



Sustainable development in East Kalimantan: A rapid appraisal using multidimensional scaling

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Abstract

For numerous decades, East Kalimantan has heavily depended on its abundant natural resources, particularly mining, to fuel its economic expansion. However, this development strategy has fostered unsustainable practices, leading to heightened environmental degradation and widening social disparities. Recognizing these detrimental effects, the provincial government has begun to shift towards a more sustainable economic framework. This study assesses the current level of sustainable development in East Kalimantan by employing multidimensional scaling (MDS) to examine social, economic, and environmental dimensions. The Rapfish analysis tool was employed for data analysis. The findings indicate that only 3 out of 10 regencies and cities resulted in a sustainable status in the social dimension, 8 out of 10 in the economic dimension, and 4 out of 10 in the environmental dimension. Sensitive attributes identified in the social, economic, and environmental dimensions are, in that order, water, cellular signal, and waste. These were determined through a leverage analysis to identify attributes with the greatest influence on sustainability scores. The findings suggest a need to prioritize improvements in these areas to support regional sustainability planning. Furthermore, the Monte-Carlo analysis across all three dimensions revealed a tight distribution, indicating minimal error from diversity in sustainability among the study areas.

Keywords: Environmental Degradation; Rapfish Analysis; Regional Development; Resource Dependency; Social Disparity

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1. Introduction

Sustainable development emphasizes the critical importance of the prudent utilization of resources, as the inability to manage them effectively poses a significant threat to the survival of future generations. Due to the complexity of environmental issues, the concept of sustainable development has become indispensable (Gore, 2015; Idham and Ariffin, 2020). The concept of sustainable development is not a novel discourse. The Brundtland Report (1987), published by the World Commission on Environment and Development (WCED), examines various factors contributing to environmental degradation. It also emphasizes the close interconnection between social equity, economic progress, and environmental issues as the three main pillars of sustainability. This report formulated policies that harmonized these three aspects, thereby establishing a significant milestone in global sustainability discourse (Jarvie, 2016). The report has since provided the foundation for numerous international policies and agreements supporting sustainable development. This implies that every decision and action must consider the long-term impact on the environment, economy, and society. The essence of sustainable development is balance: balance between human needs and the earth's capacity, a balance between present and future generations, and balance between the various dimensions of development (Sachs, 2015).

Numerous initiatives have been done to achieve sustainable development, including the Millennium Development Goals (MDGs), which were later refined into the Sustainable Development Goals (SDGs) in 2015, with a target completion by 2030 (United Nation, 2015). This underscores the importance of adopting a sustainable development paradigm to achieve inclusive and long-term prosperity. Indonesia, as a country rich in natural resources and one of the provinces with abundant natural resources is East Kalimantan. This province possesses significant extractive resource potential, particularly in the mining and quarrying sector, with the largest coal reserves in Indonesia, amounting to 13.53 billion tons or approximately 40 percent of Indonesia's total coal reserves (Ahdiat, 2023). Furthermore, over 50 percent of its land area is allocated for mining, with East Kalimantan supplying approximately 70 percent of Indonesia's coal production (Winn, 2016). This shows that for several decades, East Kalimantan has played a dominant role in the economic structure through its mining and quarrying sector, contributing 43.19 percent to the regional economy (BPS, 2024).

Natural resources are often regarded as key assets that boost development. However, as time progresses and industrialization advances, the consumption of natural resources has escalated, resulting in excessive exploitation (Bansard and Schröder, 2021). A region rich in natural resources is not exempt from experiencing the phenomenon known as the Natural Resource Curse (NRC). NRC is a phenomenon characterized by rapid growth in a single economic sector, typically in oil, gas, or minerals, which subsequently leads to a decline in the performance of other economic sectors and results in resource dependency (Corden, 1984). East Kalimantan has the highest Natural Resource Dependency Index (NRDI) among all provinces in Indonesia, indicating that its economic growth remains heavily reliant on natural resources (Rahma et al., 2021).

In response to the adverse impacts of excessive natural resource exploitation, the Provincial Government of East Kalimantan has undertaken efforts to transition towards a sustainable development paradigm. One of the key initiatives introduced is Kaltim Green, a program launched by the provincial government to promote environmentally conscious sustainable development (green development), which was first encouraged in 2010. Subsequently, in 2016, a program was launched to accommodate the parties, namely the Green Growth Compact, to achieve a green East Kalimantan (YKAN, 2016). Based on the issues outlined, this study aimed to

assess the extent to which sustainable development has been achieved across the cities/regencies of East Kalimantan in 2023 using the Multidimensional Scaling-Rapfish (MDS-Rapfish) method. The findings of this research were expected to provide insights into the sustainability status of each cities/regencies in East Kalimantan and contributed to the formulation of sustainable development strategies in a region that remains highly dependent on extractive natural resources.

2. Methodology

2.1. Location

This study was conducted in the cities/regencies of East Kalimantan Province, which consists of seven regencies and three cities. The seven regencies include Paser, West Kutai, Kutai Kartanegara, East Kutai, Berau, North Penajam Paser, and Mahakam Ulu, while the three cities are Balikpapan, Samarinda, and Bontang. The selection of this research location is based on the consideration that East Kalimantan is one of the provinces rich in natural resources, with an economy predominantly driven by extractive industries. Figure 1 illustrates the study locations.

