Institut Riset dan Publikasi Indonesia (IRPI)
IJATIS: Indonesian Journal of Applied Technology and Innovation Science
Journal Homepage: https://journal.irpi.or.id/index.php/ijatis
Vol. 1 Iss. 2 August 2024, pp: 94-102
ISSN(P): 3032-7466 | ISSN(E): 3032-7474

Comparison of Analytical Hierarchy Process and Analytical Network Process Methods In Determining The Best Tourist Attractions In West Sumatra Province

Kana Kurnia[1*], M. Bryant Rama[2], Triyawan Bagus Subakja[3], Syukri Sastrawan[4], Yogi Septiandri[5], Muhammad Igo Ilham[6]

[1,2,3,4]Department of Information System, Faculty of Science and Technology,
Universitas Islam Negeri Sultan Syarif Kasim Riau, Indonesia
[5]Department of Computer Engineering, Universitas Andalas, Indonesia
[6]Department of Sari'ah Tourism, Universitas Islam Negeri Sjech M. Djamil Djambek Bukittinggi, Indonesia

E-Mail: [1]12050317289@students.uin-suska.ac.id, [2]12050314006@students.uin-suska.ac.id,
[3]12050312553@students.uin-suska.ac.id, [4]12050318889@students.uin-suska.ac.id,
[5]2011512030_yogi@student.unand.ac.id, [6]igoilham283@gmail.com

Received Jan 7th 2024; Revised 6th Aug 2024; Accepted Aug 23th 2024
Corresponding Author: Kana Kurnia

Abstract

A tourist attraction is a place visited for its natural beauty, culture, history, or recreation, such as beaches, mountains, national parks, historical buildings, museums, and amusement parks. Each has its unique charm, with some becoming iconic symbols and major tourist destinations. Tourist attractions are vital to the tourism industry, boosting economic growth and preserving cultural and natural heritage.West Sumatra is one of the provinces in Indonesia that is rich in natural and cultural beauty. In an effort to develop the tourism industry in this area, the selection of the right tourist sites is very important. There are 5 references in determining the best tourist attractions in West Sumatra Province, which include Natural Beauty, Cultural Diversity, Infrastructure, Price, and Cleanliness. Meanwhile, there are 5 alternatives that are used as references in determining the best tourist attractions in West Sumatra Province, namely Padang Beach, Carocok Beach, Sianok Gorge, Harau Valley, and Anai Valley. From the experiments that have been carried out, the rank changes that occur with the AHP and ANP methods are shown in Table 13. It can be seen that the AHP method has a higher percentage of sensitivity with a total percentage of 0.25% compared to the percentage of 0.14% in the ANP method. This proves that the AHP method is better than the ANP method for determining tourist attractions in West Sumatra Province.

Keywords: Analytical Hierarchy Process, Analytical Network Process, Tourist Attractions, West Sumatra Province

1. INTRODUCTION

A tourist attraction is a destination or place visited by tourists to enjoy a variety of attractions, natural beauty, culture, history, or recreation. Attractions can be beaches, mountains, lakes, national parks, historical buildings, museums, amusement parks, and much more. Each attraction has its own charm that lures tourists to visit it. Some famous attractions have even become icons of an area and become the main destination for tourists who come from various parts of the world. Tourist attractions also play an important role in the tourism industry of a country or region, which contributes significantly to economic growth and preservation of cultural and natural heritage [1].

West Sumatra is one of the provinces in Indonesia that is rich in natural and cultural beauty. According to data from the Badan Pusat Statistik for West Sumatra Province in 2023, the number of tourists visiting reached 13,341,025 [2]. This number corresponds to the number of tourist attractions in West Sumatra Province. This research focuses on the 5 most popular tourist attractions based on Tripadvisor reviews, namely Padang Beach, Carocok Beach, Sianok Gorge, Harau Valley, and Anai Valley [3].

In an effort to develop the tourism industry in this area, the selection of the right tourist sites is very important. Therefore, it is important to help tourists to find such information, plan their tourism, and help making decisions for travelling on tourist attraction [4]. Decision-making regarding the selection of tourist attractions can be a complicated task as it involves many different and often interrelated factors [5]. The Analytical Hierarchy Process (AHP) and Analytical Network Process (ANP) methods are useful methods to assist in this decision making [6].

The AHP is one of the most commonly used multi-criteria decision-making methods for prioritizing or ranking specific criteria. Although AHP simplifies reality by disregarding inter-element relationships, it remains effective for various decision-making scenarios [7]. In contrast, the ANP addresses AHP's limitations by forming a network that can accommodate feedback and interdependencies within and between groups of elements. However, this makes the pairwise comparison process more complex and time-consuming. ANP functions to determine and consider relationships within a network structure with a high degree of interdependence. Most complex real-world decision-making problems involve many interdependent elements that can be analyzed and processed using the feedback and interaction capabilities of the ANP model [8]. In the context of choosing a tourist destination, both methods can be used to evaluate various criteria such as cost, comfort, facilities, distance, and previous travel experiences. The choice between AHP and ANP depends on the complexity of the relationships among the criteria being considered.

