Decision support system for choosing the best tourist attractions using simple additive weighting (SAW) method

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Article Info	ABSTRACT
	Every year, various regions in Indonesia always have many tourists both local and foreign so as to provide benefits for the government and the surrounding local community. However, due to the Covid-19 pandemic, the tourism sector has slumped. Therefore, to revive the tourism sector in the new normal due to Covid-19, there needs to be various considerations. One of them, namely decision support system for choosing tourist attractions with facilities that meet health protocol standards in the new normal/adaptation of new habits. In this study, a case was raised with the aim of choosing the best tourist attractions in Kendal Regency, Central Java with several criteria determined, especially regarding facilities that comply with health protocols. The calculation in this study was done by Simple Additive Weighting (SAW) method. The research was conducted by determining alternatives, criteria, and weight values on each criterion. Then the calculation of the value of preferences and stamps to get the best alternative. From the calculations that have been done, the result of the best tourist attractions in Kendal is Tirto Arum Baru with a preference value of 0.766. However, due to the dynamic nature of the criteria and weight data, it is possible that at any time the selected data may change.

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1. INTRODUCTION

The Covid-19 pandemic that has spread in various parts of the world since the end of 2019 raises many problems. There are many sectors affected by the pandemic, such as the economic sector, tourism, and even education. In Indonesia itself, the tourism sector experienced a significant decline. In many countries, tourism is a leading source of income and foreign exchange and, unlike other industries, provides opportunities for economic development in destinations where it will be difficult[1].

The COVID-19 pandemic that began in China and spread around the world caused the tourism industry to shut down. Many scholars and tourism professionals estimate that it will take more than 24 months for the world to recover from the impact of this global crisis[1].

Based on the Law of the Republic of Indonesia Number 10 of 2009 concerning Tourism, tourism is a variety of tourist activities supported by various facilities and services provided by the community, entrepreneurs, while tourism is a travel activity conducted by a person or a group of people by visiting a certain place for recreational purposes, personal development, or learning the uniqueness of tourist attractions visited

in a temporary period of time [2]. By a broad definition tourism is a journey from one place to another, being temporary, done individually or in groups, in an effort to find balance or harmony and happiness with the environment in a social, cultural, natural and scientific dimension [3].

Data compiled from the Badan Pusat Statistik, an institute of Indonesia government that responsible for conducting statistical surveys, explains that in 2019 foreign tourists from China who came to Indonesia touched 2.07 million tourists or 12.8% of the total number of foreign tourists throughout 2019. Several tourism support sectors such as restaurants, hotels and retail entrepreneurs are also affected by the Covid-19 pandemic. The hotel's profit decreased by up to 40%, impacting the hotel's operations and threatening its business continuity [4].

During the Covid-19 pandemic, many tourist attractions in Indonesia were closed citing the risk of becoming a new cluster of Covid-19 virus spread. In addition, the flight ban in Indonesia makes the tourism sector which was previously the second largest contributor to the country's foreign exchange in fact must experience a sharp decline to reach the figure of 87.8% [5]. This is inversely proportional to the achievement of the tourism sector which was very high for the previous year. Based on data from the World Travel &Tourism Council in 2018, Indonesia ranks 9th out of the 10 countries with the best tourism worldwide[5].

With the decline of the economic and tourism sector due to Covid-19, actually ecological tourism can be very potential to revive it. Environmental-based tourism is an integral part of love for nature. We can do it with energy efficiency. The creation of economic opportunities can provide an increase in the income of local people. The model has a sustainable impact on the local communities involved in it. There are a variety of activities or activities in the environmentally based tourism industry. Like village tourists, agrotourism, green guesthouses, and green hotels. They are a sustainable tourism model and are indeed expected to create a new economic order [6].

