Sustainability Status Assessment of The Borobudur Temple using The Rap-Tourism with Multi-Dimensional Scaling (MDS) Approach

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Abstract. Visitors' number of Indonesian-tourism increases every year and impacts the sustainability of the tourism object. Borobudur Temple is one of the most popular tourist objects in Indonesia located in Magelang, Central Java. This research aims to assess the Borobudur temple tourist destination's sustainability status and identify indicators that need improvement to increase its sustainability index. The data processing used the Rap-tourism with a Multidimensional Scaling (MDS) approach. The results show the sustainability index value is 69,84, categorize as moderate. The sustainability index was formed from four dimensions, the environmental dimension index 66,94; economic dimension index 72,62; sociocultural dimensions index 72,76; and institutional dimensions index 69,27. A recommendation was generated by an interview with tourism object management and then selected based on sensitive indicators of each dimension (highest RMS value). Selected recommendations are a rearrangement of plants, developing complaint handling services, constructing outbound rides and flying foxes, and promoting the complementary tourism and attractions at Borobudur Temple.

1. Introduction

Borobudur Temple is the largest Buddhist temple in Indonesia and the most significant Buddhist monument globally, located in Magelang, Central Java. Being a place of worship for Buddhists and one of the world's seven wonders, Borobudur Temple has become the centre of attention of the world community in terms of tourism, archaeology, and knowledge. Borobudur Temple was visited by 3.475.296 domestic tourists and 240.356 foreign tourists in 2019. The arrival of visitors has a positive and negative impact on the sustainability of Borobudur Cultural Tourism. Positive impacts are developing a business around tourism, promoting the local product, and increasing the surrounding community's income [1]. The negative impact is the disruption to the preservation of cultural tourism objects [2].

The principles of sustainable tourism, which are used as indicators based on the Regulation of the Minister of Tourism of the Republic of Indonesia on guidelines for sustainable tourism destinations that are aligned with the indicators of the United Nations

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World Tourism Organization (UNWTO) and have been recognized by the Global Sustainable Tourism Council (GSTC). The assessment criteria of sustainable tourism can be implemented in every region and every type of tourism across Indonesia. However, the key dimensions remain the same, but the set of indicators that each problem had to be adjusted according to the specific conditions of the region.

This research aims to determine the sustainability status of Borobudur Temple and defines recommendations for indicators with low sustainability conditions. The assessment was conducted using 33 assessment indicators, and the data was processed using the Rap-tourism method with the Multidimensional Scaling (MDS) approach. The researchers are not allowed to conduct direct research because of the outbreak of the COVID-19 pandemic in the research location, and the assessment only from the perspective of the visitors captured by questionnaires through a google form. It will be interesting because the assessment according to visitor perceptions can meet visitor expectations and increase satisfaction [3].

2. Literature Review

Tourism is travelling activities from one place to another, made within a period of temporary time, and exercised by any person or a group of persons as an effort to find balance, harmony, or happiness with the environment in the social, cultural, natural, and scientific dimensions [4]. Tourism attraction defines as a potential that has been the attraction for tourists to visit, which are grouped into the natural, cultural, and particular interest of tourism [5].

An aggregation method is required to produce an index value when measuring an object's sustainability that involves many indicators. The composite indicators and multidimensional scaling (MDS) and composite indicators are widely used methods. MDS is a relatively new application that evolved from the rap-fish method [6] into rap-tourism [7,8,9] Rap-tourism analyzes data using Multidimensional scaling (MDS), which is widely used to determine the sustainability status of natural resource management, such as analyzing the sustainability of tourism in the Puncak Bogor Area [7], analyzing the sustainability of the Mangrove Protection Forest in Batu Ampar [10], and analyzing the sustainability of contract farming [11].

Recommendation was formulated by interviewing the destination management official and assessing the recommendation to select the recommendation from the feasibility to implement (period and cost) and the program's significance to increase sustainability [12;13]. The assessment criteria for recommendation are shown in Table 1. Based on the data processing and analysis results, a recommendation for improvement is obtained from the opinion of the relevant experts and literature studies [13].

Table 1. Recommendation Assessment.