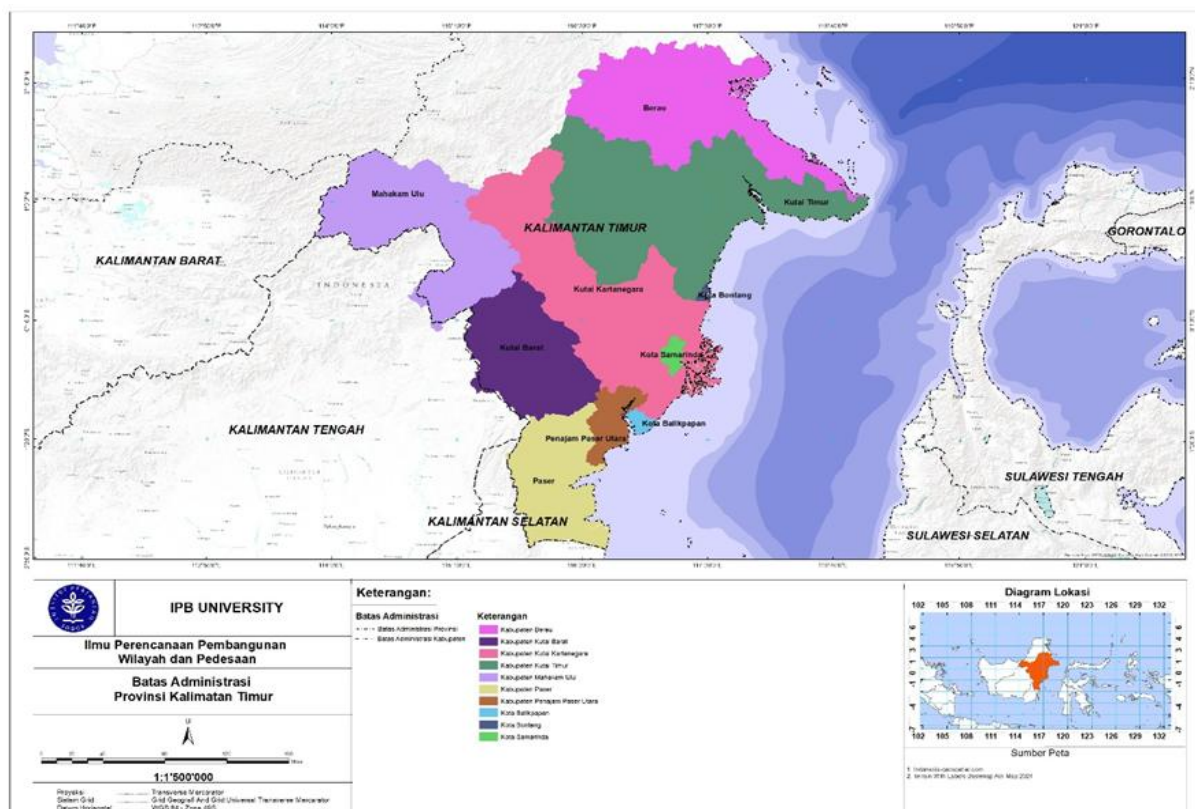


Figure 1. Map showing the Study location

2.2. Method

This study employed 10 units of analysis, representing the regencies and cities in East Kalimantan in 2023. The research used on secondary data, primarily obtained from the Central Bureau of Statistics of East Kalimantan, supplemented by relevant literature. However, due to data limitations, some datasets were sourced from the Village Potential Data of 2021.

The study used the Multidimensional Scaling (MDS) approach, utilizing three key sustainability indicators: social, economic, and environmental dimensions (Pollesch and Dale, 2016). The application of MDS and Rapfish in this research was based on their ability to comprehensively integrate various sustainability indicators. This method has been widely validated for sustainability assessments across multiple fields (Pitcher and Preikshot, 2000). The MDS analysis using Rapfish method is recognized for its ease of use and effectiveness in rapidly evaluating sustainability status (Fahly et al., 2024). By adapting this method to the context of East Kalimantan, the study assessed the sustainability status of each regency or city in the province.

The Rapfish software implementation requires the use of MDS as its primary analytical engine. In the Rapfish analysis, MDS is employed to classify the units of analysis into "good" and "bad" categories, transforming multidimensional data into a two-dimensional visual representation, where the distances between points reflect the degree of similarity or difference among units. The Alternating Least Squares (ALSCAL) algorithm in MDS is used to optimize the mapping of data into two-dimensional space (Kavanagh P and Pitcher TJ, 2004). The MDS formula is presented in Equation 1:

$$\zeta\{d\} = D^2 + E \quad (1)$$

ζ illustrates the monotonic transformation, E represents the residual (error) matrix, and D denotes the Euclidean matrix or

$$D^2 = \sqrt{(Y_1 + Y_2)^2 + (Y_3 + Y_4)^2 + \dots} \quad (2)$$

$$D^2 = \sqrt{\sum_{i=1}^n (Y_i - Y_j)} \quad i \neq j \quad (3)$$

There are several stages were involved in conducting an analysis using MDS Rapfish. First, it was essential to identify the sustainability issues to be analyzed. Second, the units of analysis and selected attributes had to be determined. In this study, the units of analysis were the cities/regencies within East Kalimantan Province. The selection of attributes was based on their relevance to the context of East Kalimantan, supplemented by a review of relevant literature to ensure a comprehensive approach (Adetama et al., 2023; Fahly et al., 2024; Liang et al., 2017; Rahma and Fauzi, 2024; Rendrarpoetri et al., 2024; Strezov et al., 2016). Third, scoring was conducted using Peer-Review Scoring, which was based on a document review and the determination of threshold values (Fauzi, 2019), comparing them to the Indonesian average. The score range was 0-10 and follows a monotonic scale, where 0 represents (bad) and 10 indicates (good). The Rapfish method, as applied here, relies exclusively on secondary data, differentiating it from primary data collection via surveys or FGDs. Data transformation into scores follows the protocol Pitcher *et al.* This scoring process is conducted by 2-3 subject-matter experts proficient in rapfish appraisal, who are responsible for establishing the scoring thresholds (Pitcher et al., 2013). The indicators and scoring thresholds are presented in Table 1.

Tabel 1. Attribute and Sustainability Scores for Each Dimension

Dimension/ attribute	Description	Scoring				
		0-2	3-4	5-6	7-8	9-10
SOCIAL						
Poverty (%)	Percentage of the population living below national poverty line	> 8	6.01 - 8	4.01 - 6	2.01 - 4	< 2
Gini Ratio	Indicator used to measure the level of inequality in the distribution of income or wealth in a population	> 0.41	0.36 - 0.40	0.31 - 0.35	0.26 - 0.30	< 0.25
Health (years)	Life expectancy	< 70	70.01 - 72	72.01 - 74	74.01 - 76	> 76.01
Education (years)	Mean years of schooling	< 8	8 - 8.99	9 - 9.99	10 - 10.99	> 11
Gender Empowerment Index (%)	Women's representation in parliament, their participation in decision-making processes as professionals, and their economic contributions through income.	< 50	51 - 60	61 - 70	71 - 80	> 80
Water (%)	Percentage of household who able to access of decent drinking water	< 80	80 - 84.99	85 - 89.99	90 - 94.99	>= 95
Prevalence of Undernourishment (%)	Percentage of the population whose habitual food consumption is insufficient to provide the dietary energy levels to maintain a normal active and healthy life.	>= 10	7.5 - 9.99	5 - 7.49	2.5 - 4.99	< 2.5
Malnutrition (%)	Percentage of growth impairment in children caused by poor nutrition, repeated infection, and inadequate psychosocial stimulation	>10	7.5 - 10	5 - 7.5	2.5 - 5	< 2.5

Dimension/ attribute	Description	Scoring				
		0-2	3-4	5-6	7-8	9-10
ECONOMIC						
Economic Growth (%)	The percentage change in the production of goods and services in a given region's economy in a specific year compared to the previous year, calculated based on constant price GDP/GRDP.	< 2	2 - 4	4 - 6	6 - 8	> 8
GDRP per capita	The value of Gross Regional Domestic Product divided by the number of people in a region in a given period	< 25	25 - 50	50 - 75	75 - 100	> 100
Labor Force Participation Rate (%)	Percentage of the number of labour force to the number of working-age population	< 65	65.01 - 68	68.01 - 71	71.01 - 74	> 74
Adjusted per Capita (Thousand Ripuah/Person/year)	Measuring human development achievements based on several fundamental components of a long and healthy life, knowledge, and decent standard of living	<= 10000	10001- 11000	11001- 12000	12001- 13000	> 13000
Cellular signal (%)	Percentage of villages/sub-districts and cellular phone internet signal reception (very strong + strong)	< 60	60 – 69	70 – 79	80 – 89	>= 90
Housing (%)	Percent distribution of household by regency/city and private home ownership status	< 75	75 – 79.99	80 – 84.99	85 – 89.99	>= 90
ENVIRONMENTAL						
Flood (%)	Percentage of villages/sub-districts experiencing floods	> 25	20 - 24.99	15 - 19.99	10 - 14.99	< 10
Land Pollution (%)	Percentage of villages/sub-districts experiencing soil pollution	> 4.1	3.1 - 4	2.1 - 3	1.1 - 2	< 1

Dimension/ attribute	Description	Scoring				
		0-2	3-4	5-6	7-8	9-10
Air Pollution (%)	Percentage of villages/sub-districts experiencing air pollution	> 12.1	9.1 - 12	6.1 - 9	3.1 - 6	< 3
Waste (%)	Percentage of villages/sub-districts where waste is collected by officials	<= 20	21 - 30	31 - 40	41 - 50	> 50
Rivers Pollution (%)	Percentage village/sub-districts with waste polluted rivers from factory/industrial/business of polluted rivers	> 20	15.01 - 20	10.01 - 15	5.01 - 10	< 5
Forest and Land Fires (%)	Percentage of villages/sub-districts experiencing forest and land fires	> 6	5 - 6	3 - 4	1 - 2	< 1

Source: Central Bureau of Statistics, 2023 and Village Potential Data, 2021

Data analysis was conducted using R software. The results of the Rapfish analysis were presented as ordination scores ranging from 0 to 100 for each dimension (social, economic, and environmental). The visual representation of the ordination results classified sustainability status into two categories: bad (B) for unsustainable status and good (G) for sustainable status for each cities/regencies. To further scrutinize the results, both leverage and Monte Carlo analyses were performed.

