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RESEARCH ARTICLE

A Holistic Approach to Alleviating Water Poverty in Gresik Regency

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Abstract The lack of access to safe drinking water and the insufficient provision of individual drinking water needs are among the defining characteristics of slum areas. This study investigates the extent of this problem in Gresik Regency, East Java, Indonesia, a region characterized by the ubiquity of slum settlements across all sub-districts. The study aims to provide a comprehensive understanding of clean water access, water quality, and community capacity in managing water resources with implications for achieving sustainable housing. This study assesses water poverty levels using the Water Poverty Index (WPI), which considers five dimensions: resource availability, accessibility, capacity, usage efficiency, and environmental sustainability. The result shows the WPI of Gresik Regency revealed a score of 73.95, indicating a low level of water poverty, suggesting that the region's water security is in a good condition. Among the five dimensions constituting the WPI, the environmental dimension falls into the category of relatively high WPI or environmental poverty, with a score of under 50. This indicates that while access to water is available and affordable, issues related to waste management and future water resilience remain low. Water scarcity in the Gresik District is an illustration of global challenges related to water poverty, such as in Myanmar, India and South Africa, which have WPI values below 55. This research emphasizes the importance of a holistic approach in managing water resources by prioritizing environmental quality as the main priority

1. Introduction

Poverty is one of the indicators of community welfare and this problem is still a crucial global issue, especially in developing countries such as Indonesia. Poverty reflects the inability to fulfil the basic needs of each individual, such as access to health, education, clean water and sanitation (Ari et al, 2021). This is a classic problem that is closely related to the stages of a country's development. In line with the Sustainable Development Goals, the sixth SDGs listed in the Global Goals: For Sustainable Development Goals set targets to ensure that all people have access to clean water and adequate sanitation, and reduce the negative impacts of water pollution for all people by 2030.

However, with limited water resources and a growing global population, the importance of distributing water equitably and efficiently is becoming increasingly urgent. However, achieving this goal is a complex challenge. The World Health Organization and UNICEF jointly report that more than two billion people worldwide lack access to safe drinking water. This challenge is further exacerbated by the impact of climate change, which contributes to an increase in the rate at which water resources are used, and their distribution is affected by an increase in the number and severity of floods and droughts around the world (Sivakumar 2011).

Drinking water, which is defined as water that contains a balanced ecosystem and meets health standards so that it can be consumed directly, is a basic need that must be met in adequate quantity and quality (Minister of Health of the Republic of Indonesia 2010 and Government Regulation 2015). Indonesia as mandated in Presidential Regulation No. 18 of 2020 on National Medium-Term Development Planning for 2020-2024, aims to achieve 100% access to safe drinking water services, eliminate polluted settlements with quality and sustainable infrastructure, and provide adequate access to sanitation to achieve 100% healthy and clean. Poverty reduction and the achievement of sustainable development targets require commitment and concrete actions to increase people's access to hygienic and healthy water and proper sanitation.

Communities that experience a shortage of water supply to fulfil their daily needs can be identified as experiencing water poverty (Marcellino et al., 2023). Water poverty, as an indicator of people living in poverty, refers to the condition of lack of access to water for daily needs. The impact of this poverty condition can be the emergence of polluted areas.

According to the definition of polluted settlements in the Housing and Settlement Area Law Number 1 of 2011, the area is considered uninhabitable because the development is irregular, the population density is high, and the quality of buildings and facilities does not meet the established standards. One of the parameters used as a reference is the condition of the drinking water supply, which is regulated in the Ministry of Public Works and Public Housing 2018. If there is no access to drinking water and the drinking water needs of each person do not meet the applicable standards, then the area can be classified as a polluted area.

Gresik Regency as one of the areas in East Java Province bordering the sea, has a regional regulation on polluted housing and settlements. By Regency Regulation Regional Gresik 2018, the typology of polluted housing and settlements is determined based on their geographical location. One of the criteria for the classification of polluted housing is its location in the waterside area, namely polluted settlements in the Gresik Regency. Gresik District Water Supply Company (PDAM) Giri Tirta as the organizer of the drinking water supply system in the district has several business units and service units. The four business units are PDAM Gresik City with Randuagung Unit and Suci Unit, PDAM Cerme, PDAM Menganti, and PDAM Driyorejo with National Housing Unit (Perumnas).

Based on Gresik Regent Decree Number: 050/228/HK/437.12/2023 which amends the previous Gresik Regent Decree Number: 050/281/HK/437.12/2021 concerning the Location of Polluted Housing and Settlements in Gresik, it is known that the polluted areas in Gresik Regency are spread across 18 Sub-districts, meaning that all Sub-districts in Gresik Regency have polluted settlements. PDAM Giri Tirta Gresik Regency obtains raw water supply from various sources, including groundwater sourced from boreholes, surface water such as river water, and rainwater with a total installed capacity of 1,352 L/sec while the production capacity is only 1,135 L/sec. In other words, the Gresik Regency Water Supply Company is still experiencing a water shortage of 217 L/second.

Infrastructure, particularly the provision of clean water, plays an important role in poverty alleviation (Safira et al, 2019). The availability of infrastructure is one of the drivers of the economy, where the availability of quality infrastructure can help increase community productivity. Empirical facts have proven that infrastructure development is directly proportional to economic development (Safira et al, 2019). Investment in optimized infrastructure is critical to improving poverty conditions and developing people's quality of life. This investment also has a broad positive impact on overall social and economic welfare (Suryani 2020).

