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Evaluating the Sustainability Status of Pinus Sari Forest as an Ecotourism Destination Using Multi-Dimensional Scaling

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ABSTRACT

Ecotourism is a type of forest management that places a strong emphasis on the idea of balancing the use of forest resources for both environmental and economic purposes. Pinus Sari Forest (PSF) is an ecotourism object destination with the main tourist attraction being old pine trees which mark the shift from pine sap harvesting to tourism activities. Due to the transition of forest management in PSF, it is necessary to assess the sustainability of ecotourism activities. This research aims to assess the sustainability status of PSF ecotourism object destinations. This research used a multi-dimensional scaling (MDS) method to cover the five specific dimensions, namely ecological, economic, social, legal and institutional, as well as accessibility and infrastructure with the given number of attributes in each dimension. This research reveals that the ecological (74.95%), economic (69.46%), social (59.5%), legal and institutional (57.42%), accessibility and infrastructure (58.66%) dimensions are all classified as moderately sustainable. Based on the sustainability index of these five dimensions, this research concludes that the level of sustainability of this PSF ecotourism object destination is moderately sustainable, with an obtained index of 62.77%. We recommend the operator evaluate and manage the sensitive attributes properly to escalate the sustainability status of the PSF ecotourism destination.

1. INTRODUCTION

The Pinus Sari Forest (PSF) is a protected forest dominated by pine trees (*Pinus merkusii*) which generate low productivity of latex due to the age of pine trees. The existence of non-productive trees has not been replanted but shifted to ecotourism object destinations and environmental services to protect the biodiversity and derive the economic value of the forest for the community that has a high dependence on forest resources [1]. The policy aspect shows that the government supports community involvement in PSF ecotourism management. Regional Regulation (*Peraturan Daerah*/Perda) DIY No. 7/2015 and Governor Regulation (*Peraturan Gubernur/Pergub*) DIY No. 5/2018 explain the form of cooperation between the government and the community that states profit sharing, 75% for cooperatives (community) and 25% for the government [2]. The proportion of profit sharing for the community is three times higher than the government, demonstrating the government's commitment to enhancing community welfare that lives around forest areas by providing the right access to forest resources [3].

The transition of forest management activities in PSF from pin sap tapping to ecotourism impacts both the community and the ecosystem. Ecotourism inside forest areas has a positive impact in terms of enhancing community welfare, but it harms the environment because the number of people accessing the forest increases [4]. To address this problem, *Kesatuan Pengelolaan Hutan* (Forest Management Unit/FMU) Yogyakarta executes the cooperation agreement with the cooperative by stipulating a maximum of 10% of protected forest areas may be managed as ecotourism areas. Thus far, the 29.4 hectares of ecotourism in *Resort Pengelolaan Hutan* (RPH) Mangunan account for barely 5% of the protected forest area [2].

Ecotourism is a non-land-based model of sustainable forest management that emphasizes the principles of forest resource utilization through environmental services, while minimizing negative environmental impacts and can contribute to poverty eradication by increasing peoples' direct financial benefits [5]. Community-based ecotourism is defined as a model of environmental management that involves managing forest areas as tourism areas by the community surrounding the forest area [6]. In ecotourism management, the community plays a crucial role in controlling over design, development, implementation, and distribution of benefits [7]. Ecotourism management must be wisely sensible to achieve sustainable

ecotourism that meets the demands of the economy, society, and environment in the present while providing benefits for future generations [8]. Sustainable ecotourism occurs when multi-stakeholders: the tourism sector, tourists, government, local communities, and researchers not only play the role but also collaborate holistically among stakeholders [9].

Numerous studies on sustainable ecotourism management have been examined by various researchers [10-14]. Some of the dimensions used in the assessment in other studies include environmental, economic, sociocultural, and institutional/ governance. In this study, the ecotourism sustainability index assessment is determined across five dimensions, namely ecological, economic, social, legal and institutional, as well as accessibility and infrastructure. The most critical things in assessing the sustainability index rely not only on the number of dimensions, but also on determining the qualities of each dimension to capture the state of each dimension [15].

Although there is an increase in research on assessing the sustainability of tourist attractions, PSF has yet to conduct a sustainable ecotourism assessment. This assessment is important considering that PSF is undergoing a management transition from pine resin tapping to an ecotourism destination. This study aimed to assess the sustainability status of PSF ecotourism as a basis for future development plans. The assessment of each dimension provides an understanding of the aspects that need to be maintained or improved so that the PSF tourist attraction runs sustainably.

2. RESEARCH METHODS

This study was conducted in PSF ecotourism object destination from June to September 2022. The PSF ecotourism object destination is located in Mangunan Village, Dlingo District, Bantul Regency, Special Region of Yogyakarta Province. This study location was chosen purposively considering ecotourism management that combines aspects of nature conservation, local community empowerment, and increasing environmental awareness. The PSF ecotourism destination is located in the protected forest area of Blok Sudimoro II and III, *Resort Pengelolaan Hutan* (RPH) Mangunan, *Bagian Daerah Hutan* (BDH) Kulonprogo-Bantul. Wana Wisata Mangunan is a community groups that manage the 9.3 hectares PSF which serves as the primary ecotourism object destination. The dominant vegetation covering the ecotourism object destination is *Pinus merkusii* (refer to Figure 1).

