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ANALYSIS OF TOURISM SUSTAINABILITY IN CISANGKU CONSERVATION VILLAGE USING A MULTIDIMENSIONAL APPROACH

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Abstract

Conservation-based tourism is a strategic approach to sustainable development because it integrates economic, social, and environmental aspects. Cisangku Conservation Village in Malasari Village, Bogor Halimun Salak Geopark Area, has the potential to become a sustainable tourism destination based on conservation and community empowerment, although it still faces various management challenges. This study aims to analyze the level of tourism sustainability in Cisangku Conservation Village multidimensionally. The method used is Multidimensional Scaling (MDS) through the RAP-Tourism tool with five dimensions of sustainability: ecology, economy, social, infrastructure, and institutions. Data were obtained through field observations, questionnaires with 100 tourists, and interviews with key informants selected purposively. Sensitivity analysis was used to identify the attributes that most influence sustainability. The results showed that the tourism sustainability index of Cisangku Conservation Village was 68.53, which is categorized as moderately sustainable. The social dimension is categorized as highly sustainable, while the other dimensions are categorized as moderately sustainable. In conclusion, tourism sustainability in Cisangku Conservation Village is determined by the integration of environmental management, community participation, infrastructure support, and strengthening local institutions.

Keywords: Sustainability Analysis, Conservation, Bogor Geopark, Sustainable Tourism.

INTRODUCTION

Tourism is a strategic sector that plays a crucial role in driving regional economic growth by increasing income, creating jobs, and strengthening the local business sector (Manthofi & Aisyah, 2024). Integration between these sectors creates new economic opportunities for local communities and increases the added value of local resources (Sintia & Nurhayati, 2025). Its development strengthens intersectoral linkages, increases the added value of local resources, and strengthens the competitiveness of destinations. According to research by Saputra and Wahyuni (2022), sustainable tourism development requires integration between economic, social, and environmental aspects to create an optimal balance. However, the intensive growth of this sector without considering sustainability aspects often results in environmental degradation and social inequality in tourist destinations. Therefore, a tourism development model that simultaneously integrates economic, environmental, and sociocultural dimensions is becoming increasingly important for the development of rural tourism destinations and conservation areas (Punzo et al., 2022).

The multidimensional sustainability approach in tourism is increasingly recognized as an evaluative framework that is not only conceptual but also methodological in assessing the impact of tourism activities comprehensively, because the concept of sustainable tourism involves the simultaneous interaction of economic, social, cultural, and environmental dimensions that cannot be understood through single or partial indicators alone. Recent research shows that to measure the sustainability performance of a destination holistically, an indicator system is needed that can cover all three main dimensions so that it can provide a valid and integrated picture for the effective planning and management of sustainable tourism destinations (for example, by determining the weights and priorities of indicators using multi-criteria decision-making methods) and overcome the complexity of measurement that arises from the multidimensional nature of the phenomenon (Komalasari & Herwangi, 2023).

In the Indonesian context, ecotourism is the implementation of sustainable tourism that integrates environmental conservation with local community empowerment through tourism activities that encourage the conservation of natural and cultural resources while creating sustainable economic opportunities. Effective ecotourism development has been proven to improve community welfare and strengthen conservation values in tourism destination management (Juniawan, 2023). Indonesia also possesses significant geological riches, one of which is reflected in the Halimun Salak Geopark in Bogor Regency, West Java, which has scientific value and great potential as a sustainable, conservation-based tourism destination (Sukamto et al., 2023).

As part of the Bogor Halimun Salak Geopark, the Cisangku Conservation Village in Malasari Village has the potential to be developed as a model for conservation-based sustainable tourism that integrates economic, social, and environmental aspects through the utilization of local natural and cultural resources with community involvement. Geopark-based tourism village development practices, such as in the Kiarasari Tourism Village in the Pongkor Geopark area, demonstrate that management that emphasizes local uniqueness can improve community welfare without neglecting environmental preservation (Krisnawati, 2021). However, tourism development in the Cisangku Conservation Village still faces obstacles in the form of limited sustainable planning, community capacity, and infrastructure and destination promotion, which have the potential to hinder the optimization of the area's benefits and sustainability.

