

Sustainability Status of Residential Areas in Bumi Harapan Village, Nusantara Capital City: A Multi-Dimensional Scaling (MDS-RAPSettlement) Approach

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Abstract

Background: The development of the Nusantara Capital City (IKN) as a sustainable forest city raises concerns regarding the sustainability of rural settlement areas that have long existed within its boundaries.

Objective: This study aims to assess the sustainability status of the Bumi Harapan Village settlement across ecology and infrastructure, economic, socio-cultural, and institutional dimensions and to identify sensitive attributes that may inform sustainable settlement development.

Methods: The study was conducted in Bumi Harapan Village using field observations, a questionnaire administered to the village government, and secondary data. Sustainability was assessed using Multi-Dimensional Scaling (MDS)-RAPSettlement across 39 attributes grouped into four dimensions.

Results: Bumi Harapan is moderately sustainable in the ecology and infrastructure dimension (60.05) and institutional dimension (62.58), but less sustainable in the economic dimension (41.16) and socio-cultural dimension (41.89). RSQ values range from 0.94 to 0.95 and stress values from 0.133 to 0.137. The most sensitive attributes include waste management, green open space, clean water availability, village market availability, community participation in waste management, and participation in decision-making.

Conclusion: These findings support evidence-based efforts to improve the sustainability of the Bumi Harapan settlement, particularly by strengthening environmental services, local economic capacity, community participation, and responsive village governance.

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INTRODUCTION

Sustainability has become an important consideration in development planning processes in recent decades. Rapid development that is not accompanied by adequate environmental management can increase pressure on ecosystems and human livelihoods. Sustainability can be interpreted as the ability to maintain good conditions into the future, measured through a combination of economic, environmental, and social dimensions (Basiago, 1998; Suparmoko, 2020).

Indonesia's sustainable development has been enshrined in the Golden Indonesia 2045 vision, which includes a pillar related to the realization of sustainable settlement areas, namely: sustainable economic development. One of the development agendas in realizing Golden

Indonesia 2045 is the development of the Nusantara Capital City (IKN) as the epicenter of Indonesia's future economic growth.

The process of moving the capital city and developing IKN Nusantara creates the potential for the emergence of urban problems similar to those occurring in the Jabodetabek area (Sutanto, 2022). Besides the consequences of land subsidence and the potential rise in sea levels threatening the sustainability of the coastal area of DKI Jakarta, economic inequality, population size, and money circulation were considerations in this decision-making process (Armansyah et al., 2024).

The relatively high circulation of money resulting from the ongoing development process creates an economic attraction that may increase population migration from surrounding areas or other regions. On one hand, this is positive for the community's economic development; on the other hand, population growth may increase population and settlement density.

The scale of IKN development quantitatively underscores its potential impact on surrounding settlements: the population in Sepaku District grew substantially during the development period (BPS Penajam Paser Utara, 2023). Between 2022 and June 2023, forest clearing was also reported within the IKN area (Forest Watch Indonesia, 2023), indicating increasing land-use pressure. These conditions motivate the need to assess the current sustainability status of existing rural settlements within the IKN development area.

High population growth may increase pressure on environmental carrying capacity. These challenges are closely related to the Sustainable Development Goals (SDGs), particularly Goal 11 concerning sustainable cities and communities.

Empirical evidence reveals that land-use transition in the IKN area has been substantial: between 2003 and 2023, built-up areas expanded while agricultural land decreased by approximately 25% (Syaban & Appiah-Opoku, 2024). The influx of workers and investors associated with IKN construction may also increase pressure on existing settlement infrastructure and residential environmental quality in surrounding areas (Rachmawati et al., 2024).

The process of creating a sustainable urban area cannot focus on only one aspect; all aspects of the urban order must be considered, including village settlement areas which are an inseparable part of the urban hierarchical structure.

Village development and village settlement areas that have been ongoing for a long time and developed without paying attention to sustainable dimensions will certainly require improvements in one or even several dimensions that affect their sustainability level. The development of IKN is oriented towards a sustainable city and is built in an area that had been established long before the government's decision to build IKN was made.

The IKN area (KIKN) covers approximately 56,180 ha, including the Core Government Center Area (KIPP). Bumi Harapan Village is an existing rural settlement in Sepaku District located within the IKN development area and directly adjacent to the KIPP, making it relevant for examining settlement sustainability under rapid development pressure.