Leverage analysis was conducted to identify the most influential variables in the model. By systematically removing each variable, we can assess the extent to which the final results are affected. A significant change in the final results upon removal of a particular variable indicates its pivotal role in determining the overall outcome (Fauzi, 2019). Monte Carlo simulations were employed to assess the robustness of the model by quantifying the uncertainty associated with the results. The Monte Carlo plot provides a visual representation of this uncertainty, with a wider distribution of points indicating higher levels of variability and a narrower distribution indicating lower levels of variability (Rendrapoetri et al., 2024). Potential sources of error in the Rapfish analysis may arise from inaccuracies in the determination of attributes and their corresponding scores, as well as the selection of attributes that are not suitable for the specific units being analyzed. The outcomes of this analysis are discussed in the following section.

3. Results and discussion

3.1. Social dimension

The evaluation of sustainable development in East Kalimantan for the social dimension involves three types of analyses: ordination, leverage, and Monte-Carlo, as illustrated in Figure 2. The sustainability position is conceived in Figure 2a, where only the horizontal axis (x-axis), ranging from bad to good sustainability, is considered. The vertical axis (y-axis) does not influence the sustainability status. In the social dimension, Figure 2 indicates that seven out of ten cities/regencies are positioned on the left side of the x-axis. This suggested that the social dimension still exhibits bad performance in these cities/regencies. Cities/regencies located further to the left on the x-axis exhibit lower sustainability scores. The figure shows that Penajam Paser Utara (PPU) had the worst position in the social dimension in 2023. Conversely, on the right side of the x-axis, three cities/regencies are classified as sustainable, with Balikpapan City demonstrating the best sustainability position compared to other cities/regencies.

Subsequently, a leverage analysis identified which showed that the most sensitive attribute to the social dimension was water or the percentage of households that had access to clean drinking water. Access to safe drinking water represents a sensitive variable within the social dimension of sustainable development due to its close association with public health, well-being, and overall quality of life. Water resources are significant in the formation of regions, fulfilling daily needs and supporting agricultural development (Colmenares-Cruz, 2024). East Kalimantan, a province still reliant on extractive industries, experiences contamination of water channels, including heavy metal mixtures and toxic sediment at coal sites (Winn, 2016). This underscores the necessity for each regency/city to prioritize the development of clean drinking water access. If this attribute was removed, the sustainability position would decline by 5.36 points.

Additionally, the Monte Carlo analysis pointed to a small spread of potential values, suggesting the social dimension was measured with little error or inconsistency. A detailed representation of the ordination (a), map shows the sustainability status (b), leverage (c), and Monte Carlo (d) analyses for the social dimension can be seen in Figure 2.

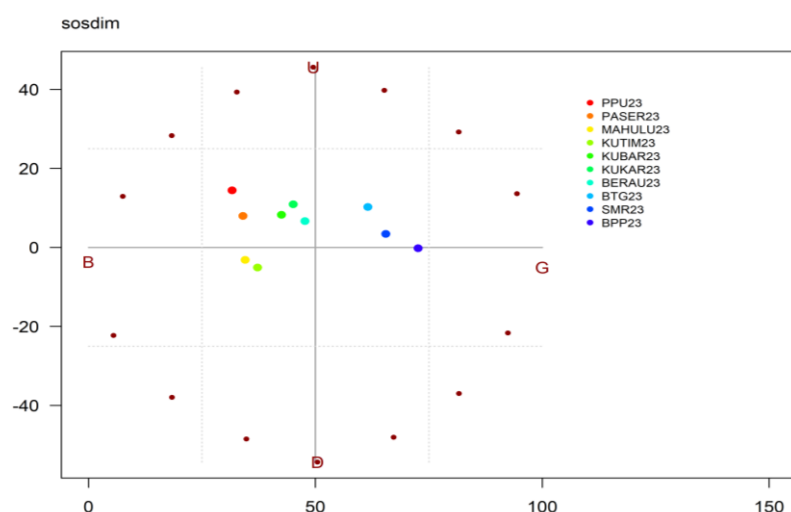


Figure 2 (a)

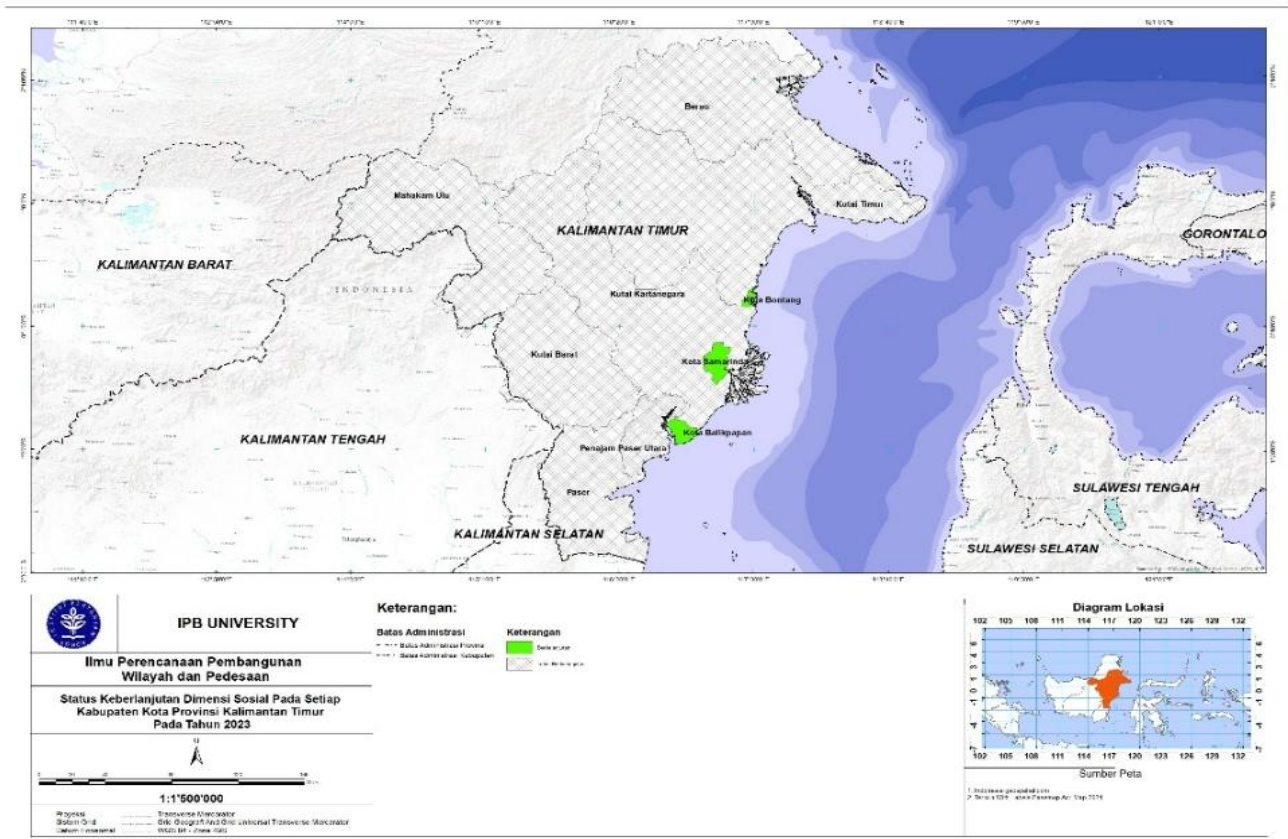


Figure 2 (b)

