sorenson, 2019). In addition, the dynamics of water balance in the study area is influenced by ecological development, which emphasizes the interaction between ecological and hydrological processes(Schaaf et al., 2017). Ecohydrological studies in the context of Balaraja Regency are very important to overcome the challenges posed by urban development and environmental change.

Urban development in Indonesia has experienced significant restructuring and decentralization, resulting in impacts on the ecological landscape and water resources(Firman, 2002; Martinez & Masron, 2020). Furthermore, the effectiveness of interdependent communication between various stakeholders, including teachers, parents, assessors and entrepreneurs, influences the work and entrepreneurship skills of vocational school students, by highlighting societal aspects that influence hydrological dynamics.(Pandjaitan & Maharani Hutajulu, 2021). In addition, GIS-based coastal vulnerability assessments in the Jatabek region provide insight into the vulnerability of coastal areas, which is critical for understanding the ecological implications of hydrological changes(Rahmawan et al., 2022). In conclusion, the synthesis of the findings and analysis above highlights the complex relationship between ecological and hydrological dynamics in the context of the sustainability of household and industrial water needs in Balaraja District, Tangerang Regency, Indonesia. The interaction of various factors such as vegetation dynamics, river networks, urban development, and coastal vulnerability significantly influences hydrological dynamics, thus emphasizing the need for a holistic understanding of ecohydrology for a region.

CONCLUSION

This research details water needs in the Balaraja Detailed Spatial Planning Development Area (RDTR) with a focus on the household and industrial sectors. An in-depth analysis of water demand per person, population, and industrial demand provides a comprehensive picture of water consumption in the region. The results of the dynamic system simulation show the potential for a water deficit in the 79th year, especially related to the decrease in the area of green open space which acts as a water catchment area. Recommendations for conservation of green open spaces, diversification of water sources, and formulation of sustainable regional development policies are key steps. In addition, further research needs to be carried out to monitor groundwater quality, identify alternative water sources, and develop sustainable solutions to overcome challenges in groundwater availability in the Balaraja RDTR. It is hoped that the integration of these findings into regional development policies can create sustainable and effective strategies in managing water resources in the region.

BIBLIOGRAPHY

A. Mohammed, M.A., Szabó, N.P., & Szűcs, P. (2023). Delineation of Groundwater Potential Zones in Northern Omdurman Area Using Electrical Resistivity Method. Iop Conference Series Earth and Environmental Science. https://doi.org/10.1088/1755-1315/1189/1/012012

Amoros, C., & Bornette, G. (2002). Connectivity and Biocomplexity in Waterbodies of Riverine Floodplains. Freshwater Biology. https://doi.org/10.1046/j.1365-2427.2002.00905.x

Archer, J. (2011). Qualitative Social Work. https://doi.org/10.1177/1473325009103372

Berg, B. L. (2001). Qualitative Research Methods For The Social Sciences (SL Kelbaugh, Ed.; 4th ed.). California State University.

Creswell, J. W. (2013). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. In Research design Qualitative quantitative and mixed methods approaches (Fourth). Sage Publications. https://doi.org/10.1007/s13398-014-0173-7.2

Denzin, N. K., & Lincoln, Y. S. (2006). The Sage Handbook of Qualitative Research, 2nd ed. Edited by. In and YSLNK Denzin (Ed.), Library (Vol. 28, Issue August). https://doi.org/10.1016/j.lisr.2006.05.004

Firman, T. (2002). Urban Development in Indonesia, 1990–2001: From the Boom to the Early Reform Era Through the Crisis. Habitat International. https://doi.org/10.1016/s0197-3975(01)00045-5

Garbin, S., Celegon, E.A., Fanton, P., & Botter, G. (2019). Hydrological Controls on River Network Connectivity. Royal Society Open Science. https://doi.org/10.1098/rsos.181428

Haile, M. (2022). Approaches for Delineating Groundwater Recharge Potential Zone Using Fuzzy Logic Model. Geofluids. https://doi.org/10.1155/2022/3637230

Lestari, W., Widodo, A., Warnana, DD, Rivensky, RS, Ilmawan, RZ, & Adausy, TA (2023). Determination of Geoelectrical Strike to Investigate the Geological Structures in Surabaya and Gresik Areas. Iop Conference Series Earth and Environmental Science. https://doi.org/10.1088/1755-1315/1127/1/012018

Martinez, R. M., & Masron, I. N. (2020). Jakarta: A City of Cities. Cities. https://doi.org/10.1016/j.cities.2020.102868

Neuman, W. L. (2014). Social Research Methods: Qualitative and Quantitative Approaches (Seventh Ed). Pearson Education Limited.

