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Selection of Marine Tourism Destinations in West Kalimantan Using the Analytical Hierarchy Process Method

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ABSTRACT

Tourism in West Kalimantan offers various destinations rich in meaning and history. However, there are issues in managing tourism in this region, such as the lack of easily accessible information for tourists and the uneven distribution of visits to tourist destinations. Tourists often struggle to choose destinations that match their preferences due to the limitations of comprehensive and objective information systems. This results in some destinations becoming overcrowded while others are less visited. Technological advancements enable the development of Decision Support Systems (DSS) to address these issues and enhance decision-making in selecting tourist destinations. This research aims to develop a decision support system using the Analytical Hierarchy Process (AHP) method to simplify the decision-making process in choosing maritime tourist destinations in West Kalimantan. The primary goal of this research is to help tourists select maritime tourist destinations that best suit their preferences, improve their tourism experience, and support sustainable tourism development in West Kalimantan. This study employs the AHP method in the decision-making process. The research stages include problem identification, literature review, data collection through questionnaires, data analysis, and final weight calculation. Data were collected from 400 respondents in West Kalimantan and analyzed to determine the priority of tourist destinations based on criteria such as scenery, distance, accessibility, facilities, cleanliness, and cost. Based on AHP analysis, it was found that Temajuk Sambas is the most preferred tourist destination, followed by Temajuk Mempawah, Jawai Bahari, Samudera Indah, Pulau Lemukutan, and Tanjung Bajau. The developed decision support system provides clear guidance for tourists in selecting maritime tourist destinations in West Kalimantan according to their preferences.

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INTRODUCTION

Tourism is an activity that occurs within the context of travel and accommodation by individuals visiting an area, primarily for the purpose of spending leisure time and recreation (Lefirsty Phricensia Gavrilla, Katili, Yahya, & Nasib, 2024). Tourism in West Kalimantan is known for its diverse tourist attractions ranging from nature, culture, shopping, to culinary delights, making it a primary destination for both local and national tourists (Pebrianti, Sirait, & Purba, 2022). The tourist spots there are not only attractive but also rich in meaning and history, often serving as destinations for school study tours and vacations (Anwar, Priyanto, & Ramdani, 2021). Although there has been a temporary decline in visits, based on data from the West Kalimantan Tourism

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Office as of December 2021, thousands of tourists continue to come to enjoy its unique culture and history (Wisman & Akomodasi, 2022). Tourism is a dynamic field, and innovation and adaptation to various situations and conditions require keeping up with technological developments (Martyani, Yamalia, & Dauli, 2022). Therefore, it is important to continuously update and improve information systems and methods used in tourism management (Novrianto & Sulistyo, 2023).

The rapid development of technology is not only limited to hardware and software, but also extends to computational methods (Sudipa, Wiguna, Putra, & Hardiatama, 2021). One commonly used computational method today is the decision support system (Fatimah, 2023). The ability to make decisions responsibly is a key benchmark for success in decision-making amidst global competition in the future (As'arie, Wati, & Cahyono, 2020).

The problem with the diversity of tourist attractions makes it difficult for tourists to choose destinations, often leading them to only visit places that are frequently visited by others (Daniswara, 2024). The selection of tourist destinations becomes a challenge for tourists who rely solely on information about those destinations. Having plenty of information alone is not sufficient, especially considering the lack of comprehensive and objective information systems, which often hinder tourists from selecting destinations that align with their preferences (Anugrah, Negara, & Sukamto, 2021). This results in uneven distribution of tourists and suboptimal utilization of maritime tourism potential in West Kalimantan. Having the best tourist destinations in the decision-making process involves applying a method that facilitates quick decision-making (Tanu Kusnadi, Supiandi, Kusnadi, Pratama, & Fauzia, 2023). However, before making decisions from various alternatives, criteria are needed (Sudipa et al., 2021). Criteria are essential in decision support systems.