Settlement areas are defined as land use in a specific location with the aim of sustaining life, gathering, and developing the lives of its inhabitants (Rusmawan, 2009). In realizing sustainable settlement areas, several dimensions that build them must be considered to ensure future availability (Amirah et al., 2023). A condition for the sustainability of a settlement area is the fulfillment of all conditions from time to time (Chaidir & Murtini, 2014).

The definition of an area, referring to Law No. 26 of 2007 concerning Spatial Planning, is part of a region whose boundaries and systems are determined based on functional aspects, consisting of protected and cultivation areas. Meanwhile, a settlement, according to Law No. 1 of 2011 concerning Housing and Settlement Areas, is defined as part of the living environment outside protected areas, both urban and rural areas, which functions as a residential environment supporting life and livelihoods.

Previous studies have examined settlement sustainability and MDS-based approaches in Indonesian contexts. Nawangsari and Ismaili (2022) applied MDS-Rapfish to evaluate public transportation sustainability in Yogyakarta, while Amirah et al. (2023) identified sustainability indicators for residential environments. Abdillah et al. (2023) employed MDS-RAPFISH to assess urban forest eco-tourism sustainability, and Rendrarpoeetri et al. (2024) applied a modified Rapfish approach to watershed sustainability assessment, demonstrating the method's

adaptability beyond fisheries contexts. However, studies applying MDS-RAPSettlement specifically to an existing rural settlement within the Nusantara Capital City development area remain limited.

The novelty of this research lies in two aspects: (1) the geographic focus on Bumi Harapan Village, an existing rural settlement directly affected by the development of IKN Nusantara; and (2) the application of RAPSettlement to assess four dimensions relevant to settlement sustainability in the IKN context, namely ecology and infrastructure, economic, socio-cultural, and institutional dimensions.

The scientific benefit of this research is the application of a multi-dimensional assessment framework for village settlement sustainability that can provide a detailed understanding of strengths and weaknesses across dimensions. Practically, the research provides evidence that can support Bumi Harapan Village, local government, and the IKN Authority (OIKN) in improving settlement sustainability and contributing to the realization of SDG 11 (Sustainable Cities and Communities).

METHOD

The study was conducted in Bumi Harapan Village, Sepaku District, Penajam Paser Utara Regency, East Kalimantan Province, Indonesia. Bumi Harapan was selected because it is an existing rural settlement within the Nusantara Capital City (IKN) development area and is directly adjacent to the Core Government Center Area (KIPP).

The research focused on the Bumi Harapan Village settlement area. The data used in this study came from primary and secondary sources, including demographic, socio-cultural, economic, infrastructure, environmental, and institutional data. A total of 39 attributes were grouped into four dimensions: ecology and infrastructure, economic, socio-cultural, and institutional.

Primary data were obtained through a questionnaire administered to the Bumi Harapan Village Government and direct field observations. The respondent was selected purposively based on knowledge of local conditions and access to village-level information relevant to the sustainability attributes. Secondary data were obtained from official sources, including BPS (Central Bureau of Statistics), E-Prodeskel of the Ministry of Home Affairs, the Village Information System (SID), and relevant village administrative records.

Sustainability status analysis was conducted using the Multi-Dimensional Scaling (MDS) approach with RAPSettlement, a modification of Rapfish for assessing the sustainability of settlement areas. The output of the analysis is the sustainability status of the studied object on an ordination scale from 0 to 100. The MDS ordination is visualized in a two-dimensional diagram, and the ordination technique is based on Euclidean distance, as described below:

$$d_{ij} = \sqrt{[(x_i - x_j)^2] + [(y_i - y_j)^2]}$$

Where

x_i and x_j = x coordinates for facility 1 and 2

y_i and y_j = y coordinates for facility 1 and 2j

Furthermore, the ordination value is projected through the regression process of the Euclidean distance from point i to point j, which can be described by the following equation:

$$d_{ij} = a + bd_{ij} + e$$

The ALSCAL algorithm is used to perform the regression of the above equation by optimizing the correspondence between distances in the ordination space and the observed dissimilarities. The S-Stress formula can be described as follows:

$$s = \sqrt{\frac{1}{m} \sum_{k=1}^m \frac{\sum_i \sum_j (d_{ijk}^2 - o_{ijk}^2)^2}{\sum_i \sum_j o_{ijk}^4}}$$