The availability and affordability of clean water play an important role in protecting health, improving well-being, and supporting sustainable development. Water is the main component of maintaining human health (Suryani 2020). By being able to consume clean water, humans will avoid various diseases. In addition, the availability of clean water that is sufficient and close to home can provide time for them to carry out economic activities, education, and other activities that can improve their quality of life. Therefore, the availability and affordability of clean water is one of the main keys that need to be fulfilled.

Based on these issues, to support global initiatives to address water scarcity, monitoring tools are needed that allow governments and development agencies to monitor whether sufficient progress has been made. The Water Poverty Index is a holistic approach that can be used to improve water management efficiency at the community level (Sayyar et al. 2022). By combining data on local water resources, access, use, socioeconomic capacity, and environmental quality of water used by communities and water resources development agencies, we can monitor progress in water provision at the community level. Such indices can be combined to provide governments and development agencies with much more accurate performance indicators to guide the policy-making process.

Given the global challenges related to poverty and access to clean water, this study uses the Water Poverty Index (WPI) approach to holistically evaluate the level of water poverty. Using a multidimensional approach, this research aims to answer questions such as how the IKP can help identify and prioritize policy interventions to reduce water poverty in areas such as Gresik District and is relevant for application in other developing countries. The main contribution of this research is the development of an IKP-based analysis as a monitoring tool that can be used by international policymakers in formulating strategies to improve the welfare of communities with limited access to clean water. Thus, this research is expected to contribute to the global discussion on how to achieve the Sustainable Development Goals (SDGs-6) related to clean water and sanitation.

2. Methods

The research method used is a quantitative approach, which is a research design with statistical procedures or quantitative assessment of several certain variables. This research was conducted to assess the level of clean water poverty in Kabupaten Gresik, to develop comprehensive recommendations and strategies to overcome the problem. This approach includes a combination of development planning, both from the physical (infrastructure) and non-physical (social) aspects, especially those related to the availability of access to clean and healthy water infrastructure.

The research began by calculating the poverty level of the community using the Water Poverty Index (WPI) as an alternative tool to formulate the components that cause water poverty. This process aims to obtain a comprehensive picture of the level of water poverty in the region. This approach involves calculating the IHP as the dependent variable, which will later be combined with the physical infrastructure value (consisting of 5 IHP components). The results of the Water Poverty Index (WPI) calculation are then used as the basis for formulating community poverty reduction strategies.

Research Variables

Based on the research objectives, namely to determine the level of community access to drinking water in coastal areas through the WPI and to develop recommendations for improving community access to proper drinking water in coastal areas, the variables and sub-variables in this study are as follows.

Analysis Method

The analytical method used in this research is the Water Poverty Index (WPI) analysis. This research approach was chosen to provide answers to the research problem formulation related to the level of drinking water poverty in Gresik Regency. The use of the Water Poverty Index analysis in this study is due to its ability to comprehensively evaluate the symptoms that play a role in the availability and accessibility of clean water, by involving variables and sub-variables that are relevant in the context of evaluating water conditions in an area.

Water Poverty Index

The Water Poverty Index (WPI) is a study approach method used to evaluate the level of water poverty in an area by considering the availability of clean water in the area (Hamid et al, 2021). In this analysis, the evaluation of the water poverty level in an area is conducted by considering five main variables, which involve several sub-variables as calculation indicators to determine the level of unavailability of clean and safe water in the study area. The five variables include resources, access, capacity, utilization, and environment. These aspects become the basis for determining which areas need to be improved when an area's IHP shows signs of being unsafe (Ari et al, 2020). Each IHP variable has indicators or sub-variables that are explained in more detail.

Resource

Resources are related to the physical aspects that can be utilized by the community, in this case, the availability of water in water sources found on the surface (rivers, reservoirs, lakes) and in the ground (wells). The calculation of this variable is through the Water Availability Index (IWA) approach, which is the sum of water availability in surface water, groundwater, and tap water with the total population in an area (Marcellino et al, 2023). The result of this calculation is water availability per capita expressed in m^3/capita/year. The following is the formula for calculating water resource variables.

$$WAI = \frac{Availability\ of\ surface\ water + groundwater + piping}{The\ number\ of\ population}$$

Access

Access is a variable determined by the availability and affordability of clean water and sanitation. The access variable in this study uses three sub-variables, namely the number of households that have access to clean water (piped), sanitation (private toilet), and waste (septic tank). The percentage of each sub-variable was determined and the average value was determined to get the value of the access variable.

Capacity

Capacity is a variable that describes the community's ability to consume and manage its water resources. This capacity variable consists of four sub-variables, namely welfare level, education level, health quality and regional income distribution. Each sub-variable is measured using a particular method, for example, the level of welfare is calculated based on gross domestic product per capita. The level of public health is obtained from information on the number of people suffering from waterborne diseases, such as dysentery, diarrhea, and so on. The sub-variable of community education level is measured by looking at the net participation rate of the community in pursuing education at least up to the senior high school level. Furthermore, the income level of a region is measured using the Gini index or the calculation of income distribution inequality, with the following formula.

$$G = 1 - \sum_{i=1} n\, fP_i(F_{ci} + F_{ci-1})$$

Use

Use is a variable that describes the qualifications of water used by the community with sub-variables of water used for household purposes and water used for industrial purposes (Marcellino et al, 2023). The use of water for domestic purposes generally ranges from 0 to 320 liters/capita/day, while the use for agricultural purposes is obtained by comparing the area of irrigated land with the total area of agricultural land. The formula for calculating the usage variable is as follows (Hamid et al, 2021).

