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To cite this article: M M Ulkhaq *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **219** 012012

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# The Fuzzy Analytic Hierarchy Process for Prioritizing the Sustainable Tourism Attitude Scale

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**Abstract.** Tourism sector is popularly known as one of biggest contributors to economic. It could create jobs, drives exports, and generates prosperity across the world. However, there are also some negative effects on cultural and natural resources that could be brought by the tourism to local communities. The sustainable tourism approach is believed to change the tourism to be more sustainable since it concerns to environmental, socio-cultural, and economic aspects. The successful practice of sustainable tourism involves all relevant stakeholders, especially the residents. Their positive attitudes toward sustainable tourism are considered to have significant influences on tourism development policy. The sustainable tourism attitude scale (SUS-TAS) which comprises seven criteria, is regarded as an effective tool to measure attitudes toward sustainable tourism development. This research aims to prioritize those seven criteria by employing the fuzzy analytic hierarchy process. It is considered important since the scale is failed in evaluating the priority of improving the residents' attitude. The logic behind this prioritizing is because each sustainable tourism is constrained by limited resources so that it has to be determined how those resources are best employed to achieve visitor satisfaction.

## 1. Introduction

Tourism, which is defined as a socio-cultural and economic phenomenon that involves movements of people to places outside their common environment for individual and/or professional purposes [1], over the past several years, has been considered steadily increasing. Based on data reported by destinations around the world, it is estimated that international tourist arrivals (overnight visitors) worldwide increased 7% in 2017. This is well above the sustained and consistent trend of 4% or higher growth since 2010 and represents the strongest results in seven years. The statistics is even projected to grow at a rate of 4 to 5% in 2018 [2].

The tourism sector, as the third export sector in the world, consolidates as a key driver in economic development. It is well-known as a main contributor to the development of economy both in the developed and developing countries [3]. The direct contribution of tourism and travel as well, to the gross domestic product (GDP) in 2017, was USD 2,570.1 billion or 3.2% of total GDP; while the total contribution was USD 8,273.3 billion or 10.4% of GDP. This direct contribution is forecast to rise by 4.0% in 2018 and to rise by 3.8% per annum, from 2018-2028 to USD 3,890.0 billion (3.6% of total GDP) in 2028 [4]. Furthermore, tourism is essential for job creation and the prosperity of communities around the world since the sector was accounted for more than 313 million jobs or 9.9% of total employment in 2017 [4].

In contrast with the benefits gained from tourism, it is an increased consciousness of the negative effects that would be brought to local communities. Speedy unplanned development, attached with huge numbers of visitors, has triggered unfavorable influences on not only cultural but also natural resources



[5]. Social and cultural impact refers to the impact which it may inflict in terms of social changes on local communities' lives and lifestyles; increased rush thus leading to over-crowding area; poor sanitation; increased crime; and loss of moral and religious values. The economic impact can be measured in terms of seasonal jobs which make low paid with long hours, shops which stock products for tourists while they are not necessary for the locals. The environmental impact means increased unrecycled waste disposal and pollution; failures in preserving natural flora and fauna; and disrupting the ecological balance of the local.

As a response to those negative effects, the United Nations World Tourism Organization has suggested a sustainable tourism approach as an alternative form in a struggle to create tourism more sustainable. The sustainable tourism, which could be described as tourism which meets the requirements of visitors and local communities at present while preserving and enhancing the prospect for the future [6], should reflect the sustainability principles, i.e., socio-cultural, economic, environmental, and aspects.

Sustainable tourism development involves the informed contribution of all relevant stakeholders and strong political will to ensure broad contribution and consensus building. It also should ensure a meaningful experience to the visitors, maintain a high level of visitor satisfaction, as well as increase their awareness about sustainability concerns and promoting sustainable tourism practices.

The residents are considered as major stakeholders as they are directly influenced by tourism regardless of their livelihood. In fact, their behavior as well as openness regarding tourism development and visitors could influence visitor satisfaction [7], [8]. Since occupants' positive attitude to sustainable tourism has a significant effect on tourism development policy, [9] suggest that policymakers and destination managers might gain advantage from a better understanding of residents' attitude to sustainable tourism. Therefore, since it is one of the factors of successful sustainable tourism, it is vital to have a tool to measure attitudes to sustainable tourism development.

Fortunately, there is sustainable tourism attitude scale (SUS-TAS) developed by [10] and was reexamined by [9], [11] which entails seven criteria, namely, perceived economic benefit, perceived social cost, long-term planning, environmental sustainability, ensuring visitor's satisfaction, community-centered economy, and maximizing community participation (see Section 2 for the detail). Although the SUS-TAS was designed as a measurement tool, however, the seven criteria were designed to have similar weights; thus, it is regarded to fail in evaluating the priority of improving the residents' attitude. The rationale behind the need of prioritizing is because each sustainable tourism development is constrained by its limited resources so that it has to be determined how those resources could be deployed to achieve visitor satisfaction.