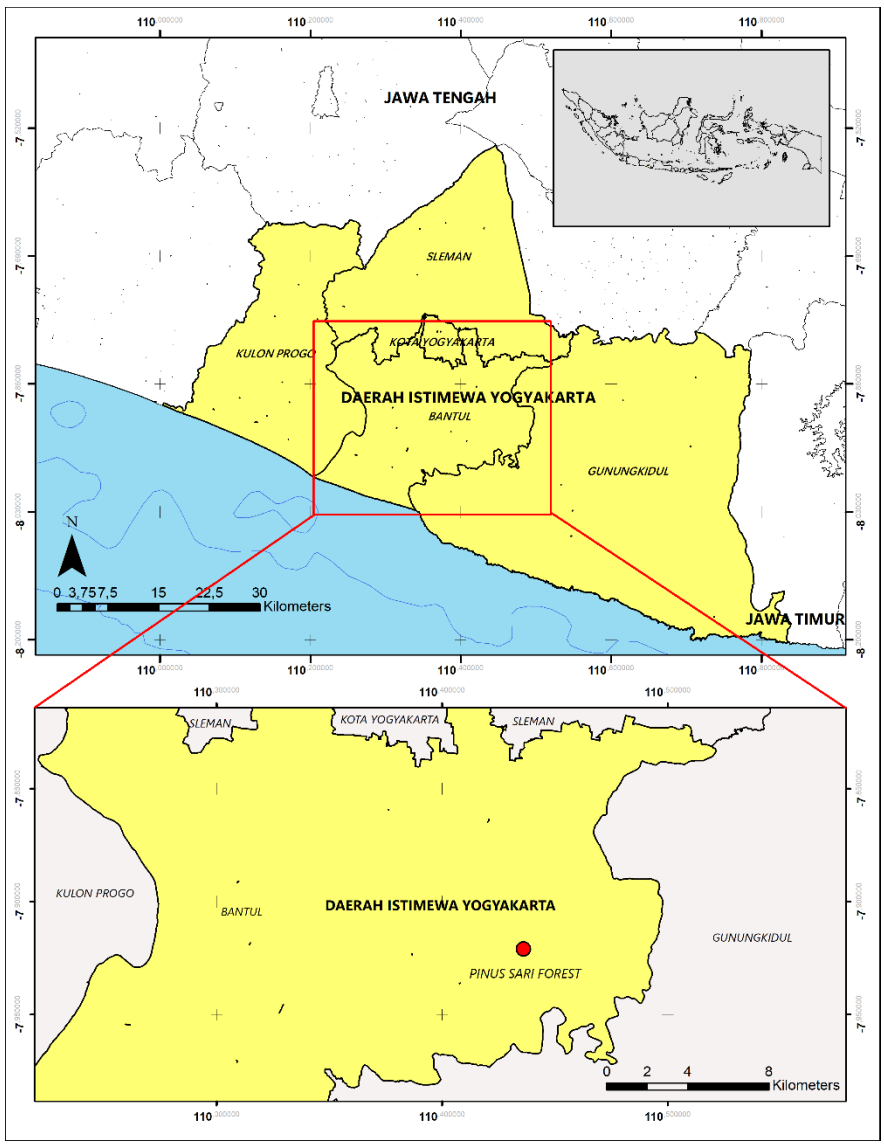

Figure 1. Study location of PSF ecotourism object destination in Bantul Regency, Yogyakarta

Data was collected by field survey results, interviews, and questionnaire distribution at the study location (Table A1). The researcher distributed a questionnaire to the respondents and then asked the follow up questions regarding their responses. The population in this study was divided into three groups: tourists, ecotourism management, and community groups that play a key part in ecotourism management activities. The sample of the tourist group was selected through accidental sampling, this technique was carried out based on the tourists who were accidentally encountered by researchers at the study location and were qualified as data sources [16].

Purposive sampling is used to determine the sample of community groups for ecotourism management. This technique is carried out by selecting respondents using a limited and effective set of criteria selected to answer the research objectives [17]. The following requirements for the ecotourism management and community groups selected in this study were 1) community around PSF ecotourism object destination, 2) actively involved in ecotourism management activities, and 3) receiving benefits from managing PSF ecotourism object destination. This study implies the respondents based on the principles of suitability and adequacy, which the number of respondents is not quantity oriented but based on the completeness of the data and information acquired [18]. Based on these principles, this study involves 38 respondents from the tourist group, 8 respondents from the ecotourism management group, and 16 respondents from community group.

Assessment of sustainable ecotourism can be done by MDS analysis using the Rapid Appraisal Technique for Evaluating Ecotourism Sustainability (RAP-Ecotourism) software which is a modified version of the Rapid Appraisal Technique for evaluating Fisheries Sustainability (RapFish). MDS Rap-Ecotourism offers the advantage of providing fast sustainability information to aid decision-makings through easy-to-understand visuals based on participatory activities. However, MDS Rap-Ecotourism has a weakness related to the subjectivity of its assessment based on the perception of respondents, thus researchers are required to crosscheck the data based on field observation [19]. The stages of ecotourism sustainability analysis consist of (1) identifying sustainable issues, (2) determining the ecotourism sustainable management analysis and attributes for each dimension, (3) attribute assessment on an ordinal scale based on the sustainability criteria for each dimension, (4) and preparation of index and sustainable status of ecotourism object [20] (refer to Table 1).

Table 1. Category of sustainability index to evaluate the sustainability status

No.	Index Value (%)	Category
1	0.00-25.00	Unsustainable
2	25.01-50.00	Less sustainable
3	50.01-75.00	Moderately sustainable
4	75.01-100.00	Sustainable

The questionnaire consists of five variables related to ecological, economic, social, legal, and institutional, as well as accessibility and infrastructure. Each dimension has 8 attributes that contribute to the sustainability analysis results. Assessment criteria provide 4 value ranges for each attribute with “good” and “bad” being the extreme value. The dimensions and attributes that used in this research questionnaire are listed in Table 2.