No	Feasibility/Ease of Implementation	Duration of Implementation	Value	Meaning
1.	Difficult	Short	-	Bad
2.	Difficult	Long	=	Same
3.	Easy	Short	+	Better
4.	Easy	Long	++	Much Better
5.	Difficult	Short	-	Bad

Sustainable development has the fundamental idea of preserving natural and cultural resources [14]. The fundamental idea is then realized in the concept of sustainable tourism development. Sustainable tourism is tourism that can meet the needs of the present and future generations. The attitudes that must exist when visiting tourist destinations are responsible do not cause damage to

nature and culture and respect the local customs and culture [15]. Sustainable tourism development is the management of all resources to meet economic, social, and aesthetic needs while maintaining cultural coherence, critical ecological processes, biological diversity, and life support systems [16]. Preliminary research has resulted in the aspects of tourism sustainability including ecological, economic, ethical, social, and technology, each of aspects contain elements and indicators describes in Table 2.

Table 2. Dimensions, Elements, and Indicators of Sustainable Tourism.

No	Elements	Indicators	References
Environmental Dimensions			
1.	Environmental Protection	Regulations to anticipate environmental risk	[17-21]
		Regulations for environmental management and protection	
		Waste management program	
		Eco-friendly transportation	[17, 20, 21]
2.	Flora Protection	Protection and rehabilitation of local flora	[17-19]
		Prohibition of destruction of local flora	
3.	Energy Management	Regulations for saving energy consumption	[17-19]
		Management of water safety and quality	
Economic Dimension			
1.	Public Participation and Access	Facilities of community service	[17-19]
		Ability to follow the development of tourism trends	
2.	Opportunities for Local Communities	Job opportunities for local people	
		Involvement and supported for local businesses	
3.	Economic Sustainability	Created the tourism attractions and programs (related to culture)	
Social Dimensions			
1.	Visitor Management & Public Relations	Supporting facilities for the visitors convenience	[17-19]
		Tourism and cultural guidelines	
		Various types of travel destinations	
		Relationship with the local community	[19]
2.	Information Services	Accurate interpretative information	[17, 18]
		Availability of information in various forms of media	
		Management to protect natural and cultural sites	
Institutional Dimensions			
1.	Management Organization	Development of tourism destinations with the addition of new tourism spots	[17, 19, 21]
		Public complaint skills	
		Responsible organization	
		Tourist destination management system	
		Doing tourism promotions	
2.	Safety and Security	Rules in handling emergency response for safety and security	[17-20]
		Rules for prevent the potential hazards	
		Rules for mitigating seasonal climate changes	[17]
3.	Visitor satisfaction	Attention to potential customers	[17, 18]
		The assessment of the level of visitor satisfaction	
4.	Planning Arrangements	Information on natural and cultural assets, flora, and fauna	[17]
		Information on resources, infrastructure, zoning, and facilities and services provided	
		Accessibility that supports tourist accommodation including people with disabilities and people with special needs	[17-19]

3. Research Methods

Sustainability assessment from visitor perceptions collected by distributing questionnaires through Google Form media, data collection was conducted in July 2020 used purposive sampling technique. Purposive sampling is an intentional selection of informants according to the specified criteria. The sample size taken is 100 respondents with a minimum age of 16 years. The respondents are tourists who have visited the Borobudur Temple.

The data processing was conducted using the Raptourism method, an analytical method to evaluate the sustainability of multidisciplinary withdrawals based on ordination techniques (placing things in the order of the measured attributes) with Multidimensional Scaling (MDS) [20]. Figure 1 shows six stages of assessment. The sustainability status of a tourism destination defines in step fourth used the sustainability index range value [23] shown in Table 3.

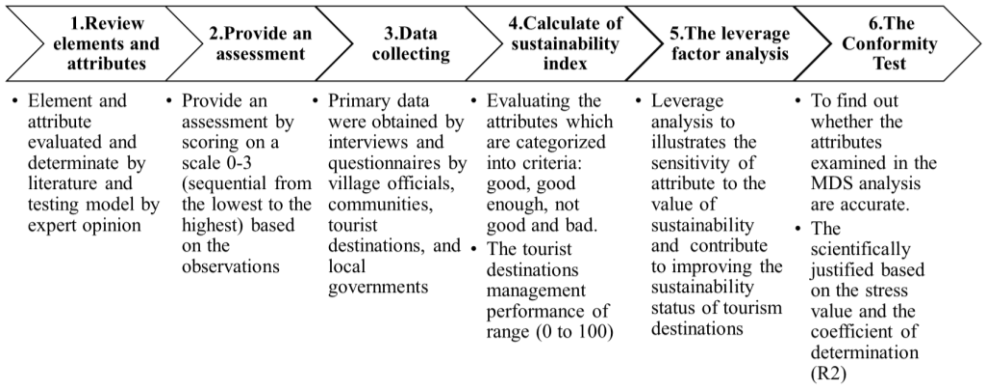

Figure 1. Six stages of assessment sustainability tourism.

