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3	C	10	0.0	Minimal 0 = **0.0 AK**	Cukup
4	D	0	0	Minimal **0 AK** dan Paling Banyak <= **0.0 AK**	Cukup
5	E	0	0	Minimal **0 AK** dan Paling Banyak <= **0.0 AK**	Cukup
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Assessing Sustainable Tourism in Top Selfie: A Mapping and Decision-Making Technique

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Abstract

Research Originality: This research paper combined literature on sustainable tourism, including the mapping and decision-making of tourism management in Top Selfie, Indonesia, towards sustainable tourism potential zones.

Research Objectives: This study examined the impact of sustainable tourism patterns in the Top Selfie Pinusan area of Magelang, Indonesia, by considering various sustainability criteria.

Research Methods: The researchers conducted comprehensive interviews with key stakeholders. The data was analyzed using ArcGIS to identify the development map of Top Selfie Pinusan and AHP analysis to policy recommendations for tourism development in Top Selfie Pinusan.

Empirical Results: The research found that the location and potential of the Top Selfie Pinusan area make it a promising tourist destination when viewed from its development map. The AHP analysis showed that the eco-environmental criterion gave the highest weight to the water resources conservation sub-criterion. The alternative policy proposed in this research emphasized the promotion of alternative tourism.

Implications: This research has important implications for the local government and tourism businesses, as they must address the challenge of creating tourist attractions aligned with the principles of sustainable tourism in Indonesia.

Keywords:

analytic hierarchy process; decision-making; geographic information system; mapping; sustainable tourism; Top Selfie

INTRODUCTION

The discourse surrounding sustainable tourism has experienced significant growth since the late 1980s (Hunter, 1997) due to the adverse effects of mass tourism (Roblek et al., 2021). The fundamental concept of sustainable tourism is driven by the UN Conference on Sustainable Development (Rio+20), which advocates for eradicating poverty, pursuing social justice, and preserving natural resources to build a society. Consequently, sustainable tourism offers principles for developing, planning, and managing the environment, society, and economy. Many previous studies highlighted the significance of sustainable tourism development as a significant concern among experts (Sharpley, 2000). This discussion underscores the guidelines for tourism development in terms of environmental, social, and economic planning or management (Roblek et al., 2021). The motivation behind the three aspects of sustainable tourism stems from recognizing that tourism has positive and negative impacts on society, the economy, and the environment (Byrd, 2007). Furthermore, distinctions can be observed in terms of content, wherein the concept of sustainable tourism emphasizes the preservation of nature (Nathaniel & Adedoyin, 2022), leading to the emergence of terms such as sustainable tourism (Casagrandi & Rinaldi, 2002), ecotourism (Lee & Jan, 2018) and green tourism (Line et al., 2018). Additionally, social sustainability has given rise to terms like responsible tourism and sustainable tourism (Burrai et al., 2019).

The tourism industry has experienced steady and rapid growth over the years. During the 1990s, income generated from international tourism exceeded that of other international sources. As the World Tourism Organisation (UNWTO) reported, the global number of international tourist arrivals reached 1.4 billion in 2018, surpassing the initial predictions by two years. The tourism industry is a significant strategic pillar and a comprehensive sector contributing to sustainable global economic growth (Liu & Suk, 2022). However, this rapid development profoundly impacted tourist destinations' natural and human environments. In light of the various challenges the tourism industry faces, the concept of sustainable tourism has emerged as an inevitable trend. It is imperative to protect and develop tourism resources rationally, thereby achieving the objectives of a sustainable tourism industry to meet the needs of present-day society without compromising the needs of future generations (Ke, 2020).

Indonesia's natural tourism potential, which encompasses its awe-inspiring landscapes, vibrant customs, rich culture, and diverse language, is the primary attraction for tourists. Moreover, the development of artificial tourism, including shopping tourism, culinary tourism, and tourist villages, emphasizes reconnecting with nature. Natural and artificial tourism fusion has now emerged as a unique allure for local and international visitors. The number of foreign tourists who come to Indonesia has consistently increased, rising from 14,039,799 in 2017 to 15,806,191 in 2018, reflecting an impressive growth rate of 11.17%. This surge in tourist arrivals was accompanied by a rise in hotel and accommodation occupancy rates and an increase in employment opportunities within the tourism sector. It provided jobs for approximately 10.6 million individuals, accounting for 8.9% of the workforce. Furthermore, the tourism sector experienced a significant

boost in its contribution to exports, which escalated from 10% in 2017 to 17% in 2017 (Rahardjo et al., 2023).

Sustainable tourism development has emerged as a recent phenomenon, encompassing various dimensions. These included the perspectives of community stakeholders, adopting sustainable practices by businesses in the tourism industry, examining sociocultural impacts, and implementing methodological approaches to ensure sustainability and progress in research, strategy, and policy-making (Roblek et al., 2021). Amongst these dimensions, sustainability stands out as a crucial aspect. It entails the consideration and assurance of well-being and quality of life for both present and future generations, aligning with the principles of environmentally responsible development. However, the path towards sustainable tourism is not without challenges. It must navigate complex issues, such as adapting to and capitalizing on societal transformations, fostering sustainable creativity, addressing climate change's impacts, and managing social media's influence.

Furthermore, pursuing a sustainable environment often involves striking a balance between environmental concerns and society's economic needs, particularly in societies experiencing rapid economic growth. Notably, there is a growing demand for nature tourism and the preservation of cultural heritage sites, which are emerging trends in the tourism industry. Strategic planning, which is conducted periodically every five years, has proven effective in increasing tourist visits. Additionally, efforts to revitalize cultural heritage play a significant role in this endeavor.

A comprehensive compilation of policies plays a vital role in facilitating the sustainable growth of the tourism sector, thereby making a substantial contribution to the overall advancement of a nation. Extensive research has been conducted on sustainable development within the tourism sector. This research delved into various ideas, models, methodologies, and frameworks to promote sustainable tourism. Within this field, two influential concepts emerged. The first concept, introduced by the World Tourism Organisation in 1993, emphasizes fulfilling societal economic, social, and aesthetic needs while preserving cultural integrity and ecological balance. By adopting this approach, the well-being of current hosts and visitors is ensured, and the interests of future generations are safeguarded through equal opportunities. The second concept was derived from the Sustainable Tourism Development Charter and Sustainable Tourism Development Action Plan. It underscores the importance of integrating tourism with human and natural environments.

Government decision-making is one of the important factors for sustainable tourism development. Research in this direction has gradually increased since the 21st Century. Research showed that policies are the key factor in promoting sustainable tourism development (Juangarcía, 2021; Ke, 2020; Kedang & Soesilo, 2021; Liu & Suk, 2022; Mei & Han, 2022; Rosardi et al., 2022) and stakeholder groups are factors that cannot be ignored in the implementation of sustainable tourism development (Aryawan et al., 2019; Gravitiani et al., 2022), which can influence the formulation and implementation of sustainable tourism development policies (Hoang et al., 2018). The tourism industry's key stakeholders include the tourism government, residents, business entities, business

people, and tourism awareness groups (Gravitiani et al., 2022; Zhu et al., 2019). Previous research related to decision-making can be done with AHP. For example, Rosardi et al. (2022) used AHP to analyze the priority of the factor criteria in a sustainable tourism development strategy with the highest priority scores, namely economic, sociocultural, ecological, and educational factors. An increase in the rate of urbanization can change vacation patterns, which increasingly crave nature tourism and tourist interest in the environment, and the enjoyment of the natural environment has increased (Ban & Ramsaran, 2017).

Many studies on sustainable tourism have been carried out, but most focused on the micro level and are mostly related to other countries (Koizumi & Chakraborty, 2016; Štrba et al., 2020). Previous studies published various criteria for measuring sustainable tourism. For example, Mei and Han (2022) stated that sustainable development encompassed three dimensions: economic, social, ecological, and cultural sustainability. The ecological aspect is of utmost importance, necessitating the harmonious advancement of environmental, social, and economic concerns (Esquivias et al., 2022; Medeiros et al., 2021; Wu et al., 2023). Rosardi et al. (2022) indicated research studies with different results that examined sustainable tourism from economic, sociocultural, ecological, and educational aspects. The results showed that the educational aspect had the highest priority. Further, different results from research by Thahir et al. (2020) showed that the economic aspect was the most important compared to social and environmental aspects. There was no agreement between previous studies, so this research was consistent with the multi-criteria used in AHP covering social, economic, and environmental aspects. A multi-criteria evaluation is needed to calculate the real economic value and apply reasonable use of tourism resources in sustainable tourism development (Hoang et al., 2018). Meanwhile, some significant research studies regarding sustainable tourism in Indonesia, such as Ariyani and Umar (2020), Gravitiani et al. (2022), Rosardi et al. (2022), Suryawardani and Wiranatha (2016), were conducted. However, few studies have considered the potential analysis of Geographic Information System (GIS) applications. Therefore, this study contributes to the literature on sustainable tourism, which is still very new in Indonesia, especially in Magelang. Consequently, the rationale for this research is sustainable tourism in several ways. Firstly, processing geospatial techniques for sustainable tourism development patterns (Hoang et al., 2018; Rezvani et al., 2022). The second multi-criteria analysis using the AHP method was used to assess policy priorities (Rosardi et al., 2022; Thahir et al., 2020) in Top Selfie Pinusan Magelang, Indonesia. Finally, the study benefits the local government of Magelang in emphasizing superior selfie tourism within the sustainable tourism framework.

Indonesia, the largest archipelagic nation globally, boasts 17,548 large and small islands, encompassing a coastline stretching over 81,000 kilometers. Moreover, the country is blessed with an incredibly diverse and thriving ecosystem. This ecosystem comprises biotic and abiotic elements, which are intricately interconnected and engaged in mutual interactions. Biotic factors encompass many living organisms, including microorganisms, animals, plants, and humans. On the other hand, abiotic factors encompass essential components such as water, soil, air, and sunlight. Within each distinct ecosystem, the

populations of these biotic factors amalgamate to form a community, which in turn contributes to the overall functioning of the ecosystem. This phenomenon could be observed in both aquatic and terrestrial ecosystems.

Furthermore, within each ecosystem, many populations of individuals come together to form a specific geographical area known as a biome. The species composition within each biome exhibits variations from one location to another. Consequently, these biomes give rise to distinct vegetation patterns, such as the pine forest found in the Top Selfie Pinusan area, situated on the slopes of Mount Merbabu.

Nevertheless, expanding pine forests has resulted in detrimental environmental consequences, particularly regarding ecosystem damage. This long-term damage to the ecosystem will inevitably lead to a decline in both the quantity and quality of forests, which also play a crucial role in enhancing individuals' well-being and purchasing power. This situation underscores the significance of conducting research focused on the development of pine forest tourism, emphasizing community empowerment and sustainable development efforts. Ecotourism can benefit society by incorporating the elements of culture and environment, provided it is integrated into tourism activities. Consequently, tourism can directly contribute to economic growth and enhance the welfare of local communities (Gravitiani et al., 2022).

Various research studies conducted in the past have not produced definite results in the tourism sector. However, research studies on mapping and decision-making in sustainable tourism management are still interesting topics because they cover three significant aspects: economic, social, and environmental. Analysis using two analytical tools is still the latest in the literature, especially in Indonesia's tourism sector. Most previous research in the tourism sector only used one analytical tool, and the depth of discussion still needs to be added. Therefore, the primary objective of this study is to employ geospatial techniques to establish sustainable tourism development patterns. Additionally, a second objective involves utilizing the analytical hierarchy process (AHP) method to conduct a multi-criteria analysis to determine policy priorities for Top Selfie Pinusan in Magelang, Indonesia. Ultimately, this research will positively impact Magelang's regional government by highlighting the significance of promoting selfie tourism as a key component of sustainable tourism initiatives.

METHODS

The study was carried out at the renowned Top Selfie Pinusan in Magelang, Central Java. The choice of this research site was deliberated, and the prevailing issues in the region were considered. The Top Selfie Pinusan Kragilan Forest Tourism has notable effects on the neighboring tourist destinations regarding social, economic, and environmental aspects. In order to collect primary data, researchers conducted comprehensive interviews with key stakeholders, such as representatives from the Youth, Sports, and Tourism Service, Mount Merbabu National Park, village administration, tourism awareness groups (*Pokdarwis*), visitors, and the local communities.

Applying the AHP method in this study concentrated on four criteria (Figure 1). Firstly, it included economic aspects, which consisted of three sub-criteria, namely business opportunities, regional income, and regional prosperity. Secondly, the socio-cultural aspect consisted of three sub-criteria: community awareness, community empowerment, and community engagement. Thirdly, the eco-environment consisted of three sub-criteria: pine forest conservation, waste management, and conservation of water resources. Fourthly, the geo-environmental aspect consisted of three sub-criteria: geological hazard, geological structure, and topographic structure. Furthermore, this study concentrated on two alternatives, mass tourism and alternative tourism, for policy recommendations related to tourism development in Top Selfie Pinusan.