$$Domestic\ use = \frac{Domestic\ water\ consumption\ need\ (liter/capita)/day)}{Standards\ for\ basic\ water\ requirements\ (liter/capita)/day)}$$

$$Agricultural\ use = \frac{Area\ of\ irrigated\ land(hectare)}{Area\ of\ agricultural\ land\ (hectare)}$$

Environment

The environment is a variable that reflects the level of ecological sustainability related to water resources (Sutrisno et al, 2020). This environmental variable consists of two calculation sub-variables, namely the level of water quality and the area of green land. Water quality is assessed based on the applicable water quality standards in Gresik Regency. The assessment of domestic water quality refers to the Decree of the Minister of Environment No. 115 of 2023 concerning Guidelines for Determining the Status of Water Quality Standards, using the STORET method, which compares water quality data with drinking water quality standards. Meanwhile,

Table 1. WPI Variable Weights

No.	Regional Characteristics	Variable Weight				
		Resource	Access	Capacity	Use	Environment
1.	Agriculture, Industry, and Social	1	2	2	3	1
2.	Social	1	2	2	1	1
3.	Environment and Social	1	2	2	1	2
4.	Industry and Agriculture	1	2	2	2	1

Source: Kristijanto et al, 2016

Table 2. WPI Classification

Scale	Water Poverty Level	Scale	Condition
75–85	Very low	> 62	Secure
65–75	Low		
55–65	Moderately low	56–61.9	Low security
45–55	Medium	48–55.9	Not secure
35–45	Moderately high	35–47.9	Critical
25–35	High		
15–25	Very high		

Source: Maulani et al. 2014

vegetation cover was measured based on the percentage of Green Open Space in the study area. The Water Poverty Index value is then calculated by summing the results of multiplying the five variables by their respective weights, then the results are divided by the total weights used. The weight of this value is determined based on the characteristics of the research area. The following are the weights and formulas for calculating the Water Poverty Index.

The Water Poverty Index is an approach used to evaluate the level of water poverty using the availability of clean water in the Gresik Regency area with the following calculation formula (Sullivan et al. 2003):

$$WPI = \frac{wrR + waA + wcC + wuU + weE}{wr + wa + wc + wu + we}$$

Description:

WPI = Water Poverty Index Value
R = Resource variable value
A = Access variable value
C = Capacity variable value
U = Use variable value
E = Environment variable value
wr = Resource variable weight
wa = Access variable weight
wc = Capacity variable weight
wu = Use variable weight
we = Environment variable weight

Once the WPI values are determined based on the above calculations, they are normalized to a reference scale that standardizes water poverty and water security values according to the standards set by the Wallingford Center for Ecohydrology (PEH). The standards can be seen in the following table (Maulani et al. 2014)

In the Water Poverty Index equation, variable weights are used to provide a relatively more appropriate or relevant value between the value of each variable and the condition of the study area, considerations related to issues, regional policies, and other components deemed important in the calculation of each variable to determine the weight criteria to be used (Marcellino et al, 2023). In this study, the variable weights used are based on the characteristics of areas that have agricultural, industrial, and social functions with a weight value of 1-2-2-3-1. The variable weights for this research area use agricultural, industrial, and social functions because Gresik Regency has the characteristics of the largest agricultural area compared to other land uses, which is 40,434.76 hectares or 32% of the total area of Gresik Regency. In addition, Gresik Regency is also famous for its industrial area, where 843 medium and large industrial companies are still actively operating. In addition, the determination of the type also takes into account the research objectives, namely comparing it with social conditions, i.e. the variable type chosen in the end is the type that has agricultural, industrial, and social characteristics.

3. Result and Discussion

Overview of Gresik Regency

Based on its astronomical position, Gresik Regency is located between 6° 50’ 55” - 7° 23’ 37” South latitude (LS) and 112° 24’ 8” - 112° 38’ 00” East longitude (BT). Gresik Regency is generally divided into two parts, namely Mainland Gresik and Bawean Island. The area of Gresik Regency reaches 1,191.25 km², with Sangkapura District having the largest area, reaching 118.72 km². Gresik Regency is located northwest of Surabaya City, the capital of East Java province, with the center of Gresik Regency government located in Gresik District (Figure 1). In 2022, the population of Gresik Regency reached 1,298,184 people, with 319,493 housing units, and a population density of 1,061.04 people per km².