Euclidean distance weighting is performed using the equation:

$$D_{ijk}^2 = \sum_{a=1}^J w_{ka} (x_{ia} - x_{ja})^2$$

To minimize the error level, an iterative process is required. The iteration process stops when the S-Stress value reaches its minimum point. The model can be considered acceptable if the S-Stress value is not greater than 0.25 (Fauzi, 2005). Model fit is also indicated by the squared correlation (RSQ), with values approaching 1 indicating a closer correspondence between the fitted ordination and the observed dissimilarity structure.

Table 1

Stress Value Interpretation Criteria for Goodness of Fit in Multidimensional Scaling (MDS)

Stress Value (%)	Goodness of fit
20.0	Poor
10.0	Fair
5.0	Good
2.5	Excellent
0.0	Perfect

Source: (Johnson & Wichern, 2002)

A studied object can be assigned a sustainability status based on its position on the X-axis, where 0% represents the least sustainable condition and 100% represents the most sustainable condition. The Y-axis represents other variation in the ordination and is not interpreted as the level of sustainability (Wardani et al., 2021). The following matrix presents the categories of settlement-area sustainability status.

Table 2

Sustainability index of village settlement areas by dimension

Index Value	Category
<25.00	Unsustainable
25.00 – 50.00	Less Sustainable
50.01 – 75.00	Moderately Sustainable
>75.00	Sustainable

Source: (Kavanagh, 1999)

The process of compiling various attributes into sustainability dimensions was based on scientific literature, relevant regulations, and the operational needs of the study. The analysis stages were as follows: 1) identify the condition of the Bumi Harapan settlement area, including economic, ecology and infrastructure, institutional, and socio-cultural conditions; 2) score all attributes based on field data, secondary data, literature, and the defined operational criteria; and 3) prepare anchors representing the bad and good conditions of each attribute.

The sensitivity of each attribute (leverage) can be determined from the root mean square (RMS) value. Attributes with relatively high RMS values are considered more sensitive because removing them produces a greater change in the ordination. The leverage value is calculated for each attribute through the RMS calculation, namely:

$$RMS = \sqrt{\frac{1}{N} \sum_{i=1}^N (X_{red} - \bar{X}_{flip})^2}$$

Where:

X_{red} : Attribute reduction ordination
 X_{flip} : Ordination without attribute reduction
 N : Number

The greater the change in the RMS value after an attribute is removed, the greater the sensitivity of that attribute in the ordination. Potential errors in the data analysis process may arise from scoring errors, data variation, or uncertainty in the ordination. Monte Carlo analysis was therefore used as an additional check on model stability.

Pitcher and Preikshot (2001) explain that Monte Carlo analysis can be used to examine uncertainty related to scoring and ordination through repeated simulation. A small difference between the MDS ordination and Monte Carlo results at a 95% confidence interval indicates that the model is relatively stable.

RESULTS AND DISCUSSION

Results

The sustainability status of the Bumi Harapan Village settlement was assessed across four dimensions. The results are presented together with the goodness-of-fit statistics of the MDS-RAPSettlement model.

Table 3

Sustainability status of Bumi Harapan Village by dimension

Dimension	Value	Status
Ecology and Infrastructure	62.58	Moderately Sustainable
Economic	41.16	Less Sustainable
Socio-Cultural	41.89	Less Sustainable
Institutional	60.28	Moderately Sustainable

Table 4

Goodness-of-fit values of the MDS-RAPSettlement analysis

Dimension	RSQ	Stress
Ecology and Infrastructure	0.95	0.133
Economic	0.95	0.137
Socio-Cultural	0.95	0.134
Institutional	0.94	0.134

The validity of the MDS analysis was evaluated using the RSQ (squared correlation) and Stress values. RSQ indicates the correspondence between the fitted ordination and the observed dissimilarity structure, with values approaching 1 indicating a better fit. Stress quantifies the discrepancy between observed and fitted distances; values below 0.25 indicate an acceptable model (Johnson & Wichern, 2002; Fauzi, 2005). In this study, RSQ values ranged from 0.94 to 0.95 and Stress values from 0.133 to 0.137, indicating that the four-dimensional sustainability assessment had an acceptable goodness of fit.