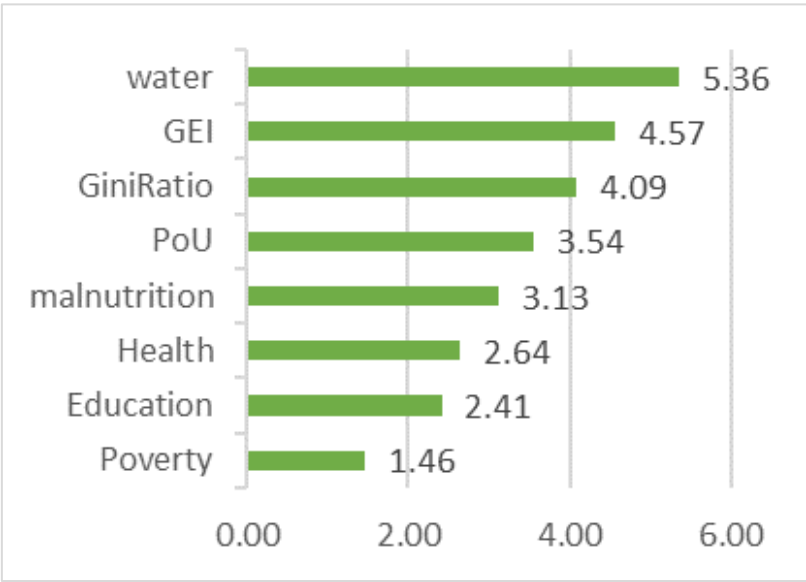


Figure 2 (c)

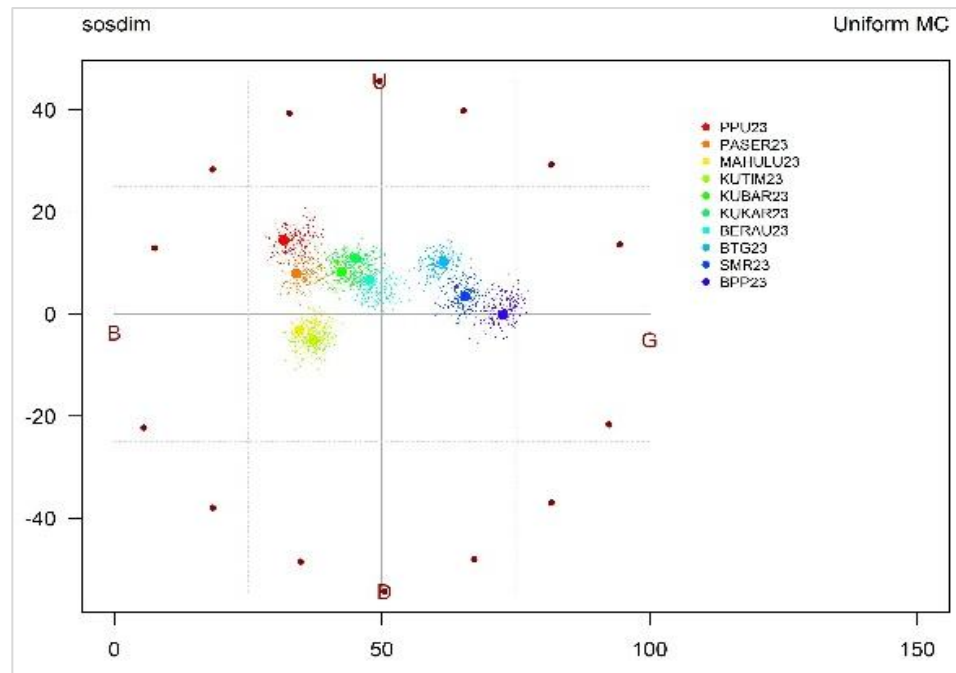


Figure 2 (d)

Figure 2. Social Dimension Sustainability assessment for East Kalimantan in 2023.

- (a) Ordination plot showing relative positions of cities/regencies along the social sustainability axis, where rightward positions indicate higher scores;
- (b) Map highlighting areas classified as sustainable (green) in the social dimension;
- (c) Leverage analysis identifying “water access” as the most influential attribute, with removal reducing the overall score by 5.36 points;
- (d) Monte Carlo simulation illustrating a narrow distribution of scores, indicating low uncertainty in the social sustainability assessment.

3.2. Economic dimension

In the economic dimension, the overall performance of each regency/city in Kalimantan Timur demonstrated considerable strength, with a significant majority exhibiting sustainable economic practices in 2023. As illustrated in Figure 3a, eight out of ten cities/regencies were positioned on the right side of the x-axis, signifying a "sustainable" classification for their economic sustainability status. Notably, Bontang City emerged as the leader in this aspect, showcasing the highest sustainability ranking compared to its counterparts. This good performance is reflected in the selection of existing attributes such as economic growth, GDRP per capita, Labor Force Participation Rate, Adjusted Per Capita, Cellular signal, and Housing, where Bontang has a score of 10 for 3 out of 6 variables. However, not all regions mirrored this success. Two regencies, namely Mahakam

Ulu (Mahulu) and Paser, were positioned on the left side of the x-axis, indicating a lower level of economic sustainability performance. These findings underscore the general economic robustness of Kalimantan Timur while also highlighting the disparities that exist between different regions and the need for targeted strategies to enhance economic sustainability across the entire province.

Furthermore, leverage analysis of the economic dimension identified cellular signal, defined as the percentage of villages/sub-districts with strong and very strong network signals, as a key determinant of sustainable development, exhibiting a sensitivity score of 9.70. This suggests that exclusion of this attribute from the analytical variables would result in a corresponding decrease of approximately 9.70 in the overall sustainability score. Networks play a crucial role in addressing numerous sustainability challenges. These networks facilitate knowledge transfer, collaboration in resource management, and policy development aimed at influencing behavior. Social networks are particularly relevant for linking knowledge with action, enhancing collective action, and promoting social learning within the context of sustainability (Henry and Vollan, 2014).

Additionally, the Monte Carlo analysis exhibited a dense distribution, indicating minimal errors in the assessment of the economic dimension. This can be attributed to the Monte Carlo method's establishment of lower and upper bounds, which facilitates the computation of distributional variance. Closely clustered points within the simulation signify a low degree of error. A comprehensive visualization of the results, including ordination (a), map shows the sustainability status (b), leverage (c), and Monte Carlo (d) analysis, for the economic dimension is presented in Figure 3.