Without integrated planning, tourism development risks encouraging overexploitation of natural resources and widening social inequalities at the local level, as demonstrated by various studies linking unsustainable tourism to environmental degradation and unequal distribution of economic benefits (Jumadi et al. 2025). Therefore, evaluating tourism sustainability through a multidimensional approach is crucial for identifying the strengths, weaknesses, opportunities, and challenges of developing conservation-based tourism destinations like the Cisangku Conservation Village. This approach allows for the formulation of tourism management strategies that are oriented not only toward local economic growth but also ensure socio-cultural sustainability and environmental preservation, so that the long-term benefits of tourism can be enjoyed equally by the community and surrounding ecosystems.

METHOD

This research was conducted in the Cisangku Conservation Village, located in the Bogor Halimun Salak Geopark area, Bogor Regency, West Java Province (Figure 1). The study was conducted from April to July 2025.

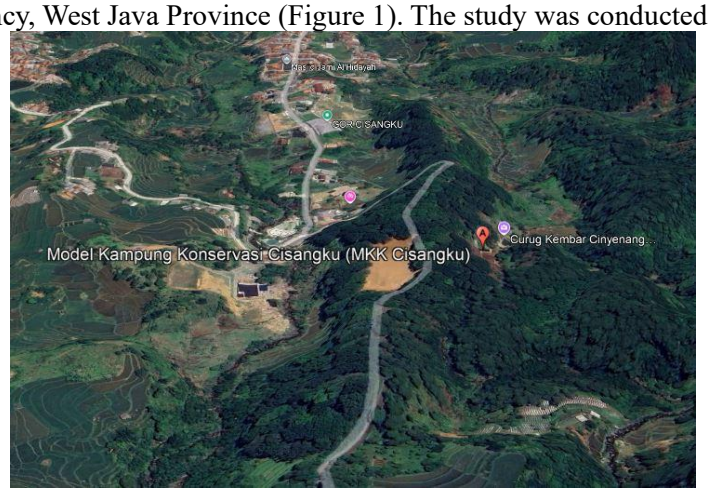

Figure 1. Research Location

2.1 Tools and Materials

The research equipment and materials included hardware and software such as a camera, a computer or laptop, and Rapfish (RAP-Tourism) software. Additionally, stationery, a questionnaire, and supporting documents included an administrative map of Malasari Village, tourist visit statistics, and laws and regulations related to the management of the Bogor Halimun Salak Geopark.

2.2 Data Collection and Analysis

The main data sources for this study were obtained from key informants and respondents selected purposively. Key informants were stakeholders with relevant knowledge of the research topic, including the managers of the Cisangku Conservation Village, the KTH MKK Cisangku Village, the Mount Halimun Salak National Park Office, and the CSR of PT Antam, who provided information related to the social, economic, and

environmental management conditions in Malasari Village. The research respondents consisted of 100 tourists selected using purposive sampling to obtain an assessment of the facilities and infrastructure of the Cisangku Conservation Village. Data collection was carried out by distributing questionnaires during the area's operational hours, namely 08.00–17.00 WIB, with the number of respondents determined using the Slovin formula (Prasetyo & Jannah, 2007):

$$n = N/(1+Ne^2) \quad \ldots\ldots (1)$$

Information:
n = Number of respondents
N = Population size
e = Percentage of tolerance for inaccuracy due to sample error that can still be tolerated

The sustainability analysis of the Cisangku Conservation Village was conducted using the Multidimensional Scaling (MDS) approach through the RAP-Tourism tool, which is a development of the Rapfish (Rapid Appraisal for Fisheries) method based on the University of British Columbia analytical framework (Kavanagh, 2004). This approach is used to systematically and measurably identify, quantify, and evaluate sustainability indicators. The Multidimensional Scaling (MDS) approach is a statistical analysis tool that utilizes software such as Rapfish or SPSS to comprehensively evaluate tourism sustainability, covering social, economic, and environmental aspects (Marhayudi, 2006). In this study, tourism sustainability was analyzed based on five main dimensions, namely environmental, economic, socio-cultural, institutional, and infrastructure, with indicators adapted from previous research and supported by field observations (Suddin et al., 2017; Trisnanto et al., 2023; Yolanda et al., 2023; Adi et al., 2024).

