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

IOP Conf. Series: Journal of Physics: Conf. Series **1464** (2020) 012052 doi:10.1088/1742-6596/1464/1/012052

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

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Abstract. The SDGs 2030 Agenda is a global development agreement to end poverty, reduce inequality and protect the environment. One of the objectives of the SDGs that will be achieved is ensuring the availability and management of sustainable clean water and sanitation for all. In order to achieve this goal, this research was conducted to measure the sustainability of the provision of clean water treatment plants (IPAB) in Soppeng District. The sustainability analysis conducted by multidimensional scaling approach that is also called Rap-IPABSoppeng approach (rapid appraisal IPAB Soppeng) which is a development of the RAPFISH method (rapid assessment techniques for fisheries). The results of the multidimensional analysis of the sustainability of Rap- IPABSoppeng for the provision of clean water treatment plants in Soppeng Regency based on existing conditions, obtained a sustainability index value of 45.64% and included in a less sustainable status. This sustainability index value is obtained based on an assessment of 48 attributes from five dimensions of sustainability, namely environmental, economic, social, infrastructure and technology, and legal and institutional dimensions. In the environmental dimension it has an index value of 36.54% with a less sustainable status, the index value in the economic dimension is 52.27% with a fairly sustainable status, the index value in the social dimension is 47.35% with a less sustainable status, the index value on the dimensions of infrastructure and technology is 36.03% with a less sustainable status, and the status is quite sustainable in the legal and institutional dimensions with an index of 51.87%. In order for the sustainability index value in the future to continue to increase until it reaches a sustainable status, then it is necessary to make improvements to 18 sensitive attributes that affect the five dimensions of sustainability.

1. Introduction

The 6th Goal of the SDGs is to guarantee the availability and management of clean water and sustainable sanitation for all. In order to achieve the goals of clean water and proper sanitation by 2030, 8 targets were set which were measured through 40 indicators. These targets include access to improved drinking water, access to proper sanitation, water and waste quality, as well as the utilization, management and conservation of water resources. Efforts made to achieve these targets are outlined in policies, programs and activities that will be carried out by the government and non-government organizations. The reality at hand is high population growth followed by economic growth and industrial development that uses a lot of land and water causes increased water scarcity. Water sources are polluted because waste generated by economic and industrial activities causes the quality of water that can be directly digested and consumed by the population to be less. Funding for

water and sanitation services is a major problem for most developing countries, it is only part of the seriousness and complexity of the overall lack of water service provision [1]. For this reason, a sustainable supply of clean water such as IPAB is needed to manage raw water into clean water that can be distributed to residents. This study aims to look at the sustainability index of clean water supply through clean water treatment plant (known as IPAB) in Soppeng.

2. Methodology

This study was conducted using a survey method through in-depth interviews and observation techniques. Respondents were taken by purposive random sampling with criteria of experts who have expertise in accordance with the field under study [2]. Data analysis in this study using Multidimensional Scaling with Approach "Rapid Appraisal - Index Sustainability of Land Management that has been modified from Rapfish (Rapid Assessment Technique for Fisheries) developed by Fisheries Center, University of British Columbia [4][6].

3. Result and Discussion

Analysis of the sustainability of the provision of clean water treatment plants (IPAB) in Soppeng District was carried out using the Multidimensional Scaling (MDS) approach, which is also called the Rap-IPABSoppeng approach (rapid appraisal IPABSoppeng) which is the development of the RAPFISH method (rapid assessment techniques for fisheries) developed by Fisheries Center, University of British Colombia [3][4]; which is then used in this study to assess the sustainability status of the provision of clean water treatment plants (IPAB). The selection of MDS in the Rap-IPABSoppeng analysis was carried out because the results obtained proved to be more stable than other multivariate analysis methods, such as factor analysis and multi-attribute utility theory [5].

The determination of the sustainability index of the clean water treatment plant provision program (IPAB) in Soppeng Regency is assessed from 5 (five) dimensions of sustainability, namely the environmental, economic, social, infrastructure and technology dimensions, as well as law and institutions with the attributes and scoring values of expert opinions. The results of Rap-IPABSoppeng analysis show that the status is less sustainable in the environmental dimension with an index of 36.54%, the index value in the economic dimension is 52.27% with a fairly sustainable status, the index value in the social dimension is 47.35% with a less sustainable status, the value the index in the infrastructure and technology dimensions was 36.03% with a less sustainable status, and the status was quite sustainable in the legal and institutional dimension with an index of 51.87%. So that the value of the sustainability index in the future can continue to increase until it reaches sustainable status, it is necessary to make improvements to the sensitive attributes that affect the five index values of the sustainability dimension. The attributes considered sensitive by experts based on the existing conditions for the supply of IPAB in Soppeng Regency in each dimension will be discussed in the next sub-chapter, while the value of the Rap-IPABSoppeng sustainability index is presented in Figure 1.