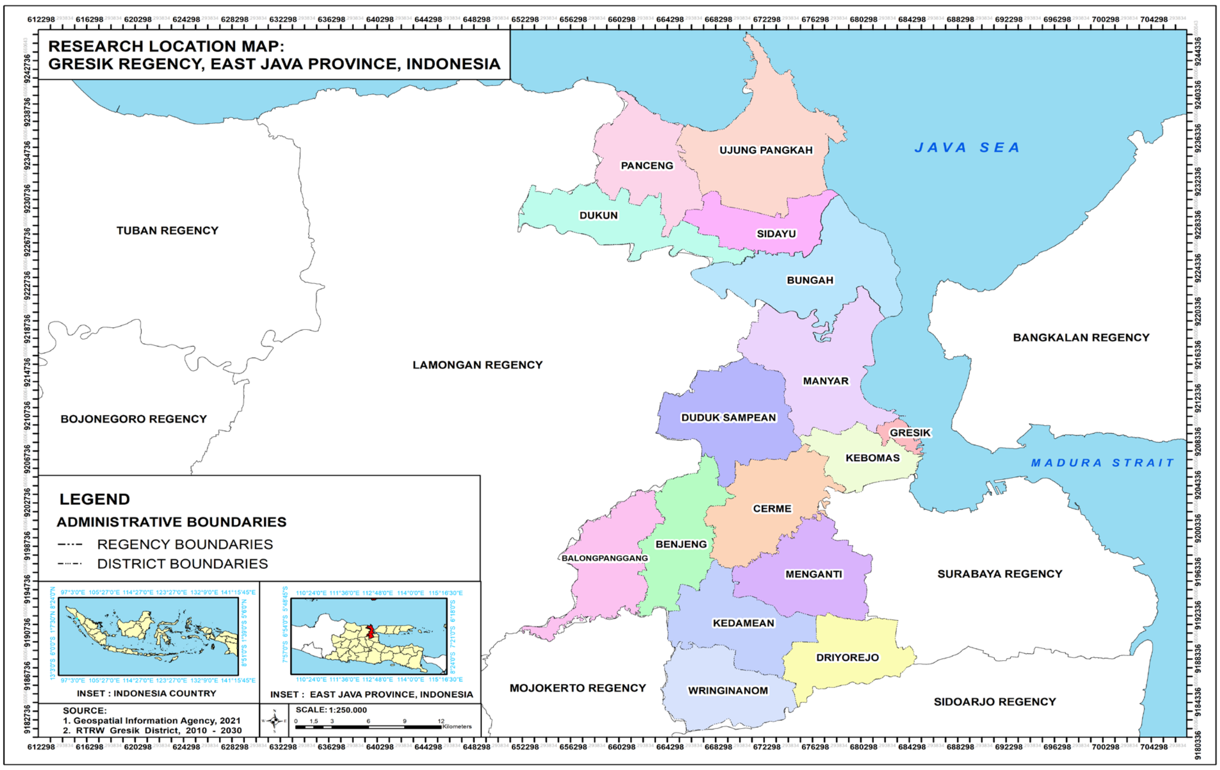

Figure 1. Map of Research Location in Gresik Regency

The drinking water management system in Gresik District is organized by the Regional Drinking Water Company (PDAM) and non-PDAM institutions. PDAM drinking water supply is implemented and organized by PDAM Giri Tirta in Gresik District. In addition, non-PDAM services are provided to areas not yet covered by the PDAM through the Drinking Water Users Association (HIPPAM) and the Community Water Supply and Sanitation Program (PAMSIMAS).

Drinking water services in Gresik Regency are implemented by PDAM Giri Tirta Gresik Regency with 4 missions and 3 service units, namely Gresik City Mission (Randuagung Unit and Suci Unit), Cerme Mission, Menganti Mission, and Driyorejo Mission (Perumnas). The number of customers of PDAM Giri Tirta Gresik District reached 109,616 domestic calls (SR); The population reached 398,180 people or equivalent to 1,298,184 people representing 30.67% of the total population of the administrative area or 42.99% of the total population. The service area has a population of 926,121.

Clean water management in the Gresik Regency area is carried out and organized by non-PDAM through community self-help, namely in the form of the Drinking Water Users Association (HIPPAM). HIPPAM is formed in areas that have not or have not been reached by PDAM system services. The number of people who have obtained clean water services from non-PDAM systems in 2019 is 21,268 families or around 85,361 people. The number of people who have been served by piped systems in administrative areas is 608,677 people or covers 46.89% of the total population that has been served by piped systems of 1,298,184 people. Meanwhile, the number of people in technical areas who have been served by piped systems is 14.02% of the total population who have been served by non-PDAM systems (HIPPAM and PAMSIMAS).

Water Poverty Index

The results of the calculation of the Water Poverty Index in the Gresik District area are calculated from five elements

Table 3. WPI of Resource

Surface Water Availability (m)	WPI Value	Groundwater Availability (m)	WPI Value	Piped Water availability (m3/ capita/year)	WPI Value	WAI Value
30	75	35	50	35,260,971	100	75

Source: Analysis Result, (2023)

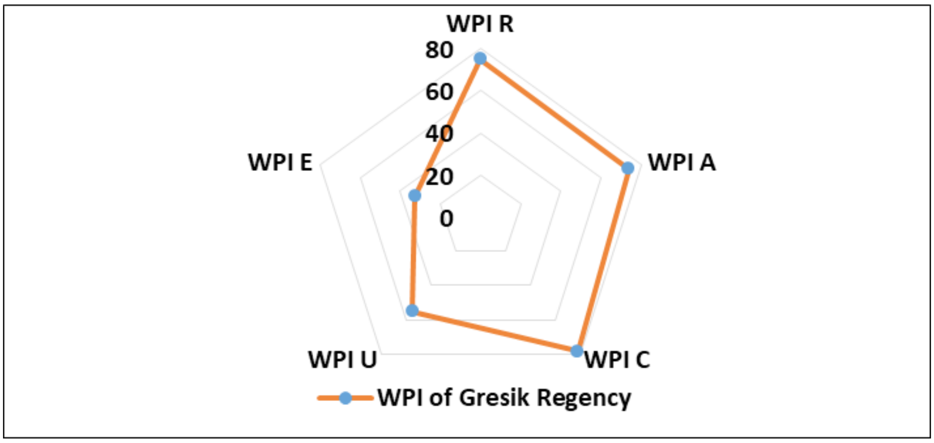

Figure 2. Pentagram Diagram of Water Poverty Index in Gresik Regency
Source: Analysis Result, (2023)