Kendal which is one of the regencies in Central Java Province, geographically located at the position of 109 °40' - 110 ° 18' East Longitude and 6 ° 32 '-7 ° 24' South Latitude with an overall area of about 1,002.23 km2 or 100,223 hectares, with an altitude above sea level ranging from 0- 2,579 meters. The boundaries of Kendal Regency include the north bordering the Java sea, the east bordering Semarang City, the south bordering Semarang Regency and Temanggung Regency and the West bordering Batang Regency. Kendal district is included in the Kedungsapur Metropolitan area. This area is the region with the 4th largest population in Indonesia, after Jabodetabek, Gerbangkertosusilo and Bandung Raya [7].

Kendal Regency has mountainous and coastal areas. Kendal has a wide variety of tourist attractions. Of the various kinds of tourism there are still some tourist attractions that are still hidden, which means access / road to these tourist attractions are still not known [7].

In order to revive the economy, especially in the tourism sector in Kendal with the reopening of tourist attractions during the Covid-19 pandemic, it is necessary to make various efforts, one of which is by traveling but still implementing health protocols. This is done to prevent the spread of Covid-19 and prevent new clusters from emerging from tourist attractions. In the recovery of tourism after Covid-19, sentiment related to this health protocol will be needed. People should also trust that others have washed their hands, not travelled when they feel sick, and want to be treated if they are sick [8].

Therefore, this research was conducted with the aim to choose the best tourist attractions in Kendal that meet various criteria. One of them has facilities with adequate health protocols.

The central government has been campaigning for the hashtag #DiIndonesiaAja which aims to encourage Indonesians to travel in the country in accordance with health protocols. It aims to ensure that the cash flow of public consumption funds only rotates in the country. Surely this will go well, if accompanied by a guarantee of security for people who want to travel in the middle of the pandemic [5].

In addition to choosing the best tourist attractions that have been determined above, one of which must meet the standard facilities of health protocol, this research was conducted to make it easier for tourists to find the best tourist attractions in the middle of the era of ease of technology and information media. As we know that in the current era, people can easily get a lot of information related to various things, including information about tourist attractions. If the community is faced with a lot of choices, the community can feel confused, therefore, to facilitate the community in filtering and determining to choose the best tourist attractions, the existence of a decision support system of the selection of tourist attractions is considered important.

In research conducted in Italy, the decision support system for the selection of tourist attractions or tourism is very important to be developed. The relationship between the two worlds (information technology and tourism) is so tight that it allows us to think of some kind of genetic bond [9]. Travel and tourism companies have been the first to make sophisticated use of the possibilities and capabilities of applying electronic

technology for the processing and management of data and information, including data and information related to tourist attractions. The tourism industry is particularly sensitive to growing competition pressures and the growing need for more effective operational and control tools. Therefore, information and communication technology is much sought after and seen as able to provide new opportunities for business development in the field of travel [9].

Jamalul Izza from the Association of Indonesian Internet Service Providers (APJII) said that the utilization of technological sophistication in the hospitality and tourism business has now begun to manifest among hotel and tourism businesses [10]. Both tourism and IT are increasingly providing strategic opportunities and powerful tools for economic growth, wealth redistribution and equity development around the world. The tourism industry relies heavily on information where customers want to get enough information about tourism destinations such as locations, accommodation, restaurants, routes, attractions and more before they plan and visit a trip [11].

The concept of Decision Support System was first introduced in the early 1970s by Michael S. Scott Morton as Management Decision System. Decision support systems (DSS) are usually built to support solutions to a problem or for an opportunity[12]. The decision model for the selection of tourism locations is used by tourists as decision makers (DM) to help with decision making [13].

Furthermore, in this research with case studies in Kendal Regency, the calculation method used is the method of calculation of SAW. The method uses weighting calculations first. Then it was determined that each alternative was determined.

Previously, there have been many studies that use SAW method to choose the best alternative tourist attractions. For example, research conducted by Angga Lipta from The University of Technology Yogyakarta related to the selection of tour packages with SAW method. After that, data normalization is carried out and then the calculation of totals and roles is carried out. From the research, the best alternative result was chosen, namely Pindul Cave in Jogja[14].