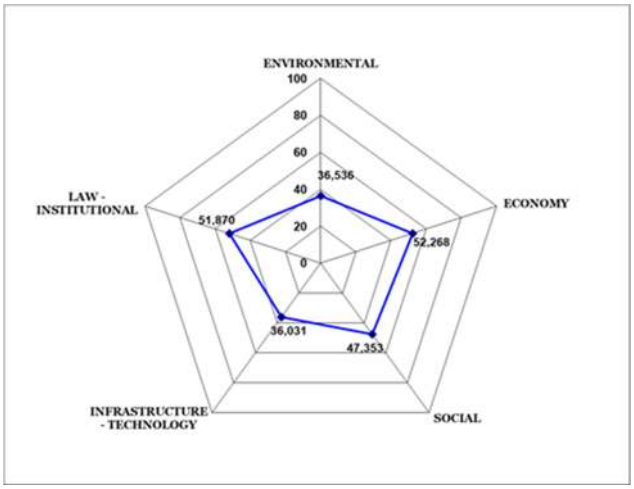
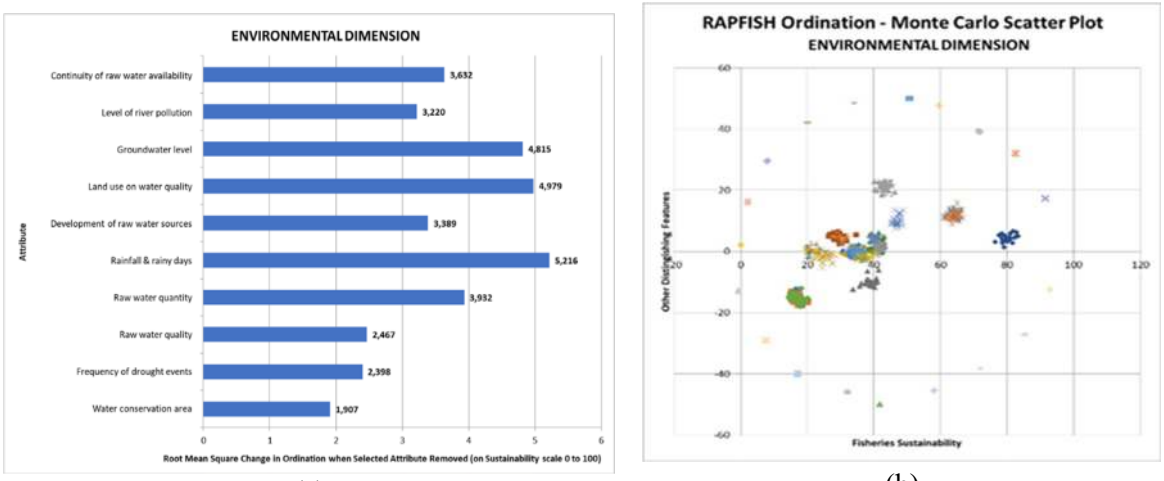


Figure 1. Value of the sustainability index for the supply of IPAB in Soppeng regency

Sustainability Status of Environmental Dimension

The potential of water resources in addition to daily life also serves to support various activities in order to improve human welfare such as agriculture, fisheries, industry, power generation and so on. In an effort to improve the welfare of the people of Soppeng Regency, one of the determining sectors is the provision of sustainable clean water. The sustainability of clean water is closely related to the environment. The results of the Rap-IPABSoppeng analysis show that the status of the environment dimension is less sustainable with a value of 36.54%. The attributes that are predicted to influence the level of sustainability in the environmental dimension consist of 10 (ten) attributes, namely (1) water conservation areas, (2) frequency of drought events, (3) raw water quality, (4) quantity of raw water, (5) rainfall and rainy days, (6) development of raw water sources, (7) land use on water quality, (8) ground water level, (9) river pollution levels, and (10) continuity of raw water availability. Based on the results of leverage analysis obtained attributes that are sensitive to the value of the sustainability index of the environmental dimensions, namely (1) rainfall and rainy days, (2) land use of water quality, (3) ground water level, and (4) quantity of raw water. The role of each environmental dimension attribute expressed in the form of root mean square value and Monte Carlo analysis in the supply of IPAB in Soppeng Regency can be seen in Figure 2.