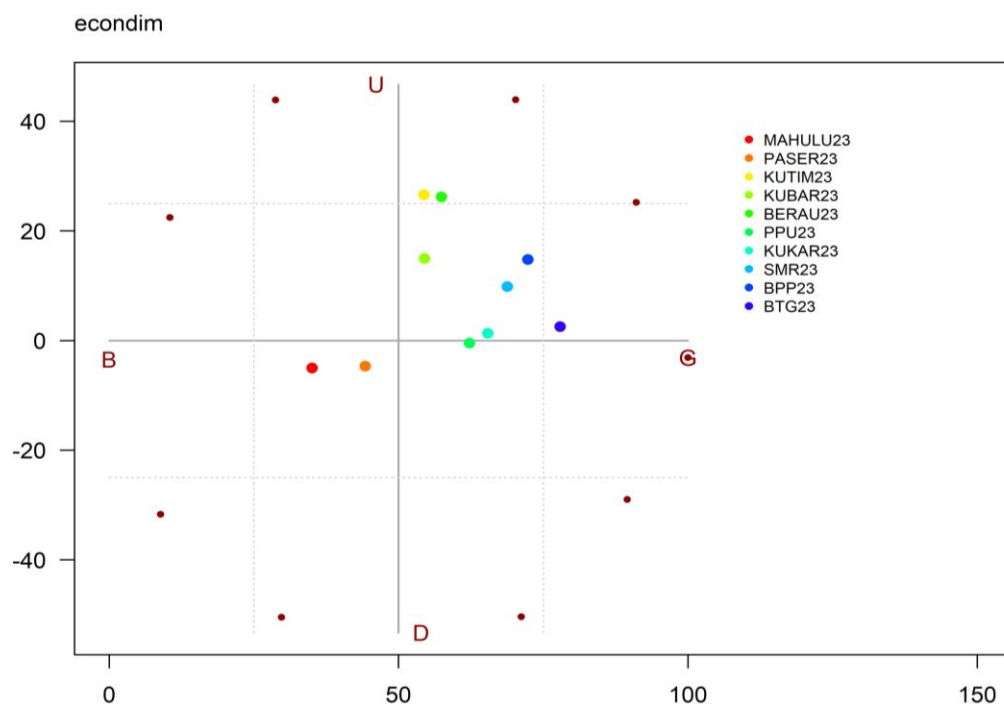


Figure 3 (a)

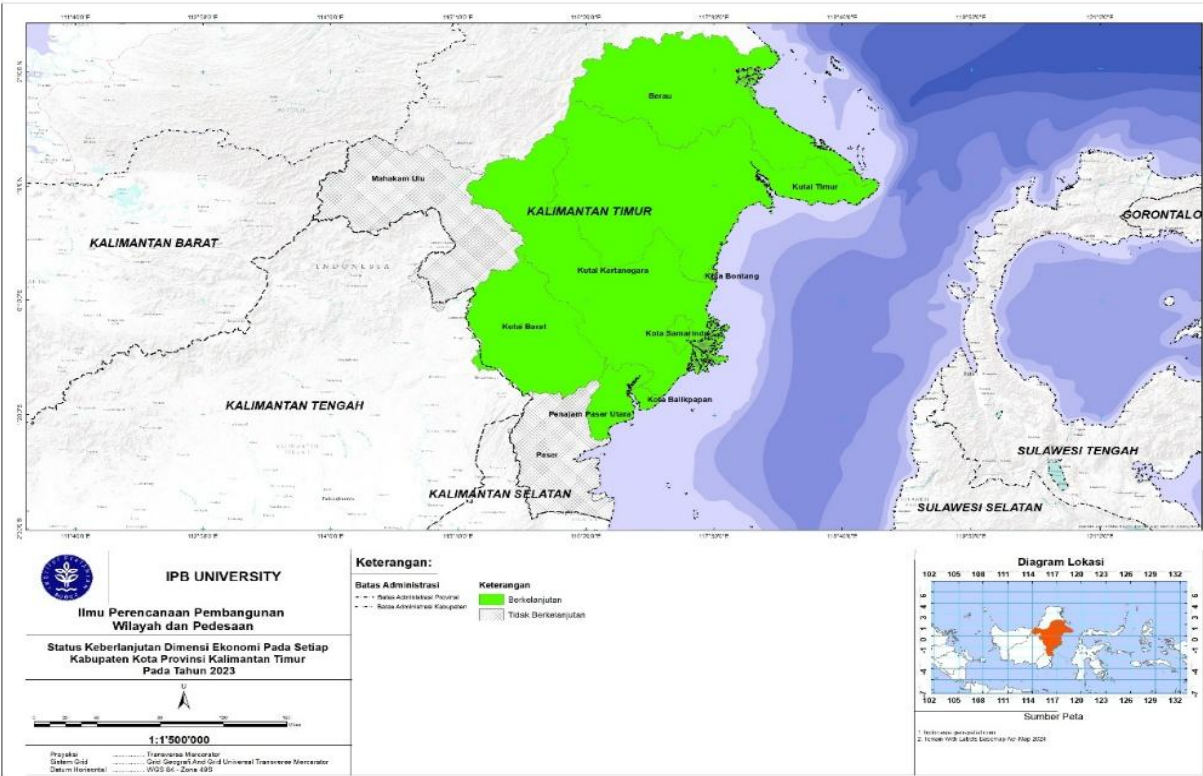


Figure 3 (b)

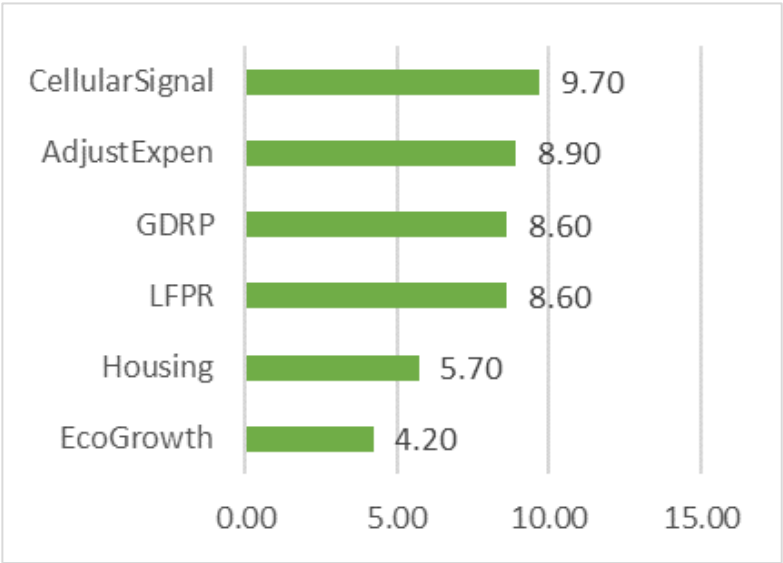


Figure 3 (c)