Table 2. Dimension and attributes of PSF ecotourism sustainability analysis

No.	Dimension	Attribute
1	Ecological	• Clean water availability • Waste management • Preservation of natural landscape • Tree diversity • Management of biodiversity • Presence of nuisance animals • Exploitation rate of tourism areas • Land cover
2	Economic	• Income growth • Contribution to local government revenue (*Pendapatan Asli Daerah* / PAD) • Job opportunities • Business diversification • Traveler retribution • Increased tourist purchasing power • Tourist visitation rate • Availability of funding sources
3	Social	• Education level • Unemployment rate • Environmental knowledge for travelers • Education and training for operator • Community involvement in forest management • Existence of local wisdom • Potential conflicts • Level of security
4	Legal and Institutional	• Availability of formal management regulations • Policy-making involves the community • Level of community compliance with rules • Coordination between stakeholders • Division of roles between groups • Law enforcement • Coaching and assistance • Monitoring and evaluation of ecotourism management
5	Accessibility and Infrastructure	• Facilities and infrastructure • Access to transportation • Access to information • Communication access • Tourism promotion • Electricity availability • Health facilities • Facility maintenance

3. RESULTS

Sensitivity analysis was conducted to evaluate the contribution of each dimensional attribute to overall influence using the leverage analysis approach based on the Root Mean Square (RMS) values [21]. The higher the RMS value, the more significant role of the sensitive attribute plays in the sustainability status [22]. The 5-dimensional leverage analysis

value of PSF ecotourism ranges between 0.01 and 4.78 (Table 3). Sensitive attributes determine based on the highest values of RMS (one or two attributes) on each dimension [23]. The results of processing attribute data for the management of the PSF ecotourism object destination on the dimensions reveal the value of each attribute in each dimension according to the conditions at the time of the study (Table 4).

Table 3. Leverage of attributes each dimension

Dimension	Attribute	RMS
Ecological	• Preservation of natural landscape	**4.07**
	• Presence of nuisance animals	**4.07**
	• Waste management	3.98
	• Exploitation rate of tourism areas	3.93
	• Tree diversity	3.84
	• Management of biodiversity	3.71
	• Clean water availability	3.63
	• Land cover	3.31
Economic	• Businesses diversification	**4.78**
	• Job opportunities	**4.50**
	• Contribution to local government revenue (PAD)	3.48
	• Travel retribution	2.86
	• Increased tourist purchasing power	2.84
	• Tourist visitation rate	2.47
	• Availability of funding sources	2.08
	• Income growth	1.66
Social	• Community involvement in forest management	**4.76**
	• Education and training for operator	**4.65**
	• Potential conflicts	3.87
	• Unemployment rate	3.55
	• Education level	1.82
	• Level of security	0.95
	• Environmental knowledge for travelers	0.94
	• Existence of local wisdom	0.33
Legal & Institutional	• Coaching and assistance	**1.89**
	• Monitoring and evaluation of ecotourism management	1.50
	• Availability of formal management regulations	0.26
	• Coordination between stakeholders	0.14
	• Division of roles between groups	0.12
	• Level of community compliance with rules	0.09
	• Policy making involves the community	0.05
	• Law enforecement	0.01
Accessibility & Infrastructure	• Tourism promotion	**4.72**
	• Health facilities	3.06
	• Facility maintenance	1.26
	• Electricity availability	0.37
	• Facilities and infrastructure	0.36
	• Access to transportation	0.24
	• Access to information	0.05
	• Communication access	0.02

The Monte Carlo analysis is used to determine the differences between ordinance values. Ordinance results could assist in overcoming random issues in scatter plots [14]. The results of the Monte Carlo analysis that developed the impact of random errors on these dimensions indicates that all of the Monte Carlo exchange rates have an index value of less than 5 (Table 4). The small validity value of the Monte Carlo analysis indicates that the data acquisition and analysis errors are minor, and the study results are safe from errors [24]. Thus, the ecotourism management model is following actual conditions. Ecotourism index values are generally visualized in kite diagrams. Table 5 shows the stress value and the value of determination (R^2). The lower the stress value, the higher the goodness of fit [25]. A good model contains the stress value of less than 0.25, and a relatively better fitting model has the R^2 value of more than 80% [26]. Rap-Ecotourism analysis (Table 5) shows the stress value and the R^2 range from 0.1420-0.1515 and 94.33-94.81, respectively. The stress and R^2 values remain within the required range, so the data analysis complies with the requirements.

Table 4. The index value of sustainability status and Monte Carlo analysis

Dimension	Sustainability Dimension Index Value (%)	
	MDS	Monte Carlo (MC)
Ecological	74.95	72.63
Economic	69.46	67.87
Social	59.50	58.88
Legal & institutional	57.42	57.00
Accessibility & infrastructure	58.66	58.29

Table 5. Stress value and the value of determination (R^2) Rap-Ecotourism

Parameter	Dimension				
	Ecol.	Econ.	Soc.	Leg.	Acc.
Value of index*	74.95	69.46	59.50	57.42	58.66
Value of Stress**	0.142	0.145	0.148	0.152	0.146
Value of R^2***	94.81	94.65	94.51	94.33	94.55
Number of Iteration	2.00	2.00	2.00	2.00	2.00

Note: *: Index values 50.00-75.00 is simply sustainable, **: Stress value <0.25 is goodness of fit, ***: R^2 value >80% is excellence contribution.
[2] Ecol: ecological; Econ: economic; Soc: social; Leg: legal and institutional; Acc: accessibility and infrastructure

