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Sustainable Development Concept of Heritage *Kampung* Tourism Using Novel Prioritization Approach

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Abstract: Rapid urban development in Southeast Asia is often the main cause of urban *kampung* formation, a cluster of sporadic and informal settlements. *Kampungs* possess the capacity to serve to build the local economy and provide culture conservation through heritage tourism. To promote sustainable development in heritage *kampung* tourism, it is imperative to propose directives that optimize its heritage qualities without compromising both the economic and environmental aspects of sustainability. This study aims to develop a comprehensive sustainable development framework on a local scale by implementing a novel prioritization approach. Descriptive statistical analysis, Analytical Hierarchy Process (AHP), and Fuzzy AHP (FAHP) provide the researchers with a holistic understanding regarding heritage tourism sustainability by considering various stakeholders' perspectives. Novel prioritization is presented using radar diagrams to understand how each variable, representing environmental, social, and economic criteria, has perceived importance according to experts and tourists. The analysis highlights the *kampung* Kayutangan's sustainability while acknowledging variations in element importance, necessitating the alignment of development directives.

Keywords: heritage tourism; sustainable development; *kampung* management; novel prioritization

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1. Introduction

The global trend toward population increase being highly concentrated in urban areas continues with the projection to be going as far up to 65–70% of global population by 2050 [1]. In Indonesia alone, the urban population percentage is expected to rise up to 68% by 2025 [2]. This poses a problem for the cities' inadequate infrastructure that is already struggling to handle the influx of population growth [3], leading to various environmental, societal, and economic consequences. This massive influx of population is often the main cause of urban *kampung* formation, a cluster of informal settlement created as a response toward people's need for affordable housing, making them commonplace within big cities [2,4–6]. They often comprise low-income, low-quality settlements with inadequate infrastructure and public services, which sprout sporadically and are often at odds with business districts, even often considered as a slum-like habitat [2,7–9]. In recent years, there has been a change in trends where *kampungs* are increasingly becoming the focus of development programs, occurring across various scales and receiving funding from multiple levels of government [10]. There are a multitude of ways one could enact improvement in *kampungs*, especially regarding its environmental and economic aspects, among which tourism is one. The creation of tourist *kampungs*, especially in the case of heritage *kampungs*, serves to build the local economy and conserve the local culture and environment [11–13].

The very core principle of planning sustainable cities, or any settlements in general, essentially always boils down to managing the balanced development of three pillars: environmental, economic, and social aspects [14,15], as any and all elements related to

sustainable planning or practices would inevitably link back to all three, which are all interconnected in some way or another [14]. This strong connection between social, environmental, and economic aspects of sustainability is because they are intrinsically linked with one another. Balancing the aspects of these pillars is key to achieve optimal sustainable development. The development of various frameworks, tools, and assessment systems is well underway to integrate the application of sustainable principles into urban planning and architectures [16].

Sustainable *kampung* development itself refers to a balance between economic stability, environmental protection, as well as social security and attachment within a community. Meanwhile, heritage tourism involves exploring and uncovering the history and distinctive identity of a location, with individuals taking on the responsibility of preserving and restoring its historic or cultural structures, which are considered essential components of tourism assets [17,18]. The heritage tourism approach in managing *kampungs* is a practice prevalent not only in Indonesia, but also in the neighboring country of Malaysia, such as *kampung* Baru in Kuala Lumpur; Intramuros in Manila, Philippines; and Chinatown in Singapore [19]. Other heritage building conservation efforts regarding *kampungs* in Malaysia can be seen in *kampung* Kuala Dal, Kuala Kangsar [18]. Cultural heritage tourism is deemed a crucial driver of growth in Malaysia, portrays a significant role to economic planning and development in Singapore, as well as being pivotal in poverty reduction strategies in Philippines. The application of heritage *kampung* tourism in Indonesia is quite limited for Indonesian *kampung* and is mostly revitalized through modernization, therefore eradicating the historical aspect that heritage *kampung* needs.

Therefore, in accordance with the various concepts mentioned above, it is important to develop a comprehensive framework that intersects the concept of sustainable *kampung* development and heritage tourism to optimize tourism potential on a local scale. It needs to be mentioned that although the sustainable development framework is readily available on a macro scale, it has not been implemented in smaller, more local, and limited segmentation such as heritage tourism *kampung*. The result of this study is expected to contribute toward creating a sustainable development framework for the micro-level community, which in turn will improve community wellbeing via social, environmental, and economic aspects for the foreseeable future.