According to Fauzi and Anna (2002), the RAP-Tourism analysis includes data collection and processing, determining the indicator scoring system, Multidimensional Scaling (MDS) analysis using the ALSCAL algorithm in SPSS, determining the sustainability position through ordination rotation, and sensitivity analysis to identify the most influential indicators. The resulting sustainability index has a scale of 0–100, with the sustainability position determined based on the ordination point relative to good and bad conditions (Raymond et al., 2011).

Table 1. Sustainability Index Values

Mark	Category Index
0 – 25	Bad (not sustainable)
26 – 50	Less (less sustainable)
51 – 75	Sufficient (sufficiently sustainable)
76 – 100	Good (very sustainable)

Source: (Fauzi, Anna 2005).

Table 2. Indicators for Each Dimension

No.	Dimensions	Scoring Indicators and References
1	Ecology	1) Air quality in the Cisangku Conservation Village area
		2) Noise levels in conservation and residential areas
		3) Waste management and sorting in conservation and residential areas
		4) Availability and quality of clean water sources for residents and conservation
		5) Condition and suitability of land for conservation and tourism use
		6) Biodiversity of flora and fauna in Cisangku Conservation Village
		7) Efforts to restore and preserve natural resources by the community
2	Economy	1) Absorption of local labor in conservation and tourism activities
		2) Average community income from conservation and tourism businesses
		3) Contribution of conservation and tourism businesses to village and geopark economies
		4) Quality and competitiveness of local products (crafts, agricultural products, food)
		5) Potential domestic and international tourism markets
		6) Length of stay of tourists and its impact on the local economy
		7) Accessibility and transportation costs to the Conservation Village
3	Social	1) Level of community participation in managing conservation villages and geoparks

No.	Dimensions	Scoring Indicators and References
		2) Level of education and public understanding of conservation and the environment
		3) Public awareness of the importance of preserving culture and nature
		4) The influence of conservation and geoparks on local social and cultural life
		5) Involvement of women and marginalized groups in conservation and tourism activities
		6) The level of social conflict or differences of interest regarding the management of conservation villages
		7) Community support for geopark conservation and development programs
4	Infrastructure	1) Condition of road access to and within Cisangku Conservation Village
		2) Availability of clean water facilities for residents and tourists
		3) Waste management and recycling facilities in the village
		4) Availability and quality of accommodation (homestays, guesthouses)
		5) Availability and quality of telecommunications and internet networks
		6) Access and availability of public transportation to the village
		7) Availability of conservation support facilities (observation posts, education centers)
5	Institutional	1) Availability of rules and policies for managing conservation villages and geoparks
		2) Coordination between stakeholders (government, community, NGOs)
		3) Frequency of meetings and coordination of conservation management
		4) Community understanding of technical guidelines for conservation and management
		5) Quality of management of conservation village management
		6) Sustainability of institutional structures for conservation and community empowerment
		7) Active support from the government and private sector in managing conservation villages

RESULTS AND DISCUSSION

3.1 Overview of Research Location

Cisangku Conservation Village is located in Malasari Village, Nanggung District, Bogor Regency, and is part of the Mount Halimun Salak National Park (TNGHS) area. Since its establishment in 2007 as a Model Conservation Village (MKK), this area has integrated environmental conservation with local community empowerment through various conservation-based activities, such as TNGHS endemic tree nurseries, Garut sheep farming, bokashi fertilizer production, and the development of traditionally processed Arabica coffee. In addition, Cisangku Village develops community-based ecotourism by utilizing the natural potential of Curug Kembar, two 12-meter-high waterfalls, which are supported by supporting facilities such as camping grounds, swimming pools, gazebos, and local stalls. The successful management of Cisangku Conservation Village is inseparable from the support of PT Antam UPBE Pongkor through the Corporate Social Responsibility (CSR) Pepeling (Community Empowerment Based on Environmental Conservation) program, which contributes to increasing community capacity, economic welfare, and the sustainability of participatory natural resource management.