Discussion

Ecology and Infrastructure Dimension

The ordination value of the ecology and infrastructure dimension is in the moderately sustainable category, with a value of 62.58. The analysis shows acceptable model fit, with a Stress value of 0.133 (<0.25) and an RSQ value of 0.95. The ordination value can be seen in Figure 1.

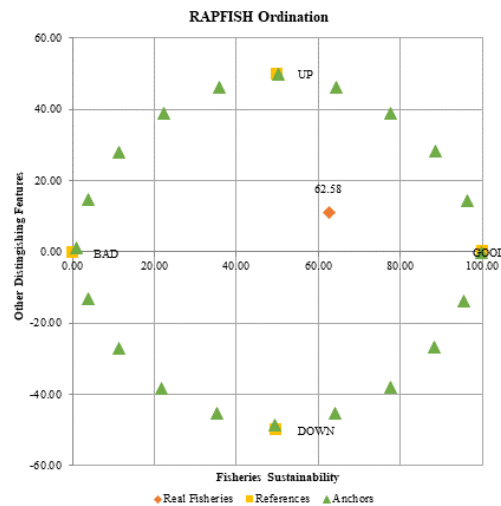


Figure 1. Ordination of the ecology and infrastructure dimension
Source: Analysis results (2024)

Figure 2 presents the attributes with the highest sensitivity in the ecology and infrastructure dimension. Based on the leverage analysis, waste management is the most sensitive attribute (RMS 6.73), followed by the availability of green open space (6.48) and clean water (5.60). The provision of clean water plays an important role in public health; the need for clean water is not only to meet bodily needs but also daily household needs.

Increasing environmental damage and climate change further strengthen the threat of a clean water crisis for communities. On the other hand, population increase also affects the demand for clean water. A shortage of clean water not only impacts health but also threatens food security and the sustainability of natural ecosystems.

As an effort to raise the sustainability status of the ecology and infrastructure dimension, improving access to clean water is an important intervention for consideration by the government. The limited coverage of the PDAM (municipal water company) network in Bumi Harapan Village affects the availability of piped water services. Alternative water sources, including river water, wells, and rainwater harvesting, therefore remain important for the community.

Field observations in Bumi Harapan Village indicated that the settlement had not yet been fully served by a piped water network (PDAM) at the time of the study. The community therefore relied on alternative water sources, including wells, river water, and rainwater harvesting. Regional data for Sepaku District also show continuing challenges in access to safe drinking water (BPS Penajam Paser Utara, 2023). These conditions provide relevant context for interpreting the ecology and infrastructure sustainability score of Bumi Harapan.

The availability of green open space is a crucial element in efforts to create a sustainable settlement environment. Law No. 26 of 2007 concerning Spatial Planning establishes a minimum green open space proportion of 30% for urban areas, consisting of 20% public green open space and 10% private green open space. Although this provision is defined at the urban scale, it underscores the importance of maintaining adequate green space as part of settlement sustainability.

Equally important is the way household waste is managed. Inadequate waste management can degrade environmental quality and create public-health risks. Waste pollution may affect both land and water resources, making appropriate collection, treatment, and disposal important components of settlement sustainability.

The limited availability of waste-management facilities has encouraged households to rely on practices such as open burning or burial of waste. These practices may persist because of limited service coverage, cost considerations, convenience, and environmental awareness. Strengthening waste-management services is therefore relevant to improving the ecology and infrastructure dimension.

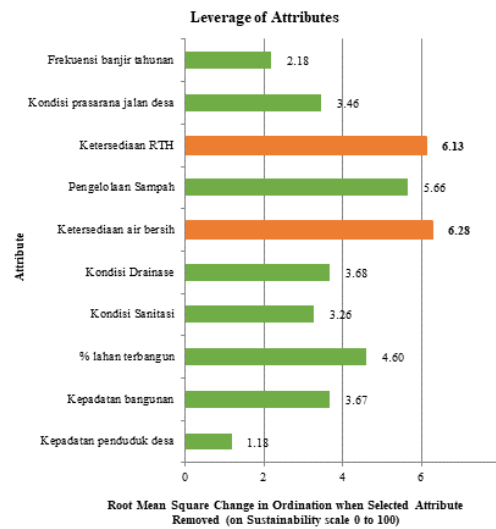


Figure 2. Leverage of the ecology and infrastructure dimension
Source: Analysis results (2024)

Economic Dimension

The ordination value of the economic dimension is in the less sustainable category, with a value of 41.16. The test results show acceptable model fit, with a Stress value of 0.137 (<0.25) and an RSQ value of 0.95.