ANP is an extension of AHP that allows us to model relationships between factors in a more complex manner [9]. In the context of tourism destination selection, ANP can help us identify the impact of factors on each other, such as how cultural diversity can affect natural beauty or vice versa. By modeling these relationships, we can make more holistic and accurate decisions [10]. Combining AHP and ANP in the decision-making of tourist attractions selection in West Sumatra can provide a more in-depth and structured view, allowing stakeholders to make better and more sustainable decisions in tourism development in this region [11].

The research entitled 'Selection of maintenance strategy using AHP and ANP algorithms: a case study' aims to demonstrate the use of two general purpose decision-making techniques in selecting the most appropriate maintenance strategy for organizations with critical production requirements. AHP and ANP were used for the selection of the most appropriate maintenance strategy in a local newspaper printing facility in Turkey. Both methods proved to be effective in selecting a maintenance strategy for printing presses. Both methods provided almost the same results. Both methods take into account the specific needs of the organization through available expertise [12].

Then, the research entitled 'Application of AHP to Support the Decision of Selection of Tourist Destinations in Yogyakarta for Non-Asian Foreign Tourists' involves designing and creating a system for selecting tourist destinations in Yogyakarta for non-Asian foreign tourists using the AHP method. This system works well according to the specified criteria. By using a decision support system with the AHP method, it is able to provide decision results with an accuracy rate of 60% of 5 alternative tourist destination data tested using the system [13].

Previous research entitled 'The Use of the ANP Method in the Selection of Paper Raw Material Suppliers at PT Mangle Panglipur' discussed that the ANP method shows the relationship within a set of elements (node comparison) and the relationship between different elements (cluster comparison). The use of the ANP method will produce a priority weight value for all elements in the decision-making system. In the research conducted at PT Mangle Panglipur, there are 4 consideration criteria consisting of 12 sub-criteria and 3 alternative choices. Based on the results of data processing, alternative supplier CV Karya Jaya was chosen as the best alternative supplier with the highest weight value of 0.158, followed by CV Makmur Jaya with 0.145 and CV Sinar Jaya with 0.134. Therefore, the Karya Jaya supplier alternative is the best supplier alternative for the company [14].

2. MATERIAL AND METHOD

2.1. Research Stages

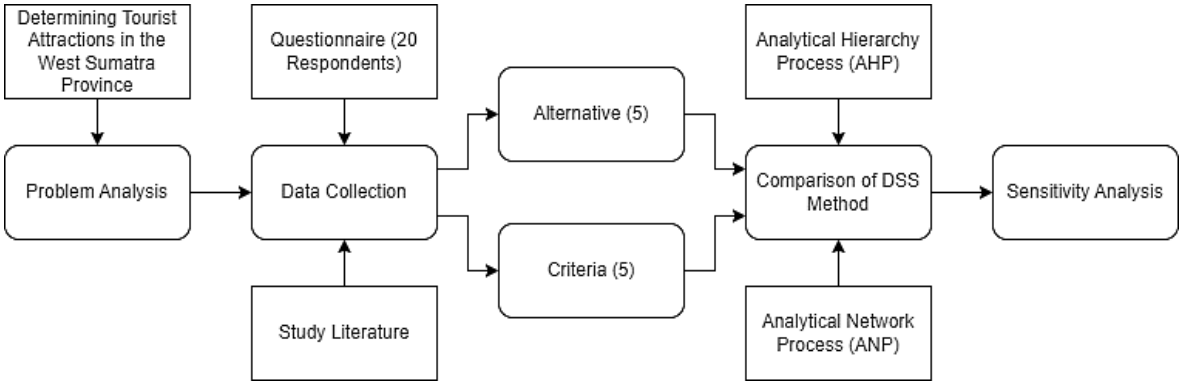

Image 1. Research Stages

Figure 1 Describes the stages of research starting from Problem Analysis in determining the best tourist attractions in West Sumatra Province by applying a comparison of the Analytical Hierarchy Process (AHP)

and Analytical Network Process (ANP) methods. Data collection is done in 2 ways, namely distributing questionnaires to 20 respondents who will produce Primary Data, and conducting literature studies to obtain Secondary Data.

There are 5 criteria used as a reference in determining the best tourist attractions in West Sumatra Province, which include Natural Beauty (C1), Cultural Diversity (C2), Infrastructure (C3), Price (C4), and Cleanliness (C5). Meanwhile, there are 5 alternatives used as a reference in determining the best tourist attractions in West Sumatra Province, which include Padang Beach (A1), Carocok Beach (A2), Sianok Gorge (A3), Harau Valley (A4), and Anai Valley (A5). This research compares 2 multi-criteria Decision Support System (DSS) methods, namely the AHP and ANP methods to determine the best tourist attractions in West Sumatra Province by conducting sensitivity analysis on both methods.