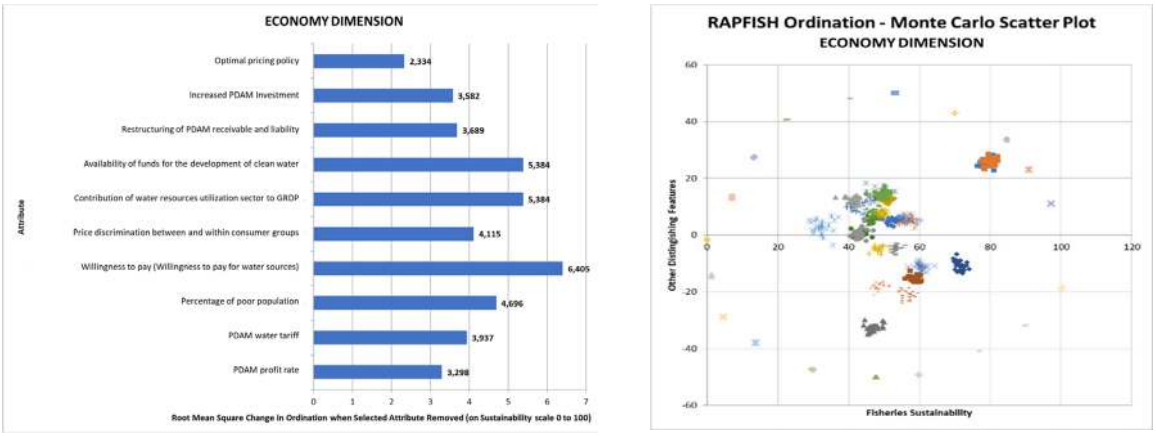


(a) (b)

Figure 2. The role of each attribute in the environmental dimension which expressed in the root mean square values (a) and the results of the Monte Carlo analysis (b)

Sustainability Status of Economy Dimension

Attributes that are estimated to have an influence on the level of sustainability in the economic dimension consist of 10 (ten) attributes, namely (1) level of PDAM profit, (2) PDAM water tariff, (3) percentage of poor population, (4) price discrimination among and within consumer groups, (5) willingness to pay (willingness to pay for water sources), (6) contribution of water resources utilization sector to GRDP, (7) availability of funds for clean water development, (8) debt restructuring PDAM, (9) increase PDAM investment, and (10) optimal pricing policy. Based on the results of leverage analysis, attributes that are sensitive to the value of the economic dimension of the sustainability dimension are obtained (1) price discrimination between and within the consumer group, (2) availability of funds for the development of clean water, (3) contribution to the sector utilization of water sources to GRDP, and (4) percentage of poor population. The role of each economic dimension attribute expressed in the form of root mean square value and Monte Carlo analysis in the supply of IPAB in Soppeng Regency can be seen in Figure 3.