2. Sustainable Urban *Kampung* Heritage Tourism

2.1. Literature Review

Sustainable development is an ideal pathway as it aims to balance economic progress and environment protection while being mindful of social interests [20]. It is commonly acknowledged that sustainability is built upon three pillars: social, economic, and environmental aspects [21–24]. In spite of perpetual changes in the sustainable development concept, its core principles and goals have fostered more awareness and adaptation behaviors across various human activities [25].

The quality of the environment should not be compromised to satisfy human needs, and certain protections need to be put in place in order to ensure its sustainability for future generations [26,27]. The constant increase in pollution and resource plundering has rendered an alarming need for environmentally sustainable practices, especially in the past decades [16,27]. Key principles to social sustainability include equity, inclusion, social mix, engagement, and democracy [28]. Living elements such as safety, comfort, strong sense of place, green spaces, infrastructure, and easy access to urban services, increase real estate satisfaction [28,29], therefore increasing the overall quality of life that supports healthy social interaction.

An overt focus on economic aspects would endanger the environmental and social elements of sustainability, such as overdrawing resources or prioritizing the economy over the human element [30–32]. Robust economic activities in urban settings tend to generate excess waste and pollutants, while the high concentration of the populace brings about social problems, stretching the capacity and resources to dangerous levels [33].

Urban *kampungs* tend to happen as either existing *kampungs* being absorbed into an urban setting or informal settlements that grew into urban *kampungs* overtime. Despite being an integral part of Indonesian cities, oftentimes the *kampung* is seen in a negative light or as simply traditional [34,35]. While it is not always the case, this is due to a lot of them beginning as informal settlements or even slums, and they are infamous for their lack of adequate infrastructure to accommodate their crowded inhabitants.

Among the most successfully implemented government program in Indonesia is the *Kampung* Improvement Program (KIP), which had been implemented ever since 1968 in Surabaya and 1978 in Semarang [36,37]. Especially in Surabaya, the KIP promotes inclusivity as well as provides a cost-effective, innovative, and sustainable method of transforming a high-density *kampung* into a green and clean neighborhood [38,39]. Aside from government-created programs, the private sector in Indonesia has also had a role in creating projects to improve slum areas through their CSR programs [40]. Other means of *kampung* development include efforts by the Indonesian government to promote collaboration between professional organizations (e.g., professional architect organization), governments, and communities through *kampung Tematik* (thematic *kampung*) programs [41]. *Kampung* tourism development, be it rural or urban, turned out to be one of the favored ways to mitigate *kampung* issues [42]. It is important to note that improvement programs in Indonesian *kampungs* tend to focus on one pillar of sustainability utmost, mainly the social aspect.

Tourism has been utilized as a development tool largely due to its multiplier effects to the surrounding environment, namely, job creation, tax generation, and as a stimulus for entrepreneurial activities [43]. Notable and marketable cultural heritage poses a competitive advantage in the tourism marketplace for it appeals to larger segments of the traveling public, especially in the context of historic cities [44]. Recent trends in urban heritage tourism have seen the increase in government participation, due to the shift in economic restructuring from traditional manufacture towards a service-based economy [45]. Cultural heritage tourism pertains to a form of tourism associated with the cultural facets of a given locality, encompassing lifestyle, historical narratives, artistic expressions, architectural marvels, religious practices, and other defining elements of life within the area.

Sustainability within the *kampung* tourism setting should be multi-purpose, promoting the *kampung*'s potential and aiming to support the local culture and individualities of the hosting community, as well as its landscape and habitat [42]. In the proposed setting, CBT (community-based tourism) is enacted to make *kampung* tourism possible as the *kampung* itself will be the site of tourism. Community participation is crucial to keep the tourist *kampung* going, as well as for maintaining upkeep. Allowing tourists to visit these communities brings benefit to both the community and tourists alike, generating benefits for the locals while allowing tourists to visit and learn about the community hosts, their cultures, and local environment [46]. This goes hand in hand with sustainable livelihood approaches that embrace community participation and are rooted in equitable, empowering ideologies [46].