2.2. Analytical Hierarchy Process (AHP) Method

The Analytical Hierachy Process (AHP) method is one of the SPK methods that can decompose a complex multi-criteria problem into a hierarchy [15]. The Analytical Hierarchy Process (AHP) method can perform a better, easier, more efficient identification process in analyzing the weight of criteria and alternatives [16]. With a hypothesis, it will be determined which element has the highest priority [17]. Below are the steps of the Analytical Hierarchy Process (AHP) method [18]:

1. Determine the criteria and alternatives to be used.
2. Organize the criteria in the form of a pairwise matrix.
3. Provide a saaty scale rating on the criteria pairwise comparison matrix.
4. Conduct consistency testing on comparisons between criteria using Equation (1).

$$\mathrm{CI} = \frac{\lambda\,\mathrm{max} - \mathrm{n}}{\mathrm{n}-1} \tag{1}$$

Description,

CI	: Consistency Index (Consistency Deviation Ratio)
λ max	: Largest eigenvalue of matrix of order n
n	: Number of elements being compared

$$\mathrm{CR} = {}^{\mathrm{CI}}/_{\mathrm{RI}} \tag{2}$$

Description,

CR	: Consistency Ratio
RI	: Random Index

5. Perform Ranking.

2.3. Analytical Network Process (ANP) Method

The Analytical Network Process (ANP) method is a development of the ANP method developed by Thomas L. Saaty which allows a person to make decisions facing interconnected factors (Dependence) and feedback systematically [19]. According to Saaty, the simplicity of the method makes ANP a more general method and easier to apply in research, such as decision making, evaluation, mapping, strategy, resource allocation and so on [20]. The stages in the ANP method are as follows [21]:

1. Determine the criteria and alternatives to be used.
2. Form a pairwise comparison matrix.
3. Calculating element weights.
4. Calculate the consistency ratio using Equations (3) and (4).

$$\mathrm{CI} = \frac{\lambda\,\mathrm{max} - \mathrm{n}}{\mathrm{n}-1} \tag{3}$$

$$\mathrm{CR} = {}^{\mathrm{CI}}/_{\mathrm{RI}} \tag{4}$$

Description,

CI	: Consistency Index (Consistency Deviation Ratio)
λ max	: Largest eigenvalue of matrix of order n
n	: Number of elements being compared
CR	: Consistency Ratio
RI	: Random Index

5. Determine the Best Alternative.

2.4. Sensitivity Analysis

Sensitivity Analysis provides a surprising insight into the multi-criteria decision-making process [22]. Sensitivity Analysis is geared towards choosing the best alternative from the many alternatives available [23]. The steps in performing Sensitivity Analysis are as follows [24]:

1. Determine the weight value of the criteria
2. Determines the initial base value, where the initial base value is used as a reference for ranking changes.
3. Change the weight of one or more criteria with a value change range of 1 to 2.
4. Normalize the weight of the criteria, so that the weight value of the criteria becomes $\Sigma = 1$.
5. Calculate the change in ranking for each method analyzed.
6. Calculate the percentage of changes in ranking for each method analyzed.

Sensitivity Analysis has a final result that can be known by calculating the presentation of changes in ranking [25], a method will become more sensitive [26], if the presentation value changes greatly [27]. Equation (3) shows how to obtain the value of the presentation of changes in ranking on alternatives [28].

