A comparison of rap-tourism method and multi attribute aggregation in sustainability assessment of tourist destination

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A comparison of rap-tourism method and multi attribute aggregation in sustainability assessment of tourist destination

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Abstract. The development of the tourism industry causes emergence of positive and negative impacts on tourist destinations. The development of the tourism industry has led the government to implement the concept of sustainable tourism. To assist the implementation of sustainable tourism, it is important to know the sustainability status of tourist destinations. The measuring tools used for calculated sustainability index values and identification of sensitive indicators. The method used must be easy to use and provide accurate results. This study compares between the rap-tourism and the multi attribute aggregation method. The aim is to choose which method better in measuring sustainability status when the objects of measurement are a lot of tourist destinations, better means easy to use and represent indicators condition briefly. The results of the assessment using both methods obtain the same sustainability status but there are differences in the sustainability index value. The two methods also use different approaches in determining sensitive indicators that should be improved to increase the sustainability index of tourist destinations.

1. Introduction

The tourism industry plays an important role in the economic growth of a country [1], [2], [3]. 6,1% of Indonesian GDP contributed by tourism sector [4]. The development of the tourism industry leads to positive and negative impacts on the local livelihoods and tourist destinations [5]. Economic growth [6], preservation of the local culture [7], and improvement in quality of life [8] are some positive impacts of tourism industry. However, with the increase in tourism activities, environmental pollution [9], [10] and social conflict also increases [8].

Countries whose economies are heavily influenced by the tourism industry are becoming more concerned about the environmental and socio-cultural impacts caused by the tourism industry [11]. In Indonesia, sustainable tourism has been implemented by the national and local governments involving all tourism stakeholders and tourists [12].

Sustainable development leads not only to prosperity and profit but also to achieve environmental sustainability and social welfare [13]. Therefore, a sustainability assessment is needed to measure the sustainability performance [14]. Sustainability assessment can be performed using a set of indicators which function as a measuring tool for evaluating the impact of tourism on sustainability [15].

Result of measuring the sustainability status of tourist destination is an index produce from multidimensional indicators that reflect the condition of the tourism destination. When the value of indicators was combined or aggregated, the result of the measurement is an index [16]. The aggregation method that easy to use and represent indicators condition briefly are needed.

This research aims to compare between the two aggregation methods, rap-tourism (rapid appraisal-tourism) and multi attribute aggregation. Rap-tourism is an adaptation of rap-fish, a statistical technique that uses a multidimensional scaling approach [17], while multi attribute aggregation used a composite index technique [18].

Indicators used in this study and calculation of data using rap-tourism are done in previous research conducted by Purwaningsih, et. al., (2020). Then, assessment result in the previous research will be compared with the assessment result using multi attribute aggregation to know the differences in value and the identification of weak indicator. Weak indicator should be improved by tourism management to increase the sustainability level. The object of this assessment is the Baturaden tourism site, the assessment is performed by assessing four dimensions of sustainability. The four dimensions of sustainability consist of economic dimension, environmental dimension, social and culture dimension, and institutional dimension [19]; [20].

2. Literature Review

2.1. Sustainable Tourism

Sustainable tourism is tourism that accommodate the needs of tourist, the tourism industry, the environment, and local communities while considering the impact of tourism activities on the state of economic, social, and environment in the present and the future [21]. Traditionally, three dimensions are included in the sustainable development paradigm which includes economic, socio-cultural, and environmental [22]. However, without an institutional perspective to manage and facilitate it is difficult to establish a balance between these three dimensions [23]. Hence, four dimension is used to assessing the sustainability status of tourist destination, each dimension is consisting of element, and each element consist of indicators. There are 12 element and 34 indicators used in assessing sustainability status of tourism, shown in Table 1.

Table 1. Dimensions, elements, and indicators of sustainable tourism

No	Element	Indicator	Reference
		Environmental Dimension	
1	Environmental Protection	1. Environmental risk management system	[12]; [24]; [25]; [26]; [27]
		2. Environmental management and protection system	
		3. Waste treatment program	[12]; [24]; [25]; [26]; [27]; [28]; [29];
		4. Transport planning and programs to improve green transportation	[12]; [26]
2	Flora Protection	1. Flora data collection	[12]; [24]; [27]
		2. Prohibition of flora destruction	
3	Energy Management	1. Energy consumption report	[12]; [24]; [25]; [28]; [29]; [30]; [31]
		2. Water quality and safety management system	[12]; [24]; [32]
		Economical Dimension	
1	Participation and access for the community	1. Communication to accommodate the aspirations of the local-residents	[12]; [24]; [27] [28]; [29]; [33]
		2. Communication regarding tourism issues	[12]; [24]; [27]
2	Employment opportunities for local communities and supporting local businesses	1. Provide employment for local residents	[12]; [24]; [25]; [27]; [29]; [32]; [34];
		2. Engage & support local businesses	
3.	Economic continuity	1. Regular reporting and monitoring of expenses, income and investments	[12]; [25]