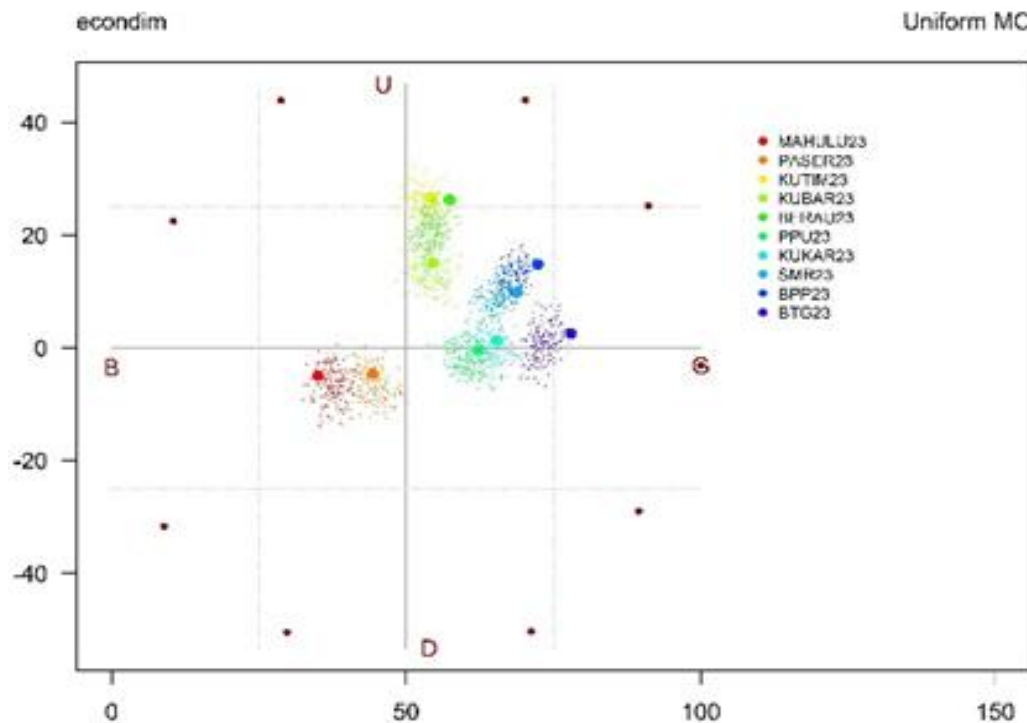


Figure 3 (d)

Figure 3. Environmental dimension sustainability assessment for East Kalimantan in 2023.

- (a) Ordination plot positioning cities/regencies by economic sustainability, with most on the right side (sustainable zone);
- (b) Map showing widespread sustainable status except for Mahakam Ulu and Paser;
- (c) Leverage analysis revealing “cellular signal” coverage as the key driver of economic sustainability, where its removal lowers the score 9.70 points;
- (d) Monte Carlo simulation indicating tightly clustered results, reflecting high robustness of the economic sustainability scores.

3.3. Environmental dimension

In the environmental dimension, only four cities/regencies in East Kalimantan Province were classified as having a "sustainable" status, demonstrating a disparity in environmental sustainability across the region. The four cities/regencies that achieved the highest sustainability rankings were Balikpapan, Berau, Mahakam Ulu, and Penajam Paser Utara, indicating relatively better environmental management and performance in these areas. Conversely, a significant portion of the province, with six cities/regencies, remained in the "unsustainable" category, highlighting persistent environmental challenges. Among these, West Kutai held the lowest sustainability ranking compared to the other cities/regencies, suggesting particularly pressing environmental concerns that need to be addressed. This range in sustainability status underscores the need

for targeted interventions and policy adjustments to promote more balanced and widespread environmental sustainability throughout East Kalimantan Province.

The fundamental principle of leverage analysis is to identify dominant attributes or those with a significant influence on the sustainability position. This is demonstrated by the fact that a higher score indicates a more sensitive attribute. The leverage analysis for the environmental dimension revealed that waste management, as measured by the percentage of villages/sub-districts where waste collection is performed by officers, exhibited the highest sensitivity level, with a score of 9.12. It is widely acknowledged that waste generation is an unavoidable consequence of human activities (Brunner and Rechberger, 2015). This indicator serves as a potent measure of public health, environmental sustainability, governance efficacy, and economic prosperity. A detailed examination of individual cities/regencies regarding the waste management indicator demonstrates a trend of consistently low scores, indicating a widespread lack of effective waste management practices across the regencies.

The Monte Carlo analysis demonstrates a tight distribution, indicating minimal errors for the environmental dimension/ This outcome, stems from the bounded simulation inherent in the Monte Carlo method, where closely grouped results signify a minimal level of uncertainty. A comprehensive overview can be seen in Figure 4, which presents the results of ordination (a), map shows the sustainability status (b), leverage (c), and Monte Carlo (d) analyses, for the environmental dimension can be seen in Figure 4.

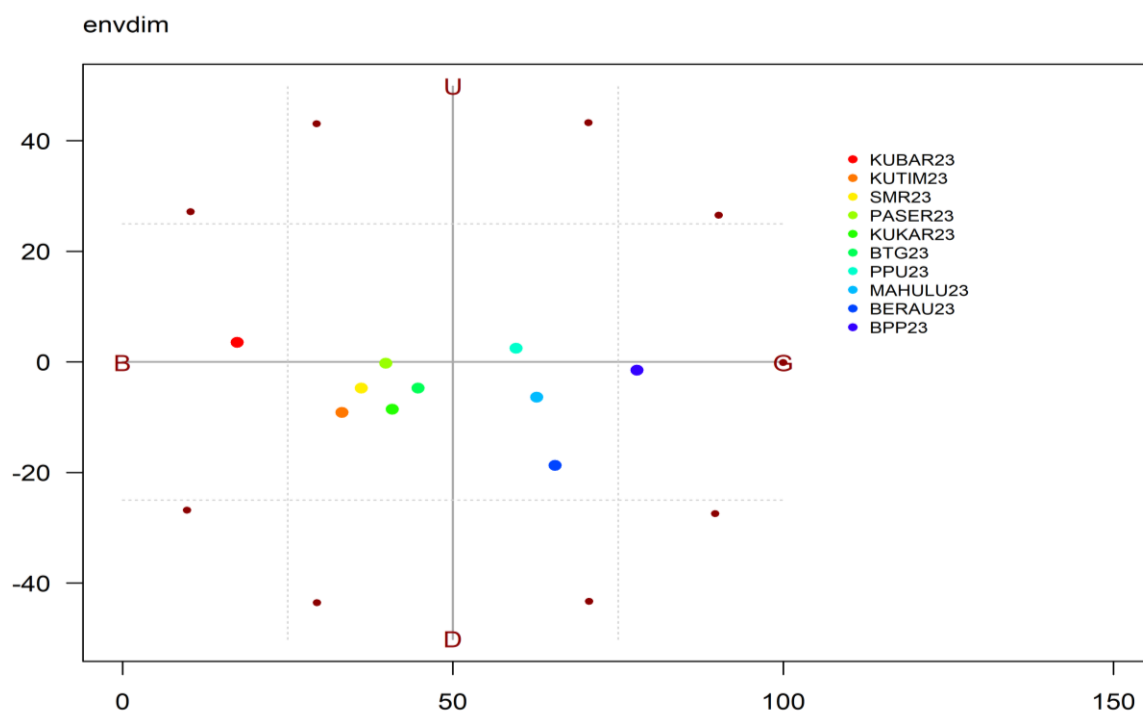


Figure 4 (a)

