DEPIK
Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan
Journal homepage: www.jurnal.usk.ac.id/depik

Analysis sustainability status of laeya river management for raw water supply in South Konawe Regency Southeast Sulawesi Province

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ARTICLE INFO

Keywords
Sustainability Raw Water
MDS
Monte Carlo
RAPS-Laeya
South Konawe Regency

DOI: 10.13170/depik.12.3.33538

ABSTRACT

South Konawe Regency experienced a decrease in water supply and an increase in water demand, due the changes in land use caused by ongoing land exploitation, which increases runoff and decreases infiltration capacity. As a result, more water is lost to the ocean, threatening the water supply from Laeya River. Laeya River raw water is not only utilized for PDAM raw water sources, but also used to meet the domestic needs of the community, agricultural irrigation and plantations, so it is important to know the its sustainability status. This research aims to carrying out activities that control the water quality of the Laeya River, as well as to serve an information regarding the status model for the sustainability of raw water management, and to raise environmental awareness. This study was carried out in the Laeya River, South Konawe Regency. Sampling was conducted at three stations representing the upstream area of the Laeya River, the middle area and the downstream area. The Multi Dimensional Scaling (MDS) analysis method was used to conduct an analysis of the status of sustainable natural resource management for sustainable raw water supply. Based on the results can be concluded that Analysis of the 41 attributes derived from five dimensions resulted in 12 attributes acting as leverage factors in each dimension partially. To improve the sustainability status of raw water management in the research area, it is necessary to intervene the 12 attributes, namely 11 attributes that need to increase the intensity of their activities, and one attribute needs to be controlled and planned for its development properly. The results of the assessment of 41 attributes from five dimensionsin the management of the Laeya River for raw water supply in South Konawe Regency, currently is at less Sustainability status(Sustainability Index value of 36.63).

Introduction

One of the Sustainable Development Goals (SDGs) is the provision of sustainable water supply. By 2030, everyone should have access to safe and affordable drinking water (Suharyanto, *et al.*, 2018). Symptoms of clean water shortage and water quality degradation have been identified in industrialized and densely populated areas. Groundwater exploitation and water pollution are uncontrolled by both industries and communities. Public ignorance of the dangers of waste discharged directly into aquatic ecosystems without prior treatment exacerbates water pollution. In addition, the lack of industrial awareness will reduce the ability of water bodies to purify themselves, thus worsening the condition of clean water raw water sources (Muhyiddin, *et al.,* 2013).

Watersheds in Indonesia amounted to 17,076, with an area of 189 million ha, of which 14.3 million ha is critical land that must be rehabilitated. Watershed degradation requires proper management in terms of government administration, and institutional, social, and biophysical conditions (Sulaiman, *et al.,* 2021). Population increase, expansion of rural activities, changing weather patterns, and the need to ensure water supply during drought periods have increased the demand for water in many parts of the world (Wang, *et al.,* 2012; Khan,

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p-ISSN 2089-7790; e-ISSN 2502-6194
Received 29 September 2023; Received in revised form 08 November 2023; Accepted 24 November 2023
Available online 31 December 2023

et al., 2019; Akbar *et al.*, 2023; Ahmed, *et al., 2019;* Ali, *et al.*, 2019; Ardiclioglu and Kuriqi, 2019; Akbar and Rahayu, 2023). Adequate environmental flow (e-flow) in rivers is necessary for sustainable river management (Hayes, *et al.*, 2018).

Integrated water resources management makes a significant contribution to addressing increasing water demands and challenges. The Global Water Partnership (GWP) defines the overall concept as economic growth, proper coordination, food security, improved health, and social equity without jeopardizing system sustainability (Masthura, *et al.*, 2021). Sustainability awareness is necessary for the effective management of water bodies and also serves as a basic basis for supporting performance and policy development (Sala, *et al.*, 2015), it is driven by the increasing needs of the population due to rapid urban growth, making the availability of raw water increasingly unbalanced. The decline in the quality of spring water to rivers due to the flow of water carrying domestic and industrial waste hurts the health of urban water ecosystems (Sofia *et al.*, 2010; McGrane, 2016; Miller and Hutchins, 2017). Agricultural activities are a major contributor to water quality degradation (Ongley *et al.*, 2010; Yang *et al.*, 2011; Shen *et al.*, 2012; Foissy *et al.*, 2013; Volk *et al.*, 2016). Thus, water must be addressed in terms of both quality and quantity, to ensure the quality and availability of clean water consumed by future generations.

Economic growth, social equality, environmental conservation, and institutional strengthening must be considered in the development paradigm and require measurable development planning management. Every policy decision in the development planning and management process can affect and change the pattern of interdependence of social, economic, and environmental conditions (Karrasch, *et al.*, 2014). Therefore, it is necessary to apply the concept of sustainable development to balance all aspects of development (Yuliansyah, *et al.*, 2021). MDS is a multivariate statistical technique that processes scored Rapfish attribute data by determining the position of the research object and displaying it through ordinate points. In addition, MDS is a dimension-reduction technique that transforms multi-dimensional data into a lower-dimensional space while maintaining its intrinsic information (Asrial, *et al.*, 2017; Saeed, *et al.*, 2019).

Aquatic environmental problems are becoming more common as society advances (Kuriqi *et al.*, 2021), and increasing economic activity and population leads to increased water demand. South Konawe District, Southeast Sulawesi Province, is experiencing a decrease in water supply caused by land use change. Land exploitation continues, having an impact on increasing runoff and reducing infiltration capacity, as stated by Cahyo *et al*, (2023) that land changes that occur in the Laeya watershed areas, especially for agricultural land (rice fields, dry land agriculture, mixed dryland agriculture, and plantations) experienced a very high rate of land change from 2015 to 2020.

Furthermore, Baco *et al.* (2023) stated that the Laeya watershed based on the critical land sub-criteria is classified as very low and the erosion index sub-criteria is classified as very high. As a result, more water is lost to the sea threatening the water supply of South Konawe Regency which is sourced from the Laeya River, the raw water of the Laeya River is not only utilized for PDAM raw water sources, but also used for meet the domestic needs of the community, agricultural irrigation and plantations, so it is necessary to know the status of Laeya River water pollution.