$$\frac{T}{i \times A} \times 100\ \% \tag{3}$$

Description,

T : Final Total Rank Change
i : Total Recurrence
A : Number of Attributes used

3. RESULTS AND ANALYSIS

3.1. Analytic Hierarchy Process (AHP) Calculation

1. Tourism Object Selection Decision Hierarchy

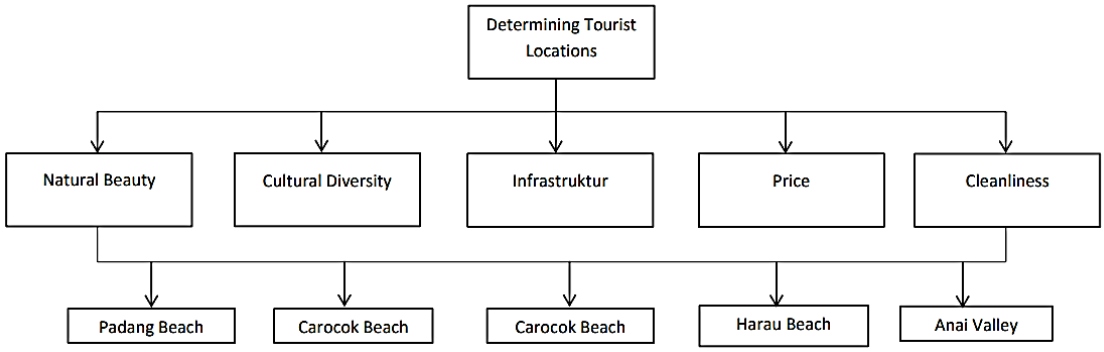

Figure 2. Hierarchy of Tourism Location Determination

Figure 2 explains that in determining tourist locations there are 5 criteria, namely Natural Beauty (C1), Cultural Diversity (C2), Infrastructure (C3), Price (C4), and Cleanliness (C5). Meanwhile, there are 5 alternatives that are used as a reference in determining the best tourist attractions in West Sumatra Province, which include Padang Beach (A1), Carocok Beach (A2), Sianok Gorge (A3), Harau Valley (A4), and Anai Valley (A5). The next stage is to determine the weight of each criterion with the Analytical Hierarchy Process (AHP) method in accordance with the steps:

2. Determine the Criteria, for the criteria used can be seen in Table 1.

Table 1. Criteria

Code	Criteria
C1	Natural Beauty
C2	Cultural Diversity
C3	Infrastructure
C4	Price
C5	Hygiene

3. Arranging these criteria in the form of a paired matrix is shown in Table 2.

Table 2. Pairwise Matrix

	C1	C2	C3	C4	C5
C1	1	3	5	3	9
C2	0,33	1	3	3	5
C3	0,20	0,14	1	7	3
C4	0,14	0,33	0,20	1	3
C5	0,11	0,14	0,14	0,33	1
Total	1,79	4,62	9,34	14,33	21,00

4. Data normalization shares each criterion element value with the sum result shown in Table 3.

Table 3. Data Normalization Results

	C1	C2	C3	C4	C5
C1	0,560	0,649	0,535	0,209	0,429
C2	0,187	0,216	0,321	0,209	0,238
C3	0,112	0,031	0,107	0,488	0,143
C4	0,080	0,072	0,021	0,070	0,143
C5	0,062	0,031	0,015	0,023	0,048

5. Determine the average value by summing up each row of normalization results divided by the number (n) of criteria shown in Table 4.

Table 4. Finding the average value

	Total	n	Average
C1	2,382	5	0,476406
C2	1,171	5	0,234299
C3	0,881	5	0,176218
C4	0,386	5	0,077225
C5	0,179	5	0,035852

6. The weighting results are obtained from the average value shown in Table 5.

Table 5. Criteria Weighting Results

Criteria	Weight
C1	0,476406
C2	0,234299
C3	0,176218
C4	0,077225
C5	0,035852

7. Calculating the Eigen Value to find the eigen value can be done by multiplying the average value by the number of columns before normalization shown in Table 6.

Table 6. Eigenvalues

Criteria	Eigenvalue
C1	2,615
C2	1,333
C3	0,953
C4	0,366
C5	0,173
Total	5,440

8. Calculate the Consistency Index (CI) value using the formula in equation 1.

$$\mathrm{CI} = \frac{5{,}440 - 5}{5 - 1} = 0{,}1100$$

9. Calculating the Consistency Ratio (CR) value using the formula in equation 2, If the CR value is <0.1, the value is considered consistent and has the right to continue. If the CR value is > 0.1, the value is considered inconsistent and has no right to continue.

$$CR = \frac{0{,}1100}{1{,}12} = 0{,}0982$$

10. Alternative Ranking Results. The following alternative ranking results can be seen in Table 7.

Table 7. AHP Ranking Results

Alternative	Vi Value	Ranking
A5	12,4688	1
A1	8,233625	2
A3	4,030185	3
A4	2,134446	4
A2	1,849147	5

3.2. Analytical Network Process (ANP) Calculation

Basically, ANP is designed to capture the perceptions of people closely related to a particular problem in a rational manner, to arrive at a scale of preferences among various alternatives using the method designed. Transforming quantitative values from qualitative is the principle behind the Analytical Network Process (ANP), so that decisions are made more objectively.