3.2 Tourism Sustainability Analysis

The analysis results show that the Cisangku Conservation Village in Malasari Village, Bogor Halimun Salak Geopark, has a sustainability index of 68.53, categorized as moderately sustainable based on five dimensions: ecology, economy, social, infrastructure, and institutions. The validity of the results is supported by the stress value and the coefficient of determination (R^2), which indicate the goodness-of-fit of the MDS model to the data. The sustainability index per dimension is presented in Table 3.

Table 3. Sustainability index and parameter values of Cisangku Village

Dimensions Sustainability	Index Sustainability	Sustainability Status	Parameters (%)	
			Stress	*R-square*
Ecology	73.73	Sustainable Enough	14.10	94.47
Economy	57.74	Sustainable Enough	14.80	94.32
Social	83.54	Highly Sustainable	13.99	94.47
Infrastructure	55.23	Sustainable Enough	15.34	94.16
Institutional	72.39	Sustainable Enough	14.10	94.38
Average	68.53	Sustainable Enough		

3.2.1 Ecological Dimension

The results of the MDS analysis using RAP-Village show that the ecological dimension sustainability status index value of the Cisangku Conservation Village in Malasari Village in the Bogor Halimun Salak Geopark Area from seven attributes is 73.73. This value indicates a fairly sustainable result, where a high RMS value indicates that an attribute has a significant level of sensitivity and influence (Fauzi, 2019). The results of the sustainability index analysis are shown in Figure 2 below.

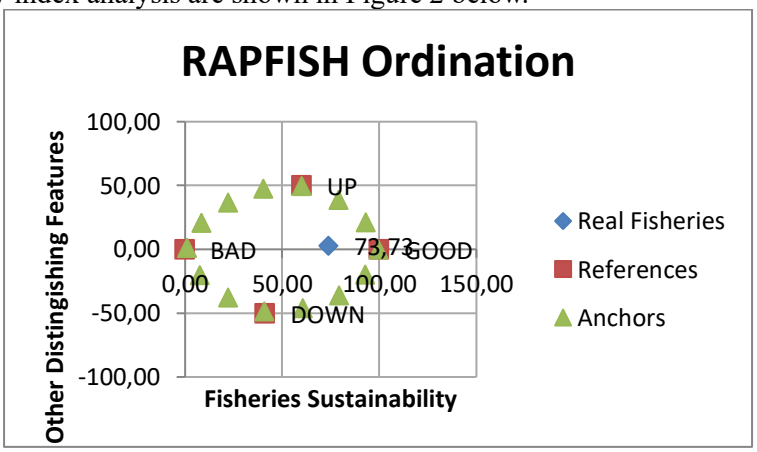

Figure 2. Rap-Village Ordination of ecological dimensions

In the ecological dimension, three attributes showed a high level of sensitivity to the sustainability index of the Cisangku Conservation Village in Malasari Village, Bogor Halimun Salak Geopark Area. The waste management and sorting attribute had the greatest influence with a Root Mean Square (RMS) value of 9.33, indicating that inadequate waste management has the potential to cause environmental pollution, disrupt conservation ecosystems, and reduce tourist attractions. Therefore, the implementation of an integrated and sustainable waste management system is a key factor in maintaining the environmental quality of the area.