Wolasi Village, Leleka Village, Anduna Village, Ambolodange Village, Ambesea Village, Laeya Village, and Labokeo Village are part of the Laeya Sub-district in Southeast Sulawesi Province, Indonesia. The Laeya River is a seasonal river that receives large amounts of water during the rainy season and little during the summer. Although the Laeya River is seasonal, it remains the most important source of water for residents, especially farmers who use river water for bathing, washing, and other household needs, as well as irrigating rice fields in several locations around it. To anticipate various possibilities arising from the utilization of surface water sources in South Konawe Regency, research is needed on the Sustainability Status Analysis of Laeya River Management for Raw Water Supply in South Konawe Regency, Southeast Sulawesi Province. This research aims to evaluate the sustainability status of the Laeya River. So that it is expected to be able to assist the government, in this case the South Konawe Regency Environmental Service, in carrying out water quality control activities for the Laeya River, and can provide information for the people of South Konawe Regency regarding the model of the sustainability status of raw water management in their area, to increase environmental awareness.

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Materials and Methods

Location and time of research

This study was carried out in the Laeya River, South Konawe Regency, Southeast Sulawesi Province, from September to October 2022.

Sampling was conducted at three stations representing the upstream area of the Laeya River with forest land use, the middle area dominated by settlements, agriculture and plantations and the downstream area dominated by plantations and ponds. Station-I is located on Axis Highway Kendari-Andoolo, Lelekaa Village, Wolasi District, South Konawe Regency at coordinates 04°13'22" South Latitude and 122°28'50" East Longitude. Station-II is located at 04°20'51" South Latitude and 122°29'00" East Longitude in Ambesea Village, Laeya District, South Konawe Regency. Meanwhile, Station-III is located at 04°25'57" South Latitude and 122°31'14" East Longitude in Labokeo Village, Laeya District, South Konawe Regency (Figure 1).

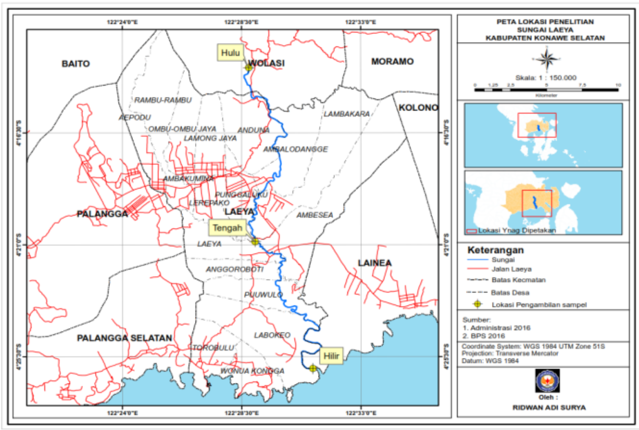

Figure 1. Map of research sites in the Laeya River Basin

Data analysis

The Data taken is the Laeya River Water Quality Test Data for determining the River Water Quality Status with the Pollution Index method as referred to Ismail *et al.*, (2023), the data is attached to the MDS Questionnaire which has been filled in by Expert Respondents as their reference material in filling out the MDS Questionnaire for the Ecological Dimension related to the Status of Laeya River Water Quality as an alternative source of PDAM raw water in South Konawe District. The Multi Dimensional Scaling (MDS) analysis method was used to conduct an analysis of the status of sustainable natural resource management for sustainable raw water supply in South Konawe Regency.

Sustainability Status Analysis

The RAPS-Laeya development software method was used in conjunction with the Multi-Dimensional Scaling method to assess the index and status of the sustainability of natural resource management for raw water supply in South Konawe Regency.

The status of raw water management sustainability in South Konawe Regency can be determined by examining five dimensions: ecological dimension, economic dimension, social dimension, technological dimension, and institutional dimension. The constituent attributes for each of these dimensions have been evaluated and determined, to obtain an overview of the level or status of sustainability in each dimension of raw water management.

The RAPS-Laeya software was used to conduct a sustainability analysis using the Multi-Dimensional Scaling analysis approach. Pitcher (1999) defines RAPS as a Non-Parametric Multi-Dimensional Scaling approach with an ordinated technique based on the Multi-Criteria Analysis (MCA) principle and relying on the MultiDimensional Scaling algorithm. The index category and sustainability status are presented in Table 1.

Table 1. Index category and sustainability status

Classification	Status
0.00 – 25	Bad (Unsustainable)
25.01 – 50	Less (Less Sustained)
50.01 – 75	Sufficient (Sufficiently Sustained)
75.01 – 100	Good (Sustained)

Source: Surya et al., (2020)

The RAPS-Laeya operational stages used in Multi-Dimensional Scaling analysis are as follows: (1) determining and defining the attributes of each sustainable dimension in this study covering the five dimensions analyzed, namely the ecological dimension, the economic dimension, the social dimension, the technological dimension, and the institutional dimension; (2) scoring each attribute on an ordinal scale based on field survey results; (3) perform ordination analysis with Multi-Dimensional Scaling to determine the position of sustainability status on each dimension in the sustainability index scale; (4) assess the index and sustainability status in each dimension; (5) perform sensitivity analysis (leverage analysis) to determine sensitive changes; and (6) Monte Carlo analysis to account for the dimensions of uncertainty (Kavanagh, 2004Pitcher and Preikshot, 2001); Leverage analysis, Monte Carlo analysis, determining the Stress value, and the coefficient of determination are all performed in the Multi-Dimensional Scaling analysis (R^2). The Sustainability Index Scale of the system under study ranges from 0% to 100%.

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Results

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According to Kavanagh and Pitcher (2004), Monte Carlo analysis is a simulation method for evaluating the impact of random error in statistical analysis. As Fauzi and Anna (2005) stated, Monte Carlo analysis is an indicator of errors caused by scoring each attribute, multidimensional scoring variations due to different opinions, repetitive data analysis processes, and data entry errors or missing data. The 'Monte Carlo parameter can use a quantitative method approach or a qualitative method.

