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Application of the Additive Ratio Assessment (ARAS) Method in Selecting Superior Tourism in the Pasaman District Region

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Abstract- Pasaman Regency has tourism potential, which has not been managed optimally as a whole. Relevant institutions can make improvements to each tourist attraction so that the tourist attractions have the same advantages, so that visitors' interest and interest in visiting each tourist attraction is equal in the future, and regional original income (PAD) will increase from the tourism sector. This research aims to apply the Additive Ratio Assessment (ARAS) Method to select superior tourism in the Pasaman Regency area. The ARAS method will rank tourist attractions in Pasaman Regency based on predetermined criteria. Based on the results of research using the ARAS method, it was found that the most superior tourism attraction was the Ambun Waterpark tourist attraction (A5) with the highest Ki value, namely 0.90231, and the last rank with the lowest Ki value, namely 0.67877, was Taluak Ambun Waterfall (A6).

1. Introduction

Tourism is a temporary trip from one place to another, with the intention not to do business or earn a living in the place visited but only to have fun and fulfil various desires (Wibowo, 2008). Tourism is said to be superior if it meets the criteria in accordance with the provisions in the regulations of the Minister of Culture and Tourism. This is stated in the Ministerial Regulation, which is based on Law No. 9 of 1990, UU No. 32 of 2004, PP No. 67 of 1996, And other regulations.

Tourism in regencies/cities in West Sumatra has several problems in the form of tourism destination governance. Therefore, it is necessary to group tourism in each district/city so that it can make it easier for the relevant government to see which tourism will be developed so that the government or all elements that influence the development of tourism understand which tourism is superior and what needs to be developed at that tourist attraction. So that existing

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Tourist attractions have equal advantages. This is expected to attract visitor interest evenly and encourage visitors to visit all tourist attractions in an area over a continuous period. Tourism can increase Regional Original Income (PAD) (Ndruru, 2019). The Pasaman Regency Government is working on a program to advance tourism by completing the Detail Engineering Design (DED) for tourism development. Currently, Pasaman Regency has received an award in the Archipelago Tourism Village Promotion competition held by the Ministry of Villages, Development of Disadvantaged Regions and Transmigration (Kemendes PDTT).
The Additive Ratio Assessment (ARAS) method was introduced by Zavadskas and Turskis (Widodo, 2019). The ARAS method is part of the Multi Criteria Decision Making (MCDM), which is interconnected with the decision support system. The ARAS method is used to make decisions for each alternative, and then each alternative is used as a basis for calculating the ARAS method (Zavadskas, 2010). The best criterion is to be in the first-ranking position (Admaja, 2011). Alternatives are different objects that have the opportunity to be chosen (Kalifadani, 2006). In this study, the alternatives used were eight tourist attractions in Pasaman Regency. Criteria in research are the measurements that will be given when considering an alternative. There are five criteria used in this research (Pujawan 2005), namely: Accessibility of tourist objects (Syahrul, 2014), completeness of public facilities at each tourist attraction (Barus, 2013), cleanliness of tourist objects (Masjehoer, 2011), entry fees for tourist attractions (Burbaeti 2021), and security and visitor safety when travelling (Khalik, 2014). Respondents will assess these criteria, and then they will apply them to the ARAS method. Decisions are usually made based on situational considerations, and the decision is usually the best (Suryadi 2002).

2. Methods

This research is a type of applied research. The research used a non-probability sampling technique, namely the accidental sampling technique (Sumargo 2020), with a sample size of 160 respondents. The primary data used in this research was obtained directly by distributing validated questionnaires to each respondent who was visiting the Pasaman district tourist attraction.
The steps taken in this research are:

1. Preliminary survey to see tourism conditions in Pasaman district to find out the problems that exist in the research object. Studi literatur untuk mengumpulkan materi dari berbagai sumber yang berkaitan dengan permasalahan yang ditemui.
2. Examine the methods used to solve problems at tourist attractions.
3. Data will be collected and used in research.
4. Analyze the data obtained and carry out calculations using the ARAS method
5. Conclude data processing

The steps taken in implementing the ARAS method used in this research are:

1. Determination of alternatives and decision criteria
2. Criteria weighting
3. Next, determine the alternative suitability rating and decision criteria
4. Formation of Decision-Making Matrix (X)

$$X = \begin{bmatrix} X_{01} & \dots & X_{0j} & \dots & X_{0n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ X_{i1} & \dots & X_{ij} & \dots & X_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ X_{n1} & \dots & X_{mj} & \dots & X_{mn} \end{bmatrix}, \quad i = 0, \text{m} ; \quad j = 1$$