3.1 Ecological dimension

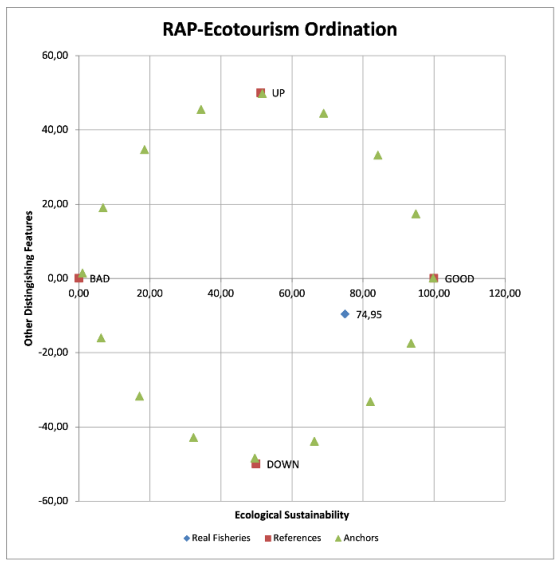

Figure 2. Ecological dimension MDS analysis result

The Rap-Ecotourism analysis on eight attributes in the dimension of ecological is 74.95% (Figure 2). The sustainability index is classified in the moderately sustainable category (50.01-75.00%). The difference between Monte Carlo and Rap-Ecotourism is 2.32% The value of less than 5% indicates that the data analysis results are valid [26]. The analysis of leverage factor for the ecological dimension show that two attributes are sensitive or affect the sustainability of ecotourism, such as the preservation of the natural landscape (RMS=4.07) and the presence of nuisance animals (RMS=4.07). These two sensitive attributes can significantly contribute to the existence of the PSF ecotourism object destination management.

3.2 Economic dimension

Rap-Ecotourism analysis shows that the economic dimensions sustainability index is 69.46% (Figure 3). The score indicates that the economic dimension is moderately sustainable, with the RMS values of business diversification (RMS=4.78) and job opportunities (RMS=4.50). Thus far, the types of businesses operated are food and beverage vendors, souvenir shops, several homestays, etc.

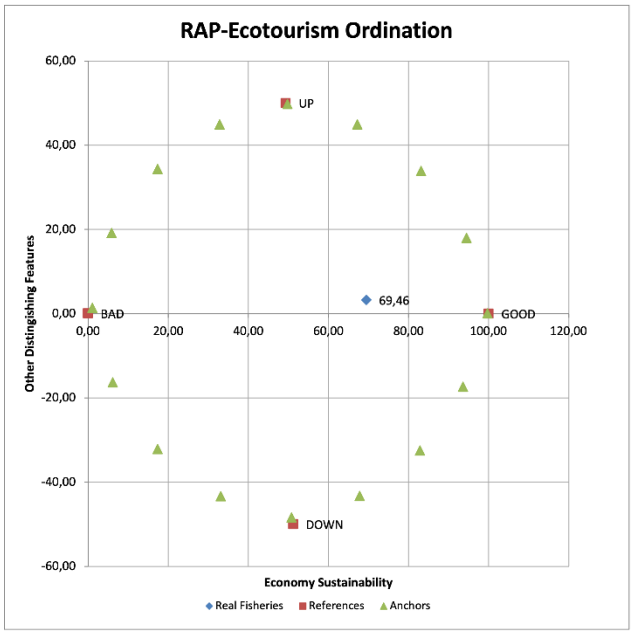

Figure 3. Economic dimension MDS analysis result

3.3 Social dimension

The results of the sustainability analysis on the social dimension place it in the moderately sustainable category, or with a sustainability index of 59.5% (Figure 4). Analysis of the eight attributes within the social dimension revealed that the two most influential factors are community involvement in forest management (RMS = 4.76) and education and training for operators (RMS = 4.65).

3.4 Legal and institutional dimension

The legal and institutional dimensions consist of eight attributes with a sustainable index value of 57.42% (Figure 5), which shows that the legal and institutional dimension is included in the moderately sustainable category. Three attributes have the most influence on the sustainability index, namely coaching and assistance (RMS=1.89). The coaching and assistance attribute has the highest RMS value compared to other attributes in this dimension. Therefore, the government through FMU Yogyakarta as the responsible party on PSF ecotourism object destination, needs to improve coaching and assistance to the community as operator of the ecotourism business unit to increase the value of the sustainability index.