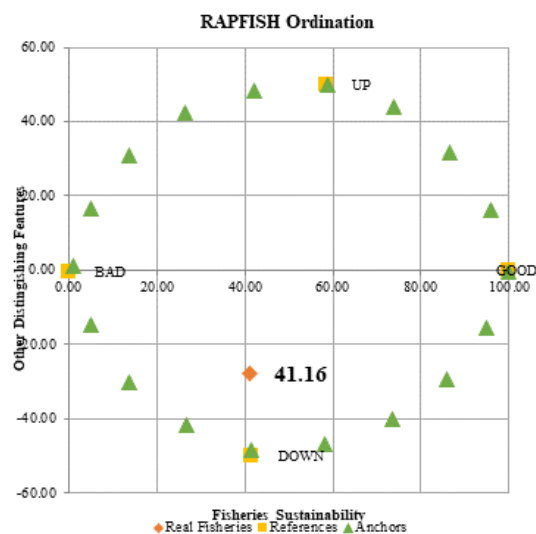


Figure 3. Ordination of the economic dimension
Source: Analysis results (2024)

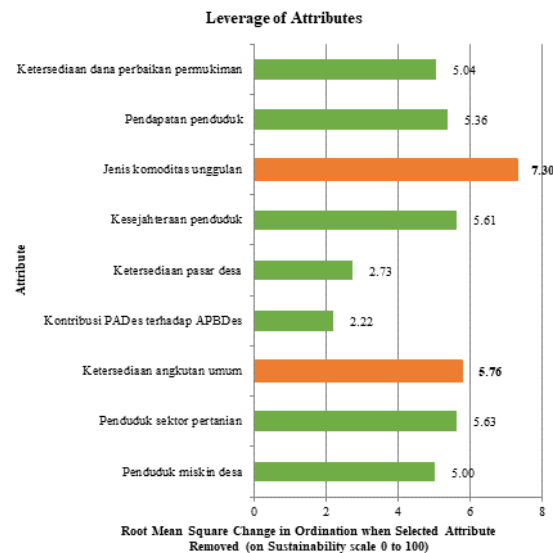


Figure 4. Leverage of the economic dimension
Source: Analysis results (2024)

The sustainability of the economic dimension is inseparable from the capacity of the settlement economy to support livelihoods over time. Chotim (2020) explains that sustainable economic development requires the use of resources in a manner that maintains productive capacity while avoiding excessive pressure on the environment.

The leverage analysis results indicate that the availability of a village market is the most sensitive attribute in the economic dimension (RMS 5.57), followed by the contribution of village-source revenue (PADes) to the village budget (5.29), the type of leading commodity (4.89), and resident welfare (4.18) (Figure 4). These attributes indicate the importance of local economic activity and the village's capacity to capture and circulate economic benefits.

The agricultural sector plays an important role in sustainable rural development by supporting employment, food security, and local economic activity. Given its importance to rural livelihoods, agricultural development remains relevant to village-oriented development programs.

Annual population growth is associated with increasing demand for agricultural products and land. This creates a challenge for the agricultural sector because productive land may face increasing pressure from other land uses. Therefore, efforts to increase the value of leading agricultural commodities should be accompanied by measures to limit the conversion of productive agricultural land.

Public transportation availability is another attribute assessed in the economic dimension. Limited public transportation may encourage greater dependence on private vehicles for daily activities. Transportation is an important supporting service for access to employment, markets, education, and other economic activities; therefore, its availability remains relevant to settlement sustainability.

Agricultural employment is also relevant to the economic sustainability of the village, with an RMS value of 3.39. The declining interest of younger generations in agricultural work may create challenges for farmer regeneration and the continuity of local agricultural production.

Although this phenomenon does not occur only in Indonesia, it should serve as a consideration for the government in efforts to improve domestic food security and the sustainability of rural economies. Oktafiani et al. (2021) found that the stereotype of agriculture as an unattractive livelihood and the socioeconomic conditions of farming households can threaten farmer regeneration.