In other studies that have been conducted related to the selection of tourist attractions, researchers from Diponegoro University combined the SAW method with the AHP (Analytical Hierarchy Process) method. The AHP method is used to determine the weight of each criterion. Meanwhile, the SAW method is used to determine the value of its alternative preferences [2]. Researchers calculate the weight value and determine the suitability of each criterion and alternative using the AHP method and then normalize and fight using the SAW method. In the study, the best alternative of Karangbolong Beach tourist attractions with its output is also an automated system.

Meanwhile, in another study conducted by Ni Kadek Sukerti, researchers performed calculations by SAW method and then weighted with fuzzy numbers so as to produce the best alternative cystal bay on nusa penida island[15]. On the other hand, in Ni Ketut Ayu's research, researchers combined SAW and AHP methods to determine the best tourism village[16].

2. METHOD

In the research that aims to determine the best tourist attractions in Kendal, the method used is the SAW method. The SAW method is often known as the weighted summation method. The basic concept of SAW method is to look for weighted summation of each performance rating on each alternative on all attributes[17]. The SAW method requires the process of normalizing the decision matrix (X) into a scale that can be compared to all existing alternative ratings. The steps to complete the SAW method include [2]:

1. Determine the alternative, i.e. Ai, where i is the number of alternatives.

2. Determine the criteria that will be referred to in decision making, namely Cj, where j is the number of criteria.

3. Provide an alternate match rating value on each criterion.

4. Determine the weight of preference or importance level (W) on each criterion. W = [W1, W2, W3, . . . Wj]

5. Create a match rating table of each alternative to each criterion.

6. Create a decision matrix (X) formed from the match rating table of each alternative on each criterion. The X value of each alternate (Ai) in each specified criterion (Cj), where i=1,2,…,m and j=1,2,...,n.

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{ij} \\ \dots & \dots & \cdots & \cdots \\ x_{1n} & x_{2n} & \cdots & x_{ij} \end{bmatrix}$$

7. Normalize the decision matrix by calculating the normalized performance rating value (rij) of the Ai alternative on the Cj criteria.

$$r_{ij} = \begin{cases} \dfrac{x_{ij}}{\underset{i}{Max} x_{ij}} & \text{if j is a benefit attribute} \\[2em] \dfrac{\underset{i}{Min} x_{ij}}{x_{ij}} & \text{if j is a cost attribute} \end{cases}$$

Description: Benefit criteria are criteria that support the selection of an alternative, while the cost criteria are the opposite [18]. Criteria are said to be advantages when the value of xi gives profit to decision makers, on the contrary the cost criteria if xij incurs costs for decision makers. If the benefit criteria, the value of xij is divided by the Maxi (xij) value of each column, while for the cost criteria, the Mini value (xij) of each column is divided by the value of xij

8. The result of the normalized performance rating value (rij) forms a normalized matrix (R).

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{ij} \\ \dots & \dots & \cdots & \cdots \\ r_{1n} & r_{2n} & \cdots & r_{ij} \end{bmatrix}$$

9. The final result of the preference value (Vi) is derived from the summation of the normalized matrix row element multiplication (R) with the preference weight (W) corresponding to the matrix column element (W).

$$V_i = \sum_{j=1}^{n} w_j r_{ij}$$

Description: W = weight; R = normalized matrix element

The larger Vi value calculation result indicates that the Ai alternative is the best alternative. The data used in this study is research data and combined with dummy data (simulation data). The criteria list can be seen in Table 1.

Table 1. Criteria List

Code	Criteria	Attribute	Weight (W)
C1	Distance (km)	Cost	0,25
C2	Price (Rp)	Cost	0,25
C3	Number of travelers (people)	Benefit	0,15
C4	Facilities (1=less good, 2=good enough, 3=good, 4=very good)	Benefit	0,35

1. Distance

   The distance referred to in this criterion is the distance from the alternative tourist attractions to the city center (square). The distance here is stated in kilometers (km). Distance is included in the

cost criteria. So alternatives that have the closest distance to the city center have a great opportunity to be selected. Distance data is obtained by research through google maps.