Tabel 3. Sustainability Category Status.

No.	Sustainability Index	Status
1	0.00-25.00	Bad (unsustainable)
2	25.01-50.00	Less (less sustainable)
3	50.01-75.00	Enough (quite sustainable)
4	75.01-100.00	Good (very sustainable)

Indicators that need improvement were identified by leverage factors that captured some sensitive attributes based on priority order. These attributes have the highest root mean square (RMS) ordination on the X-axis or the sustainability scale. The greater the value of RMS changes, the more significant the role of these attributes in increasing the status of sustainability. The conformity test result is a stress value that represents the reliability test. If the value is smaller than 0.25 or 25%, then the result was concluded as reliable. The coefficient of determination does the Validity Test, and the result is valid if the value is close to 1 or 100% [24].

The sustainability index value is defined with a composite index, determined by weighting each dimension and then multiplied by the index value of each dimension. The weight value is obtained from the normalization ranking of each dimension. The tourism site manager determines the ranking of each dimension. The formula used can be seen from Equations 1, 2, and 3. Where; for weight; for *ranking*; for dimension; for dimension; for the value of sustainability index.

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$$w_j = \frac{(1/r_j)}{\sum(1/r_k)} \quad (1)$$

$$iw_j = w_j \; x \; i_j \quad (2)$$

$$ii_k = \sum(iw_j) \quad (3)$$

4. Result and Discussion

4.1 The Analysis of Environmental Dimension

MDS analysis on the environmental dimension shows that the average sustainability index is 66,94, categorized as sufficient, sustainable status. Based on the stress values and R^2, the results obtained are 0,25 (<0,25) and 0,9 (close to 1), which means that the indicators used are quite good and precise in explaining the sustainability dimensions that were analyzed. Figure 2 shows the RMS value for each indicator in the environmental dimension.

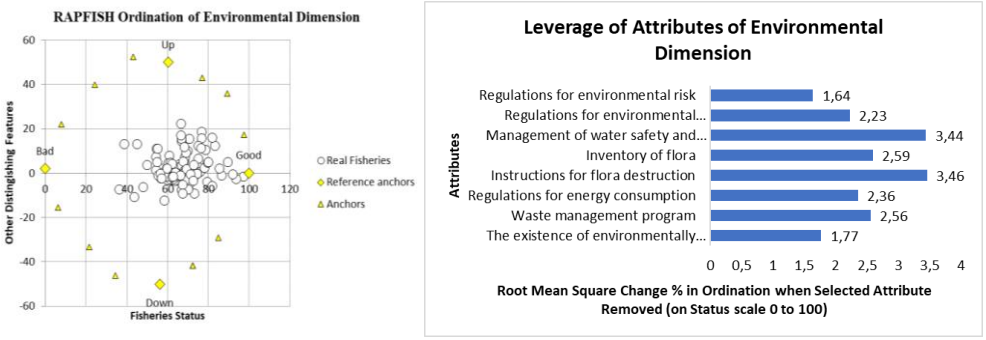

Figure 2. Sustainability Index and Leverage Factors of the Environmental Dimensions of Borobudur Temple in Magelang.

The environmental dimension has 8 indicators. The indicators with the highest RMS value are the management of water safety and quality and inventory of flora. The greater the RMS value, the more significant the role of the indicator in the sensitivity of the sustainability status [25]. Borobudur area has good water management, and also few plants or flowers in the area of tourism destination has been well maintained. These two indicators are essential to maintain the environment around the Borobudur temple as a relatively broad flat open space.

The Monte Carlo analysis was performed at a 95% confidence interval. The results of the Monte Carlo analysis were then compared to the results of the MDS analysis. If the difference value is small, the scoring error is relatively small, and the scoring variations are relatively small. The Rap-Tourism software output obtained the difference value between the MDS and Monte Carlo is 1,12 (<5%), which means that errors in the analysis are minor. This value represents differences in opinion of the respondent on giving the scale for the indicator are relatively small, and data analysis is stable because errors in inputting data and missing data can be avoided.

4.2 The Analysis of Economic Dimensions

MDS analysis on the economic dimension shows the average sustainability index of 72,62, categorized as fairly sustainable status. This means that the sustainability indicator factor is less than optimal in its implementation at the tourism destination. Based on the stress values and R^2, the results obtained are 0,29 (> 0,25) and 0,85 (close to 1), which means that the indicators used in the evaluation are quite excellent and precise in explaining the sustainability dimensions. Figure 3 describes the result of the Rapfish software and the leverage factors from the economic dimension.