Figure 1. Hierarchical model of sustainable tourism development in Top Selfie Pinusan data analysis techniques
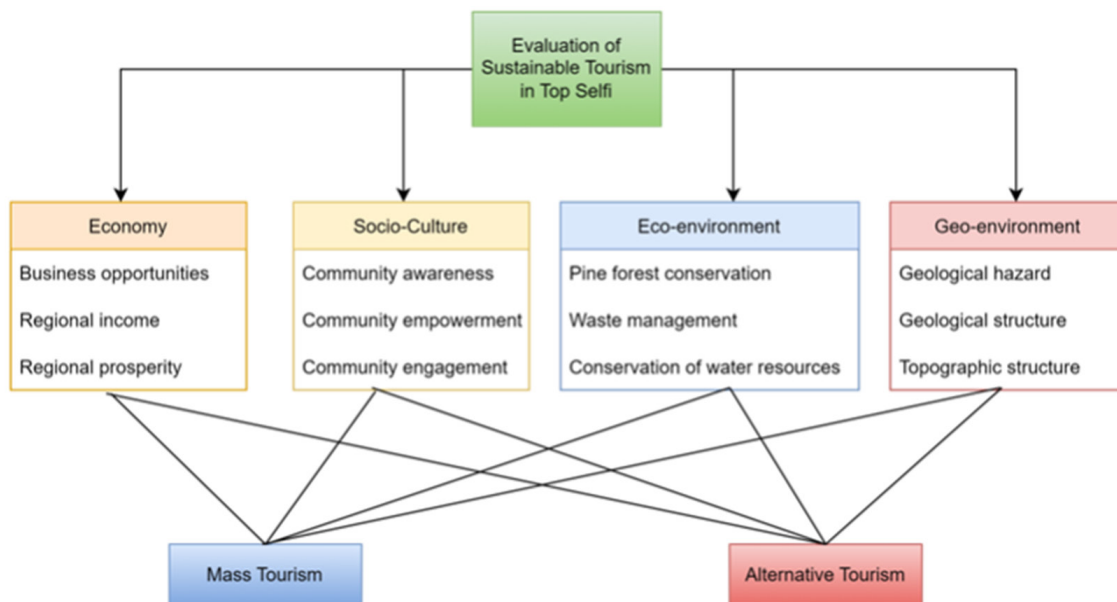
This study utilized a mixed-method approach to combine qualitative and quantitative analysis with integrated tourism potential data in the Top Selfie Pinusan Kragilan Forest area based on satellite data and Geographic Information System (GIS) environment, which is an integrated data collection that is combined and applied to identify tourism potential accurately. The GIS was employed as the analysis tool, explicitly utilizing ArcGIS software. In addition, the Analytic Hierarchy Process (AHP) was utilized as the second analysis tool, with the assistance of Expert Choice software, to prioritize sustainable tourism development in Top Selfie Pinusan. Then, the results from both analyses were integrated into a model to assess the potential and promote sustainable tourism. To compare the two criteria, the relative importance scale was employed, following Saaty's recommendation, as it is widely used in AHP (Saaty, 2008). In the initial stage of AHP, the main aim was to create a pairwise comparison among all criteria. This entailed assigning integer values ranging from 1 to 9 to express the outcomes of these comparisons for each pair of factors.

A value of 1 signifies "equal importance," while 9 represents "extreme importance." A higher numerical value indicates that the chosen factor is more significant and superior. Moving forward, the matrix was subsequently filled out. A designated scoring matrix was employed in the calculation process to ascertain the priority of the criteria.

$$A = \begin{bmatrix} a_{11} & a_{12} & ... & a_{1n} \\ a_{21} & a_{22} & ... & a_{2n} \\ ... & ... & ... & ... \\ a_{n1} & a_{n1} & ... & a_{nn} \end{bmatrix} \tag{1}$$

The pairwise comparison ranking is denoted as a_{xy}, represents the relative evaluation between criterion x and criterion y at a specific level as compared to the level immediately above it. The entry of a_{xy} follows a set of predefined rules.

$$a_{xy} > 0; \; a_{xy} = \frac{1}{a_{yx}}; \; a_{xx} = 1 \forall x \tag{2}$$

Estimation of the priority of criteria can be determined by obtaining the principal eigenvector W from Matrix A. Upon normalising the vector (W), the priority vector from a lower level of criteria to the level above can be established as follows:

$$AW = \lambda_{max} W \tag{3}$$

The maximum eigenvalue of Matrix A is denoted as λ_{max}. If the pairwise comparison matrix fulfils the condition of transitivity for all pairwise comparisons, it can be considered consistent, and it confirms the following relation:

$$a_{xy} = a_{xh} a_{hy} \forall x, y, h \tag{4}$$

The subsequent phase involved the computation of the Consistency Ratio (CR). The AHP acknowledges the possibility of inconsistency but offers a means to gauge the level of inconsistency within each evaluation set. The Consistency Ratio (CR) serves as a metric to ascertain the consistency of the scoring matrix.

$$CR = \frac{CI}{RI} \tag{5}$$

The consistency index (CI) is a measure used to evaluate the consistency of a matrix, while the random consistency index (RI) serves as a reference point.

In Table 1, the average consistency of randomly generated matrices is provided. The CI for a matrix with an order of n is defined as:

$$CI = \frac{\lambda_{max} - n}{n - 1} \tag{6}$$

A consistency ratio that is equal to or less than 0.1 is deemed to be acceptable. In the event that the score exceeds this threshold, the assessment may lack reliability, and it is advisable to replicate the process.

Table 1. The average consistencies of random matrices

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

Source: Saaty (2008)

Based on this categorisation, the evaluation of every criterion for each tourist destination was determined by employing the subsequent formula:

$$T_{ij} = S_{ij} \; x \; w_j \qquad\qquad (7)$$

Finally, the cumulative score for each tourist destination was computed by utilising the subsequent formula:

$$T_i = \sum_{i=1}^{n} S_{ij} \; x \; w_j \qquad\qquad (8)$$

Where, Tij is score of criterion j from tourist location i (alternative i), while Ti is total score of tourist location i; wj is weighed score of criterion j, and Sij is the rating score of the criteria for tourist attractions number j.

This research used two analytical tools at the same time so that both could not be combined in one treatment because each analytical tool has a different purpose. The ArcGis analysis tool can only map tourism potential, whereas to find out detailed decision-making analysis is done with Expert Choice.

RESULT AND DISCUSSION

The analysis of geographical location and sustainable tourism in Top Selfie Pinusan Magelang found that the location and potential of the Top Selfie Pinusan area is a promising tourist destination when viewed from its development map. In addition, the AHP analysis results show that the environmental ecology criteria give the highest weight to the water resource conservation sub-criteria. In addition, the policy alternatives proposed in this study emphasize the promotion of alternative tourism, which has weight. The results of the analysis of each method will be explained in depth in the following discussion.

Geographically, Magelang is situated at a specific location in terms of latitude, longitude, and altitude. This precise information provides a clear understanding of Magelang's geographical positioning. The city boasts numerous tourist attractions with great potential for further development and exploration by visitors. One such attraction is the Top Selfie Pinusan Kragilan, found in the Kragilan within the Magelang of Central Java. The closest tours that Top Selfie Pinusan visitors can access include Pine Forest photo spots and supporting photo spots, which will be developed. *Pokdarwis* and BumDes manage these tourist destinations. The development plan for the Top Selfie Pinusan Tourism destination, Kragilan Hamlet, Pogalan Village, Pakis District, and supporting facilities can be seen in Figure 2.

Originally a part of the Kragilan Pine Forest in the Traditional Area of Mount Merbabu National Park, this site has evolved into a popular tourist spot known as the Top Selfie Pinusan. In 2018 and 2019, this attraction drew a significant number of tourists, with approximately 140,000 visitors who explored its beauty. However, due to the global COVID-19 pandemic between 2020 and 2021, tourist spots had to be temporarily closed for safety reasons. Fortunately, it reopened to the public in early 2022, allowing visitors to once again immerse themselves in the enchanting allure of the Top Selfie Pinusan in Magelang. Service facilities and supporting facilities at the

Top Selfie Pinusan area include public toilets, parking areas, and homestays. This area also has various culinary delight sellers, such as fried noodles, boiled noodles, dry bread, and souvenirs.

Figure 2. Map of the Top Selfie Pinusan development plan
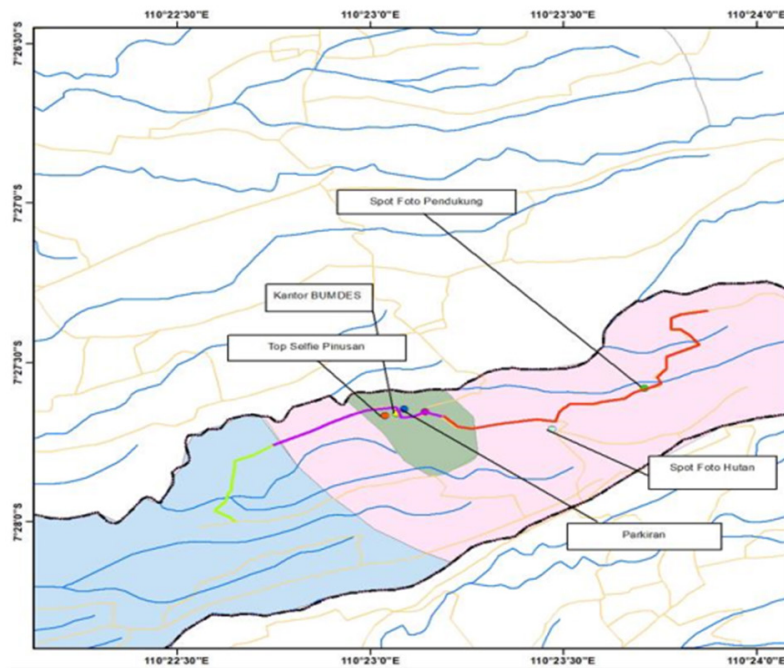
Source: ArcGIS (2022)

Various Top selfie spots have the potential to boost tourism. In the AHP analysis, the initial step involved the construction of a scoring matrix and assessing its consistency. The study primarily focused on four main criteria (economic, socio-cultural, eco-environmental, and geo-environmental aspects) and compared them pairwise regarding the objectives. Measurements were taken to determine the weight of the economic aspect, which comprised three sub-criteria (business opportunities, regional income, and regional prosperity). The Socio-Culture aspect, which consists of three sub-criteria (community awareness, community empowerment, and community engagement), was then evaluated. Following this, the eco-environment aspect was assessed using three sub-criteria (pine forest conservation, waste management, and Conservation of water resources). Lastly, the geo-environmental aspect, which encompassed three sub-criteria (geological hazard, geological structure, and topographic structure), was examined.

The pairwise comparison matrix presented the experts' weight assignment and the priority for each criterion (Table 2). The calculated consistency ratio was 0.02, which fell within the acceptable range of less than 0.1. Upon analyzing the pairwise comparison, it became evident that the Eco-Environment Aspect criteria hold significant importance, followed by the Geo-Environment Aspect, Economy Aspect, and Socio-Culture Aspect criteria.

Figure 3 illustrates the prioritization of the primary criteria for the objectives. It was evident that the Eco-Environment criteria held the highest significance, with a weight of 0.564. Following this, the Geo-Environment criteria held a weight of 0.264, while the economic criteria held a weight of 0.110. Lastly, the socio-culture criteria had the most negligible weight of 0.062. This data indicated that respondents primarily prioritized the eco-environment aspect when selecting sustainable tourism alternatives in Top Selfi. This preference could be attributed to the management of the Top Selfi tourist attraction, which is closely associated with the Mount Merbabu National Park Office, which places great emphasis on environmental Conservation. Similar findings were reported by other researchers, such as Gravitiani et al. (2022), who highlighted the significant role of the National Park Authority as a stakeholder in the management of tourist sites in Top Selfie Pinusan.

Table 2. Pairwise comparison matrix

Criteria	Economy Aspect	Socio-Culture Aspect	Eco-Environment Aspect	Geo-Environmental Aspect	Priority Vector
Economy Aspect	1	2	7	2	0.110
Socio-Culture Aspect	1/2	1	7	5	0.062
Eco-Environment Aspect	1/7	1/7	1	2	0,564
Geo-Environment Aspect	1/2	1/5	1/2	1	0,264

Source: Expert Choice data processing (2022)

Figure 3. Pairwise comparison of sub-criteria with respect to the main criterion
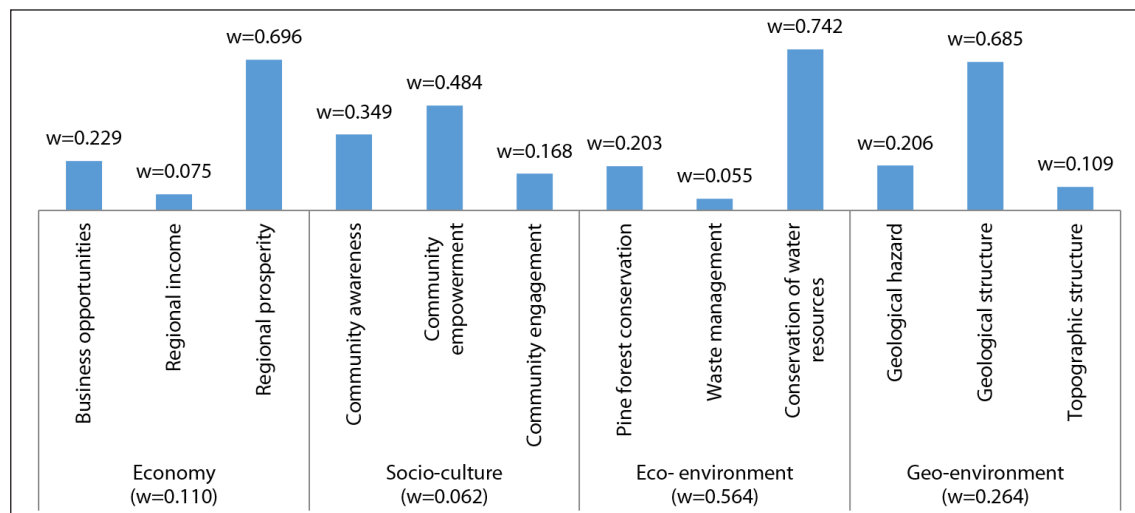
Note: w = weight criteria and sub-criteria
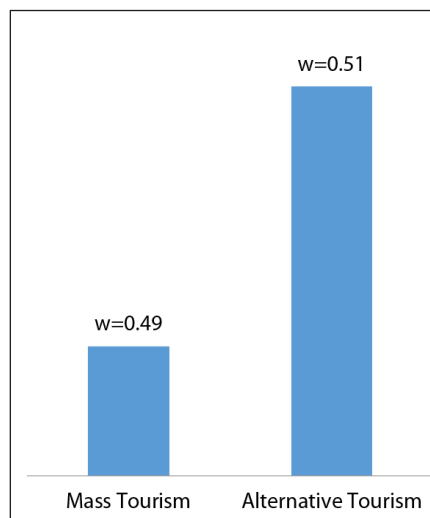
Source: Expert Choice data processing (2022)

The process of selecting the most appropriate option for developing a tourism object involved prioritizing twelve sub-criteria. In order to accomplish this, four matrices were created for pairwise comparisons based on experts' opinions, with each matrix focusing on one of the main criteria. The outcomes of these comparisons are summarised in Figure 2. The table indicates that the eco-environment criteria received the highest rating of 0.110, surpassing the other three criteria. This result signified that preserving the environment was significant in the selection process. Amongst the sub-criteria, the conservation of water resources held a considerable weight, with a rating of 0.742, surpassing the other sub-criteria. These findings were consistent with the interviews conducted with the Government of Pogalan Village, which emphasized water conservation's importance in preventing drought during the dry season and flooding during the rainy season. The next priority sub-criteria was regional property, with a weight of 0.696. This was because the development of Top Selfi as a tourist attraction had the potential to stimulate the local economy through activities such as photography, souvenir sales, and food and beverage businesses. Another significant sub-criteria was the geological structure, with a weight of 0.685. This was due to the location of tourist attractions on the slopes of Mount Merbabu. It was crucial to consider the geological structure to exploit these areas' tourism potential fully.