According to the results of the RAPS-Laeya analysis, the ecological dimension has a sustainability index of 52.27% (sufficiently sustained), the economic dimension has a sustainability index of 24.32% (unsustainable), the social dimension has a sustainability index of 35.77% (less sustained), the technological dimension has a sustainability index of 21.41% (unsustainable), and the institutional dimension has a sustainability index of 49.40%(less sustained). For each of these dimensions to be sustainable in the future, it is necessary to intervene or improve the attributes (existing conditions) of each sensitive dimension. Figure 2 depicts the worth of each dimension of sustainability (Kite Diagram).

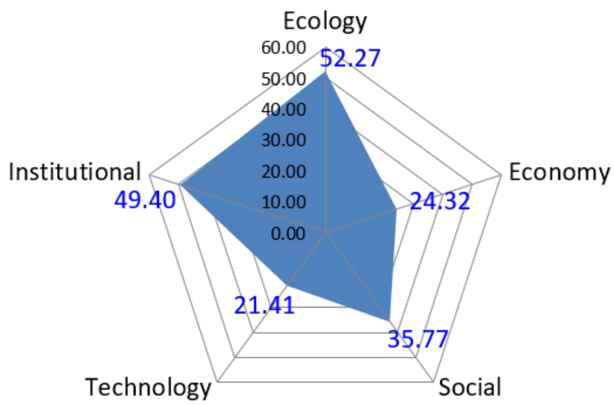

Figure 2. Kite diagram of the Laeya River management sustainability index for sustainable raw water supply in South Konawe Regency

Ecological Dimension Sustainability Status

The results of the RAPS-Laeya analysis on 12 attributes yielded a sustainability index value for the ecological dimension of 52.27, indicating that it is quite sustainable (the index lies between values 50.00-74.99). The value of the sustainability index indicates that the ecological condition in South Konawe Regency is quite good. This demonstrates that the area's ecological capability to support activities is quite sustainable. Based on the leverage analysis on ecological attributes, three (three) attributes were identified as being sensitive to the level of sustainability from the ecological dimension, namely: (1) Development of raw water sources for clean water supply (RMS = 3.14), (2) Land use on raw water quality (RMS = 2.46), and (3) Groundwater level (RMS = 2.21). The results of the leverage analysis are presented in Figure 3.

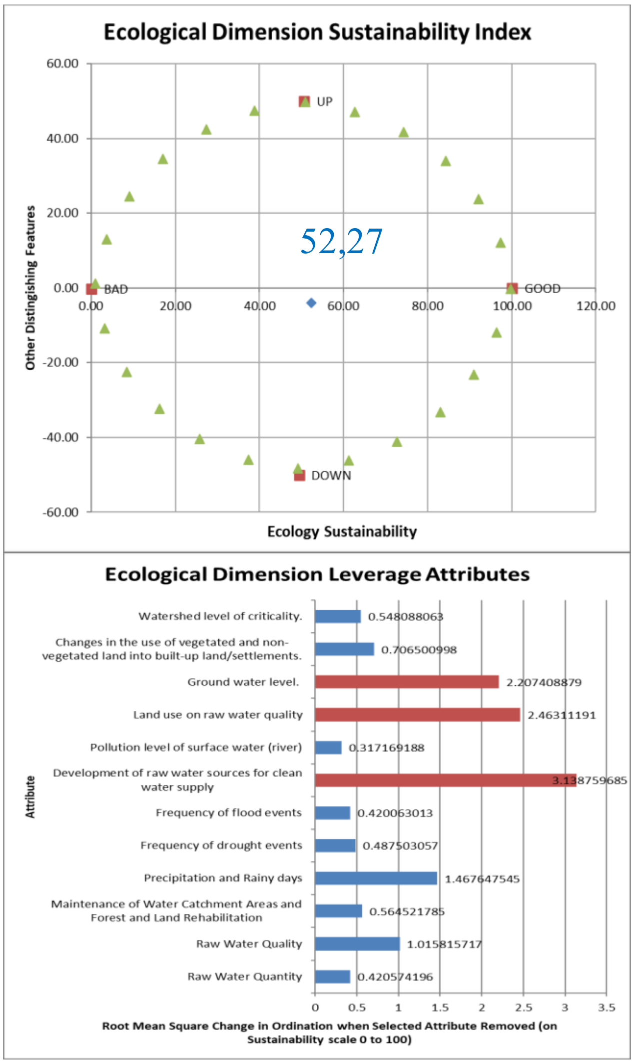

Figure 3. Sustainability status index and leveragesattributes of the ecological dimension

Economic Dimension Sustainability Status

The RAPS-Laeya analysis on seven attributes yielded a sustainability index value for the economic dimension of 24.32, indicating Unsustainable (the index lies between values 0.00-25). Based on the leverage on economic attributes analysis, three attributes were identified as being sensitive to the level of sustainability from the economic dimension, namely: (1) Percentage of the poor population (RMS

= 6.65), (2) Tariff of Clean Water Company Regional Drinking Water Company (RMS = 4.93), and (3) Profitability of Regional Water Supply Companies (RMS = 4.89). Changes to the three leverage factors will easily affect the increase or decrease in the economic dimension of the sustainability index value. The results of the leverage analysis are presented in Figure 4.