Increasing the sustainability index of a dimension can be carried out by managing sensitive indicators. The leverage factor of the economic dimension with the highest RMS value is facilities of community advice and satisfaction. Lack of active and existing relationships and accepting the aspirations of local communities need to be considered for repair. The Monte Carlo analysis was conducted at a 95% confidence interval. The difference between the two values based on MDS and Monte Carlo results is 2,02 (<5%), which means that result is valid.

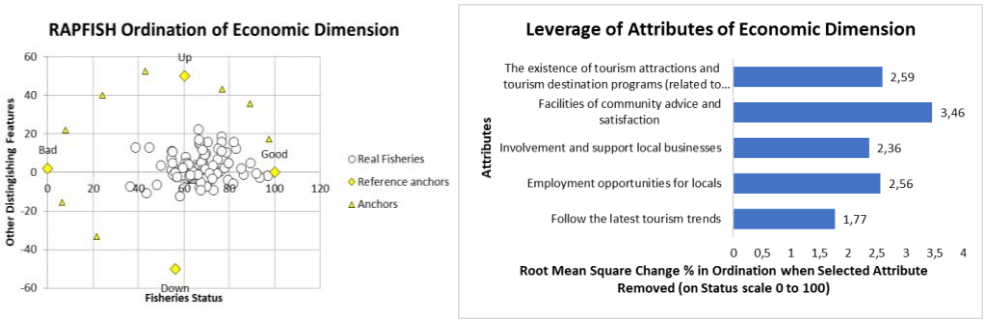

Figure 3. Sustainability Index and Leverage Factors of the Economic Dimensions of Borobudur Temple in Magelang.

4.3 The Analysis of Socio-Cultural Dimensions

MDS analysis on the socio-cultural dimension shows the average sustainability index 72,76 categorized as reasonably sustainable. This means that the sustainability indicator factors condition is less than optimal. The stress values and R^2, the results are 0,29 (<0,25) and 0,89 (close to 1), which means that the indicators used are quite good and accurate in explaining the sustainability dimensions that were analyzed.

Increasing the sustainability index of a dimension can be conducted by managing sensitive indicators. Figure 4 is the description of the output of the Rapfish software and the leverage factors from the socio-cultural dimension. The leverage factors with the highest RMS value are various types of travel destinations. Borobudur Temple is quite good regarding the volume of visits and types of tourist trips to destinations, such as outbound activities, study tours, family gatherings. The second indicator that should be maintained is the availability of information. The Monte Carlo analysis was conducted at a 95% confidence interval and obtained the difference between the two values based on the results of MDS. Monte Carlo is 2,08 (<5%), which means that errors in the analysis are relatively small and the data are stable.

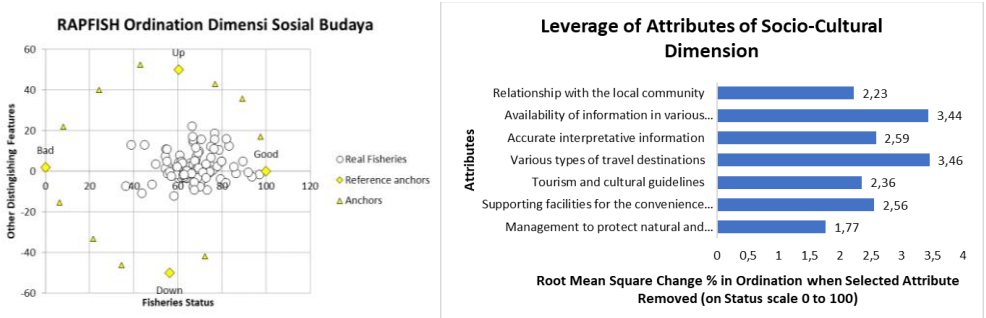

Figure 4. Sustainability Index and Leverage Factors of the Socio-Cultural Dimensions of Borobudur Temple in Magelang.