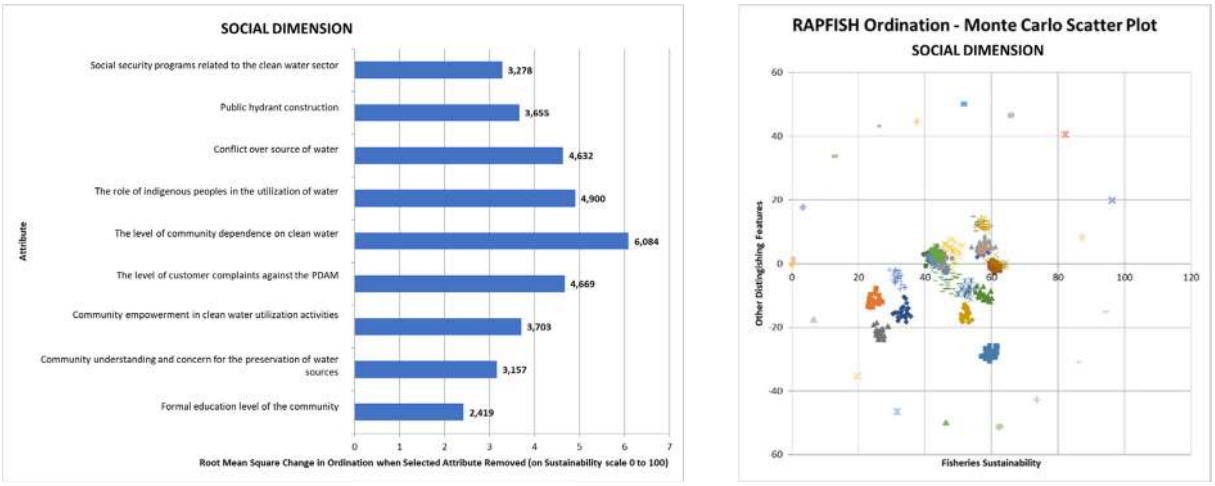


(a) (b)

Figure 3. The role of each attribute in the economy dimension which expressed in the root mean square values (a) and the results of the Monte Carlo analysis (b)

Sustainability Status of Social Dimension

Attributes that are estimated to have an influence on the level of sustainability in the social dimension consist of 9 (nine) attributes, namely (1) the level of formal education of the community, (2) the level of formal education of the community, (3) community empowerment in clean water utilization activities, (4) the level of customer complaints from the PDAM, (5) the level of community dependence on clean water, (6) the role of indigenous peoples in water use activities, (7) conflicts over sources of water, (8) development of public hydrants, and (9) programs social security (social safety net) related to the clean water sector. Based on the results of leverage analysis, the attributes that are sensitive to the social dimension sustainability index values are (1) the level of community dependence on clean water, (2) the role of indigenous peoples in water use activities, (3) the level of complaints from the customer community towards PDAMs, and (4) conflicts over taking water resources. The role of each social dimension attribute expressed in the form of root mean square value and Monte Carlo analysis in the supply of IPAB Soppeng can be seen in Figure 4.

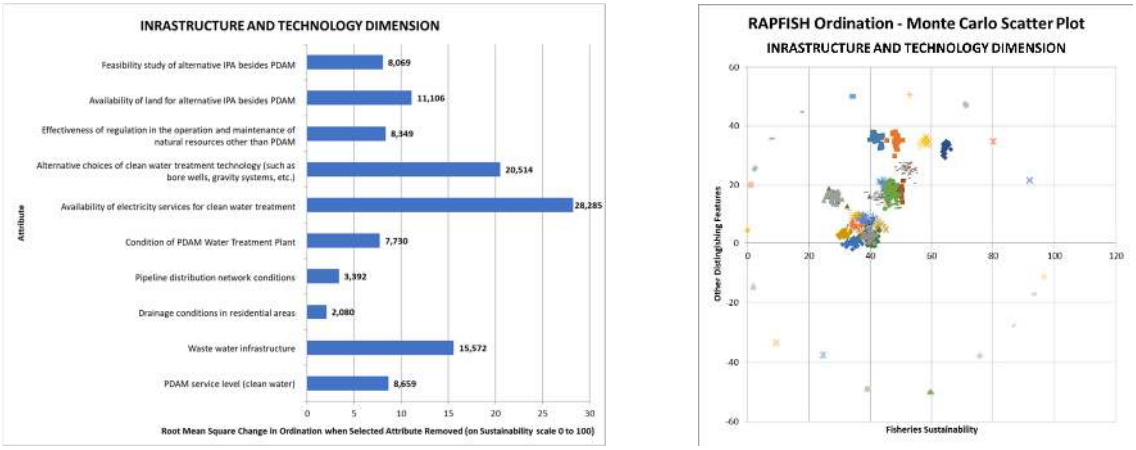


(a) (b)

Figure 4. The role of each attribute in the social dimension which expressed in the root mean square values (a) and the results of the Monte Carlo analysis (b)