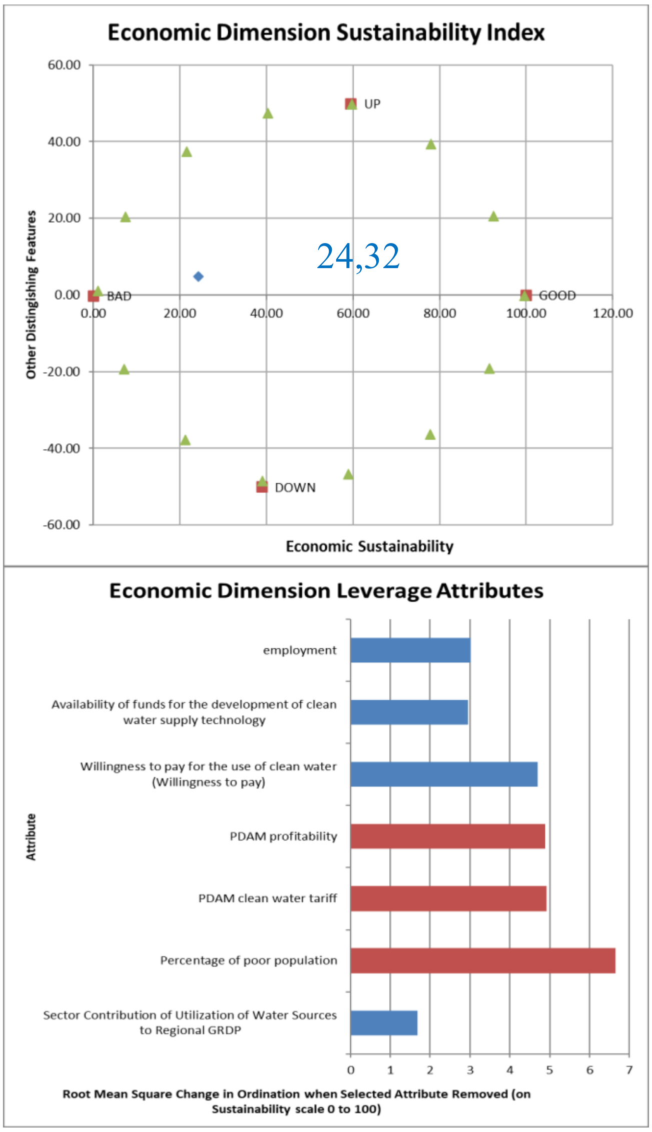

Figure 4. Sustainability status index and leverage attributes of the economic dimension

Social Dimension Sustainability Status

The results of the RAPS-Laeya analysis on seven attributes yielded a sustainability index value for the social dimension of 35.77, indicating that it is less sustainable (the index lies between values 25.00-49.99). Based on the leverage on social attributes analysis, two attributes were identified as being sensitive to the level of sustainability from the social dimension, namely: (1) Community motivation and concern for efforts to improve the environment, forest, and land rehabilitation for the preservation of raw water sources (RMS = 5.23), and (2) the community's formal education level (RMS = 4.02). Changes to this leverage factor will easily affect the increase or decrease in the value of the social dimension sustainability index. The results of the leverage analysis are presented in Figure 5.

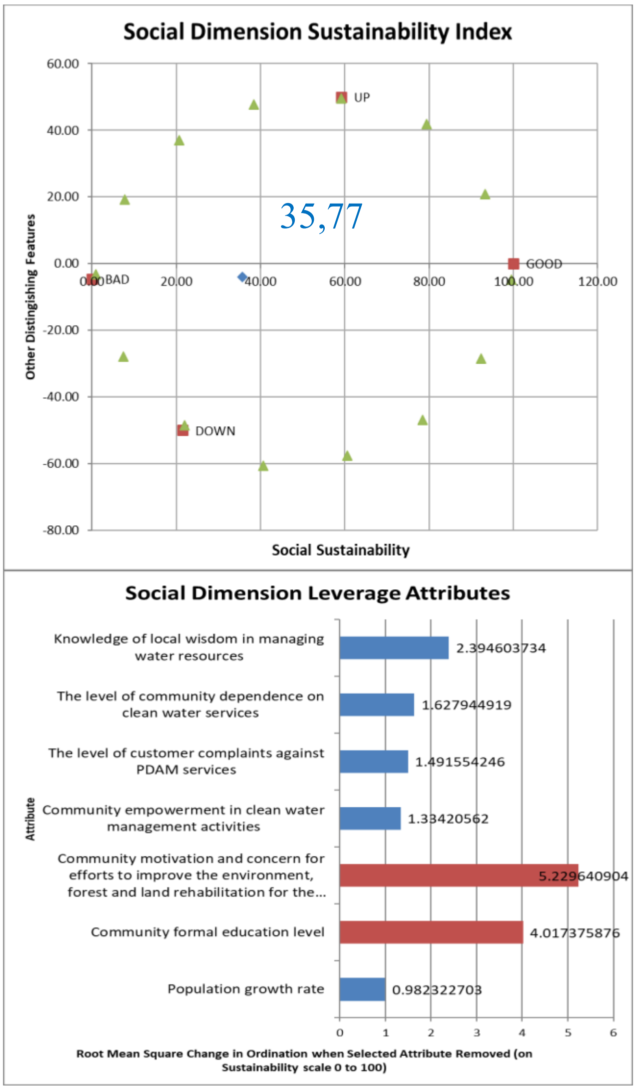

Figure 5. Sustainability status index and leverage attributes of the social dimension

Technology Dimension Sustainability Status

The results of the RAPS-Laeya analysis on eight attributes yielded a sustainability index value for the technology dimension of 21.41, indicating Unsustainable (the index lies between values 0.00-25). Based on the analysis of leverage on technological attributes, two attributes were obtained that were considered sensitive to the level of sustainability from the technological dimension, namely: (1) Drainage conditions in residential areas (RMS = 7.45), and (2) Acceptance level of new technology (Technological Innovation) (RMS = 4.50). Changes to the leverage of these two factors will easily affect the increase or decrease in the value of the sustainability index of the technology dimension. The results of the leverage analysis are presented in Figure 6.