4.4 The Analysis of Institutional Dimensions

MDS analysis on the institutional dimension show the average sustainability index is 69,27 categorized as fairly sustainable status. The stress values and R^2 the results obtained are 0,24 (<0,25) and 0,90 (close to 1), which means that the indicators used in the evaluation of the sustainability of Borobudur Temple in Magelang are quite good and accurate in explaining the dimensions of sustainability that were analyzed. Figure 5 is the description output of the Rapfish software and the leverage factors from the institutional dimension

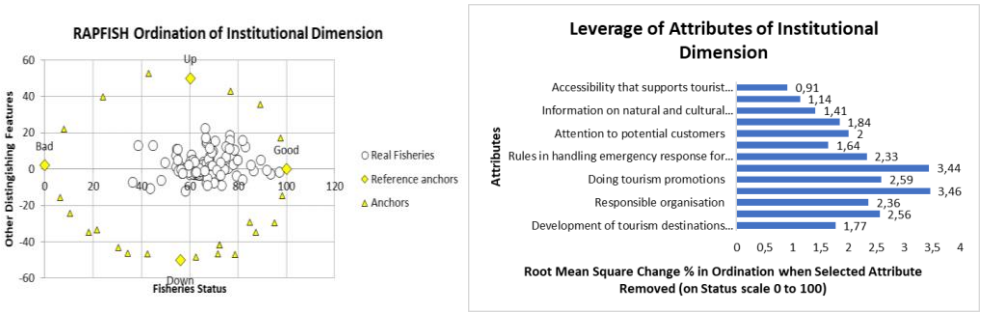

Figure 5. Sustainability Index and Leverage Factors of the Institutional Dimensions of Borobudur Temple in Magelang.

The leverage factors of the institutional dimension with the highest RMS value are the tourist destination management system. Borobudur needs to carry out various principles such as doing a conservation program, maintaining the relationship between the value of cultural assets and tourism, carrying out monitoring activities, etc. The Monte Carlo analysis was performed at a 95% confidence interval, the difference between the two values based on the results of MDS and Monte Carlo, which is 3,11 (<5%), means that the result is valid.

4.5 Formulation of Alternatives Recommendations

The formulation of alternative recommendations is made to solve problems that occur in each dimension by submitting suggestions for improvements in each sensitive indicator which has highest RMS value in each dimension. Assessment of alternative recommendations show in Table 4.

Table 4. Assessment of Alternative Recommendations.

No	Dimensions	Recommendation	Value	Meaning
1.	Environmental	Plants rearrangement	+	Better
		Standard of conformity	=	The same
2.	Economic	Developing complain handling services	++	Much better
		Increase the suggestion box	+	Better
3.	Socio-Cultural	Construction of outbound rides and flying fox	++	Much better
		Water recreation	+	Better
4.	Institutional	Periodic monitoring and evaluation	+	Better
		Promotion of complementary tourism and existing attractions	++	Much better

Recommendations for environmental dimensions are the plant rearrangement of the shape, space, composition, or placement. It is not only the beauty of the flora but also plants that can serve as shelter while walking around, also function as a natural air-conditioner or air purifier. The economic dimensions recommendation is developing complaint handling services to make it easier for the public to convey an opinion through the web, mail, social media, email, and short message services. The recommendation for socio-cultural dimensions are the construction of outbound rides and flying foxes to attract more visitors. The institutional dimensions are to disseminate the information and promote complementary tourism at Borobudur Temple.

4.6 Multidimensional Analysis

The details of the value in each dimension of the sustainability of the Borobudur Temple are the environmental dimension of 66,94; the economic dimension with a value of 72,62; the socio-cultural dimension is 72,76; and the institutional dimension has a value of 69,27. The range of values for each dimension obtained was only between the index 66 to72. Although the number of respondents was quite large, the average scores were almost the same. The average value for the environmental dimension is 3,61; for the economic dimension is 3,69; the socio-cultural dimension is 3,79; and the institutional dimension is 3,69. The value of the sustainability index of the environmental dimension is the lowest one; this is caused by the vulnerability of the environment and poor environmental management due to climate and human activity [12;25]. The sustainability index of each dimension is visualized in kite diagrams shown in Figure 6.

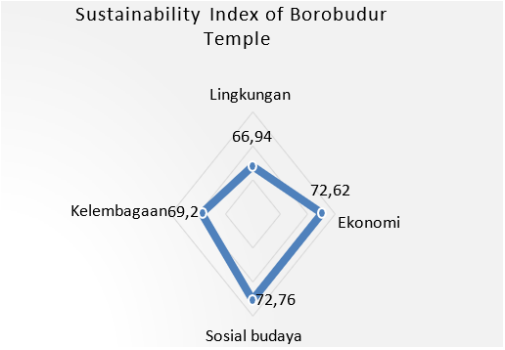

Figure 6. The kite diagrams of the sustainability index of Borobudur Temple in Magelang.