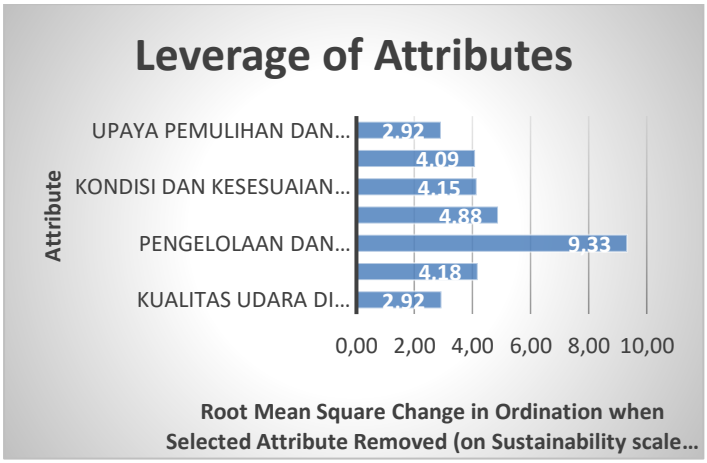

Figure 3. Analysis of ecological dimension leverage

Other attributes with a significant influence are the availability and quality of clean water sources (RMS 4.88) and noise levels in conservation areas and settlements (RMS 4.18). Adequate clean water availability plays a crucial role in maintaining ecosystem balance and community well-being, while high noise levels can disturb fauna and reduce tourist comfort. These three attributes are interrelated and are determining factors in the ecological sustainability of the Cisangku Conservation Village (Figure 3).

3.2.2 Economic Dimension

The results of the MDS analysis using RAP-Village showed a sustainability index value of 57.74 for the economic dimension of the Cisangku Conservation Village in Malasari Village within the Bogor Halimun Salak Geopark Area, based on seven attributes. This value indicates a fairly sustainable outcome. The results of the sustainability index analysis are shown in Figure 4.

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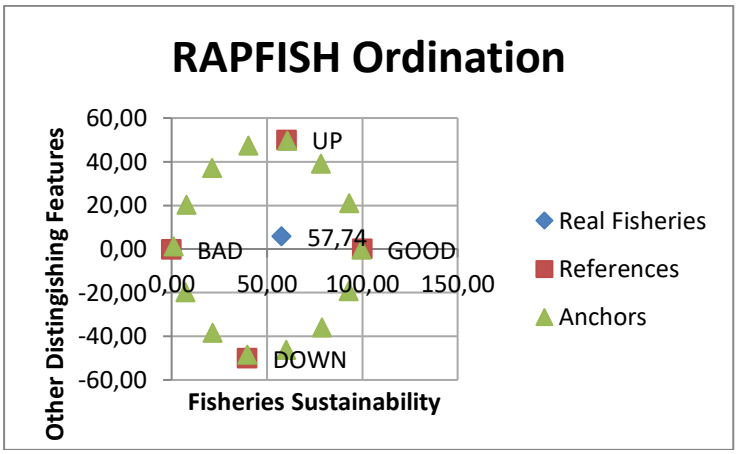

Figure 4. Rap-Village Ordination of economic dimensions

In the economic dimension, three attributes demonstrate high sensitivity to the sustainability index of the Cisangku Conservation Village. The potential of domestic and international tourism markets has the greatest influence (RMS 5.02), indicating the potential for increased visits and revenue if supported by adequate marketing strategies and facilities. Tourist length of stay also contributes significantly (RMS 3.62) because it is positively correlated with increased tourist spending, which encourages the growth of local businesses, such as homestays, culinary delights, and crafts, making the development of diverse tourism packages crucial.

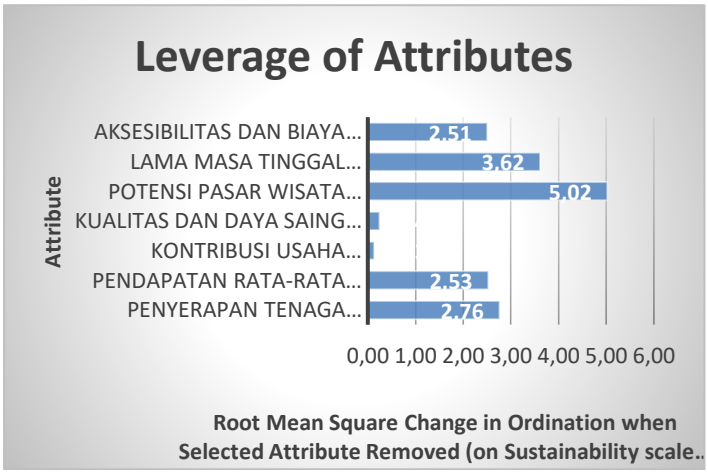

Figure 5. Analysis of economic dimension leverage

Furthermore, local employment in conservation and tourism activities (RMS 2.76) reflects the sector's role in creating jobs, increasing household incomes, and strengthening community ownership of sustainability

programs. Overall, increased tourist visits have a positive impact on employment and strengthen the multiplier effect in the local economy, supporting regional economic sustainability (Syahrif, 2025; Figure 5).