2. Price

The price in this criterion is the price of admission from each alternative tourist attraction. In this decision support system, price criteria include cost criteria where the lowest price will be sought from all available alternatives. The price is expressed in rupiah (Rp). Data on the price of admission to each alternative tourist attraction is compiled with research through google.

3. Number of Travelers

The next criterion is the number of travelers. The number of tourists considered here is the average number of tourists/visitors in each alternative tourist attraction per day. The number of tourists included in the criteria of profit / benefit, the more the average number of tourists on the alternative tourist attractions that exist, the greater the chances of alternative tourist attractions chosen.

4. Facilities

Tourist facilities greatly affect visitors who come because the majority of visitors must prioritize comfort. The facilities considered here are facilities with health protocol standards in the new normal due to Covid-19. Therefore, in the calculation on the criteria of this facility using the assessment scale as follows:

1 = less good;

2 = good enough;

3 = good;

4 = very good

Criteria of facilities included in the criteria of profit / benefit so that alternatives that have a high value of facility criteria will be likely to be selected.

In addition to the criteria, in this calculation are also required alternatives to be calculated and compared. In this study, alternative data was obtained by research through google. There are ten alternatives as follows. The alternative list can be seen in Table 2.

Table 2. Alternative List

Code	Alternative
A1	Air Terjun Curug Sewu
A2	Pulau Tiban
A3	River Walk Boja
A4	Pantai Indah Kemangi
A5	Goa Kiskendo
A6	Tirto Arum Baru
A7	Pantai Cahaya
A8	Six Water Game
A9	Kebun Teh Medini
A10	Plantera Fruit Paradise

3. RESULTS AND DISCUSSIONS

Calculation of the selection of the best tourist attractions in Kendal with several alternatives including, Curug Sewu Waterfall, Tiban Island, River Walk Boja, Pantai Indah Kemangi, Kiskendo Cave, Tirto Arum Baru,

Cahaya Beach, Six Water Game, Medini Tea Plantation, and Plantera Fruit Paradise with four criteria of refining namely distance, price, number of tourists, and facilities have been conducted in this study by SAW method and obtained results as in the following description. The alternative value can be seen in Table 3.

Table 3. Alternative Values On Each Criterion

Alternatif	C1 (km)	C2 (Rp)	C3 (people)	C4
A1	40	10000	250	3
A2	7	15000	100	2
A3	25	30000	300	4
A4	15	3000	350	3
A5	22	7500	100	2
A6	3	18000	350	4
A7	18	40000	400	4
A8	21	12000	200	3
A9	38	2500	100	2
A10	42	25000	150	2

Matrix of alternative value decisions on each criterion

$$X = \begin{bmatrix} 40 & 10000 & 250 & 3 \\ 7 & 15000 & 100 & 2 \\ 25 & 30000 & 300 & 4 \\ 15 & 3000 & 350 & 3 \\ 22 & 7500 & 100 & 2 \\ 3 & 18000 & 350 & 4 \\ 18 & 40000 & 400 & 4 \\ 21 & 12000 & 200 & 3 \\ 38 & 2500 & 100 & 2 \\ 42 & 25000 & 150 & 2 \end{bmatrix}$$

From Table 3 and matrix above, you can see each alternative value data in each predetermined assessment criteria.