Urban heritage management, defined as the study intersection between urban heritage conservation and urban facility management, plays a pivotal role in the context of heritage tourism [47]. Mismanaging urban heritage may affect the perceived value of heritage, for it was once perceived as a barrier to local development in contrast to being seen as a catalyst for urban culture and tourism development [48–50]. Mismanagement in urban heritage asset, mainly due to uncontrolled urban development and the domination of modern suburban development, had been occurring in the traditional *kampung* [51,52].

Previous research by Lucchi et al. [53] about sustainable heritage in the urban context was focused on the Urban Green Rating System (UGRS). It is a framework used to evaluate and assess the environmental sustainability and green features of urban developments, such as buildings, neighborhoods, or entire cities. It aims to encourage the adoption of sustainable practices and technologies in urban areas, promoting resource efficiency, environmental conservation, and human well-being. The results indicated that the system is proven counterproductive for heritage sites, distracting the decision-maker due to aspects

irrelevant to heritage conservation [53]. Another research in Cuenca City, Equador, utilized the Historical Urban Landscape (HUL) approach that assumes heritage to be a resource [54]. This research discusses inclusivity, social cohesion, segregation and inequality, economic social improvement, as well as urban regeneration. HUL implementation allowed the identification of a strategic framework that incorporates various stakeholders' points of view. This concept reveals previously ignored values and attributes in heritage management system in a city context.

2.2. Kampung Kayutangan Profile as Heritage Tourism Site

Malang city is brimming with heritage potential that could be developed into historical tourist destinations, for the city landscape itself is rich with the remnants of Dutch colonial times along with many other instances of heritage and culture built upon its soil [55–57]. Kayutangan, one of the longstanding and historic downtown *kampungs* in Malang city, has been recognized as a heritage *kampung*. It was formally inaugurated as a tourist destination in 2018 by the Malang city government. Its prevalence as a heritage *kampung* stems from the significant number of colonial-era buildings that remain preserved, serving as residences for local residents, while many others have been demolished and replaced with newer structures [58]. The *kampung* Kayutangan provides educational tourism focused on heritage through showcasing the existing colonial architecture, as well as antiques and artifacts, including electronics, old bicycles, cooking tools, and other household antiques [59].

Many forms of cultural heritage have also been formed through the history of the city development itself, in effect making several sites into areas with cultural heritage values, all the way back to the era of Kanjuruhan kingdom to the Dutch occupation [60]. This include *kampungs*, such as the case with *pecinan* (Chinatown) existence that is inseparable from the people of Chinese descent who live there, muslim *kampungs* such as Kauman in several parts of Indonesia, various remnants of Dutch colonial architectures such as Idjen Boulevard, and the heritage *kampung* Kayutangan in Malang city [55,61,62]. Heritage *kampungs* then can be developed into a heritage tourism destination within the *kampung* scale, effectively preserving the site for both future generations and tourists to enjoy, increasing social activities, and bringing economic advantage toward the *kampung* inhabitants. The distinctive historical characteristics exhibited by these locations may be regarded as sufficiently novel to warrant their development as tourist attractions. The locations of tourist attractions sites can be observed in Figure 1.

The *kampung* Kayutangan's profile as a heritage tourism site was analyzed based on the sustainability pillars: environment (both built and natural), economic, and social factors. Attraction sites and their management are treated as variables, initially classified as factors before being grouped under a sustainability pillar based on their attributes. The variables for these factors were obtained through a literature review, observations, as well as official government catalogues and records.

First, regarding the environmental aspect, the main built attractions are vintage houses with enormous historical value. Some of the vintage buildings were built in the *Jengki*/Yankee style, making them uniquely different from contemporary buildings in the *kampung*. Others were built in the Indies Empire style that referenced the Gothic style. Main characteristics of the Indies Empire style are its spaciousness to allow cross ventilation into the interior, symmetrical layout, and composition, with a gallery that connects the main building to a service building [63–65]. The buildings' authenticity in the heritage *kampung* Kayutangan was retained [66] even though they underwent adaptive reuse for tourism purposes, mostly for antique exhibits [67] and old-school cafes. Some buildings have lost their optimum function due to natural causes [68]. Heritage building maintenance in Kayutangan was a combined effort by the building owner, tourism-awareness groups, and the city government [69–71].