Decision Support System (DSS) is a system that can provide problem-solving capabilities, facilitating communication for specific problem-solving, whether structured or unstructured (Anwar et al., 2021). DSS is designed to be user-friendly and easily implementable by users with basic computer skills. DSS can be developed by applying the best competencies to serve as options in decision-making processes (Prehanto, 2020). DSS consists of two options: information systems and decision-making. Information systems involve a series of formal procedures in which data is collected, processed to generate information, and then provided to users (Seftiani & Chandriyanti, 2023). Decision-making is a collection of activities aimed at selecting an action to solve a problem. Choosing actions from faced alternatives based on facts and carried out through a systematic approach to provide the best solutions by managers is called decision-making (Suprapto, 2022).

One method of decision-making that is appropriate and has a calculation of consistency values in determining the priority levels of criteria and alternatives is the AHP (Parameswari, Astuti, & Ariestya, 2022). One of the designs of AHP typically converts qualitative values into quantitative values (Yasir Yusuf, Karaman, Widaningrum, Yuli Astuti, & Sucipto, 2023). This design also combines the strengths of responses and common sense related to various issues, then synthesizes various considerations into results that are consistent with intuitive estimates as presented in the considerations made (Yohana, Raheliya, & Sembiring, 2020). The AHP method was originally developed by Thomas L. Saaty, with its main utility being problem-solving and decision-making in a multi-criteria environment (Nurhidayah, Fauzan, & Rahayu, 2020). AHP establishes priority weights as alternatives by organizing goals, criteria, and sub-criteria in a hierarchical structure (Suprapto, 2022).

Based on the background outlined above and in order to help expedite and simplify the decision-making process, particularly in selecting maritime tourist destinations in West Kalimantan, a form of decision support system (DSS) is required. This DSS will aid in the selection of maritime tourist destinations using the analytical hierarchy process (AHP), with the aim of assisting in the selection of maritime tourist destinations in West Kalimantan. It is hoped that the results of the AHP will lead to the development of a decision support system that can assist tourism stakeholders, especially tourists, in choosing the maritime tourist destinations in West Kalimantan that best suit their preferences. This will enhance their tourism experience and support sustainable tourism development in West Kalimantan. Through this research, it is hoped to provide a significant contribution to the development of the tourism sector in West Kalimantan and offer new insights into the application of the AHP method in the context of tourist destination selection.

RESEARCH METHOD

The stages in this research are described as follows:

Figure 1. Research Method

These stages are illustrated in Figure 1, which visualizes the research steps systematically, from problem identification to drawing conclusions, providing a clear representation of the research flow. First, problem identification is carried out to determine and define the issue to be investigated. Next, a literature review is conducted to understand the theories and previous studies relevant to the research topic. After that, data is collected using predetermined methods, such as questionnaires or interviews, to obtain the necessary information. The collected data is then organized and prepared for further analysis. Finally, data analysis is performed to evaluate the results and draw conclusions that can provide insights into the research problem.

Problem Identification

Identifying a problem is the initial stage of the research process. This stage is based on formulating the problem, which is rooted in the background of the issue. The problem identified is how to determine the best tourist objects based on criteria (scenery, distance, accessibility, facilities, cleanliness, and cost) using the Analytical Hierarchy Process (AHP) method.

Literature Review

Conducting a literature review involves studying and reviewing various literature sources, including:

1. Reference Books
   Reference books used in this research include those that discuss decision support systems for tourism and are related to the topic, such as textbooks or papers. The reference books used in this research are a total of 5 books from 2017 to 2022.
2. Scientific Journals
   Scientific journals are obtained by downloading them from the internet. The information obtained pertains to decision support systems and the Analytical Hierarchy Process (AHP) method. The journals referenced in this research are a total of 10 journals from 2017 to 2023 with criteria focusing on AHP, UML, and DSS methods regarding tourist attractions.