Efforts to improve the sustainability status of the economic dimension can focus on developing leading agricultural products, strengthening downstream processing, improving agricultural productivity, and supporting farmer regeneration.

Institutional Dimension

The analysis results for the institutional dimension in Bumi Harapan Village fall into the moderately sustainable category, with a value of 60.28 (Figure 5). The test results show acceptable model fit, with a Stress value of 0.134 (<0.25) and an RSQ value of 0.94.

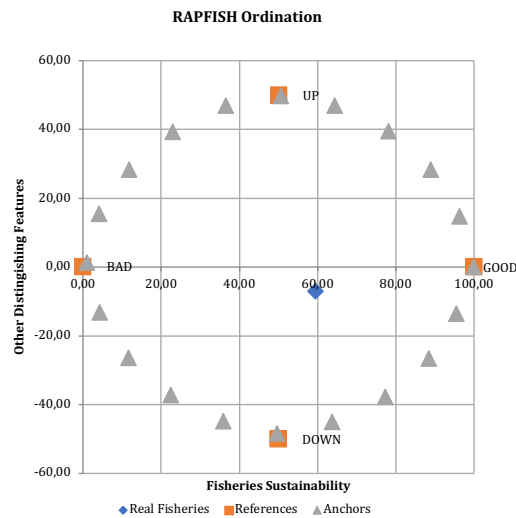


Figure 5. Ordination of the institutional dimension
Source: Analysis results (2024)

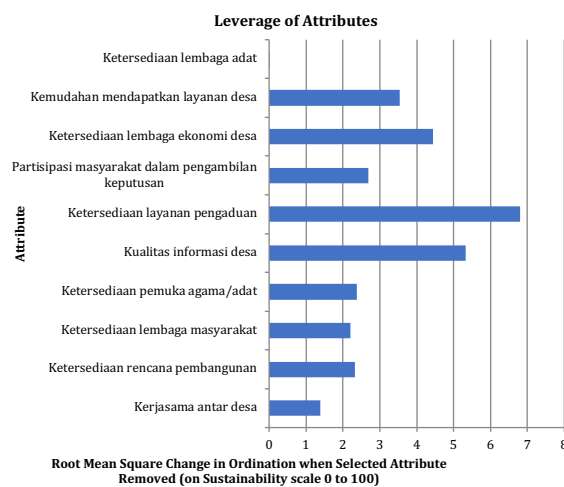


Figure 6. Leverage of the institutional dimension
Source: Analysis results (2024)

Attribute sensitivity in the institutional dimension is measured through leverage analysis (Figure 6). The analysis results show that community participation in decision-making is the most sensitive attribute (RMS 4.51), followed by the availability of religious or customary leaders (4.46), complaint services (4.38), and the quality of village information (4.03).

In policy formulation and efforts to improve the sustainability status of the institutional dimension, attention is therefore needed not only to complaint services and information availability, but also to meaningful community participation in village decision-making. With the increasing development of technology that has reached villages, online service systems can be used by village governments to improve access to information and complaint services.

Limitations in village complaint-service systems can create obstacles to effective public service, including slow responses, weak documentation, and limited access to up-to-date information on the progress of complaint follow-up. These aspects are therefore relevant to efforts to strengthen institutional sustainability in Bumi Harapan Village.

Several communication channels can be developed by the village government as part of

service-quality improvement. Access to telecommunications can be utilized to support complaint services through platforms such as WhatsApp, while official village social media can provide an additional channel for information and public communication.

The level of community participation in decision-making and village policy formulation is a critical factor in the institutional dimension. An inclusive and transparent decision-making system will strengthen the institutional capacity of the village and contribute to increasing public trust in the Village Government, which ultimately contributes to improving the sustainability status of the settlement area.