The primary focus in developing sustainable tourism should be on the environment. This was supported by Setiawan et al. (2021), which emphasized the importance of integrating environmental conservation and education with tourism to balance the needs of tourists, ecological considerations, and expectations of local communities. Achieving sustainability in the tourism industry requires careful attention to stakeholder collaboration. Gravitiani et al. (2022) highlighted those key stakeholders, such as the Department of Youth, Sports, and Tourism, Mount Merbabu National Park, and the tourism awareness group (*pokdarwis*) had played crucial roles in promoting sustainable tourism in Top Selfie Kragilan. Village governments were heavily reliant on the decisions and policies of these influential stakeholders. The actions of non-business stakeholders did not directly impact business activities. Local communities and visitors were actively involved in planning, implementing programs, and formulating policies. Key players were the Department of Youth, Sports, and Tourism, Mount Merbabu National Park, and *Pokdarwis*.

In the final phase of AHP analysis, the main objective was determining the priorities for different sustainable tourism developments. This could be achieved by integrating the local priorities of all criteria, sub-criteria, and alternatives to ascertain the global weight of each alternative. To establish the local priorities for all criteria matrices, the alternative local priority vectors were multiplied by the local priority vectors of each criterion and subsequently combined. This aggregation process ultimately produced the final priority vector, which signified the global weight assigned to each alternative. Moreover, local priority normalization criteria were implemented to ensure consistency and coherence in the final priority vector (Kurbatova & Abu-Qdais, 2020).

Figure 4 illustrates the global priorities of sustainable tourism development. Alternative tourism emerged as the most favorable choice for sustainable tourism development, with a global weight of 0.510. In comparison, Mass tourism ranked second with a weight of 0.490. This finding aligned with the research conducted by Medeiros et al. (2021), which emphasized the close association between alternative tourism and sustainable tourism. The study highlighted the importance of considering the long-term interests of all stakeholders and the quality of phenomena while considering the local human community, environment, and natural resources. Alternative tourism offers the opportunity to develop small-scale recreational activities in communities or areas, whereby it is feasible to mitigate the negative impacts of tourism (Zagonari, 2019). This approach could contribute to regional development by fostering cross-sectoral networks and relations among various stakeholders involved in tourism. It also provided alternative sources of locally generated income, benefiting the local communities.

Figure 4. Global priority (overall) sustainable tourism development in Top Selfie Pinusan

Source: Expert Choice data processing (2022)

In the GIS technique, the process of data collection, drawing, and satellite imagery played a crucial role in producing sophisticated tourism potential mapping images by prioritizing land contours (Hong et al., 2022; Wardana et al., 2023). Additionally, several mathematical models in blending models, such as AHP(Bagheri et al., 2021; Darko et al., 2019) needed to be executed during multi-criteria decision analysis to address various difficulties due to the diversity of opinions from key actors, parameter scores and regional conditions. These four factors were considered in developing tourism potential zones in Top Selfie Pinusan by using the AHP method. In-depth interview results also explained that the tourism sector in Top Selfie Pinusan had suffered due to the COVID-19 pandemic, lack of infrastructure facilities, unplanned and haphazard growth of tourist spots, information gaps, and lack of development planning. These findings were consistent with Acharya et al. (2022) research on the potential of significant

geological, geomorphological, and ecological impact changes in tourist areas. Efforts can be made to address most of these issues more scientifically and methodologically so that physiocultural heterogeneity aligns with ecological diversity and develops new terminology for tourists visiting tourist spots in the state (Sun et al., 2022). This demonstrated how various physical and cultural factors could be incorporated into the tourism potential zoning in Top Selfi and further analysis of each zone for mapping existing tourist spots, potential growth plans for tourist spots through reliable data, modification of existing spots by adding attractions, improving accessibility, focusing on necessary infrastructure development, creating awareness and appropriate tourism management, which could be enhanced through the application of geospatial techniques and mathematical methods.

CONCLUSION

The research study found that Top Selfie Pinusan's tourism potential is significant due to its unique geo-ecotourism offering. The region showcases exceptional geographic features, geological heritage, and favorable environmental conditions, making it an appealing destination for tourists.

The research results found the location and potential of the Top Selfie Pinusan area as a promising tourist destination, as seen from the development map. AHP analysis shows that eco-environmental criteria give the highest weight to the water resources conservation sub-criteria. The alternative policies proposed in this research emphasize the promotion of alternative tourism with the highest weight. This study holds significant implications for local government and tourism businesses, as they are tasked with overcoming the challenge of establishing tourist attractions in Top Selfie Pinusan that align with the principles of sustainable tourism in Indonesia. This can be accomplished by providing regulatory support to streamline tourism potential zones' development, enabling them to deliver economic and community advantages.

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Turnitin Journal

by Ika Alicia

Assessing Sustainable Tourism in Top Selfie: A Mapping and Decision-Making Technique

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Abstract

Research Originality: This research paper combined literature on sustainable tourism, including the mapping and decision-making of tourism management on Top Selfie, Indonesia towards sustainable tourism potential zones.

Research Objectives: This study examined the impact of sustainable tourism patterns in the Top Selfie Pinusan area of Magelang, Indonesia, by considering various sustainability criteria.

Research Methods: The researchers conducted comprehensive interviews with key stakeholders, such as representatives from the Youth, Sports and Tourism Service, Mount Merbabu National Park, village administration, tourism awareness groups (Pokdarwis), visitors and the local communities. The data was analysed by using ArcGIS to identify the development map of Top Selfie Pinusan and AHP analysis to policy recommendations for tourism development in Top Selfie Pinusan.

Empirical Results: The research found that the location and potential of Top Selfie Pinusan area is a promising tourist destination when viewed from its development map. The AHP analysis showed that the eco-environmental criterion gave the highest weight (0.564) to water resources conservation sub-criterion (0.742). The alternative policy proposed in this research emphasised the promotion of alternative tourism, which weighed 0.510.

Implications: This research has important implications for the local government and tourism businesses, as they must address the challenge of creating tourist attractions in Top Selfie Pinusan which are aligned with the principles of sustainable tourism in Indonesia. This can be achieved by offering regulatory assistance to expedite the development of potential tourism zones.

Keywords:
analytic hierarchy process, decision-making, geographic information system, mapping, sustainable tourism, Top Selfie

INTRODUCTION

The discourse in surrounding sustainable tourism has experienced a significant growth since late 1980s (Hunter, 1997) due to the adverse effects of mass tourism (Roblek et al., 2021). The fundamental concept of sustainable tourism is driven by the UN Conference on Sustainable Development (Rio+20), which advocates for the eradication of poverty, pursuit of social justice and preservation of natural resources as a means to build a society (Vernhes, 2019). Consequently, it can be inferred that sustainable tourism offers principles for the development, planning and management of the environment, society and economy. Many previous studies highlighted the significance of sustainable tourism development as a major concern amongst experts (Sharpley, 2000). This discussion underscores the guidelines for tourism development in terms of environmental, social and economic planning or management (Roblek et al., 2021). The motivation behind the three aspects of sustainable tourism stems from the recognition that tourism has positive and negative impacts on society, economy, and the environment (Byrd, 2007). Furthermore, distinctions can be observed in terms of content, wherein the concept of sustainable tourism emphasises the preservation of nature (Nathaniel & Adedoyin, 2022), leading to the emergence of terms, such as sustainable tourism (Casagrandi & Rinaldi, 2002), ecotourism (Lee & Jan 2018) and green tourism (Line et al., 2018). Additionally, the concept of social sustainability has given rise to terms like responsible tourism and sustainable tourism (Burrai et al., 2019).

The tourism industry has experienced a steady and rapid growth over the years. During the 1990s, income generated from international tourism had exceeded that of other international sources. As reported by the World Tourism Organisation (UNWTO), the global number of international tourist arrivals reached 1.4 billion in 2018, surpassing the initial predictions by two years (WEF, 2022). The tourism industry holds a significant position as a strategic pillar and a comprehensive sector which contribute to sustainable global economic growth (Liu & Suk, 2022). However, this rapid development had profound impacts on both the natural and human environments of tourist destinations. In light of the various challenges faced by the tourism industry, the concept of sustainable tourism has emerged as an inevitable trend. This is because, in order to meet the needs of present-day society without compromising the needs of future generations, it is imperative to protect and develop tourism resources in a rational manner, thereby achieving the objectives of a sustainable tourism industry (Ke, 2020).

Indonesia's natural tourism potential, which encompasses its awe-inspiring landscapes, vibrant customs, rich culture, and diverse language, acts as the primary attraction for tourists. Moreover, the development of artificial tourism, including shopping tourism, culinary tourism, and tourist villages, emphasises in reconnecting with nature. The fusion of natural and artificial tourism has now emerged as a unique allure for both local and international visitors. The number of foreign tourists who come to Indonesia has consistently increased, rising from 14,039,799 in 2017 to 15,806,191 in 2018;hence, reflecting an impressive growth rate of 11.17%. This surge in tourist arrivals was accompanied by a rise in hotel and accommodation occupancy rates, as well as an increase in employment opportunities within the tourism sector. It provided jobs for approximately 10.6 million individuals, which accounted for 8.9% of the total workforce. Furthermore, the tourism sector experienced a significant boost in its contribution to exports, which escalated from 10% in 2017 to 17% in 2017 (Rahardjo et al., 2023).

Sustainable tourism development has emerged as a recent phenomenon, encompassing various dimensions. These included the perspectives of community stakeholders, adoption of sustainable practices by businesses in the tourism industry, examination of socio-cultural impacts and implementation of methodological approaches to ensure sustainability and progress in research, strategy, and policy-making (Roblek et al., 2021). Amongst these dimensions, sustainability stands out as a crucial aspect. It entails the consideration and assurance of well-being and quality of life for both present and future generations, aligning with the principles of environmentally responsible development. However, the path towards sustainable tourism is not without challenges. It must navigate complex issues, such as adapting to and capitalising on societal transformations, fostering sustainable creativity, addressing the impacts of climate change and managing the influence of social media. Furthermore, the pursuit of a sustainable environment often involves striking a balance between environmental concerns and economic needs of society, particularly in societies who are experiencing rapid economic growth. Notably, there is a growing demand for nature tourism and preservation of cultural heritage sites, which are emerging trends in the tourism industry. Strategic planning, which is conducted periodically every five years, was proven effective in increasing tourist visits. Additionally, efforts to revitalise cultural heritage play a significant role in this endeavour (Mafruhah et al., 2020).

A comprehensive compilation of policies plays a vital role in facilitating the sustainable growth of tourism sector, thereby making a substantial contribution to the overall advancement of a nation (WEF, 2022). Extensive research has been conducted on the topic of sustainable development within the tourism sector. This research delved into various ideas, models, methodologies and frameworks that are aimed at promoting sustainable tourism. Within this field, two influential concepts had emerged. The first concept, introduced by the World Tourism Organisation in 1993, emphasizes the fulfilment of societal economic, social, and aesthetic needs while preserving cultural integrity and ecological balance. By adopting this approach, not only is the well-being of current hosts and visitors ensured, but also the interests of future generations are safeguarded through the provision of equal opportunities. The second concept was derived from the Sustainable Tourism Development Charter and Sustainable Tourism Development Action Plan. It underscores the vital significance of integrating the tourism industry with both human and natural environments.

Government decision-making is one of the important factors for sustainable tourism development. Research in this direction has gradually increased since the 21st Century. Research showed that policies are the key factor in promoting sustainable tourism development (Juangarcía, 2021; Ke, 2020; Kedang & Soesilo, 2021; Liu & Suk, 2022; Mei & Han, 2022; Rosardi et al., 2022) and stakeholder groups are factors that cannot be ignored in the implementation of sustainable tourism development (Aryawan et al., 2019; Gravitiani et al., 2022; Mafruhah et al., 2020), which can influence the formulation and implementation of sustainable tourism development policies (Hoang et al., 2018). In terms of tourism industry, key stakeholders include the tourism government, residents, business entities, business people, and tourism awareness groups (Gravitiani et al., 2022; Zhu et al., 2019). Previous research related to decision-making can be done with AHP. For example, Rosardi et al. (2022) used AHP to analyse priority of the factor criteria in a sustainable tourism development strategy with the highest priority scores, namely economic, socio-cultural, ecological and educational factors. Increase in the rate of urbanisation can change vacation patterns, which increasingly crave nature tourism

and tourist interest in the environment and the enjoyment of the natural environment has increased (Ban & Ramsaran, 2017).