5. Formation of a normalized matrix (R)
   a. For benefit type criteria, it is normalized using linear normalization as follows:
      $R_{ij} = \frac{X_{ij}}{\sum_{i=0}^{m} X_{ij}}$; j = 1, 2, … n
   b. The next step is to calculate the normal value as follows:
      $R_{ij} = \frac{X_{ij}^{*}}{\sum_{i=0}^{m} X_{ij}^{*}}$; j = 1, 2, …, n
6. Forming a weighted normalized matrix (D)
   D = [dij]mxn = Rij. Wj ; i = 0, 1, 2, …, m; j = 1, 2, …, n

7. Determining the value of the optimum function (S)
   $S_i = \sum_{i=1}^{n} d_{ij}$; i = 0, 1, 2, …, m ; j = 1, 2, …, n
   S_0 is the optimal function of the optimal alternative.
8. Determining the utility rating (K)
   Determine the utility level K_i for each alternative i, namely:
   $K_i = \frac{S_i}{S_0}$; i = 0, 1, 2, …, m

   Si and S_0 are the values of the optimization criteria.

3. Results and Discussion

This research was conducted to see the results of applying the Additive Ratio Assessment (ARAS) method in selecting superior tourism in the Pasaman Regency area. In this study, the data used came from respondents who visited Pasaman Regency tourist attractions and who had completed the filling as in Table 1.

Table 1. Alternative Data

No	Alternative	A_i
1	Kawasan Wisata Equator	A_1
2	Candi Tanjung Medan	A_2
3	Cagar Alam Rimbo Panti	A_3
4	Puncak Koto Panjang	A_4
5	Ambun Waterpark	A_5
6	Air Terjun	A_6
7	Bendungan Panti-Rao	A_7
8	Pemandian Bendungan Sontang	A_8

The data in Table 1 are tourist attractions that will be ranked using the ARAS method.

Each criterion will be determined as a benefit or cost type. Benefit is a criterion that if the value is large, it will be profitable, and the smaller the cost, the more profitable it will be (Hotniar, 2005). The grouping of criteria can be seen in Table 2.

Table 2. Criteria Data

No	Criteria	C_i	Type Criteria
1	Tourist Attraction Accessibility	C_1	*Benefit*
2	Completeness of Tourist Attraction Facilities	C_2	*Benefit*
3	Cleanliness of Tourist Attractions	C_3	*Benefit*
4	Tourist Attraction Entrance Fee	C_4	*Cost*
5	Security and Safety of Visitors	C_5	*Benefit*

In Table 2, the criteria that are included in the benefit type are criteria with codes C1, C2, C3, and C5. Meanwhile, C4 is included in the cost type criteria.

After collecting data using questionnaires that respondents had filled in, alternative research data was obtained, as shown in Table 3.

Table 3. Research Alternative Data

No	Alternative	Criteria				
		C_1	C_2	C_3	C_4	C_5
1	A_1	0,83	0,74	0,53	0,77	0,73
2	A_2	0,69	0,55	0,47	0,84	0,69
3	A_3	0,78	0,70	0,47	0,52	0,38
4	A_4	0,57	0,84	0,63	0,83	0,57
5	A_5	0,88	0,91	0,87	0,76	0,67
6	A_6	0,72	0,77	0,65	0,86	0,39
7	A_7	0,91	0,81	0,61	0,69	0,43

8	A_8	0,59	0,47	0,74	0,54	0,37

The data in Table 3 was obtained from questionnaire answers filled in by respondents, and then the overall average for each criterion was looked for, as shown in Table 4.

Table 4. Alternative Research Data Results

No	Alternative	Criteria				
		C_1	C_2	C_3	C_4	C_5
0	A_0	0,91	0,91	0,87	0,52	0,73
1	A_1	0,83	0,74	0,53	0,77	0,73
2	A_2	0,69	0,55	0,47	0,84	0,69
3	A_3	0,78	0,70	0,47	0,52	0,38
4	A_4	0,57	0,84	0,63	0,83	0,57
5	A_5	0,88	0,91	0,87	0,76	0,67
6	A_6	0,72	0,77	0,65	0,86	0,39
7	A_7	0,91	0,81	0,61	0,69	0,43
8	A_8	0,59	0,47	0,74	0,54	0,37

In Table 4, you can see A0, where A0 is the value obtained from categorizing criteria according to type, namely benefits and costs. The criteria for entering the benefit type use the largest value, and the cost criteria use the smallest value according to existing data.