Sustainability Status of Infrastructure and Technology Dimension

Attributes that are expected to influence the level of sustainability in the infrastructure and technology dimensions consist of 10 (ten) attributes, namely (1) level of service of PDAM (clean water), (2) wastewater infrastructure, (3) drainage conditions in residential areas, (4) pipeline distribution network conditions, (5) PDAM water treatment conditions, (6) availability of electricity services for clean water treatment, (7) alternative choices of clean water treatment technologies (such as drilled wells, gravity systems, etc.), (8) effectiveness of regulation in the operation and maintenance of WTPs other than PDAMs, (9) availability of land for alternative WTPs other than PDAMs, and (10) feasibility studies on alternative WTPs other than PDAMs. Based on the results of leverage analysis obtained attributes that are sensitive to the value of the sustainability index of infrastructure and technology dimensions, namely (1) availability of electricity services for clean water treatment, (2) alternative choices of clean water treatment technologies (such as bore wells, gravity systems, etc.), and (3) wastewater infrastructure. The role of each infrastructure and technology dimension attribute expressed in the form of root mean square value and Monte Carlo analysis in the supply of IPAB in Soppeng Regency can be seen in Figure 5.

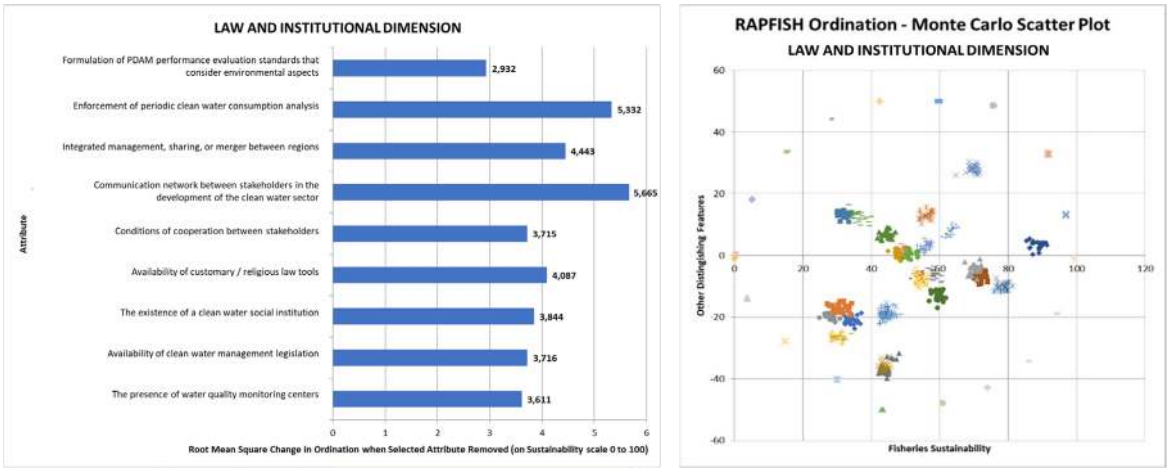


(a) (b)

Figure 5. The role of each attribute in the infrastructure and technology dimensions which expressed in the root mean square values (a) and the results of the Monte Carlo analysis (b)

Sustainability Status of Law and Institutional Dimension

Attributes that are expected to influence the level of sustainability in the legal and institutional dimensions consist of 9 (nine) attributes, namely (1) the presence of water quality monitoring centers, (2) the existence of clean water social institutions, (3) the availability of water management legislation net, (4) availability of customary / religious law instruments, (5) collaboration between stakeholders, (6) communication networks between stakeholders in the development of the clean water sector, (7) integrated management, sharing, or merger between regions, (8) implementation of analysis periodic consumption of clean water, and (9) formulation of a PDAM performance evaluation standard that considers environmental aspects. Based on the results of leverage analysis, attributes that are sensitive to the legal and institutional dimension of the sustainability index are obtained, namely (1) communication networks between stakeholders in the development of the clean water sector, (2) implementation of periodic clean water consumption analysis, and (3) integrated management, sharing or merger between regions. The role of each legal and institutional dimension attribute expressed in the form of root mean square values and Monte Carlo analysis in the supply of IPAB Soppeng Regency can be seen in Figure 6.



(a) (b)

Figure 6. The role of each attribute in the law and institutional dimensions which expressed in the root mean square values (a) and the results of the Monte Carlo analysis (b)

Multidimensional Sustainability Status

The results of the multi-dimensional sustainability Rap-IPABSoppeng analysis in Soppeng Regency for the provision of clean water treatment plants based on existing conditions, obtained a sustainability index value of 45.64% and included in the less sustainable status. This value was obtained based on an evaluation of 48 attributes from 5 (five) dimensions of sustainability, namely the environmental, economic, social, infrastructure and technology dimensions, and law and institutions. The results of the multidimensional analysis by Rap-IPABSoppeng for the sustainability status of the IPAB supply can be seen in Figure 7.