Normalization in ANP is done by separating the number of elements from the number of columns. Eigenvalues are generated based on the number of criteria from each row, as below.

$$C_{11} = \frac{1}{1{,}79} = 0{,}558$$

$$C_{12} = \frac{3}{4{,}62} = 0{,}649$$

$$C_{13} = \frac{5}{9{,}34} = 0{,}535$$

$$C_{14} = \frac{3}{14{,}33} = 0{,}209$$

$$C_{15} = \frac{9}{21} = 0{,}428$$

$$EV\ C_1 = \frac{0{,}558 + 0{,}649 + 0{,}535 + 0{,}209 + 0{,}428}{5} = 0{,}3758$$

The Eigen Value calculation for each criterion is done using the same formula. The Eigen Value for C1 is 0.03758, C2 is 0.0137, C3 is 0.0352, C4 is 0.0059, and C5 is 0.0027. After getting the Eigen Value for each criterion, λmax can be calculated from the pairwise matrix comparison with the Eigen Value.

$$\begin{pmatrix} 1 & 3 & 5 & 3 & 9 \\ 0{,}33 & 1 & 3 & 3 & 5 \\ 0{,}2 & 0{,}14 & 1 & 7 & 3 \\ 0{,}14 & 0{,}33 & 0{,}20 & 1 & 3 \\ 0{,}11 & 0{,}14 & 0{,}14 & 0{,}33 & 1 \end{pmatrix} \begin{pmatrix} 0{,}3758 \\ 0{,}0137 \\ 0{,}0352 \\ 0{,}0059 \\ 0{,}0027 \end{pmatrix} = \begin{pmatrix} 0{,}6349 \\ 0{,}2745 \\ 0{,}1616 \\ 0{,}0781 \\ 0{,}0528 \end{pmatrix}$$

$$\lambda max = \left(\frac{0{,}6349}{0{,}3758} + \frac{0{,}2745}{0{,}0137} + \frac{0{,}1616}{0{,}0352} + \frac{0{,}0781}{0{,}0059} + \frac{0{,}0528}{0{,}0027}\right) \div 5 = 5{,}324$$

After getting λmaxthe next step is to calculate the consistency index.

$$CI = \frac{(\lambda max - n)}{(n-1)} = \frac{(5{,}324 - 5)}{(5-1)} = 0{,}076$$

Consistency Ratio can be calculated after getting the Consistency Index. The Random Index used for the 5 criteria is 1.12.

$$CR = \frac{CI}{IR} = \frac{0{,}076}{1{,}12} = 0{,}0678$$

Since CR is less than 0.1, the hierarchy is declared consistent, the calculation is declared correct and can be used as a weighting standard. Alternative Ranking is done by calculating the Eigen Value of each criterion by Normalizing the Alternative Matrix.

$$V_1 = \sum(0{,}3758 \times 2{,}481) + (0{,}0137 \times 1{,}607) + (0{,}0352 \times 0{,}732) + (0{,}0059 \times 0{,}350) + (0{,}0027 \times 0{,}272)$$

$$V_1 = \sum(0{,}932 + 0{,}022 + 0{,}025 + 0{,}002 + 0{,}0007) = 0{,}9829$$

For the other alternatives, the same formula is used to generate the score values V_1 and the ranking results are shown in Table 8.

Table 8. Vi Value and Ranking of Tourist Attractions in West Sumatra

No.	Alternative	Vi	Rank
1	Padang Beach	0,9829	2nd position
2	Pamtai Carocok	0,7395	5th position
3	Sianok Gorge	0,9600	3rd position
4	Harau Valley	0,8456	4th position
5	Anai Valley	1,0274	1st position

Based on the calculation of 5 tourist attractions, it can be seen that Anai Valley (A5) is the best tourist spot in West Sumatra Province. The second and third positions are Padang Beach and Sianok Gorge. The ranking results of tourist attractions in West Sumatra Province are closely related to the weight of the criteria. The weight of criteria that focus on Natural Beauty (C1), Cultural Diversity (C2), Infrastructure (C3), Price (C4), and Cleanliness (C5) can make tourist attractions in West Sumatra Province better.

The results of manual calculations using AHP and ANP to determine the best tourist attractions in West Sumatra Province were applied and tested using Microsoft Excel. Figure 3. and Figure 4. display the implementation of comparison and ranking of tourist attractions in West Sumatra Province using AHP and ANP.

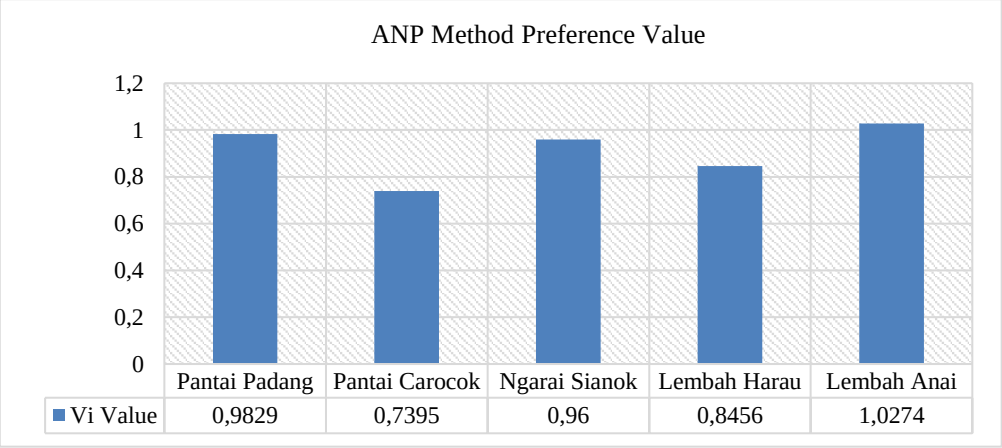

Figure 3. Preference Value of Tourist Attractions in West Sumatra Province Using ANP