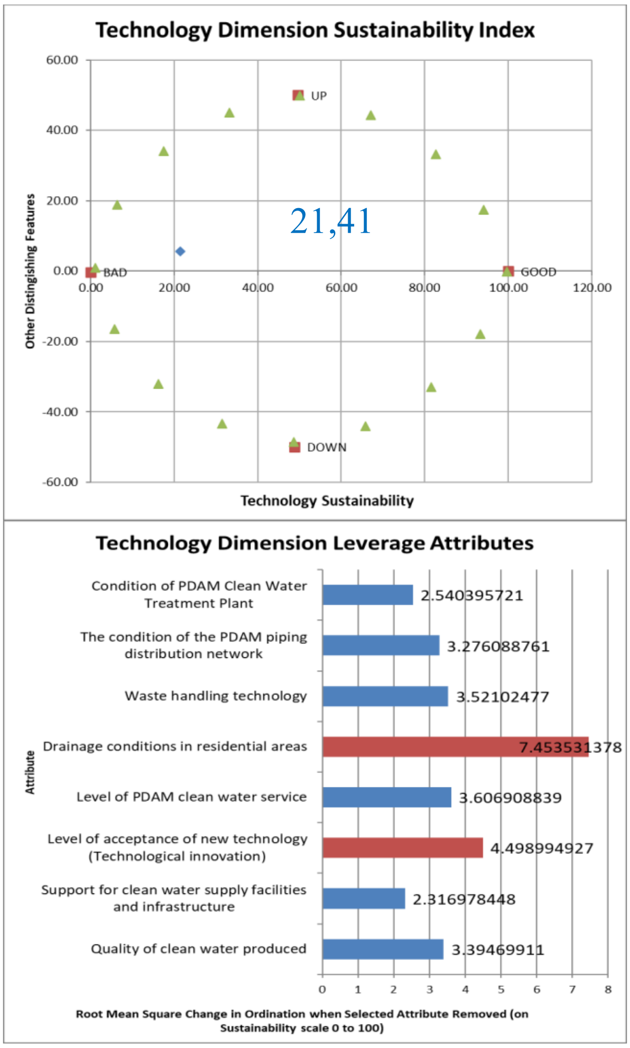

Figure 6. Sustainability Status Index and Leverage Attributes of the Technology Dimension

Institutional Dimension Sustainability Status

The results of the RAPS-Laeya analysis on seven attributes yielded a sustainability index value for the institutional dimension of 49.40, indicating that it is less sustainable (the index lies between values 25.00-49.99). Based on the analysis of institutional leverage, two attributes were identified as being sensitive to the level of sustainability from the institutional dimension, namely: (1) Availability of instruments of customary law or local wisdom (RMS = 9.41), and (2) Regime of clean water management (RMS = 7.94). Changes to the leverage of these two factors will easily affect the increase or decrease in the institutional dimension of the sustainability index value. The results of the leverage analysis are presented in Figure 7.

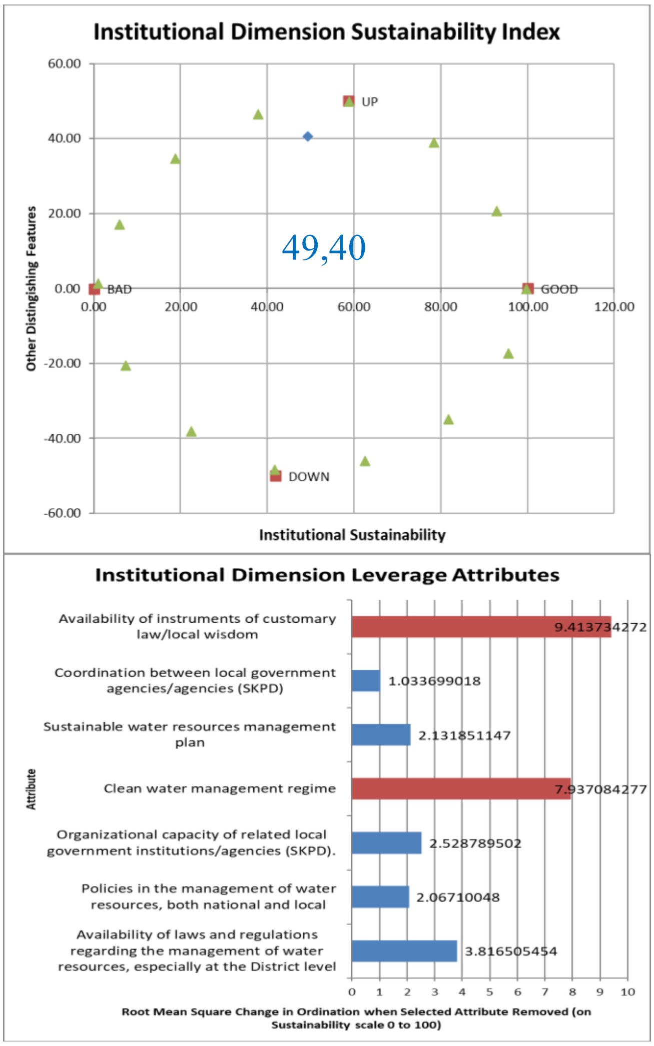

Figure 7. Sustainability Status Index and Institutional Dimension Lever Attributes

Discussion

Analysis of the Sustainability Status of Raw Water Management in South Konawe Regency

Based on the results of the analysis using RAPS-Laeya, it shows that the sustainability index values for each dimension are as follows:

a. The Ecological Dimension of 52.27% means Sufficiently Sustainable (index lies between 50.00-74.99).
b. The Economic Dimension of 24.32% means Unsustainable (index between values 00.00-25).
c. The Social Dimension of 35.77% means Less Sustainable (index lies between 25.00-49.99).
d. The Technology Dimension of 21.41% means Unsustainable (index between values 00.00-25).
e. The Institutional Dimension of 49.40% means Less Sustainable (index lies between 25.00-49.99).

For each of these dimensions to be sustainable in the future, the attributes (existing conditions) of each dimension are sensitive, and it is necessary to

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intervene or improve, in multidimensional scaling (MDS), "sensitivity" refers to sensitivity analysis. It is a technique used to evaluate how changes in input parameters or data affect the output of a model or analysis. Specifically in MDS, sensitivity analysis involves assessing how variations in input data, such as measures of dissimilarity or similarity between objects, impact the resulting spatial configuration of those objects in multidimensional space. By adjusting the input parameters or changing the data used in MDS, sensitivity analysis helps understand the robustness of the model and the reliability of the spatial representation generated by MDS. The value of each sustainability dimension (kite diagram) is presented in Figure 2.

The Laeya River Basin is part of the ecosystem area that influences the condition of the local ecosystem as well as the middle and downstream areas of the Watershed. Each region (upstream, middle, and downstream of the Watershed) has an emphasis on its management following the conditions of the Watershed, namely the characteristics of the area, its dependency, and its influence on the surrounding area. Taking into account the condition of the Laeya River Basin, each dimension in its management has the same weight of importance in its management as an integrated unit. Based on the opinions of several related experts, it was found that the weight value for each dimension was 20%.