No	Element	Indicator	Reference
		2. The existence of attractions and tourism destination programs	[24]; [27]
		Socio-Cultural Dimension	
1.	Visitor management and public relations	1. Visitor management system	[12]; [24]; [27]
		2. Tourist and cultural guide	
		3. Volume and type of tourist trips to destinations	[25]; [27]
		4. Relations with the local community	
2.	Interpretation service	1. Accurate interpretive information	[12]; [24]; [35]
		2. Availability of information in various media forms	[12]; [24]; [30]; [35]
		3. Management system to protect natural and cultural sites	[12]; [24]; [35]
		Institutional Dimension	
1	Destination management organization	1. Sustainable tourism destination development strategy	[12]; [25]
		2. The involvement of the community, government, private sector, and entrepreneurs as stakeholders	[12]; [25]; [33]
		3. Responsible organization and clear coordination	[12]; [25]
		4. Tourist destination management system	
		5. Tourism promotion strategy	
2	Safety and security	1. Emergency handling and response systems for safety and security	[12]; [24]; [25]; [26]; [27]; [29];
		2. Inspection and preventive systems against hazards	[12]; [24]; [25]; [26]
		3. Policies for mitigating seasonal changes	
3	Visitor satisfaction	1. Responsive management for visitor satisfaction	[12]; [24]; [25]; [29]; [36]
		2. Visitor satisfaction level	[12]; [24]; [25]; [29]; [33]
4	Planning arrangement	1. Periodic asset inventory	[12]
		2. Destination regulations and policies which include analysis of resources, infrastructure, zoning, as well as the facilities and services provided	
		3. Accessibility that supports tourist accommodation including persons with disabilities and special needs	[12]; [27]

The environmental dimension focused on the availability of natural resources. The economic dimension refers to infrastructure, buildings and structures, human well-being, availability of jobs or livelihoods. The social dimension refers to education, human ability, human behavior, experience, and human rights. The institutional dimension refers to social institutions, government organizations, interpersonal relationships, partnerships, or collaborations [22]; [37].

2.2. *Rap-tourism*

Rap-tourism is an adaptation of rap-fish, a rapid appraisal technique developed to evaluate the sustainability status of fisheries [38]. Rap-tourism is a rap-fish application which used to assess the sustainability status of tourist destination [19]; [20]. It uses multidimensional scaling (MDS) approach to visualize the result of sustainability assessment, quantify similarity judgement among a group of items [39].

Rap-fish transforms multidimensional concept to a lower dimension, in this case two dimension. The horizontal x dimension is to plot the fisheries from bad to good, while the y axis represents other factors. Rap-fish uses ALSCAL scaling algorithm, it generates an R2 measure which represent the proportion of variance of the scaled data [39].

Monte Carlo is used in rap-tourism to measure error from the ordination. Sensitives attribute or indicators can be identified by perform the leveraging calculation. Leverage values range between 2% to 6% in a multivariate condition. The lower the leverage value of an attribute, the lower its contribution to the sustainability status of the tourist destination. The final results of sustainability status are expressed on a scale of 0 to 100% and then visualized using a kite diagram [20].

2.3. Multi Attribute Aggregation

To aggregate the value of indicators into an index, there are several methods such as additive aggregation and geometric aggregation, and multi attribute aggregation [40]. Multi attribute aggregation uses the concept of multi criteria utility theory (MAUT). MAUT was developed by Keeney & Raiffa in 1976, MAUT generates an ordinal ranking of alternatives using a linear or multiplicative model [41]. MAUT uses multicriteria approach to generate an ordinal ranking of alternatives, it ranks the alternatives from best to worst. MAUT is a utility-based model which calculate the value of each criterion and then the values are aggregated into a final utility value [42].

In this research multi attribute aggregation is used to aggregate indicators from four sustainability dimension to calculate a sustainability index on tourism destination. The multi-attribute utility function in this study is linear and in the form of an additive model. The sustainability index is obtained by sum up multiplication value of the indicator's utility times the weight of the indicator.

3. Research Methodology

Comparison of the two methods used in measuring sustainability status will be seen from the aspect of the method or steps of implementing the measurement, the measurement results are in the form of a sustainability index and identification of indicators that are weak and need improvement. Then the steps for implementing the research are:

1. Identify the sequence of steps for carrying out measurements, especially in the data processing section to obtain a sustainability index,
2. Comparing the resulting sustainability index values, also the value of each dimension.
3. Comparing indicators that are considered weak from the two methods.

The primary data is obtained from a questionnaire filled out by stakeholders from the tourist destination. Whereas the secondary data is given by the tourist destination management. The index value found from data processing are categorized in four class of sustainability status, the scale for determining the status of sustainability is shown in table 2 [34]; [43].