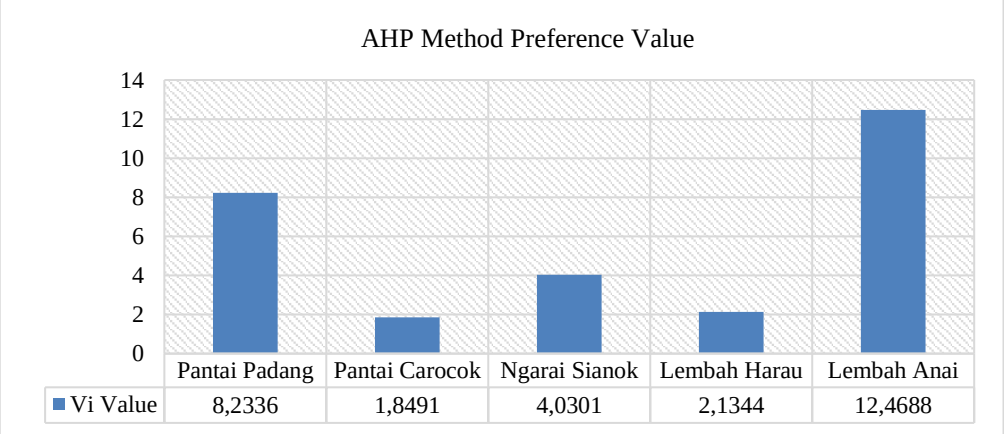

Figure 4. Preference Value of Tourist Attractions in West Sumatra Province Using AHP

3.3. Sensitivity Analysis

1. Determining the Initial Value

Table 9. Initial Value

No.	Alternative	AHP	ANP
1	Padang Beach	8.2336	0.9829
2	Carocok Beach	1.8491	0.7395
3	Sianok Gorge	4.0301	0.9600
4	Harau Valley	2.1344	0.8456
5	Anai Valley	12.4688	1.0274

Ranking using AHP and ANP methods has the same best alternative results, namely Anai Valley (A5).

2. Changing Criteria Weights

Experimented 3 times in changing the weight of the criteria by adding a value of 0.5. The steps in changing the weight of the criteria are as follows:

a. Experiment 1, adding a weight of 0.5 to C1.
b. Experiment 2, adding a weight of 0.5 to C2.
c. Experiment 3, adding a weight of 0.5 to C3.

In the first experiment, we added weight to the C1 criterion as much as 0.5, the experimental results can be seen in the table 10

Table 10. Experiment 1 Results

No.	Alternative	AHP	ANP
1	Padang Beach	18.6250	2.2234
2	Carocok Beach	4.1382	1.6555
3	Sianok Gorge	9.1285	2.1745
4	Harau Valley	4.8011	1.9021
5	Anai Valley	28.3260	2.3324

In the second experiment, the weight was added to the C2 criterion as much as 0.5, the experimental results can be seen in the table 11.

Table 11: Experiment 2 results

No.	Alternative	AHP	ANP
1	Padang Beach	14.9643	1.7864
2	Carocok Beach	3.7794	1.5115
3	Sianok Gorge	7.6215	1.8155
4	Harau Valley	4.4856	1.7771
5	Anai Valley	24.2470	1.9979

In the third experiment, the weight was added to the C3 criterion as much as 0.5, the experimental results can be seen in the table 12.

Table 12: Experiment 3 results

No.	Alternative	AHP	ANP
1	Padang Beach	11.3036	1.3489
2	Carocok Beach	2.7642	1.1055
3	Sianok Gorge	7.3855	1.8660
4	Harau Valley	2.9774	1.1796
5	Anai Valley	24.0953	1.9854

Table 13: Sensitivity Test Results

No.	Experiment	AHP	ANP
1	Experiment 1	15.8572	1.3050
2	Experiment 2	11.7782	0.9705
3	Experiment 3	12,4635	0.9580
Change (%)		0.25	0.14

From the three experiments that have been carried out, it can be seen the Rank changes that occur with the AHP and ANP methods, shown in table 13. It can be seen that the AHP method has a higher percentage of sensitivity with a total percentage of 0.25% compared to the percentage of 0.14% in the ANP method. This proves that the AHP method is better than the ANP method for determining tourist attractions in West Sumatra Province.