Table 2. Multidimensional sustainability index values for sustainable raw water management in South Konawe Regency

No.	Sustainability Dimension	Sustainability Index Value	Weight Value (%)	Weighted Value
1.	Ecology	52.27	20	10.45
2.	Economy	24.32	20	4.86
3.	Social	35.77	20	7.15
4.	Technology	21.41	20	4.28
5.	Institutional	49.40	20	9.88
	Total			**36.63**

Based on the results of the weighting of the five dimensions of sustainable raw water management, the index value of sustainable raw water management in South Konawe Regency is 36.63 (located between 25.00-49.99) this means that the status of sustainable raw water management in South Konawe Regency is currently it is in the status of Less Sustainable. The less sustainable status in the research area is caused by the low value of the sustainability index of the five dimensions assessed. Where the Ecological Dimension has Sufficiently Sustainable performance, the Economic Dimension and the Technological Dimension have Unsustainable performance, while the Social Dimension and Institutional Dimension show less sustainable performance. The weighted index values of the five dimensions are presented in Table 2.

The largest sustainability index value is obtained from the Ecological Dimension of 10.45 and then the Institutional Dimension of 9.88, while the other dimensions are smaller. The Ecological Dimension is indeed expected to be able to provide greater performance and to be able to provide greater environmental services in sustainable raw water management in South Konawe Regency. Scientific evaluation of the relationship between resources, environment, and human activities plays an important role in realizing regional sustainable development (Yang *et al.*, 2022). Water security represents ecological security and a policy priority for sustainable development (Dou *et al.*, 2021).

Urban water security explicitly includes two Sustainable Development Goals (SDGs) by protecting water resources (6th SDG) and contributing to sustainable urban development (11th SDG) demonstrating their relevance in realizing sustainable development (United Nations, 2015). Urban water security is closely related to sustainable development (Chang and Zhu, 2020). The four dimensions of sustainability (namely: environment, economy, society, and institutions (European Commission, 2012).

Leverage Factor

Analysis of the 41 attributes derived from five dimensions (ecological, economic, social, technological, and institutional) resulted in 12 attributes acting as leverage factors in each dimension partially (Table 3). To improve the sustainability status of raw water management in the research area, it is necessary to intervene in the 12 attributes, namely 11 attributes that need to increase the intensity of their activities, and one attribute needs to be controlled and planned for its development properly.

Attributes that need to increase the intensity of their activities because currently they already exist but the development is still not optimal in its implementation are the development of raw water sources for the supply of clean water; land use on raw water quality; groundwater level; percentage of poor population; clean water tariff of Regional Drinking Water Company; profit level of the Regional

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Drinking Water Company; community motivation and concern for environmental improvement efforts; community's formal education level; drainage conditions in residential areas; level of acceptance of new technology (technological innovation); and the availability of instruments of customary law or local wisdom. While the attribute that needs to be controlled in the implementation of its activities and needs to be better planned for its development in the future is the clean water management regime.

Table 3. Leveraging attributes of sustainability dimensions

No.	Sustainability Dimension	Attribute (Leverage Factor)	RMS Value
1.	Ecological Dimension	• Development of raw water sources for clean water supply	3.14
		• Land use on raw water quality	2.46
		• Ground water level	2.21
2.	Economic Dimension	• Percentage of Total Poor Population	6.65
		• Tariff for clean water from Regional Water Company	4.93
		• The profit level of the Regional Drinking Water Company	4.89
3.	Social Dimension	• Community motivation and concern for efforts to improve the environment, rehabilitate forests and land for the preservation of raw water sources	5.23
		• Community formal education level	4.02
4.	Technology Dimension	• Drainage conditions in residential areas	7.45
		• The level of acceptance of new technology (technological innovation)	4.50
5.	Institutional Dimension	• Availability of customary law instruments or local wisdom	9.41
		• Clean water management regime	7.94

According to Ren *et al.*, (2022) with the progress of urbanization, many people exploit and use rivers in various ways. However, the transformation and over-draining of rivers and the discharge of large amounts of industrial and agricultural pollutants have also affected the ecological status of rivers to varying degrees.

Monte Carlo Analysis

Taking into account the results of the Monte Carlo analysis and the Multi-Dimensional Scaling analysis at the 95% level of confidence, it was found that the Index value for Sustainable Raw Water Management in South Konawe Regency indicated that there was a very small difference in the values of the two analyzes (0.30%). This means that the resulting Multi-Dimensional Scaling analysis model is sufficient to estimate the index value of Sustainable Raw Water Management in South Konawe Regency. This very small difference in value indicates that errors in the analysis process can be minimized or avoided. Errors caused by scoring on each attribute, variations in scoring that are multidimensional due to different opinions are relatively small, the data analysis process is carried out repeatedly and relatively stable, and errors in inputting data and missing data can be avoided (Fauzi and Anna, 2005). This Monte Carlo analysis can also be used as a simulation method to evaluate the impact of random error in the statistical analysis performed on all dimensions (Kavanagh and Pitcher 2004). The results of Multi-Dimensional Scaling and Monte Carlo analysis are presented in Table 4.

Table 4. Differences in the sustainability index between RAPS-Laeya Multi-Dimensional Scaling(MDS) and Monte Carlo (MC)

Sustainability Dimension	Sustainability Index Value (%)		Difference
	MDS	Monte Carlo	(MDS – MC)
Ecology	52.27	52.23	0.04
Economy	24.32	26.05	1.73
Social	35.77	35.92	0.15
Technology	21.41	22.98	1.57
Institutional	49.40	46.53	2.87

Multi-Dimensional Scaling Analysis Accuracy Test (Goodness of Fit)

From the results of the RAPS-Laeya analysis, it was obtained that the coefficient of determination (R^2) was between 92.37%-95.16% or greater than 80% or close to 100%, meaning that the sustainability index estimation model was good and sufficient to be used (Kavanagh, 2004). Stress value between 0.14-0.15. The coefficient of determination is close to 95-100% and the stress value is less than 25% so the Multi-Dimensional Scaling analysis model obtained has a goodness of fit to assess the sustainability index of sustainable raw water management in South Konawe Regency (Fisheries, 1999). The stress value and the coefficient of determination from the RAPS-Laeya analysis are presented in Table 5.