Furthermore, the normalization calculation process of the matrix data above is carried out. If it is a benefit, criteria, the value of xij is divided by the Maxi value (xij) of each column, while for the cost criteria, the Mini value (xij) of each column is divided by the value of xij. The normalization calculation is as follows.

$$R_{11} = \frac{\min\{40;7;25;15;22;3;18;21;38;42\}}{40} = \frac{3}{40} = 0,075$$

$$R_{21} = \frac{\min\{40;7;25;15;22;3;18;21;38;42\}}{7} = \frac{3}{7} = 0,429$$

$$R_{31} = \frac{\min\{40;7;25;15;22;3;18;21;38;42\}}{25} = \frac{3}{25} = 0120$$

$$R_{41} = \frac{\min\{40;7;25;15;22;3;18;21;38;42\}}{15} = \frac{3}{15} = 0,200$$

$$R_{51} = \frac{\min\{40;7;25;15;22;3;18;21;38;42\}}{22} = \frac{3}{22} = 0,136$$

and so on.

In the same way as above, it will be obtained the results of normalization calculations for other criteria. So obtained normalized matrix as follows.

$$R = \begin{bmatrix} 0,075 & 0,250 & 0,625 & 0,750 \\ 0,429 & 0,167 & 0,250 & 0,500 \\ 0,120 & 0,083 & 0,750 & 1,000 \\ 0,200 & 0,833 & 0,875 & 0,750 \\ 0,136 & 0,333 & 0,250 & 0,500 \\ 1,000 & 0,139 & 0,875 & 1,000 \\ 0,167 & 0,063 & 1,000 & 1,000 \\ 0,143 & 0,208 & 0,500 & 0,750 \\ 0,079 & 1,000 & 0,250 & 0,500 \\ 0,071 & 0,100 & 0,375 & 0,500 \end{bmatrix}$$

From the matrix above, you can see the normalization of each alternative value in each assessment criteria. In alternative A1 criteria C1 the normalization value is 0.075. In alternative A1 criteria C2 the normalization value is 0.250, and so on until the alternative value A10 in C4 is 0.5.

Furthermore, a calculation of the total preference value (Vi) obtained from the summation of the normalized matrix row element multiplication (R) with the corresponding preference weight (W). The W value of each criterion is as follows = {0.25; 0.25; 0.15; 0.35}.

The calculation of the value of his preferences is as follows.

$V_1 = (0,075)(0,25) + (0,250)(0,25) + (0,625)(0,15) + (0,750)(0,35) = 0,438$

$V_2 = (0,429)(0,25) + (0,167)(0,25) + (0,250)(0,15) + (0,500((0,35) = 0,361$

$V_3 = (0,120)(0,25) + (0,083)(0,25) + (0,250)(0,15) + (1,000)(0,35) = 0,513$

and so on.

In the same way, the preference value of each alternative will be obtained. The following (Table 4) is a table of preference values as well as the number of each alternative.

Table 4. Values of Preferences and Preferences

Alternative	Values of Preferences (V)	Ranking
A1	0,438	6
A2	0,361	8
A3	0,513	4
A4	0,652	2
A5	0,330	9
A6	0,766	1
A7	0,557	3
A8	0,425	7
A9	0,482	5
A10	0,274	10

The results from the table of preference values and stamps above show that the alternative that has the highest total value is the alternative A6 (Tirto Arum Baru) with a value of 0.766. Then in the second place there is an alternative A4 (Pantai Indah Kemangi) with a value of 0.652. Next in the third place there is an alternative A7 (Pantai Cahaya) with a value of 0.557. And so on, until the tenth rank there is an alternative A10 (Plantera Fruit

Paradise) with a value of 0.274. From the results above, it can be interpreted that of the ten alternatives that have been calculated and compared, then the best tourist attractions in Kendal is Tirto Arum Baru.

4.   CONCLUSION

Based on the research that has been done, the best tourist attraction in Kendal Regency is alternative A6 tourist attractions Tirto Arum Baru with a total preference value of 0.766. It can be concluded that the SAW method used in decision support systems is very easy to apply. In the SAW method, the alternative values on each criterion only need to be normalized and then weighted to know the best alternative chosen. However, the selected alternative data may change because the criteria and weight data specified above are very dynamic.

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