4. CONCLUSSION

Combining AHP and ANP in tourism site selection decision-making in West Sumatra can provide a more in-depth and structured view, allowing stakeholders to make better and more sustainable decisions in tourism development in the region. Multi-criteria Decision Support System (DSS) methods, namely the Analytical Hierarchy Process (AHP) and Analytical Network Process (ANP) methods to determine the best tourist attractions in West Sumatra Province by conducting sensitivity analysis on both methods. Where from three experiments where each experiment added a weight of 0.5 that has been done, it can be seen the Rank changes that occur with the AHP and ANP methods, shown in table 13. It can be seen that the AHP method has a higher percentage of sensitivity with a total percentage of 0.25% compared to the percentage of 0.14% in the ANP method. This proves that the AHP method is better than the ANP method for determining tourist attractions in West Sumatra Province. Anai Valley is one of the best places based on ranking values, followed by Ngarai Sianok.

REFERENCES

[1] F. Ariyani, R. R. Suryono, dan Setiawansyah, “Building of Informatics, Technology and Science (BITS),” vol. 5, no. 3, 2023

[2] B. P. Statistik, “Jumlah Kunjungan Wisatawan pada Tahun 2021-2023,” Badan Pusat Statistik Provinsi Sumatra Barat. [Daring]. Tersedia pada: https://sumbar.bps.go.id/

[3] Tripadvisor, “Objek Wisata Terpopuler di West Sumatra,” Tripadvisor. [Daring]. Tersedia pada: https://www.tripadvisor.co.id/

[4] Suratthani Rajabhat University, Department of Business Information System, Faculty of Management Sciences, Surat Thani, Thailand dkk., “TOURIST DECISION SUPPORT SYSTEM FOR HOT SPRINGS, THAILAND,” Geoj. Tour. Geosites, vol. 53, no. 2, hlm. 611–621, Jun 2024, doi: 10.30892/gtg.53224-1236.

[5] M. Deveci, A. R. Mishra, I. Gokasar, P. Rani, D. Pamucar, dan E. Ozcan, “A Decision Support System for Assessing and Prioritizing Sustainable Urban Transportation in Metaverse,” IEEE Trans. Fuzzy Syst., vol. 31, no. 2, hlm. 475–484, Feb 2023, doi: 10.1109/TFUZZ.2022.3190613.

[6] Asana, I. M. D. P.; Sudipa, I. G. I.; Putra, K. A. P. A Decision Support System on Employee Assessment Using Analytical Network Process (ANP) and BARS Methods. *J. Tek. Inform. CIT Medicom* 2021, *13* (1), 1–12. https://doi.org/10.35335/cit.Vol13.2021.38.pp1-12.

[7] D. Jorge-García and V. Estruch-Guitart, “Comparative analysis between AHP and ANP in prioritization of ecosystem services - A case study in a rice field area raised in the Guadalquivir marshes (Spain),” *Ecol. Inform.*, vol. 70, no. June, p. 101739, 2022, doi: 10.1016/j.ecoinf.2022.101739.

[8] A. Janeš, N. Kadoić, and N. B. Ređep, “Differences in prioritization of the BSC’s strategic goals using AHP and ANP methods,” *J. Inf. Organ. Sci.*, vol. 42, no. 2, pp. 193–217, 2018, doi: 10.31341/jios.42.2.3.

[9] Khorrami, B.; ValiZadeh Kamran, K.; Roostaei, S. Assessment of Groundwater-Level Susceptibility to Degradation Based on Analytical Network Process (ANP). *Int. J. Environ. Geoinformatics* 2018, *5* (3), 314–324. https://doi.org/10.30897/ijegeo.451067.

[10] Jorge-García, D.; Estruch-Guitart, V. Comparative Analysis between AHP and ANP in Prioritization of Ecosystem Services - A Case Study in a Rice Field Area Raised in the Guadalquivir Marshes (Spain). *Ecol. Inform.* 2022, *70*, 101739. https://doi.org/10.1016/j.ecoinf.2022.101739.

[11] Daneshparvar, B.; Nezami, S. R.; Feizi, A.; Aghlmand, R. Comparison of Results of Flood Hazard Zoning Using AHP and ANP Methods in GIS Environment: A Case Study in Ardabil Province, Iran.

[12] Zaim, S., Turkyılmaz, A., Acar, M.F., Al-Turki, U. and Demirel, O.F. (2012), "Maintenance strategy selection using AHP and ANP algorithms: a case study", Journal of Quality in Maintenance Engineering, Vol. 18 No. 1, pp. 16-29. https://doi.org/10.1108/13552511211226166.

[13] Sandy, I. A., & Fathurahman, H. (2013). Penggunaan Metode Analytic Network Process (ANP) dalam Pemilihan Supplier Bahan Baku Kertas pada PT Mangle Panglipur. Jurnal Rekayasa Sistem Industri, 2(1), 32-39.