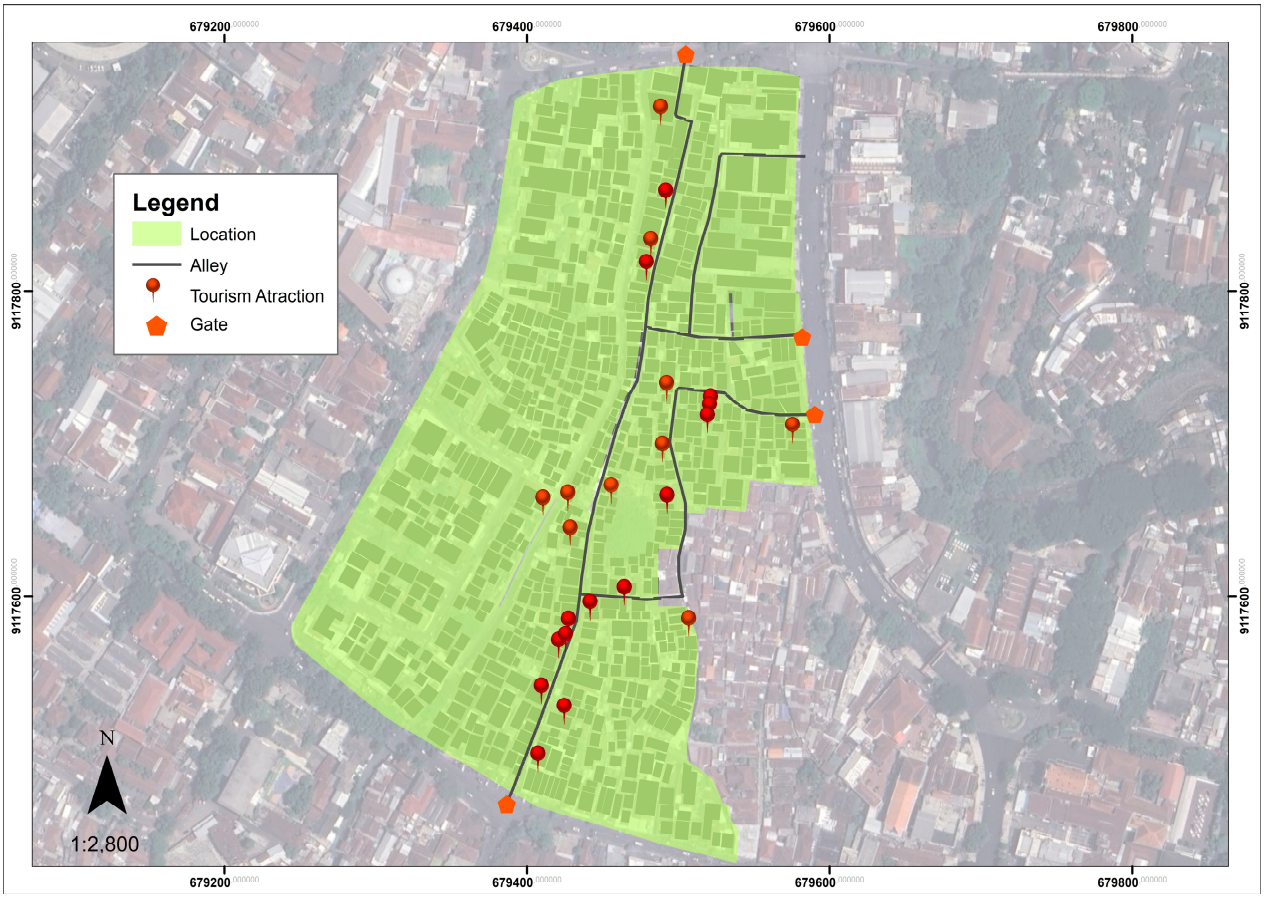

Figure 1. Research location map. Source: observation and GIS analysis.

Aside from vintage buildings, other non-building attractions are the sacred tomb (*Makam Mbah Honggo*) [72], the sewer system [72], and the vintage stairs structure (*tangga seribu*, lit. a thousand stairs) [72]. Open spaces on the heritage site are decorated with ornaments that emphasize the vintage nuance, such as mural paintings, antique streetlights starting from the *kampung*'s portal all the way through the boulevard, and andesite tile pavements as the representation of the traditional roadway [73,74]. Locals have also employed green wall structures to increase green areas in the heritage *kampung* Kayutangan [75].