3.2.3 Social Dimension

The results of the MDS analysis using RAP-Village show that the social dimension sustainability status index value of the Cisangku Conservation Village in Malasari Village in the Bogor Halimun Salak Geopark Area is 83.54 based on seven attributes. This value indicates highly sustainable results. This value indicates less sustainable results. The results of the sustainability index analysis are shown in Figure 6.

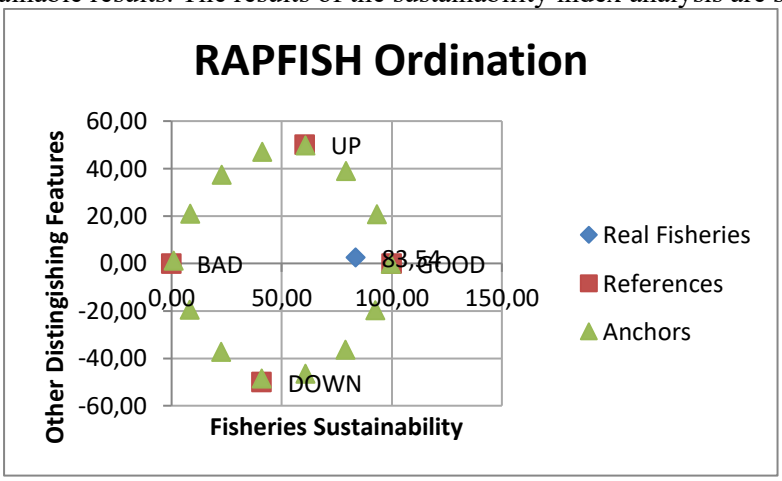

Figure 6. Rap-Village Ordination of social dimensions

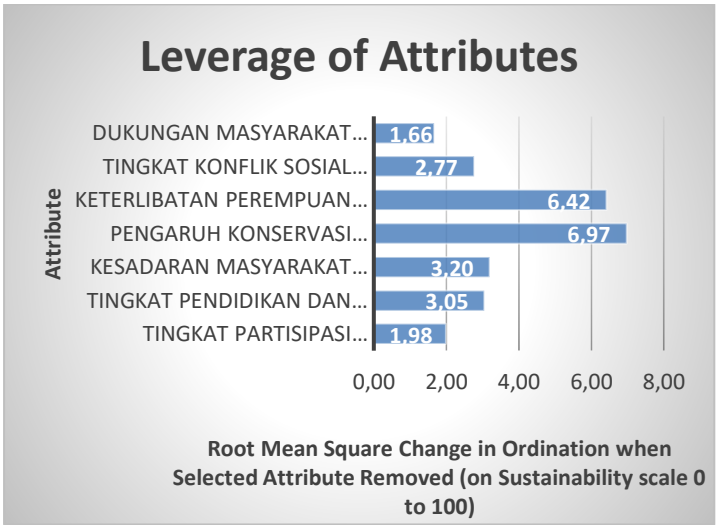

Figure 7. Analysis of social dimension leverage

In the social dimension, three attributes demonstrated high sensitivity to the sustainability index of the Cisangku Conservation Village. The influence of conservation and geopark activities on local social and cultural life had the largest contribution (RMS 6.97), which emphasized the importance of conservation management that can strengthen cultural values and social cohesion in the community. The involvement of women and marginalized groups also had a significant impact (RMS 6.42), as it encouraged equitable distribution of economic benefits and strengthened inclusiveness in conservation village management; an inclusive, participatory approach has been shown to increase the sustainability of community-based programs (Scheyvens, 1999; UNWTO, 2018). Furthermore, community awareness of cultural and natural preservation (RMS 3.20) was an important supporting factor in encouraging voluntary participation and building long-term commitment to conservation efforts (Figure 7).