Data Collection

This stage involves collecting data by distributing questionnaires to respondents. The number of questionnaires distributed using a paper-based method is presented to the population of West Kalimantan, which is 5,140,000 (Wisman & Akomodasi, 2022). To determine the sample size, the Slovin technique is used. The Slovin technique is a formula used to calculate the minimum sample size from a population with a tolerance limit of 5% (Faris & Hapantenda, 2024).

$$n = \frac{N}{1+Ne^2}$$

$$n = \frac{5.140.000}{1+5.140.000.0,05^2}$$

$$n = \frac{5.140.000}{12.851} = 399,97 \text{ or rounded to 400 samples}$$

Explanation:
n = Ukuran sampel
N = Ukuran Populasi
e = Batas Toleransi kesalahan

Research Data

In this research, the required data is divided into two categories: primary data sourced from questionnaires and secondary data sourced from journals, articles, literature, or books. Below is the questionnaire data filled out by 400 respondents:
Explanation:
P = Panorama
J = Distance
A = Accessibility
F = Facilities
K = Cleanliness
B = Cost

Data Analysis

To achieve a research goal, both qualitative data analysis and quantitative data analysis are used. Qualitative data analysis is used when the collected data cannot be quantified, meaning it consists solely of textual descriptions that are transformed into a problem. Meanwhile, quantitative data analysis is a method used when conclusions can be supported by numerical data, and calculations involve formulas related to research analysis. In this case, the analysis will be conducted using the Analytical Hierarchy Process (AHP) method, the research yields an analysis outcome that represents the results of the conducted research.

RESULTS AND DISCUSSION

The aim of this research is to select marine tourism objects based on criteria such as scenery, distance, accessibility, facilities, cleanliness, and cost. The marine tourism objects under consideration are Temajuk Sambas, Temajo Mempawah, Jawai Bahari, Samudera Indah, Pulau Lumukutan, and Tanjung Bajau.

Table .1. Explanation of Objectives, Criteria, and Alternatives

Objective	Determining the Best Marine Tourism in West Kalimantan	Determining the best marine tourist destinations in West Kalimantan
Criteria	Panorama	Scenic beauty of the tourist location
	Distance	Range of travel to the location
	Accessibility	Road access to the location

Objective	Determining the Best Marine Tourism in West Kalimantan	Determining the best marine tourist destinations in West Kalimantan
	Facilities	Availability of infrastructure and amenities
	Cleanliness	Cleanliness of the tourist site
	Cost	Expenses incurred when visiting the tourist location
Alternatives	Temajuk Sambas Beach	Candidate tourist attraction located in Sambas Regency
	Temajo Mempawah Beach	Candidate tourist attraction located in Mempawah Regency
	Jawai Marine Tourism Beach	Candidate tourist attraction located in Sambas Regency
	Samudera Indah Beach	Candidate tourist attraction located in Bengkayang Regency
	Lemukutan Island	Candidate tourist attraction located in Mempawah Regency
	Tanjung Bajau	Candidate tourist attraction located in Singkawang City

Table 1 explains the purpose of each criterion and alternative used in this research. Each criterion and alternative is identified to help achieve optimal results in the research, taking into account various relevant factors.

In the AHP method, there is a hierarchy, and the existence of this hierarchy allows for the decomposition of complex or unstructured problems, which are then organized into a hierarchy.

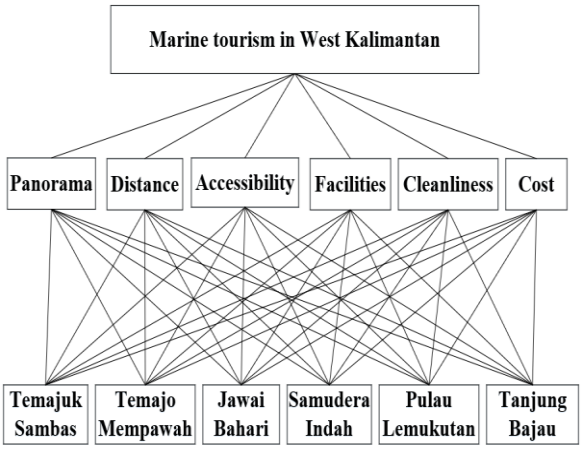

Figure 2. Hierarchy Structure

In Figure 2, the first level shows the goal, which is to identify the favorite tourist attractions in West Kalimantan, and this is the main objective of this research. At the second level, there are criteria related to all the tourist attractions that will be selected and used in the calculation process. At this level, all tourist attractions have or are related to criteria that include panorama, distance, accessibility, facilities, cleanliness, and cost. At the third level, there are alternatives related to the selected tourist attractions used in the calculation process. At this second level, there are alternative tourist attractions such as Temajo Sambas, Temajuk Mempawah, Bahari Jawai, Samudera Indah, Lemukutan Island, and Tanjung Bajau.