Many studies on sustainable tourism were carried out, but most of them had focused on the micro level and are mostly related to other countries (Koizumi & Chakraborty, 2016; Štrba et al., 2020). Various criteria for measuring sustainable tourism were published by previous studies. For example, Mei and Han (2022) stated that sustainable development encompassed three dimensions: economic, social, ecological, and cultural sustainability. The ecological aspect is of utmost importance , which necessitates the harmonious advancement of environmental, social and economic concerns (Esquivias et al., 2022; Medeiros et al., 2021; Wu et al., 2023). Research studies with different results was indicated by Rosardi et al. (2022), which examined sustainable tourism through economic, socio-cultural, ecological and educational aspects. The results showed that the educational aspect was aspect with the highest priority. Further, different results from a research by Thahir et al. (2020) showed that the economic aspect was the most important aspect as compared to social and environmental aspects. There was no agreement between previous studies, so this research was consistent with the multi-criteria used in AHP covering social, economic and environmental aspects. A multi-criteria evaluation is needed to calculate the real economic value and apply reasonable use of tourism resources in sustainable tourism development (Hoang et al., 2018). Meanwhile, some significant research studies regarding sustainable tourism in Indonesia (Ariyani & Umar, 2020; Gravitiani et al., 2022; Rosardi et al., 2022; Suryawardani & Wiranatha, 2016) were conducted, but very few studies have considered the potential analysis of Geographic Information System (GIS) applications. Therefore, this study contributes to the existence of literature on sustainable tourism, which is still very new in Indonesia, especially in Magelang. Consequently, the rationale for this research is sustainable tourism in several ways. Firstly, processing geospatial techniques for sustainable tourism development patterns (Hoang et al., 2018; Rezvani et al., 2022). The second multi-criteria analysis by using the AHP method was used to assess policy priorities (Rosardi et al., 2022; Thahir et al., 2020) in Top Selfie Pinusan Magelang, Indonesia. Finally, the study has a beneficial impact on the local government of Magelang in emphasising superior selfie tourism within the framework of sustainable tourism.

Indonesia, being the largest archipelagic nation globally, boasts a staggering count of 17,548 islands, both large and small, encompassing a coastline that stretches over 81,000 kilometres. Moreover, the country is blessed with an incredibly diverse and thriving ecosystem. This ecosystem comprises both biotic and abiotic elements, which are intricately interconnected and engaged in mutual interactions. Biotic factors encompass a wide range of living organisms, including microorganisms, animals, plants, and humans. On the other hand, abiotic factors encompass essential components such as water, soil, air, sunlight, and various others. Within each distinct ecosystem, the populations of these biotic factors amalgamate to form a community, which in turn contributes to overall functioning of the ecosystem. This phenomenon could be observed in both aquatic and terrestrial ecosystems. Furthermore, within each ecosystem, many populations of individuals come together to form a specific geographical area known as a biome. The species composition within each biome exhibits variations from one location to another. Consequently, these biomes give rise to distinct vegetation patterns, such as the pine forest found in the Top Selfie Pinusan area, situated on the slopes of Mount Merbabu.

Nevertheless, the expansion of pine forests has resulted in detrimental environmental consequences, particularly in terms of ecosystem damage. This long-term damage to the ecosystem will inevitably lead to a decline in both the quantity and quality of forests, which also play a crucial role in enhancing the well-being of individuals and their purchasing power. This situation underscores the significance of conducting research that is focused on the development of pine forest tourism, with emphasis on community empowerment and sustainable development efforts. By incorporating the elements of culture and environment, ecotourism can offer many benefits to society, provided it is integrated into tourism activities. Consequently, tourism can directly contribute to economic growth and enhance the welfare of local communities (Gravitiani et al., 2022). Various research studies conducted in the past had not produced definite results in the tourism sector, but research studies on mapping and decision-making in sustainable tourism management is still an interesting topic because it covers three major aspects: economic, social and environmental. Analysis by using two analytical tools is still the latest in literature, especially in Indonesia's tourism sector . Most previous research in the tourism sector only used one analytical tool and the depth of discussion still needs to be added. Therefore, the primary objective of this study is to employ geospatial techniques to establish sustainable tourism development patterns. Additionally, a second objective involves utilising the analytical hierarchy process (AHP) method to conduct a multi-criteria analysis to determine policy priorities for Top Selfie Pinusan in Magelang, Indonesia. Ultimately, this research will have a positive impact on Magelang's regional government by highlighting the significance of promoting selfie tourism as a key component of sustainable tourism initiatives.
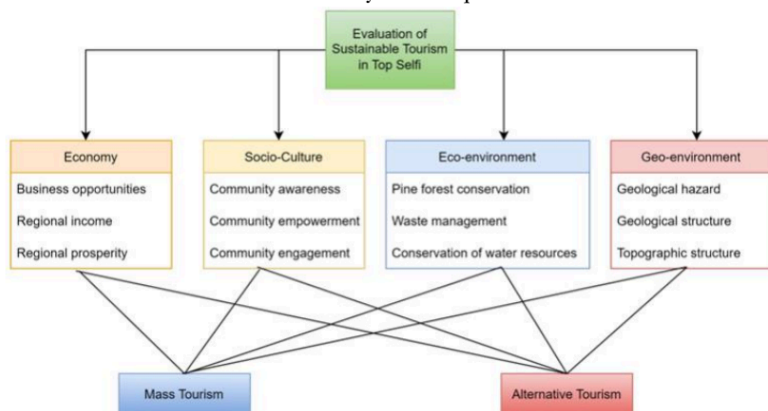
METHODS

Data sources

The study was carried out at the renowned Top Selfie Pinusan in Magelang, Central Java. The choice of this research site was deliberated and considered the prevailing issues in the region. The Top Selfie Pinusan Kragilan Forest Tourism has notable effects on the neighbouring tourist destinations in terms of social, economic and environmental aspects. In order to collect primary data, researchers conducted comprehensive interviews with key stakeholders, such as representatives from the Youth, Sports and Tourism Service, Mount Merbabu National Park, village administration, tourism awareness groups (*Pokdarwis*), visitors and the local communities.

Application of the AHP method in this study concentrated on four criteria (Figure 1). Firstly, it included economic aspects, which consisted of three sub-criteria, namely business opportunities, regional income and regional prosperity. Secondly, the socio-culture aspect consisted of three sub-criteria, namely community awareness, community empowerment and community engagement. Thirdly, the eco-environment aspect consisted of three sub-criteria, namely pine forest conservation, waste management and conservation of water resources. Fourthly, the geo-environmental aspect consisted of three sub-criteria, namely geological hazard, geological structure and topographic structure. Furthermore, this study concentrated on two alternatives, which were mass tourism and alternative tourism, for policy recommendations related to tourism development in Top Selfie Pinusan.

Figure 1. Hierarchical model of sustainable tourism development in Top Selfie Pinusan data analysis techniques

This study utilised a mixed-method approach to combine qualitative and quantitative analysis with integrated tourism potential data in the Top Selfie Pinusan Kragilan Forest area based on satellite data and Geographic Information System (GIS) environment, which is an integrated data collection that is combined and applied to accurately identify tourism potential. The GIS was employed as the analysis tool, specifically utilising ArcGIS software. In addition, the Analytic Hierarchy Process (AHP) was utilised as the second analysis tool, with assistance of Expert Choice software to prioritise sustainable tourism development in Top Selfie Pinusan. Then, the results from both analyses were integrated into a model to assess the potential and promote sustainable tourism. To compare the two criteria, relative importance scale was employed, following the recommendation of Saaty, as it is widely used in AHP (Saaty, 2008). In the initial stage of AHP, the main aim was to create a pairwise comparison amongst all criteria. This entailed in assigning integer values that ranged from 1 to 9 to express the outcomes of these comparisons for each pair of factors. A value of 1 signifies "equal importance", while a value of 9 represents "extreme importance". A higher numerical value indicates that the chosen factor is deemed more significant and superior. Moving forward, the matrix was subsequently filled out. To ascertain the priority of criteria, a designated scoring matrix was employed in the calculation process.

$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n1} & \dots & a_{nn} \end{bmatrix} \tag{1}$$

The pairwise comparison ranking is denoted as a_{xy}, represents the relative evaluation between criterion x and criterion y at a specific level as compared to the level immediately above it. The entry of a_{xy} follows a set of predefined rules.

$$a_{xy} > 0; a_{xy} = \frac{1}{a_{yx}}; a_{xx} = 1\forall x \tag{2}$$

Estimation of the priority of criteria can be determined by obtaining the principal eigenvector W from Matrix A. Upon normalising the vector (W), the priority vector from a lower level of criteria to the level above can be established as follows:

$$AW = \lambda_{max} W \tag{3}$$

The maximum eigenvalue of Matrix A is denoted as λ_{max}. If the pairwise comparison matrix fulfils the condition of transitivity for all pairwise comparisons, it can be considered consistent, and it confirms the following relation:

$$a_{xy} = a_{xh}a_{hy}\forall x, y, h \tag{4}$$

The subsequent phase involved the computation of the Consistency Ratio (CR). The AHP acknowledges the possibility of inconsistency but offers a means to gauge the level of inconsistency within each evaluation set. The Consistency Ratio (CR) serves as a metric to ascertain the consistency of the scoring matrix.

$$CR = \frac{CI}{RI} \tag{5}$$

The consistency index (CI) is a measure used to evaluate the consistency of a matrix, while the random consistency index (RI) serves as a reference point.

In Table 1, the average consistency of randomly generated matrices is provided. The CI for a matrix with an order of n is defined as:

$$CI = \frac{\lambda_{max} - n}{n - 1} \tag{6}$$

A consistency ratio that is equal to or less than 0.1 is deemed to be acceptable. In the event that the score exceeds this threshold, the assessment may lack reliability, and it is advisable to replicate the process.

Table 1. The average consistencies of random matrices

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

Source: Saaty (2008)

Based on this categorisation, the evaluation of every criterion for each tourist destination was determined by employing the subsequent formula:

$$T_{ij} = S_{ij} \, x \, w_j \dotfill (7)$$

Finally, the cumulative score for each tourist destination was computed by utilising the subsequent formula:

$$T_i = \sum_{i=1}^{n} S_{ij} \, x \, w_j \dotfill (8)$$

Where, Tij is score of criterion j from tourist location i (alternative i), while Ti is total score of tourist location i; wj is weighed score of criterion j, and Sij is the rating score of the criteria for tourist attractions number j.

This research used two analytical tools at the same time so that both could not be combined in one treatment because each analytical tool has a different purpose. The ArcGis analysis tool can only map tourism potential, whereas to find out detailed decision-making analysis is done with Expert Choice.
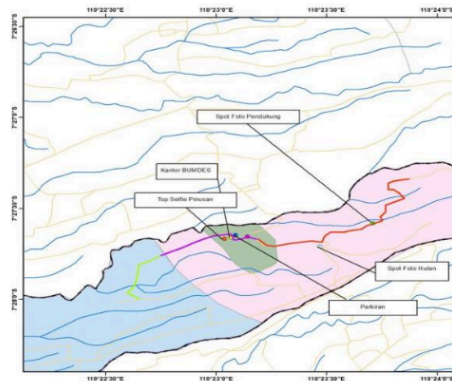
RESULT AND DISCUSSION

The main findings of the analysis of geographical location and sustainable tourism in Top Selfie Pinusan Magelang found that the location and potential of the Top Selfie Pinusan area is a promising tourist destination when viewed from its development map. In addition, when viewed from the results of the AHP analysis, it shows that the environmental ecology criteria give the highest weight to the water resource conservation sub-criteria. In addition, the policy alternatives proposed in this study emphasize more on the promotion of alternative tourism that has weight. In depth, the results of the analysis of each method will be explained in the following discussion.

Geographical Location and Sustainable Tourism in Top Selfie Pinusan Magelang

Geographically, Magelang is situated at a specific location in terms of latitude, longitude, and altitude. This precise information provides a clear understanding of Magelang's geographical positioning. The city boasts numerous tourist attractions that hold great potential for further development and exploration by visitors. One such attraction is the Top Selfie Pinusan Kragilan, which can be found in the Kragilan within the Magelang of Central Java. The closest tours that can be accessed by Top Selfie Pinusan visitors include Pine Forest photo spots and supporting photo spots, which will be developed. *Pokdarwis* and BumDes manage these tourist destinations. The development plan for the Top Selfie Pinusan Tourism destination, Kragilan Hamlet, Pogalan Village, Pakis District, and supporting facilities can be seen in Figure 2.

Figure 2. Map of the Top Selfie Pinusan development plan

Source: ArcGIS (2022)

Originally a part of the Kragilan Pine Forest, located in the Traditional Area of Mount Merbabu National Park, this site has evolved into a popular tourist spot which is known as the Top Selfie Pinusan. In 2018 and 2019, this attraction drew a significant number of tourists, with

approximately 140,000 visitors who explored its beauty. However, due to the global COVID-19 pandemic that occurred between 2020 and 2021, the tourist spot had to be temporarily closed for safety reasons. Fortunately, it reopened to the public in early 2022, allowing visitors to once again immerse themselves in the enchanting allure of the Top Selfie Pinusan in Magelang. Service facilities at the Top Selfie Pinusan area with supporting facilities include the availability of public toilets, parking areas, and homestays. This area also has sellers of various types of culinary delight, such as fried noodles, boiled noodles, dry bread and souvenirs.

Multi-Criteria Evaluation of Sustainable Tourism

Various Top selfie spots have the potential to boost tourism. In the AHP analysis, the initial step involved the construction of a scoring matrix and assessed its consistency. The study primarily focused on four main criteria (economy, socio-cultural, eco-environmental and geo-environmental aspects) and compared them pairwise in relation to the objectives. Measurements were taken to determine the weight of economic aspect, which comprised three sub-criteria (business opportunities, regional income and regional prosperity). The Socio-Culture aspect, which consisting of three sub-criteria (community awareness, community empowerment and community engagement), was then evaluated. Following this, the eco-environment aspect, with three sub-criteria (pine forest conservation, waste management and Conservation of water resources), was assessed. Lastly, the geo-environmental aspect, which encompassed three sub-criteria (geological hazard, geological structure and topographic structure), was examined.