3.2.4 Infrastructure Dimension

The results of the MDS analysis using RAP-Village show that the sustainability status index value of the infrastructure dimension of the Cisangku Conservation Village in Malasari Village in the Bogor Halimun Salak Geopark Area is 55.23, representing a relatively sustainable result. The results of the sustainability index analysis are shown in Figure 8.

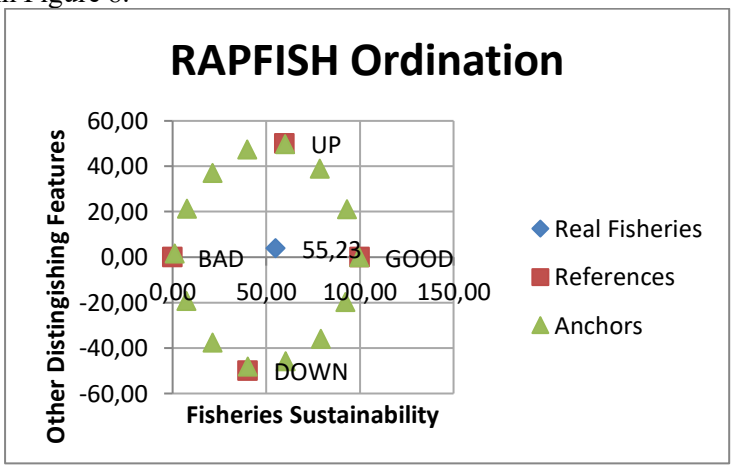

Figure 8. Rap-Village Infrastructure dimension ordination

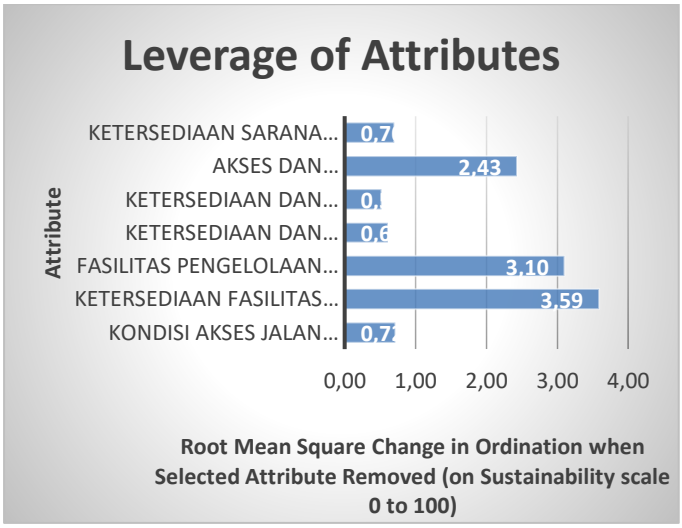

Figure 9. Infrastructure dimension leverage analysis

Within the infrastructure dimension, three attributes demonstrated high sensitivity to the sustainability index of the Cisangku Conservation Village. The availability of clean water facilities for residents and tourists had the greatest influence (RMS 3.59), confirming its role as a basic need for health, comfort, and destination attractiveness. Waste management and recycling facilities also contributed significantly (RMS 3.10) to maintaining environmental cleanliness, preventing pollution, and supporting sustainable tourism. Furthermore, access to and availability of public transportation (RMS 2.43) played a crucial role in increasing area accessibility and supporting community mobility and conservation management activities. These three attributes are interrelated and are determining factors in the sustainability of the infrastructure dimension of the Cisangku Conservation Village (Figure 9).

3.2.5 Institutional Dimension

The results of the MDS analysis using RAP-Village show that the sustainability status index value of the institutional dimension of the Cisangku Conservation Village in Malasari Village in the Bogor Halimun Salak Geopark Area is 72.39, representing a relatively sustainable result. The results of the sustainability index analysis are shown in Figure 10.