Table 5. Stress value and determination coefficient value (R^2) RAPS-Laeya results

No.	Parameter	Ecolo-gical Dimen-sion	Econo mic Dime n-sion	Social Dime n-sion	Techn o-logy Dimen-sion	Institu-tional Dimen-sion
1.	Stress Value	0.14	0.14	0.15	0.14	0.14
2.	R^2 Score	95.16	94.58	94.71	94.78	92.37

Conclusion

Based on the results of the research that has been done, it can be concluded several things as follows:

1. Analysis of the 41 attributes derived from five dimensionsresulted in 12 attributes acting as leverage factors in each dimension partially. To improve the sustainability status of raw water management in the research area, it is necessary to intervene in the 12 attributes, namely 11 attributes that need to increase the intensity of their activities, and one attribute needs to be controlled and planned for its development properly.
2. The results of the assessment of 41 attributes from five dimensionsin the management of the Laeya River for raw water supply in South Konawe Regency, currently is at less Sustainability status (Sustainability Index value of 36.63)

Acknowledgments

We would like to express our gratitude to all parties who have been willing to assist in the completion of this research: Head of Sampara River Basin Management Center, Head of The Sulawesi IV Kendari River Basin Center, Prof. Dr. Ir. La Ba Baco Sudia, M.Si (Halu Oleo University), Head of the Public Works and Spatial Planning Office of South Konawe Regency, and Head of Bappeda of South Konawe Regency. We would like to thank you for your willingness to spend your time and thoughts in the depth interview process for this research.

References

Ahmed, K., S. Shahid, E. S. Chung, X.J. Wang, S. B. Harun. 2019. Climate Change Uncertainties in Seasonal Drought Severity-Area-Frequency Curves: Case of Arid Region of Pakistan. J. Hydrol., 570: 473-485.

Akbar, S.A., H.K., Rahayu, 2023. Tinjauan Literatur: Bioakumulasi Logam Berat Pada Ikan Di Perairan Indonesia. Lantanida Journal, 11(1): 51-66.

Akbar, S.A., S. Afriani, C. Nuzlia, S. Nazlia, S. Agustina, S. 2023. Microplastics in sediment of Indonesia waters: A systematic review of occurrence, monitoring and potential environmental risks. Depik, 12(3): 259-273.

Ali, R., Ismael, A. Heryansyah, N. A. Nawaz. 2019. Long Term Historic Changes in the Flow of Lesser Zab River, Iraq. Hydrology, 6(1): 1-12.

Ardiclioglu, M., A. Kuriqi. 2019. Calibration of channel roughness in intermittent rivers using HEC- RAS model: Case of Sarimsaklicreek, Turkey. SNAppl. Sci., 1.

Asrial, E.,Hamid, A. Rahmawati, L. A. T. T. W. S. Kalih, R. Nuryadin, 2017. Measuring Sustainability Performance of Coastal Waters Resources Management (Case Study: Nusa Tenggara Barat Province, Indonesia). Journal of Biodiversity and Environmental Sciences (JBES), 11 (6) : 19-32.

Azmanajaya, E., C. A. Paulus, N. Paranoan. 2020. The Sustainability index of the provision of clean water treatment plants (IPAB) in supporting SDG 2030 programs for the availability and management of sustainable clean water in Soppeng Regency, South Sulawesi Province, Indonesia. The 1st International Conference on Education and Technology (ICETECH) 2019. IOP Conf. Series: Journal of Physics: Conf. Series 1464.

Cahyo, S.N,, L.B. Sudia, D.N. Yusuf. 2023. Analisis Spasial Tekanan Penduduk Terhadap Lahan Pertanian di Daerah Aliran Sungai Laeya Kabupaten Konawe Selatan. Jurnal Perencanaan Wilayah 8(1): 44-55

Chang, Y., D. Zhu. 2020. Urban Water Security of China's Municipalities: Comparison, Features and Challenges. Journal of Hydrology, 587(125023): 1-16

Dou, P., S.Zuo, Y.Ren, M.J.Rodriguez, S.Dai. 2021. Refined Water Security Assessment for Sustainable Water Management: A Case Study of 15 Key Cities in the Yangtze River Delta, China. Journal of Environmental Management, 290(112588): 1-13.

European Commission.(2012). Towards a life cycle based European sustainability foot print framework. Luxembourg: Joint Research Centre, European Commission.

Fauzi, A., S.Anna, .2005. Pemodelan sumber daya perikanan dan kelautan untuk analisis kebijakan.Gramedia Pustaka.Jakarta

Fisheries. 1999. Rapfish project. Retrieved from http://fisheries.com/project/rapfish.htm.

Foissy, D., J.F. Vian, C., David. 2013. Managing Nutrient in Organic Farming System: Reliance on Livestock Production for Nutrient Management of Arable Farmland. Organic Agriculture. 3: 183-199.

Hayes, D.S., J. M. Brandle, C. Seliger, B. Zeiringer, T. Ferreira, S. Schmutz. 2018. Advancing towards functional environmental flows for temperate flood plain rivers. Sci Total Environ, 633:1089-1104.

Ismail, D, R.A. Surya, A.Yasin, and L.Aba. 2023. Determining River Water Quality. Status based on the Pollution Index Method as Control of Environmental Quality: The Laeya River, South Konawe Regency. European Journal of Development Studies, *3*(1): 29–41

Karrasch, L., Klenke, T., and Woltjer, J. 2014. Linking the ecosystem services approach to social preferences and needs in integrated coastal land use management—A planning approach. Land Use Policy, 38:522-532.

Kavanagh, P, T. J. Pitcher. 2004. Implementing Microsoft Excel Software for Rapfish: A Technique for The Rapid Appraisal of Fisheries Status Fisheries Centre Research Reports 2004. University of British Columbia 12(2).