The application of calculation results using the Additive Ratio Assessment method in this research is as follows:

1. Formation of Decision-Making Matrix (DDM)

The decision matrix (X) is created from the results of alternative research data that have been determined in Table 4.

$$X_{ij} = \begin{bmatrix} 0{,}91 & 0{,}91 & 0{,}87 & 0{,}52 & 0{,}73 \\ 0{,}83 & 0{,}74 & 0{,}53 & 0{,}77 & 0{,}73 \\ 0{,}69 & 0{,}55 & 0{,}47 & 0{,}84 & 0{,}69 \\ 0{,}78 & 0{,}70 & 0{,}47 & 0{,}52 & 0{,}38 \\ 0{,}57 & 0{,}84 & 0{,}63 & 0{,}83 & 0{,}57 \\ 0{,}88 & 0{,}91 & 0{,}87 & 0{,}76 & 0{,}67 \\ 0{,}72 & 0{,}77 & 0{,}65 & 0{,}86 & 0{,}39 \\ 0{,}91 & 0{,}81 & 0{,}61 & 0{,}69 & 0{,}43 \\ 0{,}59 & 0{,}47 & 0{,}74 & 0{,}54 & 0{,}37 \end{bmatrix}$$

2. Decision Matrix Normalization (X)

Normalize the decision matrix for all criteria to a scale that can be compared with the alternatives. Matrix normalization is carried out by adding up the values for each criterion, and then each criterion is divided by the sum of the normalized matrices. As seen in Table 5.

Table 5. Decision Matrix Normalization Results

Alternative	C_1	C_2	C_3	C_4		C_5
				X_{ij}	R_{ij}	
A_0	0.1524	0.1572	0.1751	1.9231	0.1444	0.1726
A_1	0.1390	0.1278	0.1066	1.2987	0.0975	0.1726
A_2	0.1156	0.0950	0.0946	1.1905	0.0894	0.1631
A_3	0.1307	0.1209	0.0946	1.9231	0.1444	0.0898
A_4	0.0955	0.1451	0.1268	1.2048	0.0905	0.1348
A_5	0.1474	0.1572	0.1751	1.3158	0.0988	0.1584
A_6	0.1206	0.1330	0.1308	1.1628	0.0873	0.0922
A_7	0.1524	0.1399	0.1227	1.4493	0.1088	0.1017
A_8	0.0988	0.0812	0.1489	1.8519	0.1390	0.0875
$\sum_{i=0}^{m} X_{ij}^{*}$				13.3199		

Table 5 is the result of normalizing the decision matrix. Each criterion value obtained is calculated using a predetermined formula. For C4, it is calculated using two processes to obtain a value, as shown in

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Table 5. Other criteria are calculated using the benefit formula.
So, the results of the calculations on the normalization of the decision matrix obtained the following normalization results:

$$R_{ij} = \begin{bmatrix} 0.1524 & 0.1572 & 0.1751 & 0.1444 & 0.1726 \\ 0.1390 & 0.1278 & 0.1066 & 0.0975 & 0.1726 \\ 0.1156 & 0.0950 & 0.0946 & 0.0894 & 0.1631 \\ 0.1307 & 0.1209 & 0.0946 & 0.1444 & 0.0898 \\ 0.0955 & 0.1451 & 0.1268 & 0.0905 & 0.1348 \\ 0.1474 & 0.1572 & 0.1751 & 0.0988 & 0.1584 \\ 0.1206 & 0.1330 & 0.1308 & 0.0873 & 0.0922 \\ 0.1524 & 0.1399 & 0.1227 & 0.1088 & 0.1017 \\ 0.0988 & 0.0812 & 0.1489 & 0.1390 & 0.0875 \end{bmatrix}$$

3. Determining Normalized Matrix Weights

The next step is to find the results of the normalized matrix weights,
Where the weight of the criteria in this research is given or validated by someone who is an expert in the field of tourism.

Table 6. Criteria Weights

Criteria Weight (Wj)	C1	C2	C3	C4	C5
	0.15	0.15	0.20	0.25	0.25

Criteria weights in Table 6 are given based on the level of importance of each criterion.

The next step is to determine the weights of the normalized matrix obtained from the results of multiplying the normalized matrix in the previous step with the weights of the criteria that have been determined. So the results obtained in Table 7 are:

Table 7. Weights Normalization Matrix Results

	C1	C2	C3	C4	C5
D0	0.0229	0.0236	0.0350	0.0361	0.0431
D1	0.0209	0.0192	0.0213	0.0244	0.0431
D2	0.0173	0.0142	0.0189	0.0223	0.0408
D3	0.0196	0.0181	0.0189	0.0361	0.0225
D4	0.0143	0.0218	0.0254	0.0226	0.0337
D5	0.0221	0.0236	0.0350	0.0247	0.0396
D6	0.0181	0.0199	0.0262	0.0218	0.0230
D7	0.0229	0.0210	0.0245	0.0272	0.0254
D8	0.0148	0.0122	0.0298	0.0348	0.0219

Table 7 is the result of the weighted normalization matrix, where the values will be added up for each criterion to get the results in the next step.