The experts' weight assignment and the resulting priority for each criterion were presented in the pairwise comparison matrix (Table 2). The calculated consistency ratio was found to be 0.02, which fell within the acceptable range of less than 0.1. Upon analysing the pairwise comparison, it became evident that the Eco-Environment Aspect criteria hold significant importance, followed by the Geo-Environment Aspect, Economy Aspect, and Socio-Culture Aspect criteria.
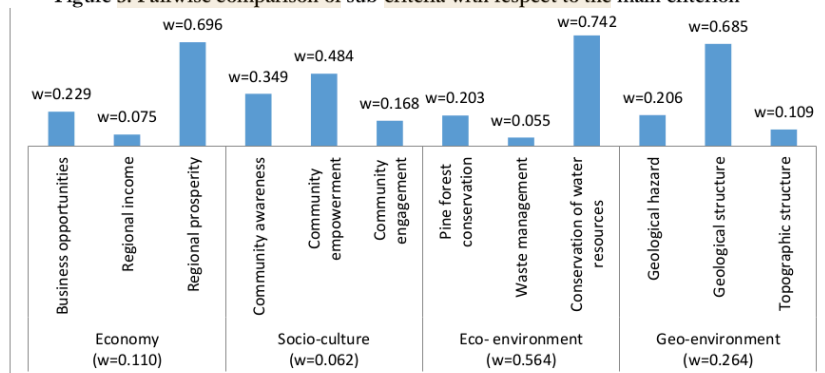
Table 2. Pairwise comparison matrix

Criteria	Economy Aspect	Socio-Culture Aspect	Eco-Environment Aspect	Geo-Environmental Aspect	Priority Vector
Economy Aspect	1	2	7	2	0.110
Socio-Culture Aspect	1/2	1	7	5	0.062
Eco-Environment Aspect	1/7	1/7	1	2	0,564
Geo-Environment Aspect	1/2	1/5	1/2	1	0,264

Source: Expert Choice data processing (2022)

Figure 3 illustrates the prioritisation of the primary criteria in relation to the objectives. It was evident that the Eco-Environment criteria held the highest significance, with a weight of 0.564. Following this, the Geo-Environment criteria held a weight of 0.264, while the economic criteria held a weight of 0.110. Lastly, the socio-culture criteria had the smallest weight of 0.062.

This data indicated that when selecting sustainable tourism alternatives in Top Selfi, respondents primarily prioritised the eco-environment aspect. This preference could be attributed to the fact that the management of the Top Selfi tourist attraction is closely associated with the Mount Merbabu National Park Office, which places great emphasis on environmental Conservation. Similar findings were reported by other researchers, such as Gravitiani et al. (2022), who highlighted the significant role of the National Park Authority as a stakeholder in the management of tourist sites in Top Selfie Pinusan.

Figure 3. Pairwise comparison of sub-criteria with respect to the main criterion

Note: w = weight criteria and sub-criteria
Source: Expert Choice data processing (2022)

The process of selecting the most appropriate option for the development of a tourism object involved prioritisation of twelve sub-criteria. In order to accomplish this, four matrices were created for pairwise comparisons based on the opinions of experts, with each matrix focusing on one of the main criteria. The outcomes of these comparisons are summarised in Figure 2. The table clearly indicates that the eco-environment criteria received the highest rating of 0.110, surpassing the other three criteria. This signified that the preservation of the environment held the utmost significance in the selection process. Amongst the sub-criteria, the Conservation of water resources held a considerable weight, with a rating of 0.742, surpassing the other sub-criteria. These findings were consistent with the interviews conducted with the Government of Pogalan Village, which emphasised the importance of water conservation in order to prevent drought during the dry season and flooding during the rainy season. The next priority sub-criteria was regional property, with a weight of 0.696. This was because the development of Top Selfi as a tourist attraction had potential to stimulate the local economy through activities such as photography, souvenir sales as well as food and beverage businesses. Another sub-criteria which held significance was the geological structure, with a weight of 0.685. This was due to the location of tourist attractions on the slopes of Mount Merbabu. It was crucial to consider the geological structure in order to fully exploit the tourism potential of these areas.

The primary focus in the development of sustainable tourism should be on the environment. This was supported by Setiawan et al. (2021), which emphasised the importance of integrating environmental conservation and education with tourism to strike a balance between the needs of tourists, ecological considerations and expectations of local communities. Achieving sustainability in the tourism industry requires careful attention to stakeholder collaboration. Gravitiani et al. (2022) highlighted that key stakeholders, such as the Department of Youth, Sports, and Tourism, Mount Merbabu National Park, and the tourism awareness group (pokdarwis) had played crucial roles in promoting sustainable tourism in Top Selfie Kragilan. Village governments were heavily reliant on the decisions and policies of these influential stakeholders. The actions of non-business stakeholders did not directly impact business activities. Local communities and visitors were actively involved in the planning, implementation of programs, and formulation of policies, with key players being the Department of Youth, Sports, and Tourism, Mount Merbabu National Park and Pokdarwis.

In the final phase of AHP analysis, the main objective was to determine the overall priorities for different sustainable tourism developments. This could be achieved by integrating the local priorities of all criteria, sub-criteria and alternatives to ascertain the global weight of each alternative. To establish the local priorities for all criteria matrices, the alternative local priority vectors were multiplied by the local priority vectors of each criterion and subsequently combined. This process of aggregation ultimately produced the final priority vector, which signified the global weight assigned to each alternative. Moreover, local priority normalisation criteria were implemented to ensure consistency and coherence in the final priority vector (Kurbatova & Abu-Qdais, 2020).

Figure 4. Global priority (overall) sustainable tourism development in Top Selfie Pinusan

Source: Expert Choice data processing (2022)

Figure 4 illustrates the global priorities of sustainable tourism development. It was evident that Alternative tourism emerged as the most favourable choice for sustainable tourism development, with a global weight of 0.510. In comparison, Mass tourism ranked second with a weight of 0.490. This finding aligned with the research conducted by Medeiros et al. (2021),

which emphasised the close association between alternative tourism and sustainable tourism. The study highlighted the importance of considering the long-term interests of all stakeholders and quality of phenomena while taking into account the local human community, environment and natural resources. Alternative tourism offers the opportunity to develop small-scale recreational activities in communities or areas, whereby it was feasible to mitigate the negative impacts of tourism (Zagonari, 2019). This approach could contribute to regional development by fostering cross-sectoral networks and relations amongst various stakeholders involved in tourism. Additionally, it provided alternative sources of locally generated income, thereby benefiting the local communities.

In GIS technique, the process of data collection, drawing and satellite imagery played a crucial role in producing sophisticated tourism potential mapping images by prioritising land contours (Hong et al., 2022; Wardana et al., 2023). Additionally, several mathematical models in blending models, such as AHP(Bagheri et al., 2021; Darko et al., 2019) needed to be executed during multi-criteria decision analysis to address various difficulties due to the diversity of opinions from key actors, parameter scores and regional conditions. These four factors were taken into consideration in the development of tourism potential zones in Top Selfie Pinusan by using the AHP method. In-depth interview results also explained that the tourism sector in Top Selfie Pinusan had suffered due to COVID-19 pandemic, lack of infrastructure facilities, unplanned and haphazard growth of tourist spots, information gaps and lack of development planning. These findings were consistent with Acharya et al. (2022) research on the potential of significant geological, geomorphological and ecological impact changes in tourist areas. Efforts can be made to address most of these issues in a more scientific and methodological manner so that physiocultural heterogeneity aligns with ecological diversity and develops new terminology for tourists visiting tourist spots in the state (Sun et al., 2022). This demonstrated how various physical and cultural factors could be incorporated into the tourism potential zoning in Top Selfi and further analysis of each zone for mapping existing tourist spots, potential growth plans for tourist spots through reliable data, modification of existing spots by adding attractions, improving accessibility, focusing on necessary infrastructure development, creating awareness and appropriate tourism management, which could be enhanced through the application of geospatial techniques and mathematical methods.

CONCLUSION

The research study found that the tourism potential of Top Selfie Pinusan is of great significance due to its unique offering of geo-ecotourism. The region showcases exceptional geographic features, geological heritage, and favourable environmental conditions, making it an appealing destination for tourists.

The research results found that the location and potential of the Top Selfie Pinusan area as a promising tourist destination if seen from the development map. AHP analysis shows that eco-environmental criteria give the highest weight to the water resources conservation sub-criteria. The alternative policies proposed in this research emphasise the promotion of alternative tourism with the highest weight. This study holds significant implications for local government and tourism businesses, as they are tasked with the responsibility of overcoming the challenge in establishing tourist attractions in Top Selfie Pinusan that are in line with the principles of sustainable tourism in Indonesia. This can be accomplished by providing regulatory support to

streamline the development of tourism potential zones, thereby enabling them to deliver economic and community advantages.

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REVIEW FORM

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Assessing Sustainable Tourism in Top Selfie: A Mapping and Decision-Making Technique

Ika Alicia Sasanti[1], Evi Gravitiani[2*], Rebecca Cindy Sartika[3], Dwi Herniti[4]

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Abstract

Research Originality: This research paper combined literature on sustainable tourism, including the mapping and decision-making of tourism management on Top Selfie, Indonesia towards sustainable tourism potential zones.

Research Objectives: This study examined the impact of sustainable tourism patterns in the Top Selfie Pinusan area of Magelang, Indonesia, by considering various sustainability criteria.

Research Methods: The researchers conducted comprehensive interviews with key stakeholders, such as representatives from the Youth, Sports and Tourism Service, Mount Merbabu National Park, village administration, tourism awareness groups (Pokdarwis), visitors and the local communities. The data was analysed by using ArcGIS to identify the development map of Top Selfie Pinusan and AHP analysis to policy recommendations for tourism development in Top Selfie Pinusan.

Empirical Results: The research found that the location and potential of Top Selfie Pinusan area is a promising tourist destination when viewed from its development map. The AHP analysis showed that the eco-environmental criterion gave the highest weight (0.564) to water resources conservation sub-criterion (0.742). The alternative policy proposed in this research emphasised the promotion of alternative tourism, which weighed 0.510.

Implications: This research has important implications for the local government and tourism businesses, as they must address the challenge of creating tourist attractions in Top Selfie Pinusan which are aligned with the principles of sustainable tourism in Indonesia. This can be achieved by offering regulatory assistance to expedite the development of potential tourism zones.

Keywords:
analytic hierarchy process, decision-making, geographic information system, mapping, sustainable tourism, Top Selfie

INTRODUCTION

The discourse in surrounding sustainable tourism has experienced a significant growth since late 1980s (Hunter, 1997) due to the adverse effects of mass tourism (Roblek et al., 2021). The fundamental concept of sustainable tourism is driven by the UN Conference on Sustainable Development (Rio+20), which advocates for the eradication of poverty, pursuit of social justice and preservation of natural resources as a means to build a society (Vernhes, 2019). Consequently, it can be inferred that sustainable tourism offers principles for the development, planning and management of the environment, society and economy. Many previous studies highlighted the significance of sustainable tourism development as a major concern amongst experts (Sharpley, 2000). This discussion underscores the guidelines for tourism development in terms of environmental, social and economic planning or management (Roblek et al., 2021). The motivation behind the three aspects of sustainable tourism stems from the recognition that tourism has positive and negative impacts on society, economy, and the environment (Byrd, 2007). Furthermore, distinctions can be observed in terms of content, wherein the concept of sustainable tourism emphasises the preservation of nature (Nathaniel & Adedoyin, 2022), leading to the emergence of terms, such as sustainable tourism (Casagrandi & Rinaldi, 2002), ecotourism (Lee & Jan 2018) and green tourism (Line et al., 2018). Additionally, the concept of social sustainability has given rise to terms like responsible tourism and sustainable tourism (Burrai et al., 2019).

The tourism industry has experienced a steady and rapid growth over the years. During the 1990s, income generated from international tourism had exceeded that of other international sources. As reported by the World Tourism Organisation (UNWTO), the global number of international tourist arrivals reached 1.4 billion in 2018, surpassing the initial predictions by two years (WEF, 2022). The tourism industry holds a significant position as a strategic pillar and a comprehensive sector which contribute to sustainable global economic growth (Liu & Suk, 2022). However, this rapid development had profound impacts on both the natural and human environments of tourist destinations. In light of the various challenges faced by the tourism industry, the concept of sustainable tourism has emerged as an inevitable trend. This is because, in order to meet the needs of present-day society without compromising the needs of future generations, it is imperative to protect and develop tourism resources in a rational manner, thereby achieving the objectives of a sustainable tourism industry (Ke, 2020).

Indonesia's natural tourism potential, which encompasses its awe-inspiring landscapes, vibrant customs, rich culture, and diverse language, acts as the primary attraction for tourists. Moreover, the development of artificial tourism, including shopping tourism, culinary tourism, and tourist villages, emphasises in reconnecting with nature. The fusion of natural and artificial tourism has now emerged as a unique allure for both local and international visitors. The number of foreign tourists who come to Indonesia has consistently increased, rising from 14,039,799 in 2017 to 15,806,191 in 2018; hence, reflecting an impressive growth rate of 11.17%. This surge in tourist arrivals was accompanied by a rise in hotel and accommodation occupancy rates, as well as an increase in employment opportunities within the tourism sector. It provided jobs for approximately 10.6 million individuals, which accounted for 8.9% of the total workforce. Furthermore, the tourism sector experienced a significant boost in its contribution to exports, which escalated from 10% in 2017 to 17% in 2017 (Rahardjo et al., 2023).