[14] Prasetyaningrum, P. T., & Sari, A. (2019). Penerapan analytical hierarchy process (AHP) untuk mendukung keputusan pemilihan desrinasi tempat wisata daerah istimewa yogyakarta untuk para wisatawan mancanegara non asia. Simetris: Jurnal Teknik Mesin, Elektro dan Ilmu Komputer, 10(2), 519-528.

[15] Ndruru, T.; Riandari, F. Decision Support System Feasibility Lending At KSU Mitra Karya Cooperative Customer Unit XXVIII with Analytical Hierarchy Process Method. 2019, *3* (3).
[16] Dwi Putra, M. S.; Andryana, S.; Fauziah; Gunaryati, A. Fuzzy Analytical Hierarchy Process Method to Determine the Quality of Gemstones. *Adv. Fuzzy Syst.* 2018, *2018*, 1–6. https://doi.org/10.1155/2018/9094380.
[17] Sharma, V.; Gidwani, B. D.; Sharma, V.; Meena, M. L. Implementation Model for Cellular Manufacturing System Using AHP and ANP Approach. *Benchmarking Int. J.* 2019, *26* (5), 1605–1630. https://doi.org/10.1108/BIJ-08-2018-0253.
[18] Kusnadi, I. T.; Supiandi, A.; Kusnadi, W.; Pratama, A. K.; Fauzia, A. Implementasi Metode Analytical Hierarchy Process dalam Pemilihan Tempat Wisata di Sukabumi. 2023, No. 2.
[19] Rahmatin, N.; Santoso, I.; Indriani, C.; Rahayu, S.; Widyaningtyas, S. Integration of the Fuzzy Failure Mode and Effect Analysis (Fuzzy FMEA) and the Analytical Network Process (ANP) in Marketing Risk Analysis and Mitigation. *Int. J. Technol.* 2018, *9* (4), 809. https://doi.org/10.14716/ijtech.v9i4.2197.
[20] Borjalilu, N.; Ghambari, M. Optimal Maintenance Strategy Selection Based on a Fuzzy Analytical Network Process: A Case Study on a 5-MW Powerhouse. *Int. J. Eng. Bus. Manag.* 2018, *10*, 184797901877617. https://doi.org/10.1177/1847979018776172.
[21] Sianturi, A. V.; Wahyuni, L. Perbandigan Metode ANP dan AHP Pemilihan Siswa Berprestasi pada SD Negeri 060862 Berbasis Online. 2023, No. 1.
[22] Sari, N. K. A. P. Implementation of the AHP-SAW Method in the Decision Support System for Selecting the Best Tourism Village. *J. Tek. Inform. CIT Medicom* 2021, *13* (1), 24–35.
[23] Nimawat, D.; Gidwani, B. D. Prioritization of Important Factors towards the Status of Industry 4.0 Implementation Utilizing AHP and ANP Techniques. *Benchmarking Int. J.* 2020, *28* (2), 695–720. https://doi.org/10.1108/BIJ-07-2020-0346.
[24] Kahraman, C.; Cebi, S.; Onar, S. Ç.; Öztayşi, B. Recent Developments on Fuzzy AHP&ANP Under Vague and Imprecise Data: Evidence from INFUS Conferences. *Int. J. Anal. Hierarchy Process* 2022, *14* (2). https://doi.org/10.13033/ijahp.v14i2.1033.
[25] Okfalisa, O.; Rusnedy, H.; Iswavigra, D. U.; Pranggono, B.; Haerani, E. H.; Saktioto, S. DECISION SUPPORT SYSTEM FOR SMARTPHONE RECOMMENDATION: THE COMPARISON OF FUZZY AHP AND FUZZY ANP IN MULTI-ATTRIBUTE DECISION MAKING. *SINERGI* 2020, *25* (1), 101. https://doi.org/10.22441/sinergi.2021.1.013.
[26] Sudipa, I. G. I.; Hardiatama, I. K.; Yanti, C. P.; Wiguna, I. K. A. G. Analisis Sensitivitas Metode AHP Dan TOPSIS Dalam Pemilihan Objek Wisata di Kabupaten Karangasem. *J. Comput. Syst. Inform. JoSYC* 2022, *3* (4), 493–501. https://doi.org/10.47065/josyc.v3i4.2152.
[27] Sudipa, I. G. I.; Hardiatama, K. Implementasi Metode Analytical Hierarchy Process Dan Interpolasi Linier Dalam Penentuan Lokasi Wisata Di Kabupaten Karangasem. 2021, *5*.
[28] Anwar, S. K.; Priyanto, A.; Ramdani, C. Sistem Pendukung Keputusan Pemilihan Objek Wisata Menggunakan Metode AHP. 2021, *5*.