It is important to study sustainable tourism with cultural tourism objects in Indonesia, also to focus research to find out the hidden attractions that are unique as Indonesian identity and have added value, on other hand, it can also introduce Indonesian culture so that it is preserved.

5. Conclusion and suggestion

The sustainability status assessment of the Borobudur Temple shows a sustainability index of 69,84, formed by the environmental dimensions 66,94; economic dimensions 72,62; socio-cultural dimensions 72,76; and institutional dimensions 69,27. This index is categorized as fairly sustainable status for all dimensions. Leverage analysis defines several sensitive indicators based on the highest Root Mean Square of indicators in each dimension.

Recommendations for improvement of the sustainability index are a rearrangement of plants, developing complaint handling services, constructing outbound rides and flying foxes, and disseminating the information and promoting the complementary tourism and attractions at Borobudur Temple.

References

1. M. Rantetadung, Jurnal Agroforensi, **7**, 1 (2012)
2. R. Biantoro and S. Ma'rif, Jurnal Teknik PWK **3**, 4 (2014)
3. L.D. Anggraini, P. Deoranto, and D.M. Ikasari, Jurnal Industri Customer Satisfaction Index **4**, 2 (2015)
4. F.J. Blancas, M.L. Oyola, M. Gonzalez, and R. Caballero, Journal Of Sustainable Tourism **24**, 1403-1424 (2016)
5. S. Gamal. *Dasar-dasar Pariwisata* (Penerbit Andi, Yogyakarta, 2004)

6. T. J. Pitcher, and D. Preikshot, Fisheries Research **49** 3, 255-270 (2001)
7. S. S. Dwikorawati*,* Institut Pertanian Bogor (2012)
8. R.Purwaningsih, F. Agusti, S.N.W. Pramono, A.Susanty, and B. Purwanggono, E3S Web of Conferences 202, 03001 (2020)
9. R.Purwaningsih, H.Santoso, and U.Khasanah, IOP Conference Series: Materials Science and Engineering **722** (2020)
10. E. Karlina, C. Kusmana, Marimin, and M. Bismark, Jurnal Analisis Kebijakan **13** 3, 201-219 (2016)
11. A.Susanty, N. B. Puspitasari, R. Purwaningsih, and A. R. R.Siregar, I*EEE* International Conference on Industrial Engineering and Engineering Management (IEEM)*,* 756-760 (2020)
12. T. Bimawan, Domestic Case Study (2018)
13. R. Purwaningsih, N. Susanto, C. Y. Mahardhika, Jurnal Teknik Industri **18** 1, 31-42 (2016)
14. D. Janianto and W. Helmut, *Perencanaan Ekowisata Dari Teori ke Aplikasi* (PUSPAR UGM dan Andi, Yogyakarta, 2006)
15. M. Wiwik. Ekowisata: Panduan Dasar Pelaksanaan (Online: http ://unesdoc.unesco.org., 21 Desember 2014)
16. P . Murphy, *Tourism and sustainable development* (W. Theobald (ed), Global Tourism, the Next Decade, Butterworth-Heinemann: Oxford, 1994)
17. Ministry of Tourism, *Regulation of Tourism Minister of the Republic Indonesia Number 14 in 2016 concerning Guidelines for Sustainable Tourism Destinations* (Tourism Ministry of the Republic Indonesia, 2016)
18. UNWTO, *Definition of Sustainable Tourism* (United Nations World Tourism Organization, 2012)
19. UNEP, *Destinasi Pariwisata Berkelanjutan* (Kementerian Pariwisata Republik Indonesia, 2007)
20. I. Kozic and J. Mikulic, FEB-Working Paper Series **11**, 4 (2011)
21. S. Dwikorawati, *The Competitive and Sustainable Model of Tourism Management Policy in Bogor Regency Peak Area* (Bogor Agricultural Institute, 2012)
22. T. Pitcher and D. Preikshot, *Rapfish: A Rapid Appraisal Technique to Evaluate the Sustainability Status of Fisheries* (Fisheries Centre Research, University of British Columbia, 2001)
23. R. Purwaningsih, H.N. Annisa, A. Susanty, and D.D. Puspitaningrum, AIP Conference Proceedings (2020)
24. P. Kavanagh and T. Pitcher, Fisheries Centre Research Reports **12** (2004)
25. M.H. Yanuardi, Jurnal Sejarah Lontar **6**, 2 (2009)