Socio-Cultural Dimension

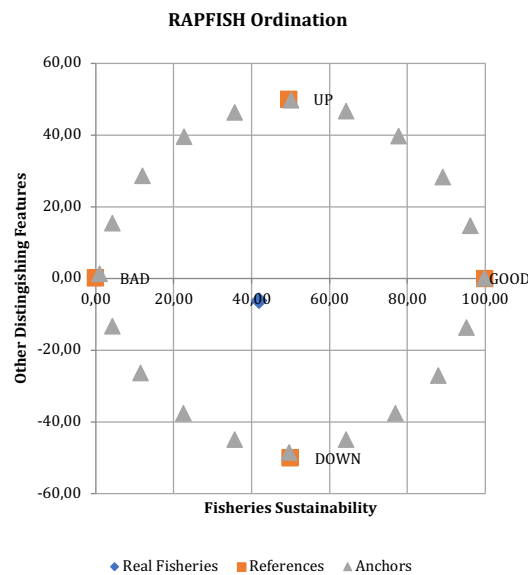


Figure 7. Ordination of the socio-cultural dimension
Source: Analysis results (2024)

The analysis of the socio-cultural dimension in Bumi Harapan Village falls into the less sustainable category, with an ordination value of 41.89, as seen in Figure 7. The Stress value of 0.134 (<0.25) and an RSQ value of 0.95 indicate an acceptable model fit.

Socio-cultural conditions in rural communities continue to change alongside technological development and broader social transformation. These changes may influence patterns of interaction, community values, and the social organization of rural life.

Fajrin (2021) discusses how globalization and social change may influence perceptions of security, comfort, and socio-cultural values in rural communities. This provides relevant context for interpreting the socio-cultural sustainability of Bumi Harapan Village.

The sensitivity of attributes in the socio-cultural dimension can be described through the leverage analysis shown in Figure 8. Community participation in waste management is the most sensitive attribute (RMS 6.76), followed by community empowerment in environmental management (6.38) and the availability of social facilities (5.95). Social conflict (5.66) and the village crime rate (5.04) also show relatively high sensitivity. Social facilities in this context include infrastructure and facilities needed by the community, such as education, sports, health, meeting spaces, and markets (Putro & Purwaningsih, 2014).

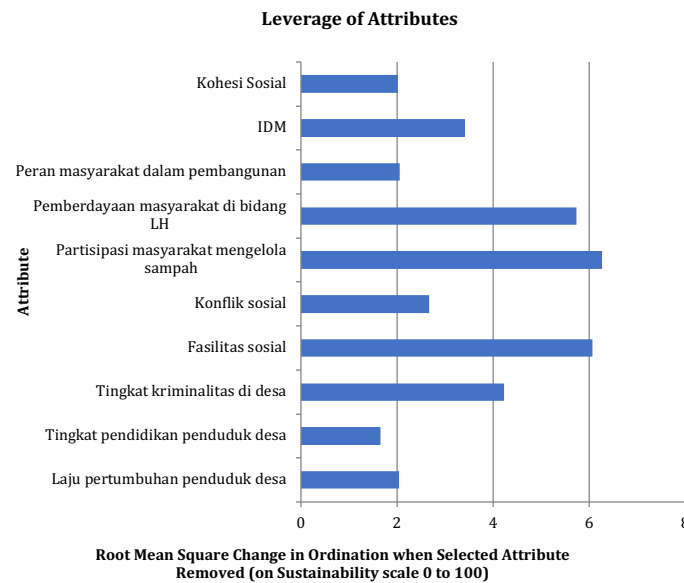


Figure 8. Leverage of the socio-cultural dimension
Source: Analysis results (2024)

Social facilities within settlement areas play an important role in maintaining interaction and communication among residents and can support activities that influence the economic and social development of an area. Community participation and empowerment are equally important because the performance of environmental services, including waste management, depends on collective action. Maryati et al. (2022) explain that the availability of infrastructure and social facilities in rural areas contributes to economic growth and improvement in quality of life and should be planned according to village needs and characteristics.

The village crime rate is another attribute that requires attention from government and relevant authorities in efforts to improve socio-cultural sustainability. The development of the new capital may contribute to increased in-migration and social interaction in surrounding areas, underscoring the importance of maintaining social order and community security.

Socio-cultural change can also influence community attitudes and social interaction. Putra et al. (2020) identify economic conditions, education, social interaction, environmental conditions, population size, and unemployment among factors associated with variations in crime rates. These factors indicate that community security should be understood as a multidimensional issue rather than as the result of a single cause.

These socio-cultural attributes are interrelated. Improvements in social facilities, community participation, environmental empowerment, education, and social interaction may contribute to stronger social conditions and support crime prevention. Low education levels may be associated with low economic standards and limited educational infrastructure (Elvira, 2021; Pudyastuti & Mulyaningsih, 2021).