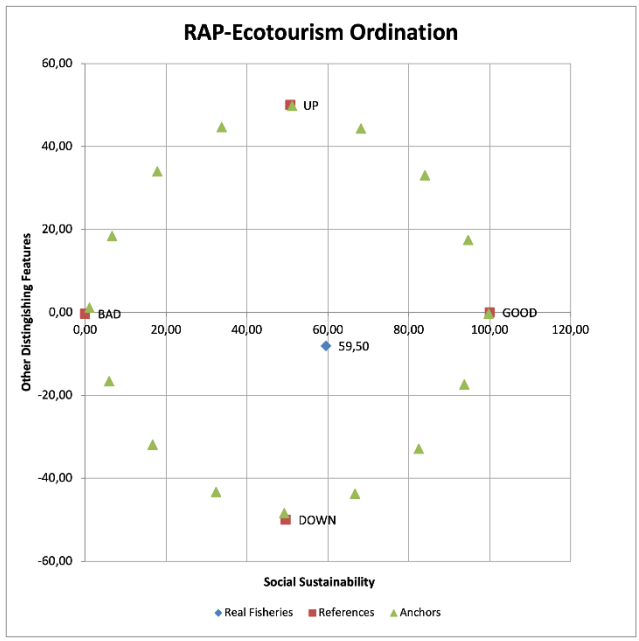

Figure 4. Social dimension MDS analysis result

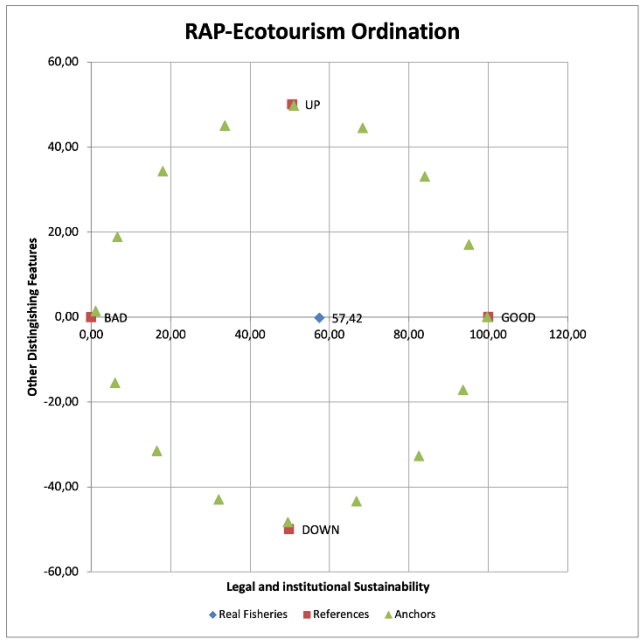

Figure 5. Legal and institutional MDS analysis result

3.5 Accessibility and infrastructure dimension

The results of the Rap-Ecotourism analysis on eight attributes in the dimensions of accessibility and infrastructure are 58.66% (Figure 6). The sustainability index falls in the moderately sustainable category (50.01-75.00%). Leverage factor analysis of the accessibility and infrastructure dimensions identifies one sensitive variable, namely tourism

promotion (RMS = 4.72), which significantly impacts the sustainability of ecotourism. These attributes can significantly contribute to the existence of the PSF ecotourism object destination management.

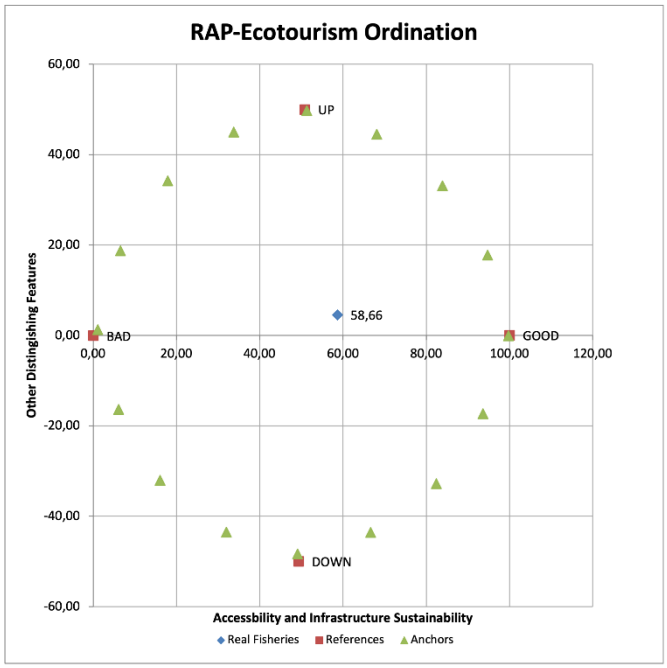

Figure 6. Accessibility and infrastructure MDS analysis result

The kite diagram results (Figure 7) indicate that all five dimensions are classified as moderately sustainable. It demonstrates that all dimensions of PSF ecotourism need to be improved to achieve the sustainable category. Assistance priorities can be sorted according to the lowest sustainability value, namely 1) legal and institutional; 2) social; 3) accessibility and infrastructure; 4) economic; and 5) ecological dimension. The ecological dimension requires the least assistance, as the existing sustainability value is close (<1%) to the sustainable category.

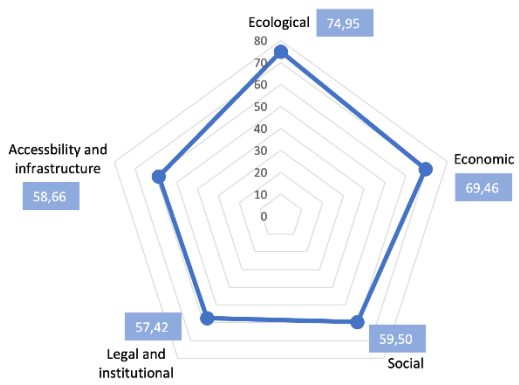

Figure 7. Kite diagram of the PSF based on Rap-Ecotourism analysis

4. DISCUSSION

First, we discussed sensitive attributes in the ecological dimension, namely waste management. The waste problem in tourist areas is not only limited to the issue at the PSF ecotourism destination but also in other tourist areas. This issue is generally caused by ineffective waste management programs, a lack of environmental protection regulations, and inadequate infrastructure [27]. The PSF ecotourism management has been managing waste by separating organic and inorganic waste. Inorganic waste in the form of plastic is collected and sold for recycling every five days. The waste production significantly increasing during the holiday season. This frequently becomes a problem because not all waste has been sorted and can be sold. Furthermore, the Special Region of Yogyakarta has recently been facing waste management issues as the result of the closure of the Piyungan Final Disposal Site (*Tempat Pembuangan Akhir*/TPA), resulting in waste accumulation in several locations.