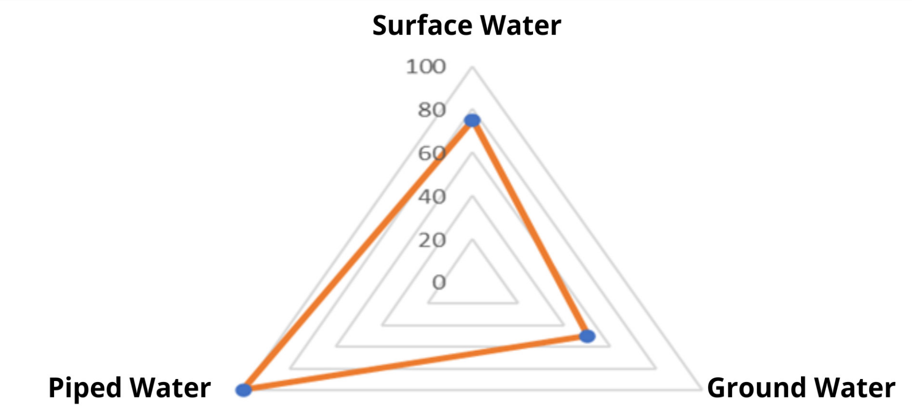

Figure 3. Pentagram Diagram of Resource Component in Gresik Regency
Source: Analysis Result, (2023)

with the value of each element displayed in a radar diagram (pentagram). Based on the calculations carried out, the overall IHP of Gresik District is 72.165. Thus, Gresik Regency is classified as having a low water poverty level with safe water resources.

Figure 2 shows that the water poverty index is calculated using five factors and the lowest factor is the environmental variable. The IHP value of the environmental variable is at or near zero, which is the smallest value. Each component of the index value is obtained by calculating the sub-variables of the water poverty index. The following is a table of the IHP calculation for Kabupaten Gresik that presents the weights of the five variables, with the total calculation as follows.

As seen in Table 3, the resource variable can be calculated based on the availability of water resources, which is divided into the availability of surface water, the presence of groundwater, and the availability of piped water. The people of Kabupaten Gresik rely on tap water and groundwater for their daily needs in the form of well water, with an average depth of 25 to 35 meters. However, several households still utilize reservoirs as a source of clean water with a reservoir depth of around 30m. The availability of piped water is calculated from the availability of surface water from PDAM Gresik Regency, which is 35,260,971 m^3/capita/year.

Figure 3 shows the calculation of access variables in Gresik District, which consists of clean water access, sanitation access, and septic tank access. The number of PDAM Giri Tirta customers in Gresik District is 109,616 house connections (SR). The number of people whose water source is supplied by the piped system is 398,180 people or 30.67% of the total population of the administrative area of 1,298,184 people or 42.99% of the total population of the service area of 926,121 people.

Based on Table 4 and Figure 4, the subcomponent that has the lowest score is access to clean water, as seen from the household water piping system. Access to clean water is a crucial aspect of achieving water resources sustainability. Efforts that can be made include strengthening policies and regulations that encourage sustainable water management. This includes setting limits and implementing monitoring activities that have the potential to pollute water sources, as well as providing strict sanctions for violations of these policies. In addition, efforts to increase the availability of clean water can be made by investing in clean water infrastructure, such as building wells, installing water supply systems, and developing efficient water distribution systems. Integrated water management that takes into account the needs of various sectors such as agriculture, industry, and households also needs to be implemented to ensure optimal water utilization. Public education and awareness on the importance of keeping water clean is also crucial. Empowering local communities in decision-making processes related to water resources management is an equally important endeavour (Ari et al, 2021).

This was done to enhance the achievement of Sustainable Development Goals (SDGs) 6 and 11, which underscore the importance of universal access to clean water and sanitation (SDG 6) and inclusive, safe and sustainable urban development (SDG 11). SDG 6 sets targets to ensure that all people have access to clean water and adequate sanitation while reducing the negative impacts of water pollution. Meanwhile, SDG 11 sets a target to make cities more inclusive, safe and sustainable. Therefore, there needs to be an optimal management of water resources equipped with adequate infrastructure.

Table 5 shows that the public health level in Gresik Regency is 97. The quality of health is calculated based on

Table 4. WPI of Access

Number of Houses	Sample House	Access to Clean Water	Access to Sanitation	Access to Septic Tank	WPI Value	
25,758	608	30.67%	98%	93%	74%	74

Source: Analysis Result, (2023)