This research attempted to prioritize the seven criteria of SUS-TAS by employing the fuzzy analytic hierarchy process (FAHP). The FAHP approach extends the traditional AHP proposed [12] by combining it with the fuzzy set theory [13], see Section 2 for the detail. This FAHP has been extensively applied in various fields of management sciences, see [14]–[16] for the example of the application of the FAHP.

The object of this study was Candi Gedong Songo, which is located in Central Java Province, Indonesia. It is a group of small Hindu Javanese temples on the slope of Mount Ungaran, about 900 meters above sea level. It is one of the most beautiful site temple complexes with the breath-taking views and cool air. The site has been attempting to be sustainable tourism destination (STD) according to the local government; thus, the positive attitude of the residents is necessary to successfully succeed the program.

Tourism in Indonesia is fairly emerging and considered as a promising investment. The direct contribution of tourism to GDP in 2017 was USD 2,570.1 billion (3.2% of total GDP) according to World Travel & Tourism Council. It is forecast to rise by 4.0% in 2018, and to rise by 3.8% per annum, from 2018-2028, to USD 3,890.0 billion (3.6% of total GDP) in 2028. Tourism directly supported 118,454,000 jobs (3.8% of total employment). In 2018, it is expected to rise by 2.4% and in 2028 to rise by 2.2% per annum to 150,139,000 jobs or 4.2% of total employment [17].

## 2. Research design

### 2.1. Sustainable tourism scale criteria

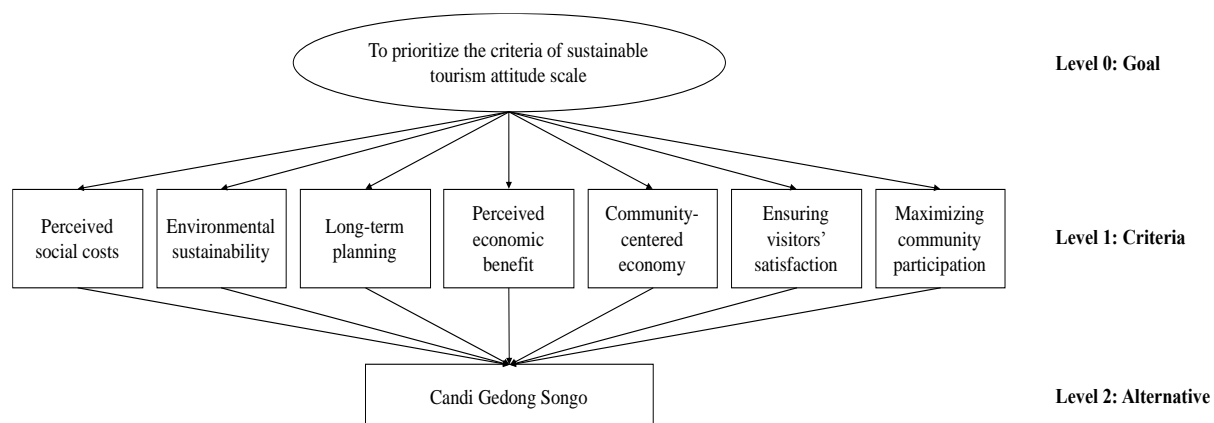
In this study, the criteria for evaluating the SUS-TAS were determined as seven criteria, namely, perceived social cost, environmental sustainability, long-term planning, perceived economic benefit, community-centered economy, ensuring visitor's satisfaction, and maximizing community participation [9], [10]. However, those seven criteria have been modified as this research was managed in Indonesia, which obviously has different characteristics than the original study.

The first criterion is perceived social costs. It refers to any social cost that impacts the residents around the STD. This includes such effect to the life of the surrounding residents and the use of resources around there; for instance, how the tourists disrupt the life's quality of the residents; the crowd of the STD that is caused due to tourism; the usage of the resources that is used by the tourists; and the growth of the tourism in the STD. The second criterion is environmental sustainability. It refers to the condition of the environment in the STD; for instance, how the diversity of nature, wildlife, natural habitats, and natural environment are valued and protected at present and also for the future; how to promote positive environmental ethics; as well as how to develop tourism in harmony with the environment. The third is long-term planning. This indicates how the STD will "be" in the future. It includes how to plan tourism development for the long-term that needs well-coordinated planning and requires to take a long-term vision to achieve the successful management of tourism.