Although the provision of primary and secondary education facilities is not entirely within village authority, the village government can support early childhood education and other community-based initiatives. On the economic side, Village-Owned Enterprises (BUM Desa) can develop village markets or other business units based on leading local products, thereby supporting local employment and economic activity.

Multidimensional Sustainability

The ordination values resulting from the RAPSettlement analysis for each dimension are visualized in a kite diagram, as shown in Figure 9. Visualizing the four sustainability dimensions in a single diagram is intended to provide a holistic view of the Bumi Harapan settlement profile.

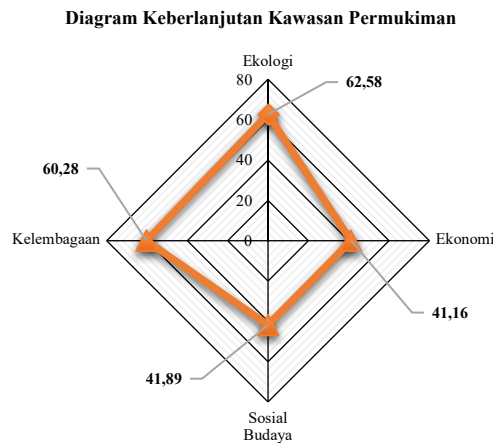


Figure 9. Kite diagram of Bumi Harapan Village settlement sustainability
Source: Analysis results (2024)

The sustainability profile of Bumi Harapan Village is uneven across the four dimensions. The ecology and infrastructure dimension (62.58) and institutional dimension (60.28) are moderately sustainable, whereas the economic dimension (41.16) and socio-cultural dimension (41.89) are less sustainable. The arithmetic mean of the four dimension scores is 51.85 and is presented only as a descriptive summary rather than a weighted composite index. Bali Swain and Yang-Wallentin (2020) emphasize the importance of economic and social dimensions in achieving sustainable development, indicating that the lower economic and socio-cultural scores require particular attention.

The economic dimension, which remains in the less sustainable category, requires particular attention. Efforts to improve its sustainability status can include developing leading agricultural products, strengthening village markets and local economic activities, improving access to transportation, and supporting farmer regeneration.

The IKN development context adds pressure to the economic sustainability of existing rural settlements. Land-use analysis from 2003 to 2023 documents a reduction of approximately 25% in agricultural land within the broader IKN area as land has been converted to infrastructure and urban uses (Syaban & Appiah-Opoku, 2024). For Bumi Harapan, this regional transformation is relevant because agricultural livelihoods and local commodities remain part of the village economy. Maintaining productive land and strengthening local economic opportunities are therefore important considerations for improving economic sustainability.

CONCLUSION

Overall, Bumi Harapan Village, which is located adjacent to the Core Government Center Area (KIPP), shows different sustainability conditions across the four dimensions analyzed. The ecology and infrastructure dimension and institutional dimension are moderately sustainable, while the economic and socio-cultural dimensions are less sustainable. Several attributes serve as important leverage points because of their relatively high sensitivity, including waste management, green open space, clean water, village markets, village-source revenue, leading commodities, community participation in waste management, environmental empowerment, social facilities, participation in decision-making, complaint services, and village information quality.

From a scientific standpoint, this study demonstrates the application of MDS-RAPSettlement for evaluating multi-dimensional settlement sustainability at the village level. Operationally, the findings indicate that efforts to improve sustainability in Bumi Harapan should include strengthening waste management and clean-water services, maintaining green open space, supporting village markets and leading local commodities, increasing community participation and environmental empowerment, and improving participatory decision-making, complaint services, and village information systems. These interventions are not presented as a formal priority ranking but as areas requiring integrated attention based on the sustainability and

leverage results.

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AUTHOR CONTRIBUTION STATEMENT

Oza Satria: Conceptualization, methodology, investigation, data curation, formal analysis, visualization, writing – original draft, and project administration. Ernan Rustiadi: Conceptualization, methodology, supervision, validation, writing – review and editing, and critical revision of the manuscript. Sugeng Budiharsono: Supervision, validation, results interpretation, writing – review and editing, and critical revision of the manuscript. All authors have read and approved the final version of the manuscript.

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