Sustainable tourism development has emerged as a recent phenomenon, encompassing various dimensions. These included the perspectives of community stakeholders, adoption of sustainable practices by businesses in the tourism industry, examination of socio-cultural impacts and implementation of methodological approaches to ensure sustainability and progress in research, strategy, and policy-making (Roblek et al., 2021). Amongst these dimensions, sustainability stands out as a crucial aspect. It entails the consideration and assurance of well-being and quality of life for both present and future generations, aligning with the principles of environmentally responsible development. However, the path towards sustainable tourism is not without challenges. It must navigate complex issues, such as adapting to and capitalising on societal transformations, fostering sustainable creativity, addressing the impacts of climate change and managing the influence of social media. Furthermore, the pursuit of a sustainable environment often involves striking a balance between environmental concerns and economic needs of society, particularly in societies who are experiencing rapid economic growth. Notably, there is a growing demand for nature tourism and preservation of cultural heritage sites, which are emerging trends in the tourism industry. Strategic planning, which is conducted periodically every five years, was proven effective in increasing tourist visits. Additionally, efforts to revitalise cultural heritage play a significant role in this endeavour (Mafruhah et al., 2020).

A comprehensive compilation of policies plays a vital role in facilitating the sustainable growth of tourism sector, thereby making a substantial contribution to the overall advancement of a nation (WEF, 2022). Extensive research has been conducted on the topic of sustainable development within the tourism sector. This research delved into various ideas, models, methodologies and frameworks that are aimed at promoting sustainable tourism. Within this field, two influential concepts had emerged. The first concept, introduced by the World Tourism Organisation in 1993, emphasizes the fulfilment of societal economic, social, and aesthetic needs while preserving cultural integrity and ecological balance. By adopting this approach, not only is the well-being of current hosts and visitors ensured, but also the interests of future generations are safeguarded through the provision of equal opportunities. The second concept was derived from the Sustainable Tourism Development Charter and Sustainable Tourism Development Action Plan. It underscores the vital significance of integrating the tourism industry with both human and natural environments.

Government decision-making is one of the important factors for sustainable tourism development. Research in this direction has gradually increased since the 21ˢᵗ Century. Research showed that policies are the key factor in promoting sustainable tourism development (Juangarcía, 2021; Ke, 2020; Kedang & Soesilo, 2021; Liu & Suk, 2022; Mei & Han, 2022; Rosardi et al., 2022) and stakeholder groups are factors that cannot be ignored in the implementation of sustainable tourism development (Aryawan et al., 2019; Gravitiani et al., 2022; Mafruhah et al., 2020), which can influence the formulation and implementation of sustainable tourism development policies (Hoang et al., 2018). In terms of tourism industry, key stakeholders include the tourism government, residents, business entities, business people, and tourism awareness groups (Gravitiani et al., 2022; Zhu et al., 2019). Previous research related to decision-making can be done with AHP. For example, Rosardi et al. (2022) used AHP to analyse priority of the factor criteria in a sustainable tourism development strategy with the highest priority scores, namely economic, socio-cultural, ecological and educational factors. Increase in the rate of urbanisation can change vacation patterns, which increasingly crave nature tourism

and tourist interest in the environment and the enjoyment of the natural environment has increased (Ban & Ramsaran, 2017).

Many studies on sustainable tourism were carried out, but most of them had focused on the micro level and are mostly related to other countries (Koizumi & Chakraborty, 2016; Štrba et al., 2020). Various criteria for measuring sustainable tourism were published by previous studies. For example, Mei and Han (2022) stated that sustainable development encompassed three dimensions: economic, social, ecological, and cultural sustainability. The ecological aspect is of utmost importance , which necessitates the harmonious advancement of environmental, social and economic concerns (Esquivias et al., 2022; Medeiros et al., 2021; Wu et al., 2023). Research studies with different results was indicated by Rosardi et al. (2022), which examined sustainable tourism through economic, socio-cultural, ecological and educational aspects. The results showed that the educational aspect was aspect with the highest priority. Further, different results from a research by Thahir et al. (2020) showed that the economic aspect was the most important aspect as compared to social and environmental aspects. There was no agreement between previous studies, so this research was consistent with the multi-criteria used in AHP covering social, economic and environmental aspects. A multi-criteria evaluation is needed to calculate the real economic value and apply reasonable use of tourism resources in sustainable tourism development (Hoang et al., 2018). Meanwhile, some significant research studies regarding sustainable tourism in Indonesia (Ariyani & Umar, 2020; Gravitiani et al., 2022; Rosardi et al., 2022; Suryawardani & Wiranatha, 2016) were conducted, but very few studies have considered the potential analysis of Geographic Information System (GIS) applications. Therefore, this study contributes to the existence of literature on sustainable tourism, which is still very new in Indonesia, especially in Magelang. Consequently, the rationale for this research is sustainable tourism in several ways. Firstly, processing geospatial techniques for sustainable tourism development patterns (Hoang et al., 2018; Rezvani et al., 2022). The second multi-criteria analysis by using the AHP method was used to assess policy priorities (Rosardi et al., 2022; Thahir et al., 2020) in Top Selfie Pinusan Magelang, Indonesia. Finally, the study has a beneficial impact on the local government of Magelang in emphasising superior selfie tourism within the framework of sustainable tourism.

Indonesia, being the largest archipelagic nation globally, boasts a staggering count of 17,548 islands, both large and small, encompassing a coastline that stretches over 81,000 kilometres. Moreover, the country is blessed with an incredibly diverse and thriving ecosystem. This ecosystem comprises both biotic and abiotic elements, which are intricately interconnected and engaged in mutual interactions. Biotic factors encompass a wide range of living organisms, including microorganisms, animals, plants, and humans. On the other hand, abiotic factors encompass essential components such as water, soil, air, sunlight, and various others. Within each distinct ecosystem, the populations of these biotic factors amalgamate to form a community, which in turn contributes to overall functioning of the ecosystem. This phenomenon could be observed in both aquatic and terrestrial ecosystems. Furthermore, within each ecosystem, many populations of individuals come together to form a specific geographical area known as a biome. The species composition within each biome exhibits variations from one location to another. Consequently, these biomes give rise to distinct vegetation patterns, such as the pine forest found in the Top Selfie Pinusan area, situated on the slopes of Mount Merbabu.

> **Commented [A4]:** Thank you for your suggestion. We have added the research gas and contribution of this research in the introduction.

Nevertheless, the expansion of pine forests has resulted in detrimental environmental consequences, particularly in terms of ecosystem damage. This long-term damage to the ecosystem will inevitably lead to a decline in both the quantity and quality of forests, which also play a crucial role in enhancing the well-being of individuals and their purchasing power. This situation underscores the significance of conducting research that is focused on the development of pine forest tourism, with emphasis on community empowerment and sustainable development efforts. By incorporating the elements of culture and environment, ecotourism can offer many benefits to society, provided it is integrated into tourism activities. Consequently, tourism can directly contribute to economic growth and enhance the welfare of local communities (Gravitiani et al., 2022). Various research studies conducted in the past had not produced definite results in the tourism sector, but research studies on mapping and decision-making in sustainable tourism management is still an interesting topic because it covers three major aspects: economic, social and environmental. Analysis by using two analytical tools is still the latest in literature, especially in Indonesia's tourism sector . Most previous research in the tourism sector only used one analytical tool and the depth of discussion still needs to be added. Therefore, the primary objective of this study is to employ geospatial techniques to establish sustainable tourism development patterns. Additionally, a second objective involves utilising the analytical hierarchy process (AHP) method to conduct a multi-criteria analysis to determine policy priorities for Top Selfie Pinusan in Magelang, Indonesia. Ultimately, this research will have a positive impact on Magelang's regional government by highlighting the significance of promoting selfie tourism as a key component of sustainable tourism initiatives.
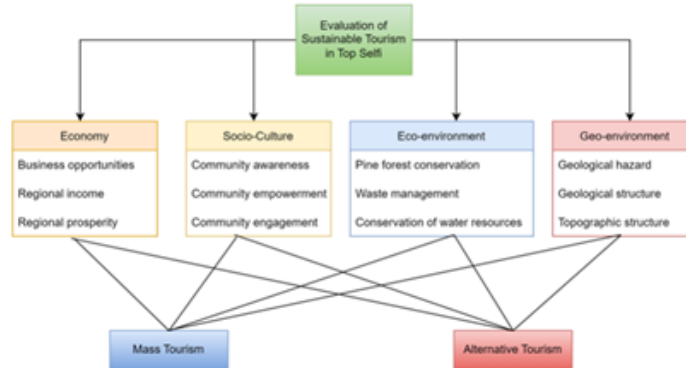
METHODS

Data sources

The study was carried out at the renowned Top Selfie Pinusan in Magelang, Central Java. The choice of this research site was deliberated and considered the prevailing issues in the region. The Top Selfie Pinusan Kragilan Forest Tourism has notable effects on the neighbouring tourist destinations in terms of social, economic and environmental aspects. In order to collect primary data, researchers conducted comprehensive interviews with key stakeholders, such as representatives from the Youth, Sports and Tourism Service, Mount Merbabu National Park, village administration, tourism awareness groups (*Pokdarwis*), visitors and the local communities.

Application of the AHP method in this study concentrated on four criteria (Figure 1). Firstly, it included economic aspects, which consisted of three sub-criteria, namely business opportunities, regional income and regional prosperity. Secondly, the socio-culture aspect consisted of three sub-criteria, namely community awareness, community empowerment and community engagement. Thirdly, the eco-environment aspect consisted of three sub-criteria, namely pine forest conservation, waste management and conservation of water resources. Fourthly, the geo-environmental aspect consisted of three sub-criteria, namely geological hazard, geological structure and topographic structure. Furthermore, this study concentrated on two alternatives, which were mass tourism and alternative tourism, for policy recommendations related to tourism development in Top Selfie Pinusan.

Commented [A5]: Thank you for your suggestion. In this section, we add the differences between this study and previous studies.

Figure 1. Hierarchical model of sustainable tourism development in Top Selfie Pinusan data analysis techniques

This study utilised a mixed-method approach to combine qualitative and quantitative analysis with integrated tourism potential data in the Top Selfie Pinusan Kragilan Forest area based on satellite data and Geographic Information System (GIS) environment, which is an integrated data collection that is combined and applied to accurately identify tourism potential. The GIS was employed as the analysis tool, specifically utilising ArcGIS software. In addition, the Analytic Hierarchy Process (AHP) was utilised as the second analysis tool, with assistance of Expert Choice software to prioritise sustainable tourism development in Top Selfie Pinusan. Then, the results from both analyses were integrated into a model to assess the potential and promote sustainable tourism. To compare the two criteria, relative importance scale was employed, following the recommendation of Saaty, as it is widely used in AHP (Saaty, 2008). In the initial stage of AHP, the main aim was to create a pairwise comparison amongst all criteria. This entailed in assigning integer values that ranged from 1 to 9 to express the outcomes of these comparisons for each pair of factors. A value of 1 signifies "equal importance", while a value of 9 represents "extreme importance". A higher numerical value indicates that the chosen factor is deemed more significant and superior. Moving forward, the matrix was subsequently filled out. To ascertain the priority of criteria, a designated scoring matrix was employed in the calculation process.

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ a_{n1} & a_{n1} & \cdots & a_{nn} \end{bmatrix} \tag{1}$$

Commented [A6]:
Thanks for the suggestion.
We have added tools of analysis.

The pairwise comparison ranking is denoted as a_{xy}, represents the relative evaluation between criterion x and criterion y at a specific level as compared to the level immediately above it. The entry of a_{xy} follows a set of predefined rules.

$$a_{xy} > 0; \quad a_{xy} = \frac{1}{a_{yx}}; \quad a_{xx} = 1 \forall x \qquad (2)$$

Estimation of the priority of criteria can be determined by obtaining the principal eigenvector W from Matrix A. Upon normalising the vector (W), the priority vector from a lower level of criteria to the level above can be established as follows:

$$AW = \lambda_{max} W \qquad (3)$$

The maximum eigenvalue of Matrix A is denoted as λ_{max}. If the pairwise comparison matrix fulfils the condition of transitivity for all pairwise comparisons, it can be considered consistent, and it confirms the following relation:

$$a_{xy} = a_{xh} a_{hy} \forall x, y, h \qquad (4)$$

The subsequent phase involved the computation of the Consistency Ratio (CR). The AHP acknowledges the possibility of inconsistency but offers a means to gauge the level of inconsistency within each evaluation set. The Consistency Ratio (CR) serves as a metric to ascertain the consistency of the scoring matrix.

$$CR = \frac{CI}{RI} \qquad (5)$$

The consistency index (CI) is a measure used to evaluate the consistency of a matrix, while the random consistency index (RI) serves as a reference point.

In Table 1, the average consistency of randomly generated matrices is provided. The CI for a matrix with an order of n is defined as:

$$CI = \frac{\lambda_{max} - n}{n-1} \qquad (6)$$

A consistency ratio that is equal to or less than 0.1 is deemed to be acceptable. In the event that the score exceeds this threshold, the assessment may lack reliability, and it is advisable to replicate the process.

Table 1. The average consistencies of random matrices

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

Source: Saaty (2008)

Based on this categorisation, the evaluation of every criterion for each tourist destination was determined by employing the subsequent formula:

$$T_{ij} = S_{ij} \times w_j \qquad (7)$$

Finally, the cumulative score for each tourist destination was computed by utilising the subsequent formula:

$$T_i = \sum_{i=1}^{n} S_{ij} \times w_j \qquad (8)$$

Where, Tij is score of criterion j from tourist location i (alternative i), while Ti is total score of tourist location i; wj is weighed score of criterion j, and Sij is the rating score of the criteria for tourist attractions number j.

This research used two analytical tools at the same time so that both could not be combined in one treatment because each analytical tool has a different purpose. The ArcGis analysis tool can only map tourism potential, whereas to find out detailed decision-making analysis is done with Expert Choice.