4. Determining the value of the optimization function (Si)

The value of the optimization function is obtained from the sum of the criteria values contained in the results of multiplying the matrix and the criteria weights, which was carried out in the previous step. So the results obtained are shown in Table 8. Results of Optimization Function Values

Table 8. Results of Optimization Function Values

	Si
S0	0.1607
S1	0.1289
S2	0.1136
S3	0.1152
S4	0.1177
S5	0.1450
S6	0.1091
S7	0.1210

S8	0.1134

Table 8 shows the result of the optimization function values that were carried out according to a predetermined formula. The function value in S0 will be used as a divider in the next step.

5. Determining the Rating Level or Degree of Utility

The utility degree value is a way to determine the highest-ranking level for each alternative. In this research, the degree of utility that has the highest value is the most superior tourism object among the others.

The calculation results of the degree of utility that have been carried out are presented in Table 9 below:

Table 9. Utility Degree Results

K0	1
K1	0.80201
K2	0.70710
K3	0.71691
K4	0.73270
K5	0.90231
K6	0.67877
K7	0.75308
K8	0.70574

In Table 9, it can be seen that the ranking can be determined for each existing alternative.

After obtaining the calculation results of the degree of utility, a ranking can be determined by looking at the higher value for each alternative. The alternative that gets the highest score is the most superior tourist attraction in Pasaman Regency, which can be seen in the graph in Figure 1.

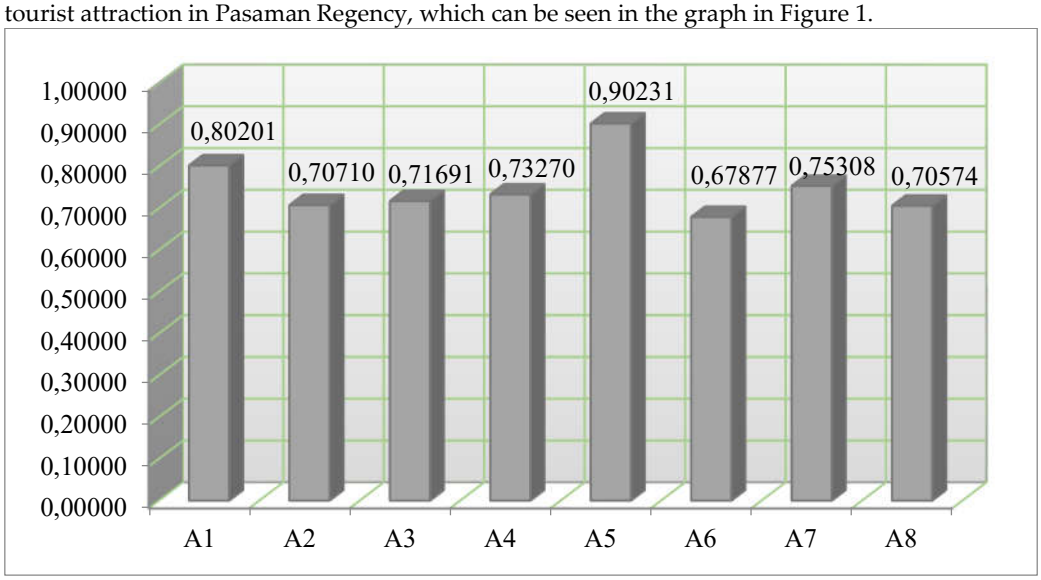

Figure 1. Graph of Final Results of Regency-Superior Tourism Ranking

In the graph, it can be seen that the highest number was obtained by the alternative coded A5, where A5 is the code for the Ambun Waterpark tourist attraction; therefore, the Ambun Waterpark tourist attraction is the most superior in Pasaman Regency based on assessments carried out by visitors to the Pasaman Regency tourist attraction at the time of the research. This took place while visiting tourist attractions in Pasaman Regency. For the next ranking from the graph, it can be seen that the alternative with code A1 is in second place, A7 is in 3rd place, 4th place is A4, A3 is in 1st place, 6th place is A2, 7th place is A8, and the last rank is A6 or Taluak Ambun Waterfall.

4. Conclusion

Based on the results of the research that has been carried out, it can be concluded that the application of the Additive Ratio Assessment (ARAS) method in selecting superior tourism in the Pasaman Regency area obtained first-place results with the highest Ki value of 0.90231, namely Ambun Waterpark which is located in Taluak Ambun, Lubuk Suhuing. The application of the Additive Ratio Assessment (ARAS) method can determine the ranking of each tourist attraction by considering criteria, namely accessibility, completeness of facilities, cleanliness, costs, and security and safety at the tourist attraction, from the first ranking, namely the Ambun Waterpark tourist attraction, to the lowest ranking or eighth ranking with The lowest degree of utility value is the Sontang Bathing Dam tourist attraction.

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