The next step is to determine the pairwise comparison matrix of criteria to determine the weight/priority values for each criterion.

Table 2. Recapitulation for all criteria

Criteria	Panorama	Distance	Accessibility	Facilitess	Cleanliness	Cost
Panorama	1.00000	2.4547	2.4014	2.4931	2.4503	2.3138
Distance	0.4074	1.0000	2.3160	2.4233	2.3334	2.4410
Accessibility	0.4164	0.4318	1.0000	2.4430	2.3742	2.4941
Facilities	0.4011	0.4127	0.4093	1.0000	2.1643	2.2031
Cleanliness	0.4081	0.4286	0.4212	0.4620	1.0000	2.5233
Cost	0.4322	0.4097	0.4009	0.4539	0.3963	1.0000
Total	**3.0652**	**5.1373**	**6.9489**	**9.2754**	**10.7186**	**12.9753**

Table 2 is a recap of the pairwise comparison matrix of criteria. This table provides a summary of the comparisons between criteria used in the research. Afterwards, normalized pairwise comparison assessments were conducted.

Table 3. Normalized Matrix

Criteria	Panorama	Distance	Accessibility	Facilities	Cleanliness	Cost	Eigen
Panorama	0.3262	0.4778	0.3456	0.2688	0.2286	0.1783	0.3042
Distance	0.1329	0.1947	0.3333	0.2613	0.2177	0.1881	0.2213
Accessibility	0.1359	0.0840	0.1439	0.2634	0.2215	0.1922	0.1735
Facilities	0.1309	0.0803	0.0589	0.1078	0.2019	0.1698	0.1249

Criteria	Panorama	Distance	Accessibility	Facilities	Cleanliness	Cost	Eigen
Cleanliness	0.1331	0.0834	0.0606	0.0498	0.0933	0.1945	0.1025
Cost	0.1410	0.0797	0.0577	0.0489	0.0370	0.0771	0.0736
Total	**1.0000**	**1.00000**	**1.00000**	**1.0000**	**1.00000**	**1.00000**	**1.00000**

The results of this assessment can be found in Table 3, which shows data that has been adjusted to facilitate further analysis.

Next, the eigenvalue vector is multiplied by the original matrix to produce values for each row, which are then divided by the corresponding eigenvalue. The average value of these divisions is the principal maximum eigenvalue (λmax).

$$\begin{pmatrix}1.9969\\1.4685\\1.1277\\0.7931\\0.6379\\0.4626\end{pmatrix} : \begin{pmatrix}0.3042\\0.2213\\0.1735\\0.1249\\0.1025\\0.0736\end{pmatrix} = \begin{pmatrix}6.5638\\6.6350\\6.5003\\6.3484\\6.2259\\6.2878\end{pmatrix}$$

$$\lambda max = \frac{(6.5638+6.6350+6.5003+6.3484+6.2259+6.2878)}{6}$$

$$\lambda max = 6.4269$$

$$CI = \frac{\lambda - n}{n-1}$$

$$CI = \frac{(6.4269-6)}{6-1} = 0.0854$$

Next, calculate the Consistency Ratio (CR) with n = 6, where IR = 1.24. Therefore:

$$CR = \frac{CI}{IR}$$

$$CR = \frac{0.0854}{1.24} = 0.0689$$

Explanation:
CI = Consistency Index
CR = Consistency Ratio
IR = Indeks Random Consistency

After calculating all the pairwise comparison matrices for criteria and alternatives, the evaluation factor matrix for each criterion against the alternatives, as well as the CI and CR calculations, are determined. Because the CR value is < 0.100, it means that the respondents' preferences are consistent.

For the calculation of alternative weights for the existing criteria, it can be done as explained above. After performing the calculations for each criterion and alternative using the AHP method, the final weight calculations are obtained.