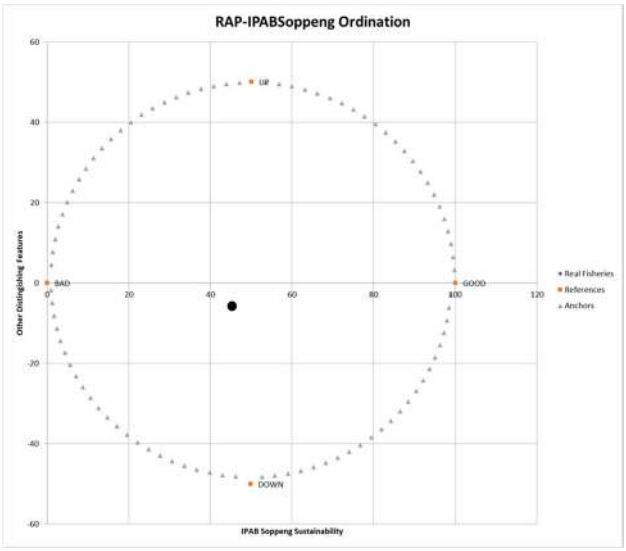


Figure 7. Multidimensional Sustainability Index of Provision of IPAB in Soppeng regency

Monte Carlo Analysis

Monte Carlo analysis is a feature of sustainability for detecting sources of error from diversity. The results of the Monte Carlo analysis evaluated the effect of the error on the estimated value of the ordination of the provision of clean water treatment plants in Soppeng Regency. The results of the Monte Carlo analysis show that the index value of the sustainability of the provision of clean water treatment plants in Soppeng Regency at a level of 95%, shows the results that have not changed much with the results of the Rap-IPABSoppeng analysis [Kavanagh, 2001]. This can be interpreted that errors in data analysis both in terms of scoring each attribute and the variation of scoring is low because the differences in opinion are relatively small, and the process of data analysis can be done repeatedly and stably, and errors in inputting data are minimal. The difference in the sustainability index values of the MDS and Monte Carlo analysis is presented in Table 1.

Table 1. Difference in Value of Sustainability Index between Rap-IPABSoppeng Analysis and Monte Carlo Analysis

Dimensions of sustainability	Value of sustainability index (%)		Difference
	Rap-IPABSoppeng	*Monte Carlo*	
Environmental	36,54	34,58	1,96
Economy	52,27	51,93	0,34
Social	47,35	47,35	0,00
Infrastructure and Technology	36,03	35,66	0,37
Law and Institutional	51,87	51,33	0,54
Multi dimensions	45,64	46,03	0,39

The results of the Rap-IPABSoppeng analysis show that all of the attributes reviewed in the Soppeng Regency's sustainability status for the provision of clean water treatment plants are accurate enough to provide better analytical results and can be scientifically justified. This can be seen from the stress value which only ranges between 13 to 20% and the coefficient of determination (R2) obtained ranges between 0,86 and 0,95[Pitcher and Priekshot. 2001]. This

is in accordance with Fisheries (1999), which states that the analysis results are adequate if the stress value is smaller than 0.25 (25%) and the coefficient of determination (R2) approaches the value of 1.0. The stress value and the coefficient of determination (R2) are presented in Table 2.

Table 2. Results of stress values analysis dan coefficient of determination (R2) Rap-IPABSoppeng

Parameter	Dimensions of sustainability					
	A	B	C	D	E	F
Stress	0,17	0,18	0,20	0,19	0,17	0,13
R^2	0,89	0,87	0,87	0,86	0,92	0,95
Iteration	2	3	3	3	2	2

Description: A = Environmental, B = Economy, C = Social, D = Infrastructure and Technology, E = Law and Institutional, dan F = Multidimensions (A,B,C,D,E)

4. Conclusion

Sensitive attributes contribute to the multidimensional sustainability index value based on leverage analysis spread over 5 (five) dimensions of 18 (eighteen) attributes. These attributes need to be improved in the future to improve the sustainability status of Soppeng regency for the supply of IPAB. The intended improvement is to increase the capacity of attributes that have a positive impact on increasing the value of the sustainability index and vice versa to minimize the attributes that have the potential to cause a negative impact or decrease the value of the sustainability index of the supply of IPAB in Soppeng regency.

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