> **Commented [A7]:** Thank you for your comment
> The two analysis tools in this method cannot be combined because GIS and AHP have different purposes as explained in this section
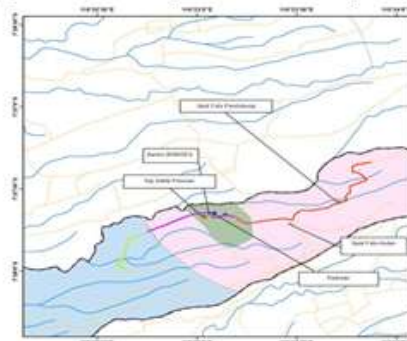
RESULT AND DISCUSSION

The main findings of the analysis of geographical location and sustainable tourism in Top Selfie Pinusan Magelang found that the location and potential of the Top Selfie Pinusan area is a promising tourist destination when viewed from its development map. In addition, when viewed from the results of the AHP analysis, it shows that the environmental ecology criteria give the highest weight to the water resource conservation sub-criteria. In addition, the policy alternatives proposed in this study emphasize more on the promotion of alternative tourism that has weight. In depth, the results of the analysis of each method will be explained in the following discussion.

> **Commented [A8]:**
> Thank you for your comment. We have written the main findings of this study in the first paragraph of the results section.

Geographical Location and Sustainable Tourism in Top Selfie Pinusan Magelang

Geographically, Magelang is situated at a specific location in terms of latitude, longitude, and altitude. This precise information provides a clear understanding of Magelang's geographical positioning. The city boasts numerous tourist attractions that hold great potential for further development and exploration by visitors. One such attraction is the Top Selfie Pinusan Kragilan, which can be found in the Kragilan within the Magelang of Central Java. The closest tours that can be accessed by Top Selfie Pinusan visitors include Pine Forest photo spots and supporting photo spots, which will be developed. *Pokdarwis* and BumDes manage these tourist destinations. The development plan for the Top Selfie Pinusan Tourism destination, Kragilan Hamlet, Pogalan Village, Pakis District, and supporting facilities can be seen in Figure 2.

Figure 2. Map of the Top Selfie Pinusan development plan

Source: ArcGIS (2022)

Originally a part of the Kragilan Pine Forest, located in the Traditional Area of Mount Merbabu National Park, this site has evolved into a popular tourist spot which is known as the Top Selfie Pinusan. In 2018 and 2019, this attraction drew a significant number of tourists, with approximately 140,000 visitors who explored its beauty. However, due to the global COVID-19 pandemic that occurred between 2020 and 2021, the tourist spot had to be temporarily closed for safety reasons. Fortunately, it reopened to the public in early 2022, allowing visitors to once again immerse themselves in the enchanting allure of the Top Selfie Pinusan in Magelang. Service facilities at the Top Selfie Pinusan area with supporting facilities include the availability of public toilets, parking areas, and homestays. This area also has sellers of various types of culinary delight, such as fried noodles, boiled noodles, dry bread and souvenirs.

Multi-Criteria Evaluation of Sustainable Tourism

Various Top selfie spots have the potential to boost tourism. In the AHP analysis, the initial step involved the construction of a scoring matrix and assessed its consistency. The study primarily focused on four main criteria (economy, socio-cultural, eco-environmental and geo-environmental aspects) and compared them pairwise in relation to the objectives. Measurements were taken to determine the weight of economic aspect, which comprised three sub-criteria (business opportunities, regional income and regional prosperity). The Socio-Culture aspect, which consisting of three sub-criteria (community awareness, community empowerment and community engagement), was then evaluated. Following this, the eco-environment aspect, with three sub-criteria (pine forest conservation, waste management and Conservation of water resources), was assessed. Lastly, the geo-environmental aspect, which encompassed three sub-criteria (geological hazard, geological structure and topographic structure), was examined.

The experts' weight assignment and the resulting priority for each criterion were presented in the pairwise comparison matrix (Table 2). The calculated consistency ratio was found to be 0.02, which fell within the acceptable range of less than 0.1. Upon analysing the pairwise comparison, it became evident that the Eco-Environment Aspect criteria hold significant importance, followed by the Geo-Environment Aspect, Economy Aspect, and Socio-Culture Aspect criteria.
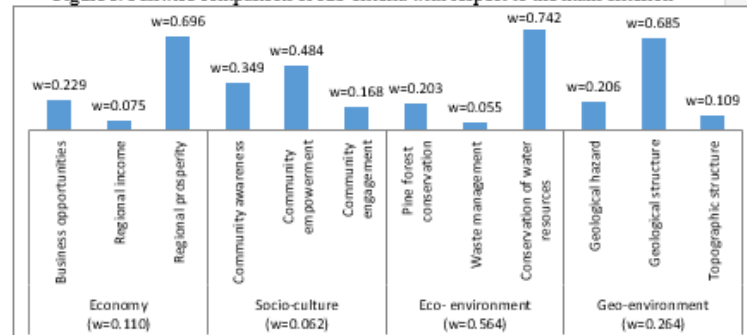
Table 2. Pairwise comparison matrix

Criteria	Economy Aspect	Socio-Culture Aspect	Eco-Environment Aspect	Geo-Environmental Aspect	Priority Vector
Economy Aspect	1	2	7	2	0.110
Socio-Culture Aspect	1/2	1	7	5	0.062
Eco-Environment Aspect	1/7	1/7	1	2	0,564
Geo-Environment Aspect	1/2	1/5	1/2	1	0,264

Source: Expert Choice data processing (2022)

Figure 3 illustrates the prioritisation of the primary criteria in relation to the objectives. It was evident that the Eco-Environment criteria held the highest significance, with a weight of 0.564. Following this, the Geo-Environment criteria held a weight of 0.264, while the economic criteria held a weight of 0.110. Lastly, the socio-culture criteria had the smallest weight of 0.062. This data indicated that when selecting sustainable tourism alternatives in Top Selfi, respondents primarily prioritised the eco-environment aspect. This preference could be attributed to the fact that the management of the Top Selfi tourist attraction is closely associated with the Mount Merbabu National Park Office, which places great emphasis on environmental Conservation. Similar findings were reported by other researchers, such as Gravitiani et al. (2022), who highlighted the significant role of the National Park Authority as a stakeholder in the management of tourist sites in Top Selfie Pinusan.

Figure 3. Pairwise comparison of sub-criteria with respect to the main criterion

Note: w = weight criteria and sub-criteria
Source: Expert Choice data processing (2022)

The process of selecting the most appropriate option for the development of a tourism object involved prioritisation of twelve sub-criteria. In order to accomplish this, four matrices were created for pairwise comparisons based on the opinions of experts, with each matrix focusing on one of the main criteria. The outcomes of these comparisons are summarised in Figure 2. The table clearly indicates that the eco-environment criteria received the highest rating of 0.110, surpassing the other three criteria. This signified that the preservation of the environment held the utmost significance in the selection process. Amongst the sub-criteria, the Conservation of water resources held a considerable weight, with a rating of 0.742, surpassing the other sub-criteria. These findings were consistent with the interviews conducted with the Government of Pogalan Village, which emphasised the importance of water conservation in order to prevent drought during the dry season and flooding during the rainy season. The next priority sub-criteria was regional property, with a weight of 0.696. This was because the development of Top Selfi as a tourist attraction had potential to stimulate the local economy through activities such as photography, souvenir sales as well as food and beverage businesses. Another sub-criteria which held significance was the geological structure, with a weight of 0.685.
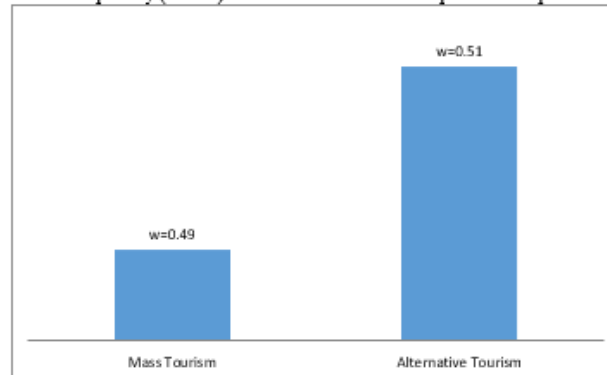
This was due to the location of tourist attractions on the slopes of Mount Merbabu. It was crucial to consider the geological structure in order to fully exploit the tourism potential of these areas.

The primary focus in the development of sustainable tourism should be on the environment. This was supported by Setiawan et al. (2021), which emphasised the importance of integrating environmental conservation and education with tourism to strike a balance between the needs of tourists, ecological considerations and expectations of local communities. Achieving sustainability in the tourism industry requires careful attention to stakeholder collaboration. Gravitiani et al. (2022) highlighted that key stakeholders, such as the Department of Youth, Sports, and Tourism, Mount Merbabu National Park, and the tourism awareness group (pokdarwis) had played crucial roles in promoting sustainable tourism in Top Selfie Kragilan. Village governments were heavily reliant on the decisions and policies of these influential stakeholders. The actions of non-business stakeholders did not directly impact business activities. Local communities and visitors were actively involved in the planning, implementation of programs, and formulation of policies, with key players being the Department of Youth, Sports, and Tourism, Mount Merbabu National Park and Pokdarwis.

In the final phase of AHP analysis, the main objective was to determine the overall priorities for different sustainable tourism developments. This could be achieved by integrating the local priorities of all criteria, sub-criteria and alternatives to ascertain the global weight of each alternative. To establish the local priorities for all criteria matrices, the alternative local priority vectors were multiplied by the local priority vectors of each criterion and subsequently combined. This process of aggregation ultimately produced the final priority vector, which signified the global weight assigned to each alternative. Moreover, local priority normalisation criteria were implemented to ensure consistency and coherence in the final priority vector (Kurbatova & Abu-Qdais, 2020).

Figure 4. Global priority (overall) sustainable tourism development in Top Selfie Pinusan

Source: Expert Choice data processing (2022)

Commented [A9]: Thank you for the comment. We have written the main findings of this study

Figure 4 illustrates the global priorities of sustainable tourism development. It was evident that Alternative tourism emerged as the most favourable choice for sustainable tourism development, with a global weight of 0.510. In comparison, Mass tourism ranked second with a weight of 0.490. This finding aligned with the research conducted by Medeiros et al. (2021), which emphasised the close association between alternative tourism and sustainable tourism. The study highlighted the importance of considering the long-term interests of all stakeholders and quality of phenomena while taking into account the local human community, environment and natural resources. Alternative tourism offers the opportunity to develop small-scale recreational activities in communities or areas, whereby it was feasible to mitigate the negative impacts of tourism (Zagonari, 2019). This approach could contribute to regional development by fostering cross-sectoral networks and relations amongst various stakeholders involved in tourism. Additionally, it provided alternative sources of locally generated income, thereby benefiting the local communities.

In GIS technique, the process of data collection, drawing and satellite imagery played a crucial role in producing sophisticated tourism potential mapping images by prioritising land contours (Hong et al., 2022; Wardana et al., 2023). Additionally, several mathematical models in blending models, such as AHP(Bagheri et al., 2021; Darko et al., 2019) needed to be executed during multi-criteria decision analysis to address various difficulties due to the diversity of opinions from key actors, parameter scores and regional conditions. These four factors were taken into consideration in the development of tourism potential zones in Top Selfie Pinusan by using the AHP method. In-depth interview results also explained that the tourism sector in Top Selfie Pinusan had suffered due to COVID-19 pandemic, lack of infrastructure facilities, unplanned and haphazard growth of tourist spots, information gaps and lack of development planning. These findings were consistent with Acharya et al. (2022) research on the potential of significant geological, geomorphological and ecological impact changes in tourist areas. Efforts can be made to address most of these issues in a more scientific and methodological manner so that physiocultural heterogeneity aligns with ecological diversity and develops new terminology for tourists visiting tourist spots in the state (Sun et al., 2022). This demonstrated how various physical and cultural factors could be incorporated into the tourism potential zoning in Top Selfi and further analysis of each zone for mapping existing tourist spots, potential growth plans for tourist spots through reliable data, modification of existing spots by adding attractions, improving accessibility, focusing on necessary infrastructure development, creating awareness and appropriate tourism management, which could be enhanced through the application of geospatial techniques and mathematical methods.

Commented [A10]: Thank you for your suggestion. We have presented a more in-depth analysis.

CONCLUSION

The research study found that the tourism potential of Top Selfie Pinusan is of great significance due to its unique offering of geo-ecotourism. The region showcases exceptional geographic features, geological heritage, and favourable environmental conditions, making it an appealing destination for tourists.

The research results found that the location and potential of the Top Selfie Pinusan area as a promising tourist destination if seen from the development map. AHP analysis shows that eco-environmental criteria give the highest weight to the water resources conservation sub-criteria. The alternative policies proposed in this research emphasise the promotion of alternative

tourism with the highest weight. This study holds significant implications for local government and tourism businesses, as they are tasked with the responsibility of overcoming the challenge in establishing tourist attractions in Top Selfie Pinusan that are in line with the principles of sustainable tourism in Indonesia. This can be accomplished by providing regulatory support to streamline the development of tourism potential zones, thereby enabling them to deliver economic and community advantages.

> **Commented [A11]:** Thanks for the suggestion. We have added the research objectives and policy implications in the conclusion.

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It is my pleasure to inform you that your paper has been **accepted** by Etikonomi Jurnal Ekonomi. Your article will be published on Vol. 24(1), 2025 edition.

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It is my pleasure to inform you that your paper has been **accepted** by Etikonomi: Jurnal Ekonomi. Your article will be published on Vol. 24(1), 2025 edition.