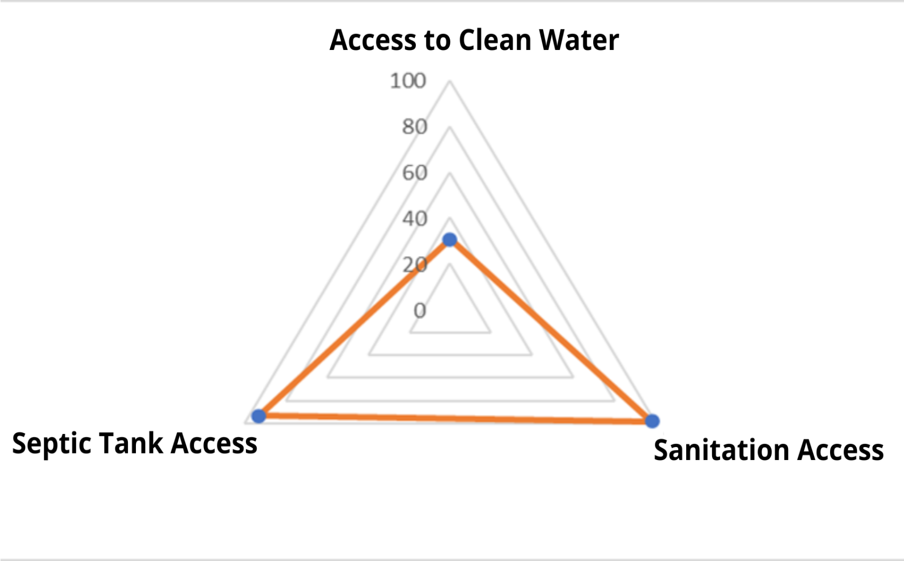

Figure 4. Pentagram Diagram of Access Component in Gresik Regency
Source: Analysis Result, (2023)

Table 5. WPI of Capacity

Health Quality	Education Level	Gini Index	WPI Health Quality	WPI Education Level	WPI of Gini Index	WPI
97%	74.24%	0.36	97.00	74.24	64	78.41

Source: Analysis Result, (2023)

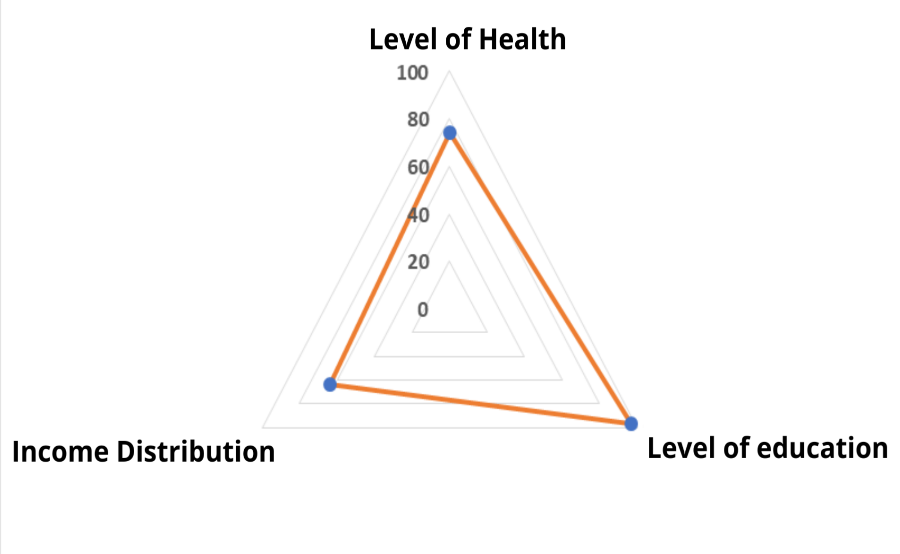

Figure 5. Pentagram Diagram of Capacity Component in Gresik Regency
Source: Analysis Result, (2023)

the number of people who have experienced illness caused by their clean water source, for example, diarrhoea and dengue fever. Based on the education level of the community in Kabupaten Gresik, most of the population has graduated from senior high school, which means that they have completed 12 years of compulsory education. This value is higher than 50% of the total population of Kabupaten Gresik. The Gini coefficient value illustrates the inequality of aggregate income distribution, the Gini coefficient value is assumed to be evenly distributed in Gresik Regency. Thus, the WPI value of capacity is obtained as 78 with safe conditions.

Based on Figure 5, the subcomponent that has the lowest value is income distribution, which can be observed from the calculation of the Gini index. To improve the Gini Index, which is an indicator of income inequality and wealth distribution in a population, a comprehensive approach involving economic, social and educational policies is needed (Zare-Bidaki et al, 2023). A possible corrective measure is through fair and progressive tax/levy reforms, where the government can revisit the levy structure to ensure that the burden of payment does not fall on low- and middle-income groups (Zare-Bidaki et al, 2023). This is being done to enhance the achievement of Sustainable Development Goals (SDGs) 6 and 11, which underscore the importance of universal access to clean water and sanitation (SDG 6) and inclusive, safe and sustainable urban development (SDG 11). SDG 6 sets targets to ensure that all people have access to clean water and adequate sanitation while reducing the negative impacts of water pollution. Meanwhile, SDG 11 sets a target to make cities more inclusive, safe and sustainable. Therefore, in this context, a well-structured government policy is needed to determine the levy payment in the PDAM piped system.

Table 6 shows that the average domestic water consumption is below the water quality standards, which means that the community does not use water excessively and is still within the water quality standards. To calculate industrial demand, the area of the industrial area is divided by the area of the industrial area stipulated in the Gresik Regency Regional Spatial Plan (RTRW). The reason for choosing this industrial area is because the Gresik Regency is known as the second largest industrial area in East Java, and industrial land is evenly distributed in the Gresik Regency.

Based on Figure 6, the subcomponent that has the lowest score is domestic clean water use. Measures to adapt to changes in domestic clean water use and domestic waste management are essential to address increasingly complex environmental challenges. One of the key strategies in adapting is the adoption of more efficient technologies in water use and waste management at the household level. Water-saving devices, such as efficiently designed toilets and shower heads that can reduce water consumption without compromising service quality, offer practical solutions that can be adopted by communities. In addition, water recovery and reuse is an important focus in addressing dynamics in water use. Implementing rainwater collection and storage systems in households can help reduce pressure on clean water supplies and provide an additional source of water for non-consumable needs. Reusing treated wastewater for purposes such as watering plants or gardening toilets can also optimize water resource management (Qurat-ul-Ann et al, 2023). In this regard, efforts to adapt to changes in household water use and household waste management should include an integrated approach and involve technology, education and community participation to achieve sustainable water and waste management in the coming years.