Table 4. Ranking

	E	TS	TM	JB	SI	PL	TB
P	0.3042	0.3086	0.2170	0.1718	0.1287	0.1022	0.0731
J	0.2213	0.2976	0.2244	0.1750	0.1305	0.0988	0.0737
A	0.1735	0.3018	0.2219	0.1713	0.1318	0.0984	0.0748
F	0.1249	0.3015	0.2156	0.1748	0.1314	0.1023	0.0744
K	0.1025	0.2952	0.2239	0.1770	0.1280	0.1029	0.0730
B	0.0736	0.2941	0.2221	0.1688	0.1329	0.1031	0.0790

Explanation:
E = Eigen/Weight
P = Panorama
J = Distance
A = Accessibility
F = Facilities
K = Cleanliness
B = Cost
TS = Temajuk Sambas
SI = Samudera Indah
TM = Temajo Mempawah
PL = Pulau Lemukutan
JB = Jawai Bahari
TB = Tanjung Bajau

Table 4, ranking to find the best tourist attractions by calculating the value of each alternative.

The calculation of each weight for the criteria to determine the global priority is formulated as follows:

TS = (0.3042 x 0.3086) + (0.2213 x 0.2976) + (0.1735 x 0.3018) + (0.1249 x 0.3015) + (0.1025 x 0.2952) + (0.0736 x 0.2941)
TS = 0.0939 + 0.0659 + 0.0524 + 0.0377 + 0.0302 + 0.0216
TS = 0.3016

TM = (0.3042 x 0.2170) + (0.2213 x 0.2244) + (0.1735 x 0.2219) + (0.1249 x 0.2156) + (0.1025 x 0.2239) + (0.0736 x 0.2221)
TM = 0.0660 + 0.0497 + 0.0385 + 0.0269 + 0.0229 + 0.0163
TM = 0.2204

JB = (0.3042 x 0.1718) + (0.2213 x 0.1750) + (0.1735 x 0.1713) + (0.1249 x 0.1748) + (0.1025 x 0.1770) + (0.0736 x 0.1688)
JB = 0.0523 + 0.0387 + 0.0297 + 0.0218 + 0.0181 + 0.0124
JB = 0.1731

SI = (0.3042 x 0.1287) + (0.2213 x 0.1305) +

(0.1735 x 0.1318) + (0.1249 x 0.1314) + (0.1025 x 0.1280) + (0.0736 x 0.1329) +
SI = 0.0391 + 0.0289 + 0.0229 + 0.0164 + 0.0131 + 0.0098
SI = 0.1302

PL = (0.3042 x 0.1022) + (0.2213 x 0.0988) + (0.1735 x 0.0984) + (0.1249 x 0.1023) + (0.1025 x 0.1029) + (0.0736 x 0.1031)
PL = 0.0311 + 0.0219 + 0.0171 + 0.0128 + 0.0105 + 0.0076
PL = 0.1009

TB = (0.3042 x 0.0717) + (0.2213 x 0.0737) + (0.1735 x 0.0748) + (0.1249 x 0.0744) + (0.1025 x 0.0730) + (0.0736 x 0.0790)
TB = 0.0218 + 0.0163 + 0.0130 + 0.0093 + 0.0075 + 0.0058
TB = 0.0737

CONCLUSION

Based on calculations using the Analytical Hierarchy Process (AHP) method, the selection results of tourist attractions based on criteria are as follows: Temajuk Sambas (0.3016), Temajuk Mempawah (0.2204), Bahari Jawai (0.1731), Samudera Indah (0.1302), Pulau Lemukutan (0.1009), and Tanjung Bajau (0.0737). For further researchers, it can be developed for other calculations specifically using the Analytical Hierarchy Process (AHP) method with different criteria and alternatives. The author suggests that the application can be developed using other methods such as Simple Additive Weighting (SAW), TOPSIS, PROMETHEE, Profile Matching, or other methods that can be used for multi-criteria decision making.

After conducting the research, it can contribute to how the AHP method is used to evaluate and select tourist attractions in West Kalimantan. The use of AHP allows for a more objective and systematic assessment of various criteria, which is highly useful in decision-making related to tourism development by identifying the best tourist attractions such as Temajuk Sambas, Temajuk Mempawah, Bahari Jawai, and others. Based on the AHP calculations, it can assist local stakeholders in developing more effective marketing and development strategies to attract tourists.

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