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	PANGKAT/GOL RUANG	:	Pembina/ IV/a
	JABATAN	:	Wakil Dekan Bidang Akademik dan Penelitian Fakultas Ekonomi dan Bisnis (FEB)
	UNIT KERJA	:	Fakultas Ekonomi dan Bisnis - Universitas Sebelas Maret
4	EVALUASI KINERJA		
	CAPAIAN KINERJA ORGANISASI	:	BAIK
	PREDIKAT KINERJA PEGAWAI	:	BAIK
5	CATATAN/REKOMENDASI		

Surakarta, 03 Januari 2025
7. Pegawai Yang Dinilai

Ika Alicia Sasanti, S.E., M.E.
199611092024062001

Surakarta, 02 Januari 2025
6. Pejabat Penilai Kinerja

Muhammad Yusuf Indra Purnama, S.E., M.Rech.,Ph.D
1982110320130201

SASARAN KINERJA PEGAWAI
JABATAN PELAKSANA
PENDEKATAN HASIL KERJA KUANTITATIF

UNIVERSITAS SEBELAS MARET

PERIODE PENILAIAN :
02 Januari 2024 s.d 31 Desember 2024

PEGAWAI YANG DINILAI		PEJABAT PENILAI KINERJA	
NAMA	Ika Alicia Sasanti, S.E., M.E.	NAMA	Muhammad Yusuf Indra Purnama, S.E., M.Rech.,Ph.D
NIP	199611092024062001	NIP	198211032013020 1
PANGKAT/GOL RUANG	Penata Muda Tingkat I/ III/b	PANGKAT/GOL RUANG	Penata Muda Tingkat I/ III/b
JABATAN	Tenaga Pengajar	JABATAN	Ketua Program Studi S1 Ekonomi Pembangunan
INSTANSI	S-1 Ekonomi Pembangunan - Universitas Sebelas Maret	INSTANSI	S-1 Ekonomi Pembangunan - Universitas Sebelas Maret

NO	RENCANA KERJA ATASAN LANGSUNG	RENCANA KINERJA	ASPEK	INDIKATOR KINERJA INDIVIDU	TARGET
(1)	(2)	(3)	(4)	(5)	(6)
A. KINERJA UTAMA					
1	Terlaksananya Dharma Pendidikan	Terlaksananya Perkuliahan	Kuantitas	Jumlah SKS	15 sks
			Kualitas	Prosentase Kehadiran (>95%)	100 %
			Waktu	Ketepatan waktu pembelajaran	12 Bulan
		Terlaksananya Pelatihan Diklat Prajabatan CPNS	Kuantitas	Jumlah Kegiatan	1 Kegiatan
			Kualitas	Prosentase Kelulusan	100 %
			Waktu	Ketepatan waktu kelulusan	6 Bulan

PERILAKU KERJA

1. Berorientasi pelayanan

- Memahami dan memenuhi kebutuhan masyarakat
- Ramah, cekatan, solutif, dan dapat diandalkan
- Melakukan perbaikan tiada henti

Ekspektasi Pimpinan:
- Belajar dari kesalahan untuk perbaikan kinerja selanjutnya

2. Akuntabel

- Melaksanakan tugas dengan jujur, bertanggungjawab, cermat, disiplin dan berintegritas tinggi
- Menggunakan kekayaan dan barang milik negara secara bertanggungjawab, efektif, dan efisien
- Tidak menyalahgunakan kewenangan jabatan

Ekspektasi Pimpinan:
- Menyajikan data/dokumen yang valid dan dapat dipertanggungjawabkan

3. Kompeten

- Meningkatkan kompetensi diri untuk menjawab tantangan yang selalu berubah
- Membantu orang lain belajar
- Melaksanakan tugas dengan kualitas terbaik

Ekspektasi Pimpinan:
- Aktif mengikuti kegiatan pengembangan kompetensi

4. Harmonis

- Menghargai setiap orang apapun latar belakangnya
- Suka menolong orang lain
- Membangun lingkungan kerja yang kondusif

Ekspektasi Pimpinan:
- Membangun komunikasi yang lebih terbuka dan menjaga hubungan baik dengan stakeholder

5. Loyal

- Memegang teguh ideologi Pancasila, Undang-Undang Dasar Negara Republik Indonesia Tahun 1945, setia kepada Negara Kesatuan Republik Indonesia serta pemerintahan yang sah
- Menjaga nama baik sesama ASN, Pimpinan, Instansi, dan Negara
- Menjaga rahasia jabatan dan negara

Ekspektasi Pimpinan:
- Tidak menyalahgunakan jabatan dan wewenang

6. Adaptif

- Cepat menyesuaikan diri menghadapi perubahan
- Terus berinovasi dan mengembangkan kreativitas
- Bertindak proaktif

Ekspektasi Pimpinan:
- Mudah beradaptasi dengan perubahan

7. Kolaboratif

- Memberi kesempatan kepada berbagai pihak untuk berkontribusi
- Terbuka dalam bekerja sama untuk menghasilkan nilai tambah
- Menggerakkan pemanfaatan berbagai sumberdaya untuk tujuan bersama

Ekspektasi Pimpinan:
- Aktif berpartisipasi dan berkontribusi sesuai keahliannya

Pegawai Yang Dinilai
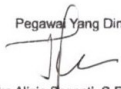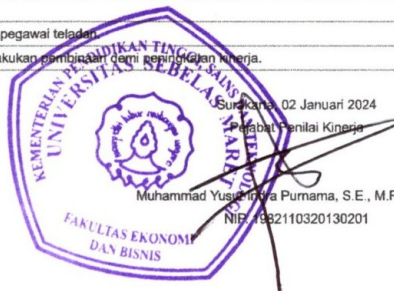

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Surakarta, 02 Januari 2024
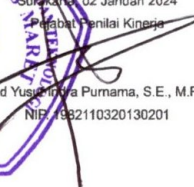Pejabat Penilai Kinerja

Muhammad Yusuf Indra Purnama, S.E., M.Rech.,Ph.D
NIP. 198211032013020 1

UNIVERSITAS SEBELAS MARET

PERIODE PENILAIAN :
02 Januari 2024 s.d 31 Desember 2024

DUKUNGAN SUMBER DAYA

1	Dukungan sarana prasarana untuk tercapainya target kinerja
2	Dukungan komitmen pimpinan untuk tercapainya target kinerja

SKEMA PERTANGGUNGJAWABAN

1	Progres dan evaluasi pengembangan pegawai dilaporkan secara berkala.

KONSEKUENSI

1	Apabila memenuhi ekspektasi Pimpinan direkomendasikan sebagai role model / pegawai teladan
2	Apabila tidak memenuhi ekspektasi Pimpinan maka direkomendasikan untuk dilakukan pembinaan demi peningkatan kinerja.

Pegawai Yang Dinilai

Ika Alicia Sasanti, S.E., M.E.
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Surakarta, 02 Januari 2024
Pejabat Penilai Kinerja

Muhammad Yusuf Indra Purnama, S.E., M.Rech.,Ph.D
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EVALUASI KINERJA PEGAWAI
JABATAN PELAKSANA
PENDEKATAN HASIL KERJA KUANTITATIF
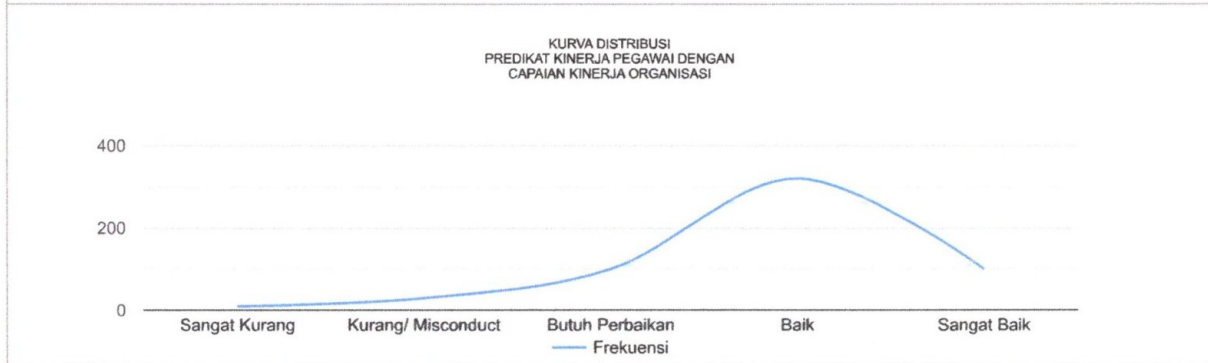
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UNIVERSITAS SEBELAS MARET

PERIODE PENILAIAN :

02 Januari 2024 s.d 31 Desember 2024

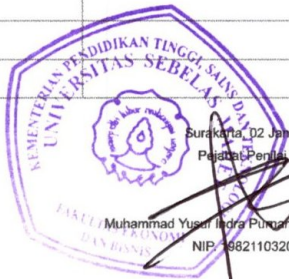| PEGAWAI YANG DINILAI		PEJABAT PENILAI KINERJA	
NAMA	Ika Alicia Sasanti, S.E., M.E.	**NAMA**	Muhammad Yusuf Indra Purnama, S.E., M.Rech.,Ph.D
NIP	199611092024062001	**NIP**	1982110320130201
PANGKAT/GOL RUANG	Penata Muda Tingkat I/III/b	**PANGKAT/GOL RUANG**	Penata Muda Tingkat I/III/b
JABATAN	Tenaga Pengajar	**JABATAN**	Ketua Program Studi S1 Ekonomi Pembangunan
INSTANSI	S-1 Ekonomi Pembangunan - Universitas Sebelas Maret	**INSTANSI**	S-1 Ekonomi Pembangunan - Universitas Sebelas Maret

CAPAIAN KINERJA ORGANISASI*

BAIK

POLA DISTRIBUSI:

KURVA DISTRIBUSI
PREDIKAT KINERJA PEGAWAI DENGAN
CAPAIAN KINERJA ORGANISASI

	HASIL KERJA						
NO	RENCANA HASIL KERJA PIMPINAN YANG DIINTERVENSI	RENCANA HASIL KERJA	ASPEK	INDIKATOR KINERJA INDIVIDU	TARGET	REALISASI BERDASARKAN BUKTI DUKUNG	UMPAN BALIK BERKELANJUTAN BERDASARKAN BUKTI DUKUNG
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. KINERJA UTAMA							
1	Terlaksananya Dharma Pendidikan	Terlaksananya Perkuliahan	Kuantitas	Jumlah SKS	15 sks	15 sks	Hasil kerja sesuai jumlah target SKS yang ditetapkan. Tingkatkan!
			Kualitas	Prosentase Kehadiran (>95%)	100 %	100 %	Hasil kerja sudah sesuai yang diharapkan. Tingkatkan!
			Waktu	Ketepatan waktu pembelajaran	12 Bulan	12 Bulan	Penyelesaian kerja sesuai waktu yang ditetapkan, sesuai ekspektasi. Tingkatkan!
2	Terlaksananya Dharma Pendidikan	Terlaksananya Pelatihan Diklat Prajabatan CPNS	Kuantitas	Jumlah Kegiatan	1 Kegiatan	1 Kegiatan	
			Kualitas	Prosentase Kelulusan	100 %	100 %	
			Waktu	Ketepatan waktu kelulusan	6 Bulan	6 Bulan	

RATING HASIL KERJA*

SESUAI EKSPEKTASI

PERILAKU KERJA		UMPAN BALIK BERKELANJUTAN BERDASARKAN BUKTI DUKUNG
1. Berorientasi pelayanan		
• Memahami dan memenuhi kebutuhan masyarakat • Ramah, cekatan, solutif, dan dapat diandalkan • Melakukan perbaikan tiada henti	Ekspektasi Khusus Pimpinan: • Belajar dari kesalahan untuk perbaikan kinerja selanjutnya	• Selalu berusaha meningkatkan kinerjanya berdasarkan potensi pengembangan
2. Akuntabel		
• Melaksanakan tugas dengan jujur, bertanggungjawab, cermat, disiplin dan berintegritas tinggi • Menggunakan kekayaan dan barang milik negara secara bertanggungjawab, efektif, dan efisien • Tidak menyalahgunakan kewenangan jabatan	Ekspektasi Khusus Pimpinan: • Menyajikan data/dokumen yang valid dan dapat dipertanggungjawabkan	• Selalu menyajikan data/dokumen dan dapat dipertanggungjawabkan
3. Kompeten		
• Meningkatkan kompetensi diri untuk menjawab tantangan yang selalu berubah • Membantu orang lain belajar • Melaksanakan tugas dengan kualitas terbaik	Ekspektasi Khusus Pimpinan: • Aktif mengikuti kegiatan pengembangan kompetensi	• Berupaya menyelesaikan tugas dengan optimal dan secara aktif mengikuti kegiatan pengembangan kompetensi
4. Harmonis		
• Menghargai setiap orang apapun latar belakangnya • Suka menolong orang lain • Membangun lingkungan kerja yang kondusif	Ekspektasi Khusus Pimpinan: • Membangun komunikasi yang lebih terbuka dan menjaga hubungan baik dengan stakeholder	• Secara aktif membangun komunikasi dengan stake holder
5. Loyal		
• Memegang teguh ideologi Pancasila, Undang-Undang Dasar Negara Republik Indonesia Tahun 1945, setia kepada Negara Kesatuan Republik Indonesia serta pemerintahan yang sah • Menjaga nama baik sesama ASN, Pimpinan, Instansi, dan Negara • Menjaga rahasia jabatan dan negara	Ekspektasi Khusus Pimpinan: • Tidak menyalahgunakan jabatan dan wewenang	• Selalu memegang teguh sumpah jabatan
6. Adaptif		
• Cepat menyesuaikan diri menghadapi perubahan • Terus berinovasi dan mengembangkan kreativitas • Bertindak proaktif	Ekspektasi Khusus Pimpinan: • Mudah beradaptasi dengan perubahan	• Segera menyesuaikan dengan perubahan yang berkaitan dengan tugasnya
7. Kolaboratif		
• Memberi kesempatan kepada berbagai pihak untuk berkontribusi • Terbuka dalam bekerja sama untuk menghasilkan nilai tambah • Menggerakkan pemanfaatan berbagai sumberdaya untuk tujuan bersama	Ekspektasi Khusus Pimpinan: • Aktif berpartisipasi dan berkontribusi sesuai keahliannya	• Memberikan kontribusi secara aktif untuk kinerja unit kerja sesuai dengan keahliannya

RATING PERILAKU KERJA*
DI ATAS EKSPEKTASI

PREDIKAT KINERJA PEGAWAI*
BAIK

Pegawai Yang Dinilai

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NIP. 199611092024062001

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Pejabat Penilai Kinerja

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