Based on Table 7, the water quality in this area is less than ideal, reflected in the IHPB value for raw water quality of 50. This means that residents obtain clean water with slightly polluted water quality. The water quality value is

Table 6. WPI of Use

Total Population	Domestic Water Demand (L/day)	Average Usage (l/person/ day)	Existing/ Standard	WPI of Water Use	Industrial Land Area (Ha)	Industrial Land Use (Ha)	Percentage of Industrial Land Use	WPI of Industry	WPI of Using
1,298,184	194,727,600	71,389,890.41	0.367	36	5,240.06	3,879.802759	74%	74	55

Source: Analysis Result, (2023)

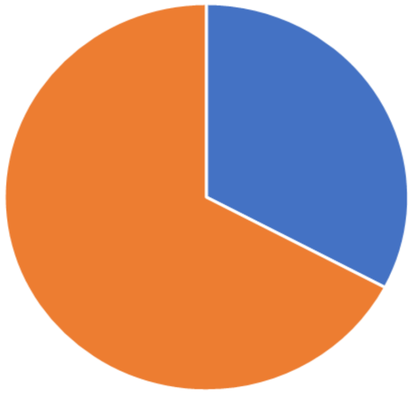

Figure 6. Pie Chart of Use Component in Gresik Regency
Source: Analysis Result, (2023)

Table 7. WPI of Environment

Water Quality	WPI Value	Green Open Space Area (Ha)	Area (Ha)	Percentage of Vegetation Cover	WPI Value (Area of Green Open Space)	WPI Value
-20	50	13,452.83	125,350.52	11%	11	32.5

Source: Analysis Result, (2023)

Figure 7. Pie Chart of Environmental Component in Gresik Regency
Source: Analysis Result, (2023)

obtained from the results of the water quality assessment by the Environmental Agency (DLH). Meanwhile, the area of vegetation cover is 11%. The value of vegetation can be assessed from the amount of green open space in the Gresik Regency area (Figure 8).

Based on Figure 7, the subcomponent that has the lowest score is vegetation land cover. Mitigation of clean water sources involves a series of actions aimed at protecting, managing and optimizing the availability of clean water. Thus, conserving forests, maintaining wetlands and sustainable water management can help maintain water quality and minimize the risk of pollution (Sayyar et al. 2022). Minimizing the risk of pollution of water sources requires a series of coordinated and sustainable efforts. One of them is to enforce the concept of protected zoning around water sources to prevent human activities that can pollute water. The regulation of land around springs can help protect ecosystems and prevent the pollution of harmful substances. In addition, increasing green coverage can be done by planting trees and maintaining green areas to improve water absorption and air quality. In addition, the development of urban parks, green belts and public open spaces are some of the key measures to increase green coverage (Koirala et al. 2020). This not only provides recreational space for people but also contributes to increasing the open space required for water absorption and addressing pollution while offering social benefits and enabling well-being.

The results of the Water Poverty Index (WPI) assessment in Gresik District show that the water poverty score is 72.165 (Table 8). This means that the water poverty level in this area is at a low level, which indicates a safe condition. Looking at each variable, it can be seen that the variable with the lowest score is the environment. For this variable, the calculations include water quality and vegetation cover, both of which are classified as low. This is because the area of natural vegetation is very small compared to other land uses in Gresik District. In addition, community water quality in this study is considered sub-optimal, where the value of water quality after normalizing the IHP value is 50, which is classified as low. This indicates that the community's drinking water supply is in a moderately polluted condition. This water quality assessment is based on the results of testing using the STORET water quality measuring instrument which produces a water classification.