Oyeyemi, KD, Olofinnade, OM, Aizebeokhai, AP, Sanuade, OA, Oladunjoye, MA, Ede, AN, Adagunodo, TA, & Ayara, WA (2020). Geoengineering Site Characterization for Foundation Integrity Assessment. Cogent Engineering. https://doi.org/10.1080/23311916.2020.1711684

Pandjaitan, RH, & Maharani Hutajulu, ES (2021). The Effectiveness of Communication Interdependence Between Teachers, Parents, Assessors, and Entrepreneurs Affecting the Work and Entrepreneurial Skills of Vocational High School Students. Journal of Vocational Education. https://doi.org/10.21831/jpv.v11i1.35876

Rahmawan, GA, Dhiauddin, R., Wisha, UJ, Gemilang, WA, Syetiawan, A., Ambarwulan, W., & Rahadiati, A. (2022). Gis-Based Assessment of Coastal Vulnerability in the Jatabek (Jakarta, Tangerang, and Bekasi) Region, Indonesia. Geographia Technica. https://doi.org/10.21163/gt_2022.172.08

Ramzi, M., & Al-Gburi, M. (2022). Delineation of Groundwater Potential Using GIS, RS and AHP Techniques of the Chia Sur Sub-Basin in Sulaymaniyah-Kirkuk, Northeastern Iraq. Iraqi Geological Journal. https://doi.org/10.46717/igj.55.2e.11ms-2022-11-25

Rinaldo, A., Gatto, M., & Rodrı́guez-Iturbe, I. (2018). River Networks as Ecological Corridors: A Coherent Ecohydrological Perspective. Advances in Water Resources. https://doi.org/10.1016/j.advwatres.2017.10.005

Rodriguez-Iturbe, I. (2000). Ecohydrology: A Hydrologic Perspective of Climate-soil-vegetation Dynamies. Water Resources Research. https://doi.org/10.1029/1999wr900210

Ruhiat, Y. (2022). Forecasting Rainfall and Potential for Repeated Events to Predict Flood Areas in Banten Province, Indonesia. Journal of Measurements in Engineering. https://doi.org/10.21595/jme.2022.22363

Schaaf, W., Pohle, I., Maurer, T., Gerwin, W., Hinz, C., & Badorreck, A. (2017). Water Balance Dynamics During Ten Years of Ecological Development at Chicken Creek Catchment. Vadose Zone Journal. https://doi.org/10.2136/vzj2017.04.0074

Siev, S., Paringit, E.C., Yoshimura, C., & Hul, S. (2019). Modeling Inundation Patterns and Sediment Dynamics in the Extensive Floodplain Along the Tonle Sap River. River Research and Applications. https://doi.org/10.1002/rra.3491

Stone, M.C., Byrne, C.F., & Morrison, R.R. (2017). Evaluating the Impacts of Hydrologic and Geomorphic Alterations on Floodplain Connectivity. Ecohydrology. https://doi.org/10.1002/eco.1833

Suhendra, A., Supratikta, H., Kartika, RS, Santoso, WB, Hartopo, A., Wahyudianto, H., & Abinda, I. (2024). Transforming Local Governance: Indonesia's One Data Policy in Mesuji Regency and Semarang City. MIgration Letters, 20(6), 353–367. https://migrationletters.com/index.php/ml/article/view/3488/2256.

Tabacchi, E., Correll, D.L., Hauer, R.J., Pinay, G., Planty-Tabacchi, A., & Wissmar, R.C. (1998). <b>Development, Maintenance and Role of Riparian Vegetation in the River Landscape</B>. Freshwater Biology. https://doi.org/10.1046/j.1365-2427.1998.00381.x

Thoms, M., & Sorenson, E. (2019). Interactive Effects of Hydrogeomorphology on Fish Community Structure in a Large Floodplain River. Ecosphere. https://doi.org/10.1002/ecs2.2731

Zarif, F., Elshenawy, A., Barseem, M.S., Al-Abaseiry, A.A., & El Sayed, A.N. (2022). Evidence of Geoelectrical Resistivity Values on Groundwater Conditions in Wadi El Natrun and Its Vicinities, West Delta, Egypt (Cases Studies). Scientific Reports. https://doi.org/10.1038/s41598-022-12644-0