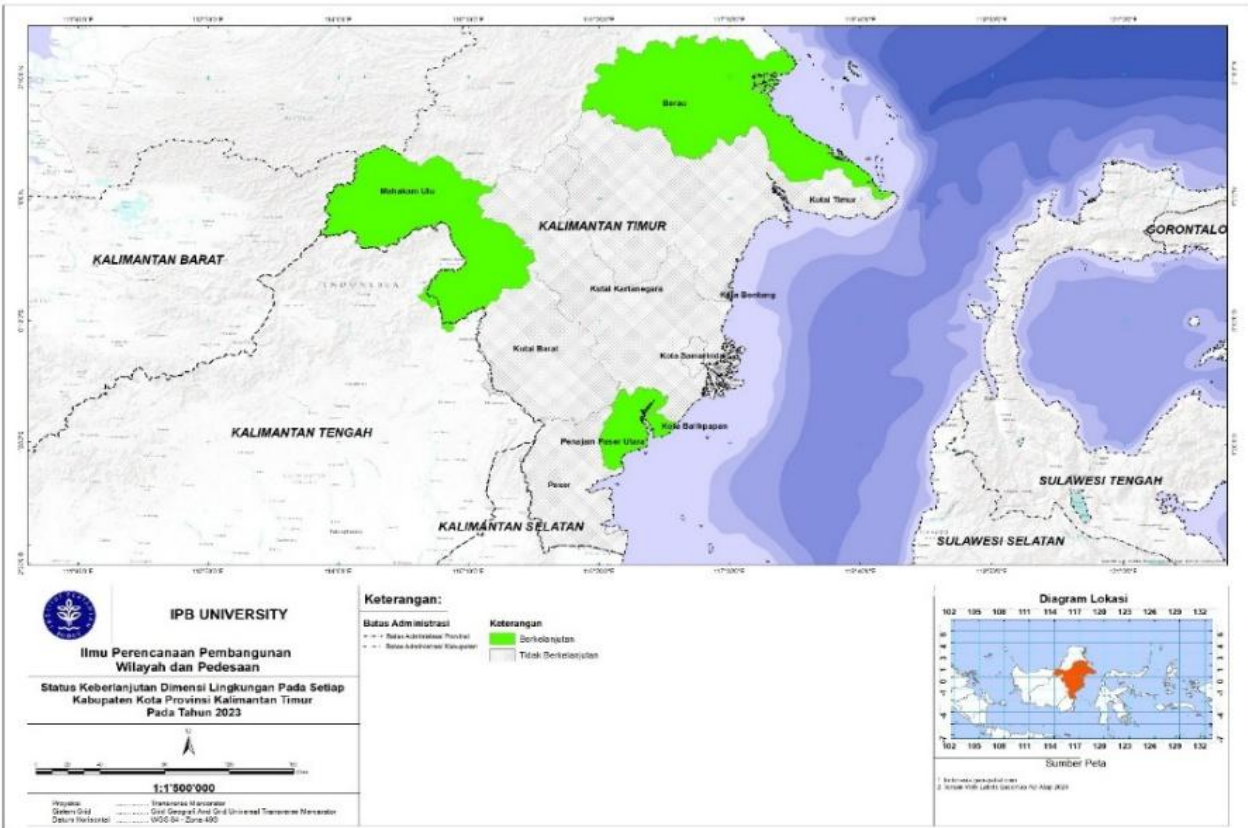


Figure 4 (b)

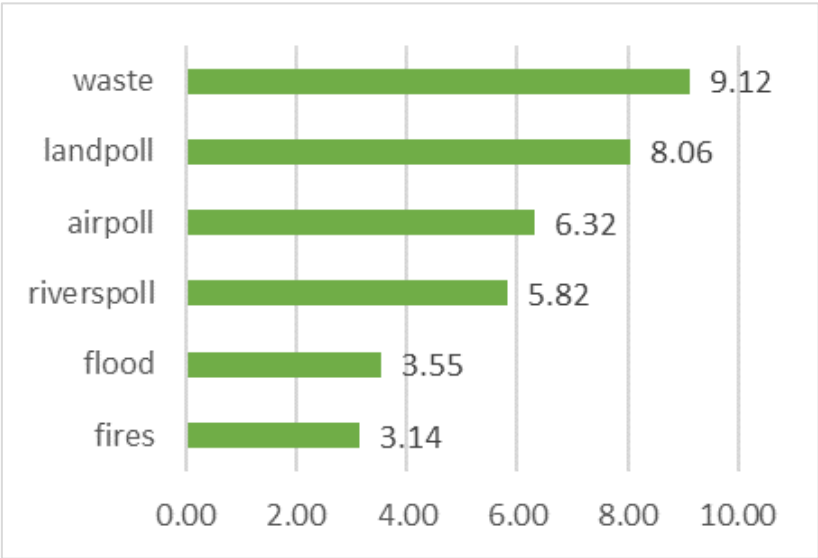


Figure 4 (c)

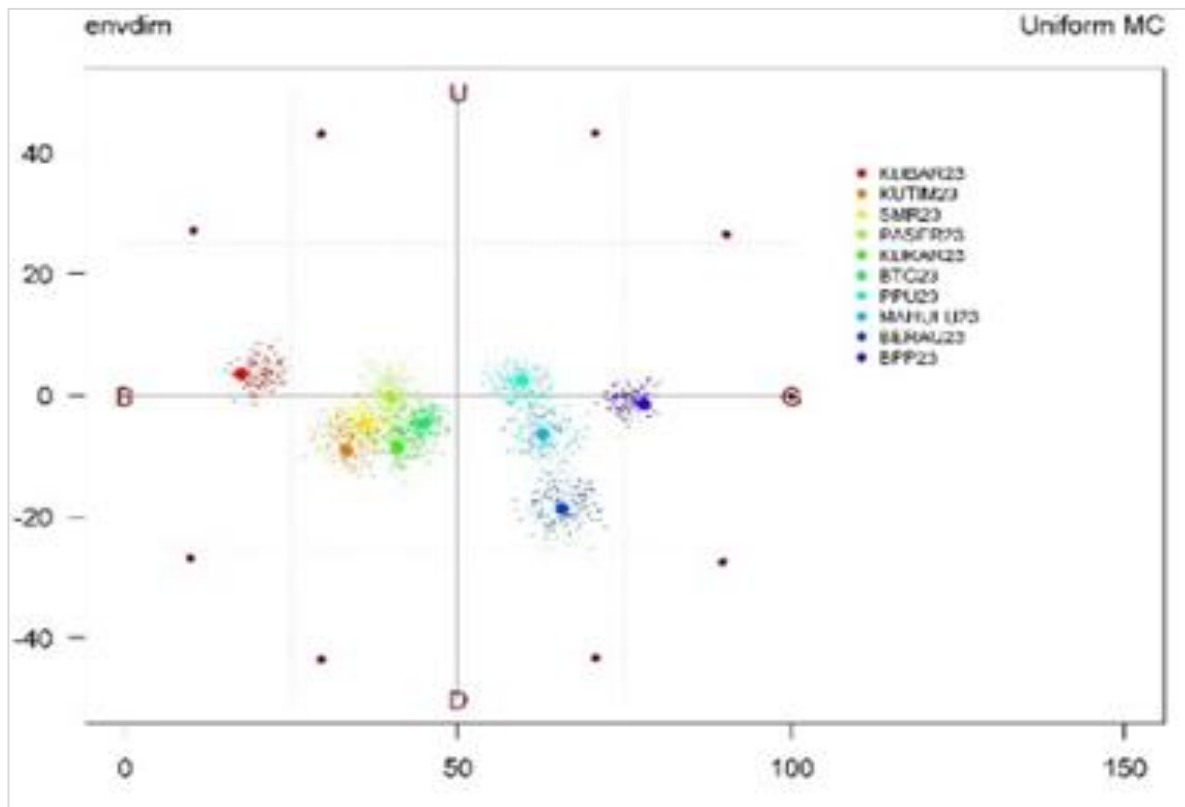


Figure 4 (d)

Figure 4. Environmental dimension sustainability assessment for East Kalimantan in 2023.