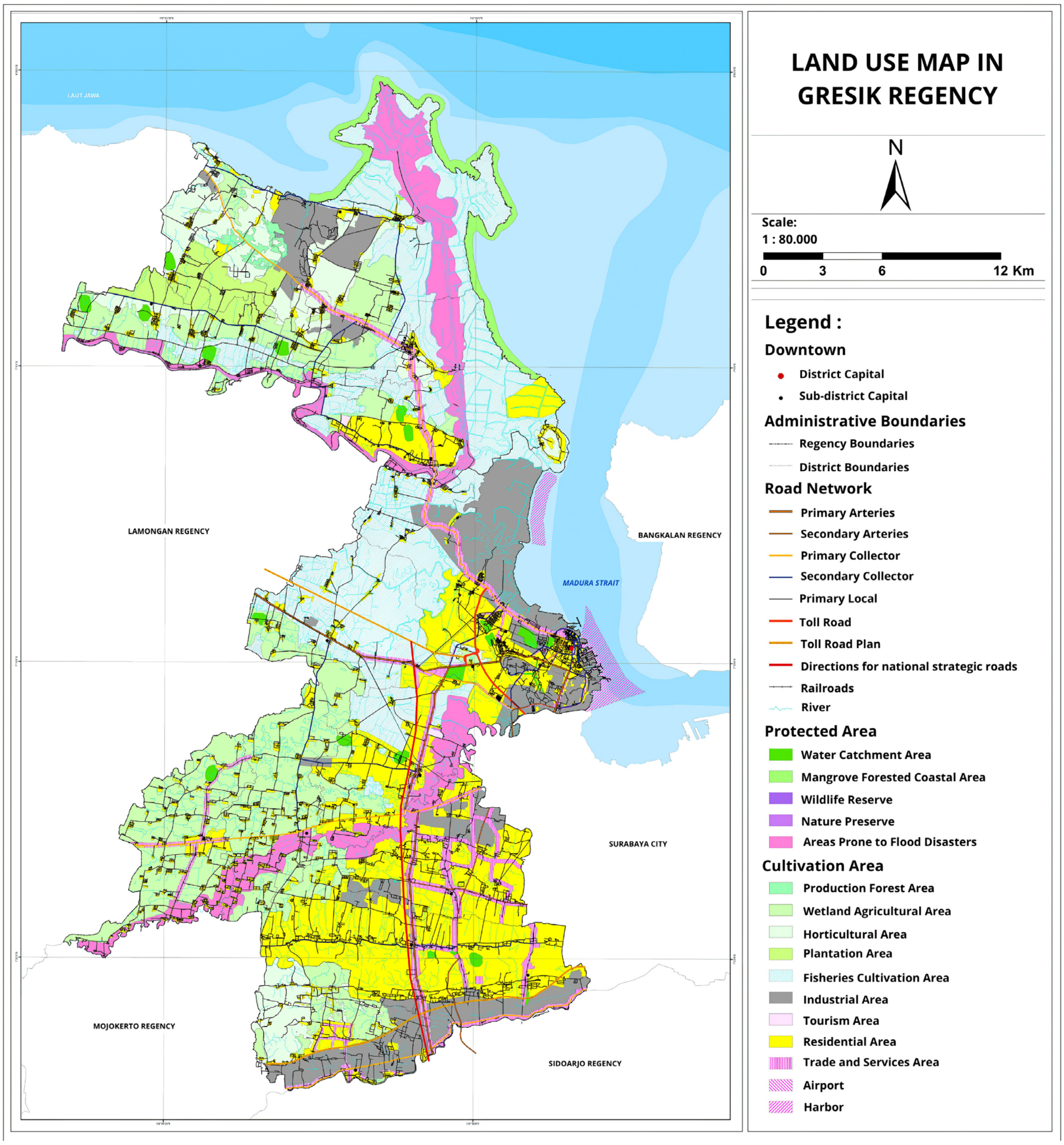

Figure 8. Land Use Map In Gresik Regency
Source: Analysis Result, (2023)

Table 8. WPI of Gresik Regency

	Resource	Access	Capacity	Use	Environment	Total
WPI Value	75	74	78.41	55	32.5	
Variable Weight	1	2	2	3	1	
Total	75	148	156.82	165	32.5	72.165

Source: Analysis Result, (2023)

However, without physical testing, the quality of HIPPAM water and well water used by the community is still relatively healthy and of good quality, colourless, tasteless, flavourless, and does not contain sediment.

The low environmental value indicates that the Gresik Regency area has poor water quality, water bodies with moderate levels of pollution, and a lack of Green Open Space (RTH). If this continues, it could jeopardize the health quality of the surrounding community. Although the high value of water access and water availability in the WPI variable indicates that all households have the same quality of drinking water services, this is not balanced with good environmental quality. As a result, this may lead to reduced water availability due to the lack of green spaces that can absorb and store groundwater.

The index of water poverty (IHP) assessment is an interdisciplinary approach in measuring socioeconomic characteristics through water scarcity. Similar research in Beheshtabad, Iran, through the calculation of IHP by considering five criteria, namely Resources, Access, Capacity, Use, and Environment, obtained a value of 64.4 (Ladi et al, 2021). Gresik Regency is still better than Beheshtabad, Iran and the world WPI average. The world average WPI value is 56.74, which means the level of water poverty is quite low (Lawrence et al, 2003).

Water resources are essential for quality of life and are in line with the sustainable development goals (SDGs-6). An increase in the water poverty index will be directly proportional to an increase in the human development index, which reflects the level of development of the region. Therefore, alternative solutions that can be applied in Gresik District can adopt the approach taken in Iran, including sustainable natural resource management, water management capacity building, environmental approaches, efficiency, water use, and sustainable access (Zare-Bidaki et al. 2023).

4. Conclusion

The conclusion of the research entitled "A Holistic Approach to Water Poverty Alleviation in Gresik District" is that the results of the calculation of water poverty based on the Water Poverty Index show a value of 72.165. In other words, the research area experiences water scarcity and drinking water. Water scarcity in Gresik Regency is triggered by the value of environmental variables that are below the standard (poor water quality and vegetation, usually in a polluted condition). Water scarcity in the Gresik District is an illustration of global challenges related to water poverty, such as in Myanmar, India and South Africa, which have WPI values of 50-55. This research emphasizes the importance of a holistic approach in managing water resources by prioritizing environmental quality as the main priority. Therefore, several strategies can be carried out to overcome water poverty, including building wastewater treatment plants to minimize water pollution and maintain water quality. In addition, sustainable management of water resources can also be carried out, such as fulfilling and planting vegetation or green open spaces and making conservation efforts to ensure sufficient water availability in the long term. Overcoming water poverty requires a collaborative effort involving various international stakeholders. Long-term commitments between governments, academia, global community organizations, the private sector and civil society are essential to realizing sustainable and inclusive solutions. This model, which prioritizes cross-sector collaboration and environmental adaptation, can serve as a reference for other regions of the world experiencing similar challenges.

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