Another sensitive attribute is the natural landscape, the natural landscape in the PSF ecotourism object destination is the primary focus because it is ecotourism based. Ecotourism is a type of sustainable tourism based on nature, raises environmental awareness, and enhances the welfare of the local community [28]. The presence of obnoxious wildlife in the PSF ecotourism object destination, such as monkeys is quite rare, they often appear after the food in another forest region has run out. To overcome the presence of obnoxious wildlife during that season, the ecotourism operator planted fruit trees in other forest areas as a source of food for these nuisance animals. Some animals often found in the PSF ecotourism object destination are domestic pigeons, squirrels, butterflies, etc. These animals are not present as obnoxious animals, but as one of the attractions in PSF ecotourism destination.

In the economic dimension, business diversification (RMS = 4.78%) is the primary focus because the business development around the PSF ecotourism object destination is still limited, with only a few numbers of food and beverage shops, souvenir merchants, and homestay businesses. The local government needs to develop the business diversification by providing training and education; consultation and involvement; business information and advice; financial assistance; and business mentorship [29]. Previously, PSF ecotourism object destination was a protected forest with the main commodity being pine sap. Most people around the forest work as tappers for pine sap, which the government pays for through the FMU Yogyakarta. Meanwhile, the youths of communities around PSF work outside the area according to their fields, such as construction and manufacturing. Currently, most remaining people that live around the PSF work as ecotourism operators, such as tour operators, food & beverage merchants, and parking attendants. Meanwhile, the transition of communities' work from tapping pine resin to ecotourism operators increased their income ratio significantly by 135% [1]. Ecotourism also provides another multiplier effect, with the government investing several times to improve infrastructure such as roads, electricity networks, and public facilities, thus will encourage economic activity. Furthermore, ecotourism encourages sustainable economic improvement for community through training and counselling activities.

During the Covid-19 pandemic, the PSF ecotourism object destination area was closed for several months. The closed area of ecotourism certainly impacts ecotourism management and the surrounding community because they do not get income for their livelihood. At that time, they only carried out maintenance on the facilities. This results in a gap between their monthly expenses and income, and a concern in the economic dimension. Another sensitive attribute is the

contribution of PSF ecotourism object destinations to local revenue (PAD). Based on data from June 2022, the total revenue of PSF ecotourism object destinations reached approximately 204 million rupiah, which approximately 51 million rupiah or around 25% was given to the government as a PAD contribution. Ecotourism is considered the fastest-growing sub-sector of the tourism industry that plays a crucial role on enhancing the economic well-being for operators and the community [6]. The development of ecotourism/environment-based tourism is an opportunity and attraction for the region to increase local revenue, invite investors, develop infrastructure and transportation facilities [30].

Increasing community involvement to manage the area, improving the quality of operators through training activities in the forestry sector, and managing conflict can increase the sustainability index of the social dimension. Community involvement in managing PSF ecotourism object destinations is quite good. Their involvement was proved by many communities around the ecotourism area that work in the tourism sector. In addition, community participation with other stakeholders from the planning to the implementation stage is critical for developing sustainable ecotourism [31]. Furthermore, ecotourism management that neglects community participation may promote neocolonial practices, because community participation is an important aspect of achieving sustainable development [32, 33].

A limited number of skilled and trained human resources constrain community-based ecotourism from a structural perspective [34]. PSF ecotourism target destination management has included a variety of training activities involving many partners, including tour guide training, tourism services, forest fire prevention, and product marketing. To enhance their skills and knowledge, the Provincial Environment Service and the Provincial Tourism Service provide this training. Apart of mandatory training, community members also carry out voluntary training in collaboration with other communities such as the Jogja Slow Food Community, which promotes healthy local food. They were introduced to culinary diversity and serving methods. This collaboration aims to create an independent society through food culture. This activity was carried out to minimize conflicts in tourism management and preserve the biodiversity in the ecotourism area.

For the legal and institutional dimensions, the most sensitive attributes, namely coaching and assistance, monitoring and evaluation, and the availability of management regulations, are the focus of increasing this dimension index. Coaching and assistance activities for local communities and workers in ecotourism activities from external parties (i.e. government, NGO) are essential to improve their quality and capability in managing ecotourism. Furthermore, coaching and assistance in ecotourism allow local communities and tourists to be more aware of their environment [35]. Many coaching and assistance activities have been carried out in collaboration with various parties, such as local governments, the private sector, colleges, NGOs, etc. In addition, monitoring and evaluation are the second most sensitive attributes. Many programs or activities can run optimally because of the implementation of effective monitoring and evaluation activities in various fields [36]. Routine monitoring activities are carried out at any time, whereas evaluation activities are carried out routinely by various stakeholders at the end of the year. The ecotourism stakeholders perform all the hard work to achieve tourist satisfaction, since it would raise tourist demand to help local stakeholders gain higher financial benefits [37].

Within the accessibility and infrastructure dimension, tourism promotion is vital in spreading positive content to increase tourist visitation. Various media platforms are also used as tools to promote the PSF ecotourism object destination, including Facebook, Instagram, websites, and YouTube, with the help of local vloggers. Another sensitive leverage attribute is healthcare facilities. Currently, the closest healthcare facility to the PSF ecotourism object destination area is the auxiliary health centre (*Puskesmas Pembantu*) in Mangunan, located 1.6 kilometers away and accessible by motorbike or car in about four minutes. However, the facilities at the auxiliary health centre in Mangunan are limited, therefore it is necessary to improve the quality of healthcare facilities by establishing the healthcare posts in PSF ecotourism object destinations. Even while incidental health accidents rarely occur and can be addressed, it is nevertheless vital to increase the quantity and quality of healthcare facilities to assure the safety of tourists.