Table 2. 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)

The literature review and the previous research found that the stages of data processing using rap-tourism are [19]; [20]:

1. Determining the measurement scale to quantify each indicator
2. Calculating the index of sustainability for each dimension using multidimensional scaling technique
3. Performing conformity test by calculating stress value and coefficient of determination
4. Calculating leverage value to identifying sensitive indicator
5. Performing Monte Carlo simulation at 95% confidence interval to validate the model
6. Calculating the final sustainability index
7. Categorizing the index of sustainability into sustainability status scales

The second method is multi attribute aggregation, the stages of data processing using multi attribute aggregation are:

1. Collecting utility data of each indicator
2. Performing data normalization to standardize the data into 0 to 1 scale using min-max method [44]
3. Weighting each dimension based on expert opinion
4. Aggregating the indicators using multi attribute utility function
5. Categorizing the index of sustainability into sustainability status scales
6. Analyzing sensitive indicators based on the utility value

The weighting method is based on expert opinion can increase the legitimacy of the result and can lead to a consensus for policy action [40]. The scale for determine the status of the sustainability is based on the scale developed by Allen (1997) and was used in research on tourism sustainability assessment conducted by Weng (2019).

4. Results and Discussion

4.1 Compare the step

There are different stages of data processing between the two methods, table 3 will show the differences and similarities between the two methods.

Table 3. comparison of data processing stage

Data Processing Stage	Rap-tourism	Multi Attribute Aggregation
Data Transformation	Ordination using the ALSCAL Algorithm	Normalization using min-max procedure, feature scaling, z-score
Conformity Test (Goodness of Fit)	Using the stress value and the coefficient of determination	-
Sensitivity Analysis	Using leverage analysis which will generate the root mean square	-
Model Validation	Using the monte Carlo simulation	-
Weighting Method	The weighting is done by ranking method, the only weight required is the weight of each dimension	The weighting is carried out by the ranking method, generally in the composite index method the weight value is sought for each attribute or indicator
Aggregation Method	Determining the weighted index by multiplying the value of the sustainability index by the dimensional weight	Determining the value of the sustainability composite index with a multi-attribute utility function, which is multiplying the utility value by the weight.

4.2 Compare the index

The following are the results using rapid appraisal technique and multi attribute approach. The comparison of index is shown in table 4.

Table 4. index value comparison

Data Processing Method	Rap-tourism	Multi Attribute Aggregation	Deviation
Baturaden Tourism Site			
Environmental Dimension	39,72	41,36	1,64
Economic Dimension	14,11	14,6	0,49
Socio-Cultural Dimension	9,17	9,85	0,68
Institutional Dimension	18,92	20,03	1,11
Average of Deviation			0,98

Data Processing Method	Rap-tourism	Multi Attribute Aggregation	Deviation
Global Index Value	81,92	85,84	
Sustainability Status	Sustainable	Sustainable	

There is a deviation in the value of the sustainability index between rap-tourism method and multi attribute aggregation. With the value of 85,84 and 81,92, Baturaden tourism site can be categorized as sustainable. The deviation in the sustainability index value is caused by using different data transformation methods. In the rap-tourism method the data transformation is carried out by ordination using the ALSCAL algorithm, whereas the multi-attribute approach using normalization with the min-max procedure for the data transformation. Using the same measurement tool, even though the data processing method is different still resulting the same sustainability status. Increasing the sustainability index can be done by improving the performance of its indicators.

4.3 Compare the weak indicators

Rap-tourism and multi attribute aggregation have different way to determine which indicators should be improved. The rap-tourism method uses leverage analysis to identify sensitive indicators. Increasing the sustainability index can be done by improving the sensitive indicators Sensitive indicator is an indicator whose has a major contribution on the value of sustainability index.

Leverage analysis calculate at the root mean square, the bigger the root mean square, the greater the influence of the indicators on the value of sustainability index [38]. In the multi-attribute aggregation, the indicator that must be improved is the indicator that has the lowest utility value. The lower the utility value of the indicator, the worse the performance of the indicator [45]. To increase the sustainability index of the tourist destination site, indicators that have low utility values must be improved. Table 5. shows the indicators that must be improved on each dimension.

Table 5. Indicators that need improvement

Dimension	Indicators that need improvement	
	Multi Attribute Aggregation	Rap-tourism
Environmental	Transport planning and programs to improve green transportation	Transport planning and programs to improve green transportation
Economy	Engage & support local businesses	Engage & support local businesses
Socio-Cultural	Availability of information in various media forms	Visitor management system
Institutional	Sustainable tourism destination development strategy	Inspection and preventive systems against hazards

Table 5 shows that the two method result on different finding on the weak indicators. This differences caused by different approach in identify the weak indicators. The rap-tourism used leverage value and the multi aggregations used utility value.

4. Conclusion

Based on the comparison done in this study, the stages of data processing using rap-tourism are more complex compared to multi attribute aggregation. Rap-tourism has a conformity test and validation test. While rap-tourism result more reliable, multi attribute aggregation is more common and easy to conduct, it can combine qualitative judgement and quantitative data to effectively rank indicator and aggregate indicator value in multidimensional concept.

Although there is deviation of 0.98 in the sustainability index value between the rap-tourism method and multi attribute aggregation. The result of the two methods still falls into the same sustainability category with the final value in the range of 75.01-100. To help stakeholders increase the value of the sustainability index, identification of indicators that need improvement is performed. The basis for selecting indicators that need to be improved is different for the two methods, rap-tourism using leverage factor value while multi attribute aggregation using utility value.

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8