- (a) Ordination plot showing that most cities/regencies fall in the unsustainable range, with Balikpapan, Berau, Mahakam Ulu, and Penajam Paser Utara performing best;
- (b) Map visualizing environmental sustainability status, highlighting West Kutai as the lowest-performing area;
- (c) Leverage analysis identifying “waste management” as the most sensitive attribute, with a leverage score of 9.12;
- (d) Monte Carlo simulation showing a tight clustering of results, indicating minimal uncertainty in environmental sustainability estimates.

3.4. Multidimensional scaling

Multidimensional analysis is employed to comprehensively assess the sustainability of each dimension in relation to the units of analysis. The primary objective is to identify strengths, weaknesses, and areas for improvement within the analyzed units. Table 2 presents the sustainability scores derived from this multidimensional analysis, offering a detailed overview of the performance of each unit across different dimensions.

Table 2. Sustainability status in each Cities/Regencies in 2023

Cities/ Regencies	Social Dimension	Economic Dimension	Environmental Dimension
Paser	34.01	44.21	39.85
Kubar	42.54	54.47	17.34
Kukar	45.10	65.41	40.82
Kutim	37.25	54.39	33.18
Berau	47.70	57.41	65.46
Penajam Paser Utara	31.66	62.25	59.53
Mahakam Ulu	34.50	35.03	62.68
Balikpapan	72.61	72.33	77.87
Samarinda	65.49	68.76	36.11
Bontang	61.56	77.90	44.70

The table presents the sustainability status of ten cities/regencies in 2023, measured across three dimensions: Social, Economic, and Environmental. A score of 50 is used as the threshold to determine sustainability in each dimension. Overall, the data reveals a mixed picture across the region, with some areas performing well while others face significant sustainability challenges. The MDS analysis concluded that Paser demonstrates a lack of sustainability across all dimensions. Kutai Barat (Kubar), Kutai Kartanegara (Kukar), Kutai Timur (Kutim) exhibit a heterogeneous sustainability status, characterized by their economic dimensions surpassing the established threshold, in contrast to their environmental and social dimensions, which remain below the sustainability benchmark. Berau and Penajam Paser Utara (PPU) also demonstrate mixed results; however, both regencies exhibit unsustainability within their economic dimensions. In contrast, Samarinda and Bontang exhibit unsustainability in their environmental dimensions, a stark contrast to Mahakam Ulu (Mahulu), which demonstrates sustainability solely in the environmental aspect. Lastly, Balikpapan City displays the most robust performance, achieving sustainability across all three dimensions.

The results presented in the Table can serve as a reference for policy priorities and as a consideration for local government interventions. For instance, as Paser Regency is categorized as unsustainable in all dimensions, targeted interventions are needed. In the social dimension, efforts should focus on optimizing access to clean drinking water, as indicated by a score of 0 in this attribute. Then the economic dimension of Paser Regency must improve cellular signal or the percentage of villages/urban wards with very strong and strong signals, as evidenced by a cellular signal score of 2. A similar concern was observed in Kutai Barat Regency, which has the lowest environmental sustainability score among all regions, with a waste

management score of 0. Figure 5 presents the radar diagram of sustainability performance across all dimensions.

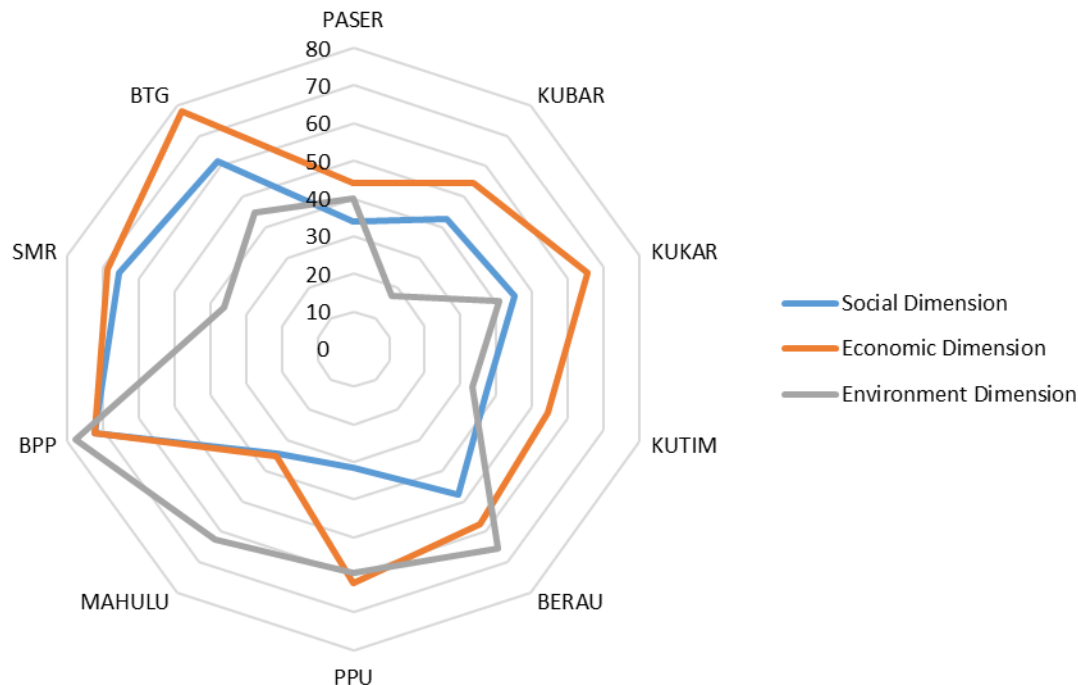


Figure 5. Radar chart summarizing the sustainability scores for each city/regency in East Kalimantan across the social, economic, and environmental dimensions (2023). The diagram highlights balanced performance in Balikpapan, strong economic performance in most areas, and widespread underperformance in the environmental dimension.

4. Conclusions

Based on the research findings, out of the 10 cities/regencies in East Kalimantan, three have achieved sustainability status in the social dimension, eight in the economic dimension, and four in the environmental dimension. These results underscore the varying levels of progress across the region and highlight specific areas requiring targeted interventions. Priority programs should focus on addressing the sensitive attributes identified within each dimension. For instance, if a city/regency exhibits a low score in the social dimension, efforts should be directed toward improving access to safe drinking water, a fundamental aspect of social well-being. Similarly, if the economic dimension is weak, the focus should be on enhancing cities/regencies that still exhibit weak cellular signals, potentially through initiatives that promote economic diversification or strengthen local businesses. Meanwhile, if the environmental dimension scores low, priority should be given to improving waste management in areas where it remains inadequate, as effective waste management is crucial for environmental health and sustainability. Ultimately, sustainability is a continuous pathway, and the scores obtained will constantly evolve based on the efforts implemented. This underscores the fact that

sustainability is not a fixed end goal but rather a dynamic process that requires ongoing evaluation and continuous improvement. Therefore, continuous monitoring of these indicators and adaptive management strategies are essential to ensure sustained progress towards a more sustainable East Kalimantan.

Despite these findings, this study acknowledges certain inherent limitations. The reliance on secondary data, not all of which reflects the most recent 2023 timeframe due to data availability constraints – particularly evident in the village potential data which is released triennially – may not fully encapsulate the intricate nuances of localized conditions. Furthermore, potential scoring bias and the possible omission of other pertinent variables warrant consideration when interpreting these results. While the use of secondary data may not reflect specific contemporary situations, it is important to emphasize the diagnostic nature of the Rapfish method. Nevertheless, this research furnishes a valuable foundational understanding of sustainability within the East Kalimantan context.

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