Lastly, facility maintenance emerged as one of the most critical attributes in the sensitivity analysis. The development of ecotourism facilities should prioritize those that enhance visitor convenience, promote environmental education, and support the ecological preservation of ecotourism sites [38]. Facility maintenance is certainly very influential in the sustainability of ecotourism because the accessible infrastructural facilities are one of the factors that increase tourist interest in returning to a tourist area [39]. The facilities at the PSF ecotourism object destination include prayer rooms, trash cans, photo spots, school stages, and seats. All facilities can be accessed for free without spending extra money, which means the facilities include the entrance fees. The facility is routinely maintained by the operator once a month, and they promptly fix any damage caused by accidents.

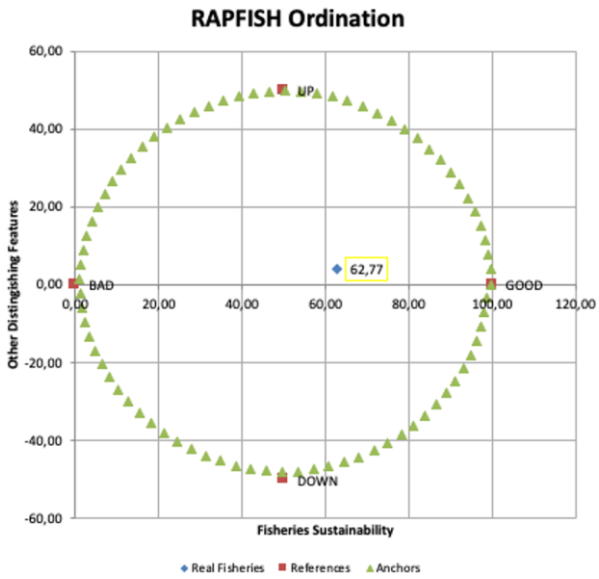

Figure 8. Sustainability index of PSF Ecotourism

The overall sustainability status of the PSF Ecotourism Destination is classified as moderately sustainable, with a score of 62.77%. The stress value obtained is 0.130, which is below the threshold of 0.25, indicating a better fit. Additionally, the coefficient of determination (R^2) is relatively high, at 95.68%, reflecting a strong model fit. Thus, it indicates

that the PSF Ecotourism Destination requires more sustainable management in each of its dimensions (refer to Figure 8). The form of a combination of various attributes in each dimension is a sustainable ecotourism management [21]. However, only a few attributes have a significant impact on each dimension [13]. Therefore, the selected attributes are key attributes that influence the level of sustainability of ecotourism, derived from the leverage analysis results for each dimension. Theoretically, the holistic approach offered in this research, through comprehensive research, is expected to yield integrative results. Thus, theoretical research provides an effort for sustainable ecotourism management, which can serve as a foundation for developing ecotourism. As a practical implementation, it is necessary to pay attention to activities in the legal and institutional dimension because it has the lowest sustainability index value (57.42%). The implementation of activities in this dimension needs to be formulated by involving all relevant stakeholders, discussing the factors that need to be considered, challenges and opportunities, as well as applying the strategies for the success of ecotourism management efforts. Furthermore, efforts need to be made to enhance the sustainability of PSF ecotourism management by considering the sensitive attributes in this research as driving factors for ecotourism sustainability. Moreover, the government and policymakers need to strengthen the role of institutions and the organizations in PSF ecotourism, so that government policies can be promptly altered to fit the needs of local communities.

5. CONCLUSIONS

The Pinus Sari Forest ecotourism destination has a sustainability index of 62.77%, indicating it falls within the moderately sustainable category. The value of the ecological (74.95%), economic (69.46%), social (59.5%), legal and institutional (57.42%), and accessibility and infrastructure dimensions (58.66%) are all categorized as moderately sustainable, according to sustainability indexes. Eight sensitive attributes of 5 dimensions need to be managed properly to improve the moderately sustainable category into sustainable category. The sensitive attributes consist of a) preservation of natural landscape, b) presence of nuisance animals, c) business diversification, d) job opportunities, e) community involvement in forest management, f) education and training for operator, g) coaching and assistance, and h) tourism promotion. We recommend the operators of PSF to 1) maintain the ecological value of forest areas by intensifying utilization of the 5% protected forest area that has been used for ecotourism, without the need for extensification in other areas; 2) increase economic benefits through involving more communities to improve the welfare evenly; 3) provide regulations and assistance for managers; and 4) maintain and improve tourist facilities to escalate the number of visitors.