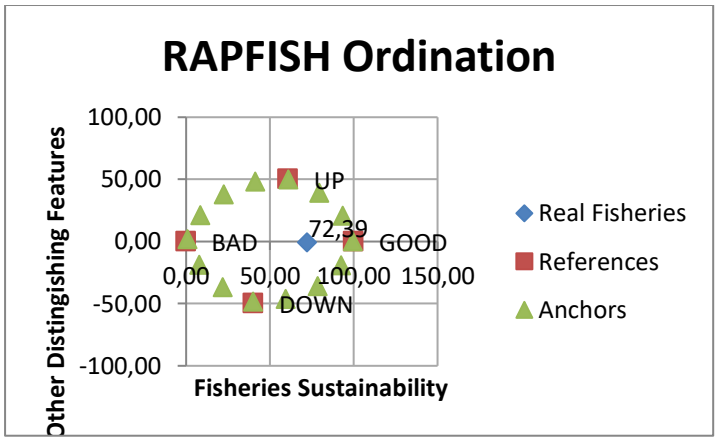

Figure 10. Rap-Village Ordination of institutional dimensions

Within the institutional dimension, three attributes demonstrated high sensitivity to the sustainability index of the Cisangku Conservation Village. The quality of conservation village management had the greatest influence (RMS 8.70), emphasizing the importance of a professional and structured management system for effective conservation program implementation and synchronization of stakeholder interests. Community understanding of conservation technical guidelines contributed significantly (RMS 5.40) as a foundation for active community participation, while the sustainability of institutional structures (RMS 4.36) emphasized the need for strong and independent local institutions to ensure program continuity and strengthen community collaboration in resource management, supporting long-term sustainability (Figure 11; Massiri et al., 2019).

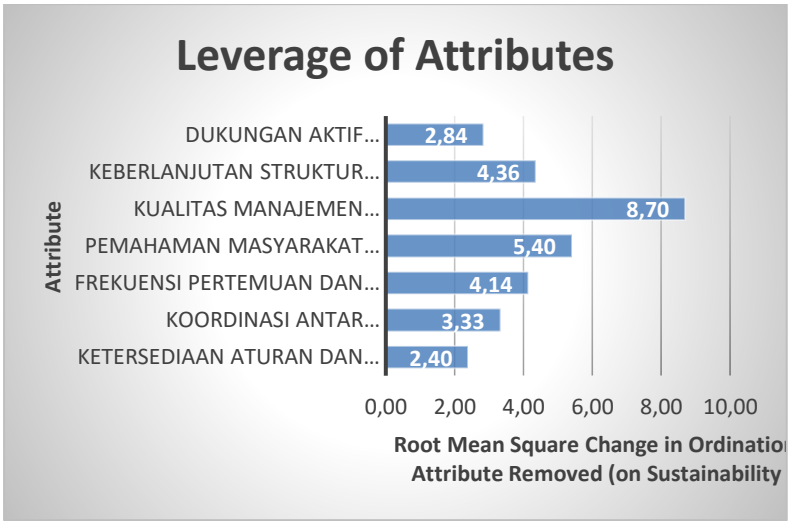

Figure 11. Analysis of institutional dimension leverage

CONCLUSION

This study shows that the sustainability status of Cisangku Conservation Village tourism in Malasari Village, Bogor Halimun Salak Geopark Area, is in the moderately sustainable category, with a sustainability index value of 68.53. The results of multidimensional analysis using the Multidimensional Scaling (MDS) method through RAP-Tourism indicate that conservation-based tourism management in this area has integrated ecological, economic, social, infrastructure, and institutional aspects in a relatively balanced manner. The social dimension shows the most optimal performance with a very sustainable category, which is mainly supported by the strong influence of conservation on local socio-cultural life, the involvement of women and marginalized groups, and high public awareness of the importance of environmental and cultural preservation. Meanwhile, the ecological, economic, infrastructure, and institutional dimensions remain in the moderately sustainable category, with a number of sensitive attributes requiring management priorities, including waste management and clean water availability, developing tourism market potential and increasing tourist length of stay, providing basic infrastructure, and strengthening the quality of management and local institutional structures. These findings confirm that the sustainability of tourism in

the Cisangku Conservation Village is highly dependent on strengthening community capacity, improving coordination between stakeholders, and implementing integrated and long-term management strategies, to ensure that economic, social, and environmental benefits are distributed equitably and sustainably.

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