Khan, N., S. H. Pour, S. Shahid, T. Ismail, K. Ahmed, E. S. Chung, N. Nawaz, X. Wang. 2019. Spatial distribution of secular trends in rain fall indices of Peninsular Malaysia in the presence of long-term persistence. Meteorol. Appl., 26: 655-670.

Kuriqi, A., A. N. Pinheiro, A. S. Ward, M. D. Bejarano, L. Garrote. 2021. Ecological Impacts of Run-of-River Hydropower Plants-Current Status and Future Prospects on the Brink of Energy Transition. Renewable and Sustainable Energy Reviews, 142 (110833): 1-45

Masthura, L., B. S. Wignyosukarto, J. Sujono, F. Nurrochmad. 2021. Assessment of integrated water resourcemanagement sustainabilityofAcehMeureuduriver basin.International Journal of GEOMATE,21(85):32-43.

McGrane, S. J. 2016. Impacts of Urbanisation on Hydrological and Water Quality Dynamics, and Urban Water Management: A Review. Hydrological Sciences Journal, 61(13): 2295-2311.

Miller, J. D., M.Hutchins. 2017. The Impacts of Urbanisation and Climate Change on Urban Flooding and Urban Water Quality: A Review of the Evidence Concerning the United Kingdom. Journal of Hydrology: Regional Studies, 12: 345-362.

Muhyiddin, Y.,Sumardjo,Muljono,P.Hasim.2013.Dominant factoranalysisthatinfluencethe sustainability of quality controlof waterresources inBogor, Indonesia. Journal of Education and Practice,4(26):107-114.

Ongley, E. D., Z. Xiaolan,Y. Tao. 2010. Current Status of Agricultural and Rural Non-Point Source Pollution Assessment in China. Environmental Pollution, 158(5): 1159-1168.

Pitcher, T. J. 1999. Rapfish, A Rapid Appraisal Technique for Fisheries, and Its Application to the Code of Conduct for Responsible Fisheries. FAO Fisheris Circular, 947.

Pitcher, T.J., D.Preikshot. 2001. RAPFISH: A Rapid Appraisal Technique to Evaluate the Sustainability Status of Fisheries. Fisheries Research, 49(3): 255-270.

Ren, L., S.Song,Y.Zhou. 2022. Evaluation of River Ecological Status in the Plain River Network Area in the Context of Urbanization: A Case Study of 21 Rivers' Ecological Status in Jiangsu Province, China. Ecological Indicators, 142: 1-10.

Saeed,N.,Nam,H.,Haq,M.I.U.,and SaqibD.B.M.2019. A survey on multi dimensional scaling.ACM Computing Surveys,51(3),pp.1-25.

Sala,S.,B.Ciuffo,P.Nijkamp.2015. A Systemic framework for sustainability assessment. Ecological Economics,119:314-325.

Shen, Z., Q .Liao., Q.Hong, Y.Gong. 2012. An Overview of Research on Agricultural Non-Point Source Pollution Modelling in China. Separation and Purification Technology, 84: 104-111.

Sofia H. 2011. Air Bersih Untuk Sabak Auh. Pekanbaru, Indonesia: Pusat Studi Wanita (PSW) UIN Sultan Syarif Kasim Riau.

Suharyanto,K.Deasy,A.,Sudarno.(2018).Sustainable Community Based Water Supply at Salatiga by Use of Rapfish Method. MATEC Web of Conferences 159.

Sudia, L. B., Kahirun, S. C. R. Kete and L. O. M. Erif. 2023. Watershed Management Performance Assessment Based on Land Condition Indicators (Laeya Watershed Case, Southeast Sulawesi Province. *ASTONJADRO*, *12*(2),583–590.

Sulaiman, I.A., Nasution, Z., Rauf,A., and Kusuma, M.S.B.2021. Multidimensional scaling approach to evaluate sustainability status of Belawan watershed management. 3rdInternational Conference on Natural Resources and Technology. IOPConf.Series: Earth and Environmental Science 912.

Surya, R.A., A.Yasin, A. Setiawan. 2020. Pengelolaan Sumberdaya Alam untuk Penyediaan Air Baku Berkelanjutan.CV. Karya Bakti Makmur. Yogyakarta

Tortajada,C.2014. Water infrastructure as anessential element for human development. International Journal of Water Resources Development, 30(1): 8-19.

United Nations.2015. Transforming our world: The 2030 agenda for sustainable development. United Nations.New York

Volk, M., D.Bosch, V.Nangia,B.Narasimhan. 2016. SWAT: Agricultural Water and Non-Point Source Pollution Management at A Watershed Scale. Agricultural Water Management, 175: 1-3.

Wang,X-J.,Z.J.Yun,S.Shahid,A.E.Mahdi,H.R.min,B.Z.Xin,.,M Ali.2012.Water resources management strategy for adaptation to droughts in China.Mitig.Adapt.Strateg.Glob.Chang,17: 923-937.

Yang, S, G.Dong, D.Zheng, H.Xiao,Y.Gao, Y.Lang. 2011. Coupling Xinanjiang Model and SWAT to Simulate Agricultural Non-Point Source Pollution in Songtao Watershed of Hainan, China. Ecological Modelling, 222: 3701-3717.

Yang, Y.,H.Lu, D. Liang, Y. Chen, P.Tian, J.Xia, H.Wang, X.Lei. 2022. Ecological Sustainability and Its Driving Factor of Urban Agglomerations in the Yangtze River Economic Belt Based on Three-Dimensional Ecological Footprint Analysis. Journal of Cleaner Production, 330(129802): 1-10

Yuliansyah,Y, D.A.Suriamihardja, P.J. Davey.2021. Assessmen of Kendari Bay reclamation areas status in Kendari City, Southeast Sulawesi, Indonesia. International Journal of Engineering and Science Applications,8(2):51-66..

Surya, R.A., D. Ismail, A. Yasin, L. Aba, L. O.M. Erif. 2023. Analysis Sustainability Status of Laeya River Management for Raw Water Supply in South Konawe Regency Southeast Sulawesi Province. Depik Jurnal Ilmu-IlmuPerairan,Pesisir danPerikanan, 12(3): 421-430