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APPENDIX

Table A1. List of questionnaires distributed to respondents

No.	Dimension	Attribute	Score	Good	Bad	Scoring Criteria
1	Ecological	Clean water availability	0-3	3	0	0= not available; 1= available, limited; 2= available, enough; 3= available, abundant
		Waste management	0-3	3	0	0= not available; 1= not well managed; 2= managed quite well; 3= well managed
		Preservation of natural landscape	0-3	3	0	0= not maintained; 1= less maintained; 2= moderately well maintained; 3= well maintained
		Tree diversity	0-3	3	0	0= number of trees < 5 species; 1= number of trees mature 5-20 species; 2= number of trees mature 21-35 species; 3= number of trees mature > 35 species
		Management of biodiversity	0-3	3	0	0= There is no plan; 1= There is a plan, but not yet implemented; 2= There is a plan, well implemented; 3= There is a plan, it has been implemented and the results of biodiversity management are documented.
		Presence of nuisance animals	0-3	3	0	0= existing, very disturbing; 1= existing, often disturbing; 2= existing, not disturbing; 3= none
		Exploitation rate of tourism areas	0-3	3	0	0= high; 1= moderately; 2= low; 3= none
		Land cover	0-3	3	0	0= < 25% of the area covered by dense vegetation; 1= <50% of the area covered by dense vegetation; 2= 50-75% of the area covered by dense vegetation; 3= > 75% of the area covered by dense vegetation
2	Economic	Income growth	0-3	3	0	0=<1 million rupiah; 1=1 million rupiah– regional minimum wage (*Upah Minimum Regional* / UMR); 2= regional minimum wage; 3= > regional minimum wage
		Contribution to local government revenue (PAD)	0-3	3	0	0= does not exist and tourism utilization causes damage; 1= none; 2= existing, the proportion between income and maintenance costs illustrates the fulfillment of all cost needs to preserve the area; 3= There is, the proportion between income and maintenance costs illustrates the obtaining of profits can also be fulfilled all the cost needs to maintain its sustainability
		Job opportunities	0-3	3	0	0= Increased employment opportunities around tourism objects but exceeds the carrying capacity of the area; 1= Declining employment opportunities around tourism objects but still exceeding the carrying capacity of the area; 2= Decreased employment opportunities around tourism objects and not exceeding the carrying capacity of the area; 3= Increased employment opportunities around tourism objects and does not exceed the carrying capacity of the area
		Businesses diversification	0-3	3	0	0= Increasing business opportunities around tourism objects but exceeding the carrying capacity of the area; 1= Declining business opportunities around tourist attractions but still exceeding the carrying capacity of the area; 2= Decreased business opportunities around tourism objects and not exceeding the carrying capacity of the area; 3= Increased business opportunities around tourism objects and does not exceed the carrying capacity of the area
		Travel retribution	0-3	3	0	0= none; 1= exists, needs review; 2= exists, enough; 3= exist, expensive
		Increased tourist purchasing power	0-3	3	0	0= none; 1= exists, low; 2= exists, moderate; 3= exists, high
		Tourist visitation rate	0-3	3	0	0= low; 1= moderate; 2= high; 3= very high
		Availability of funding sources	0-3	3	0	0= none; 1= less capital; 2= enough capital; 3= a lot of capital
3	Social	Education level	0-3	3	0	0= elementary school; 1= junior high school; 2= senior high school; 3= bachelor's degree- up
		Unemployment rate	0-3	3	0	0= high; 1= moderate; 2= low; 3= very low
		Environmental	0-3	3	0	0= less; 1= moderately; 2= good; 3= very good

No.	Dimension	Attribute	Score	Good	Bad	Scoring Criteria
		knowledge for travelers				
		Education and training for operator	0-3	3	0	0= none; 1= present, infrequent; 2= present, fairly routine; 3= present and scheduled
		Community involvement in forest management	0-3	3	0	0= Communities are not involved in planning and decision-making in area management; 1= Community involved but not contributing to management; 2= The community is involved but their contribution is still passive and lacks initiative; 3= Communities are actively involved in planning and managing the area
		Existence of local wisdom	0-3	3	0	0= none; 1= exists, but is not well maintained; 2= exists, well-maintained but not yet well-documented; 3= exist, well-maintained and documented
		Potential conflicts	0-3	3	0	0= exists, a lot; 1= exists, moderately 2= exists, low; 3= does not exist
		Level of security	0-3	3	0	0= not safe; 1= moderately safe; 2= safe; 3= very safe
		Availability of formal management regulations	0-3	3	0	0= not exist; 1= exist, not optimized; 2= exist, moderately optimized; 3= exist, optimized
		Policy making involves the community	0-3	3	0	0= no involvement; 1= present, passive; 2= present, active; 3= present, very active
		Level of community compliance with rules	0-3	3	0	0= not compliant; 1= less compliant; 2= moderately compliant; 3= highly compliant
4	Legal and Institutional	Coordination between stakeholders	0-3	3	0	0= bad; 1= moderate; 2= good; 3= very good
		Division of roles between groups	0-3	3	0	0= low; 1= moderate; 2= good; 3= very good
		Law enforcement	0-3	3	0	0= not exist; 1= exist, less; 2= exist, good; 3= exist, very good
		Coaching and assistance	0-3	3	0	0= none; 1= exist, rarely; 2= exist, moderately regular; 3= exist and scheduled
		Monitoring and evaluation of ecotourism management	0-3	3	0	0= none; 1= exist, rarely; 2= exist, moderately regular; 3= exist and scheduled
		Facilities and infrastructure	0-3	3	0	0= less adequate; 1= moderately adequate; 2= good, adequate; 3= good, very adequate
		Access to transportation	0-3	3	0	0= not exist; 1= exist, difficult to access; 2= exist, easy to access, 3= exist, very easy to access
		Access to information	0-3	3	0	0= not exist; 1= exist, difficult to access; 2= exist, easy to access, 3= exist, very easy to access
5	Accessibility and Infrastructure	Communication access	0-3	3	0	0= none; 1= exists, rarely; 2= exists, moderately accessible; 3= exists, easily accessible
		Tourism promotion	0-3	3	0	0= none; 1= exist, seldom; 2= exist, often; 3= exist, regularly
		Electricity availability	0-3	3	0	0= not exist; 1= exist, inadequate; 2= exist, adequate; 3= exist, very adequate
		Health facilities	0-3	3	0	0= not exist; 1= exist, inadequate; 2= exist, adequate; 3= exist, very adequate
		Facility maintenance	0-3	3	0	0= none; 1= exist, rarely; 2= exist, fairly regularly; 3= exist and scheduled