The fourth is perceived economic benefit. It is such a perception from the residents that the existence of the STD could generate some benefits, such as substantial tax revenues. The fifth criterion is community-centered economy. The existence of the STD should hire the employees that come from people around there. In addition, the tourism industry should contribute economically by purchasing products from the local community. The next criterion is ensuring visitors' satisfaction. Shortly, the tourism business should ensure the tourists satisfied when there visited the STD. It also includes monitoring visitors' satisfaction, as well as fulfilling their needs. The last criterion is maximizing community participation. It emphasizes the role of the community in conserving the STD, such as the decisions have to be made by all members in the communities.

### 2.2. The evaluation framework

This study aims to select the best criterion among those seven aforementioned criteria of the SUS-TAS. The object of the research is Candi Gedong Songo that is considered as the STD. It is a group of Hindu temples located in Semarang, Central Java, Indonesia. The site was originally built during the early period of the Medang Kingdom which controlled Central Java during the 8th and 9th centuries. The temples predate Borobudur and Prambanan—two most popular temples in Indonesia—and show considerable influence from Indian Hindu temple architecture [18]. Candi Gedong Songo is considered as one of the most beautifully sited temple complexes in Central Java. Visitors could explore the nature and the panoramic beauty of the scenery, as well as interact with the inhabitants in there.



**Figure 1.** The Evaluation Framework for Prioritizing the Criteria of Sustainable Tourism Attitude Scale

The objective of the research was achieved by performing the FAHP that will be described in the next subsection. Those seven criteria are then structured into hierarchy levels that is depicted in figure 1. The goal as level 0 is to choose the best criterion of the SUS-TAS. This hierarchy is the subject of a pairwise comparison of the FAHP. Data have been composed from five respondents that have abundant experiences in the field of sustainable tourism. They are coming from university (academia), tourist, local community, local government, and non-profit organization. The respondents are asked to compare the criteria to estimate their relative importance. A nine-point scale questionnaire has been employed to show the respondents' judgment between preferences as equally, moderately, strongly, very strongly, and extremely favorable (or unfavorable).

### 2.3. The fuzzy analytic hierarchy process

This research employed the FAHP to prioritizing the criteria of the SUS-TAS. To be straightforward, the fuzzy AHP extends the conventional AHP [12] by integrating it with the fuzzy set theory [13]. The AHP is often used in solving various multi-criteria decision-making problems due to its many benefits. It is considered as an intuitive method, easy to handle multiple criteria, user friendly since it lets the users to structure complex problems in the form of a hierarchy levels, and has an advantage as seeking consistency in judgments [19] (see [20]–[22] for the example the AHP's application).

Despite its advantages, the AHP does not completely reflect the human thinking style since his/her judgments are characterized as a precise number; though, it is irrational to use those precise numbers to denote linguistic judgments when the decision makers' preferences are affected by uncertainty [23]. The fuzzy logic is incorporated into the AHP to be the FAHP approach to deal with the afore-mentioned problems. The FAHP then converts linguistic judgments in triangular fuzzy numbers (TFNs).

Let  $M \in F(R)$  be a fuzzy number if exists  $x_0 \in R$  such that  $\mu_M(x_0) = 1$ .  $A_\alpha = [x, \mu_{A_\alpha}(x) \geq \alpha]$  is a closed interval for any  $\alpha \in [0,1]$ .  $F(R)$  is represented all fuzzy number sets while  $R$  is the set of real numbers. A TFN is then represented as  $M = (l, m, u)$  if its membership function  $\mu_M(x): R \rightarrow [0,1]$  is equal to:

$$\mu_M(x) = \begin{cases} \frac{x}{m-l} - \frac{l}{m-l}, & x \in [l, m], \\ \frac{x}{m-u} - \frac{u}{m-u}, & x \in [m, u], \\ 0, & \text{otherwise,} \end{cases} \quad (1)$$

Where  $l \leq m \leq u$ ;  $l$ ,  $u$ , and  $m$  are lower, upper, and mid-value of the support of  $M$  respectively. The support of  $M$  is the set of elements  $\{x \in R | l < x < u\}$ .

Let TFNs  $M_1, M_3, M_5, M_7$ , and  $M_9$  denote the assessment from equally to extremely important; and  $M_2, M_4, M_6$ , and  $M_8$  are the middle values. Let  $X = \{x_1, x_2, \dots, x_n\}$  be an object set and  $U = \{u_1, u_2, \dots, u_n\}$  be an objective set. Each object is taken to execute extent analysis for each goal respectively. Then the  $m$  extent analysis values for each object can be discovered with the following signs:

$M_{g_i}^1, M_{g_i}^2, \dots, M_{g_i}^m$ ,  $i = 1, 2, \dots, n$ ; where  $M_{g_i}^j = (l_{g_i}^j, m_{g_i}^j, u_{g_i}^j)$ ,  $j = 1, 2, \dots, m$ , are the TFNs. The value of fuzzy synthetic extent with respect to the  $i$ -th object is expressed as:

$$S_i = \sum_{j=1}^m M_{g_i}^j \otimes \left[ \sum_{i=1}^n \sum_{j=1}^m M_{g_i}^j \right]^{-1} \quad (2)$$

The degree of possibility of  $M_1 \geq M_2$  is expressed as:

$$V(M_1 \geq M_2) = \sup_{x \geq y} [\min(\mu_{M_1}(x), \mu_{M_2}(y))] \quad (3)$$

When a pair  $(x, y)$  exists such that  $x \geq y$  and  $\mu_{M_1}(x) = \mu_{M_2}(y) = 1$ , then  $V(M_1 \geq M_2) = 1$ , iff  $m_1 \geq m_2$ . If  $m_1 \leq m_2$ , let  $V(M_1 \geq M_2) = \text{hgt}(M_1 \cap M_2)$ , then

$$V(M_1 \geq M_2) = \begin{cases} \frac{l_2 - u_1}{(m_1 - u_1) - (m_2 - l_2)}, & l_2 \leq u_1 \\ 0, & \text{otherwise} \end{cases} \quad (4)$$

The degree of possibility for a TFN that is greater than  $k$  TFNs  $M_i$  ( $i = 1, 2, \dots, k$ ) can be expressed as  $V(M \geq M_1, M_2, \dots, M_k) = \min V(M \geq M_i)$ . Assume that  $d^*(A_i) = \min V(S_i \geq S_k)$ , where  $d^*$  is the abscissa of the highest intersection point between  $M_1$  and  $M_2$ ; and  $A_i$  is the  $i$ -th element of the  $k$ -th level for  $k = 1, 2, \dots, n$ ;  $k \neq i$ . The weight vector of the  $k$ -th level is  $W = (d^*(A_1), d^*(A_2), \dots, d^*(A_n))^T$ . The normalized weight vector is then obtained by normalization as  $W = (d(A_1), d(A_2), \dots, d(A_n))^T$ , where  $W$  is a non-fuzzy number.

### 3. Case study result

The following is the application of FAHP to prioritize SUS-TAS in Candi Gedong Songo, Central Java, Indonesia. The method was engaged according to the seven afore-mentioned criteria. First, the respondents completed the nine-point scale questionnaire to express their preferences between those seven criteria. Their answers were transformed into the TFN.

The FAHP was then applied to calculate the importance degrees for each criterion. The consistency test was conducted to ensure that the pairwise comparison is reasonable and acceptable. The consistency ratio is 0.03 or below the threshold of 0.1. It means that the evaluation of the importance degrees for each criterion is reasonable. The results of the FAHP can be seen in Table 1.

**Table 1.** Weights for each criterion of SUS-TAS

Criteria	Weights
Perceived social costs	0.1189
Environmental sustainability	0.1520
Long-term planning	0.1422
Perceived economic benefit	0.1397
Community-centered economy	0.1504
Ensuring visitor's satisfaction	0.1524
Maximizing community participation	0.1445

The results indicated that the most important criterion of SUS-TAS is ensuring visitors' satisfaction with 0.1524. Second most important criterion is environmental sustainability with 0.1520. The third one is community-centered economy with 0.1504. Next is maximizing community participation with 0.1445, long-term planning with 0.1422, perceived economic benefit with 0.1397, and the least important is perceived social cost with 0.1189.

It seemed that the decision makers view the visitor's satisfaction is the most important factor to develop sustainable tourism at Candi Gedong Songo. Furthermore, community attractiveness is one thing to be considered by tourism business as they have a responsibility to meet visitor's needs. The logic is, if the visitors had good experiences, they can give a recommendation and suggestion to their friends or families so that they could consider Candi Gedong Songo as their next planning vacation.

The decision makers also view that environmental sustainability is one important factor for sustainable tourism development. Community's diversity, protection of the wildlife and natural habitats, as well as community's environment, are the things that should get more attention for developing environmental sustainability. Tourism development has to promote positive environmental ethics and developed in harmony with the environment. The least important criterion is perceived social cost. It is

regarded that the decision makers view that even though tourist will disrupt the quality life community, but it is not crucial as long as the tourists enjoy their recreational resources.

#### 4. Conclusion

The objective of this research is to identify which criterion of SUS-TAS should first be developed and suited to the sustainable tourism development. Data were collected from five experts who have abundant experiences related to the object of the research, i.e., Candi Gedong Songo, located in Central Java, Indonesia. By using the FAHP for calculating the weights of each criterion, the result of the research is depicted in Table 1. It shows that ensuring visitors satisfaction is the most important criterion. It means that in order to implement sustainable tourism approach in Candi Gedong Songo, the first priority should be given to this criterion. On the other hand, the least important criterion is perceived social cost. It does not mean that this criterion is not important, but as long as tourists enjoy the recreational resource it does not consider as a problem.

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