Second, from a social standpoint, the factors are limited to activities and partnership, mainly for marketing and management purposes. Sustainable heritage tourism mainly relies on community involvement, especially local community and organizations. Marketing activities are pivotal in the success and sustainability of heritage tourism. Such activities are mainly conducted by the awareness tourism group (*Kelompok Sadar Wisata*, henceforth shall be addressed as *Pokdarwis*) [76,77], the local women association [78], and local youth groups [78,79], in the form of public events [80] and art showcases [81].

Aside from activities, partnerships are fundamental in managing heritage-based tourism where collaboration among various stakeholders is essential for sustainable development. The important stakeholders in sustainable heritage tourism management are the government [82,83], non-government organizations [83], universities [84], as well as the local community's engagement especially for decision-making [83] and hospitality [85].

Last, income is required to ensure the continuation of the heritage *kampung*. Tourism sites often require both farebox and non-farebox revenue to diversify their income streams, enhance financial sustainability, and support ongoing development and maintenance. The existing sources of non-farebox revenue in Kayutangan heritage tourism site consist of antiquities [67], traditional markets [86], cafes and traditional drinks' vendors [63], roadside stalls [87], as well as selfie spots [88]. Farebox revenue includes ticketing [89],

art performance [90], tourism package [91], tourism guidance services [92], as well as sponsorship [93]. Variables of this research are shown in Table 1.

Table 1. Sustainable heritage *kampung* tourism factors and variables.

Aspects	Factors	Variables	Code
Environmental	Built attractions	Building uniqueness	BU
		Permanent antiquities' exhibits	AE
		Building authenticity	BA
		Building performance	PER
		Building maintenance	MAIN
		Sacred tomb (*Makam Mbah Honggo)*	MMH
		Vintage sewer system	SS
	Non-building attractions	Vintage stairs' structure *(Tangga Seribu)*	TS
		Street furniture, signs, and decorations	SFD
		Green area	GA
Social	Activities	*Pokdarwis*	PO
		Art showcase	AS
		Public events	EVE
		Local women associations	WO
		Local youth groups	YO
		Community involvement in decision-making	DM
		Community hospitality	HP
	Partnership	Non-government organization involvement	NGO
		Government involvement	GOV
		University involvement	UNI
Economic		Antiquities	AN
		Traditional market	TM
	Non-farebox revenue	Cafe and traditional drinks vendor	CTV
		Roadside stalls	RS
		Selfie spots	SLF
		Ticketing	TIK
		Art performance	AP
	Farebox revenue	Tourism package	TP
		Tourism guidance services	GI
		Sponsorship	SP

3. Methods

This research aims to develop sustainable development directives that promote sustainability in heritage *kampung* tourism. This research utilizes a mixed method/both quantitative and qualitative approaches, which can be seen in Figure 2. The mixed method approach provides the researchers holistic understanding regarding heritage tourism sustainability by considering various stakeholders' perspectives, namely tourists and experts [94]. The required data are collected using two types of instruments: Likert-scale questionnaire and pairwise comparison survey. Both the Likert-scale questionnaire and pairwise comparison survey are composed of three sections: environmental, social, and economic aspects as described in Table 1. Those variables are obtained through a literature review on sustainability, heritage tourism, and existing conditions in Kayutangan heritage *kampung*.

3.1. Data Distribution Analysis

Data distribution analysis is a quantitative analysis to comprehend the opinions of heritage tourists regarding factor importance in Kayutangan heritage *kampung*, especially regarding the importance of each variable on the decided criteria. The Likert-scale questionnaire is used extensively to measure attitudes and opinions in tourism research [95,96]. In this case, the Likert scale consists of five points, namely, 5 = "Very Important" (VI), 4 = "Important" (I), 3 = "Neutral" (N), 2 = "Not Important" (NI), and 1 = "Not Important at All" (NIA). The population of the survey is identified through the visitors' log, from which the number of annual tourists in Kayutangan heritage *kampung* is identified. Afterward, simple random sampling with a 5% error rate is applied to calculate the number of necessary participants, which is 86 participants. The survey occurred in December 2022. To ensure the validity and reliability of the questionnaire, 30 pilot questionnaires were first administered and the results should fulfill the following requirements:

- The questionnaires are considered valid if each variable obtains Rxy > 0.212 (from R table with an error rate 0.05). The factors that were unable to fulfill this requirement were deleted from the questionnaires.
- The questionnaires are considered reliable if the questionnaire has a Cronbach's Alpha > 0.75.

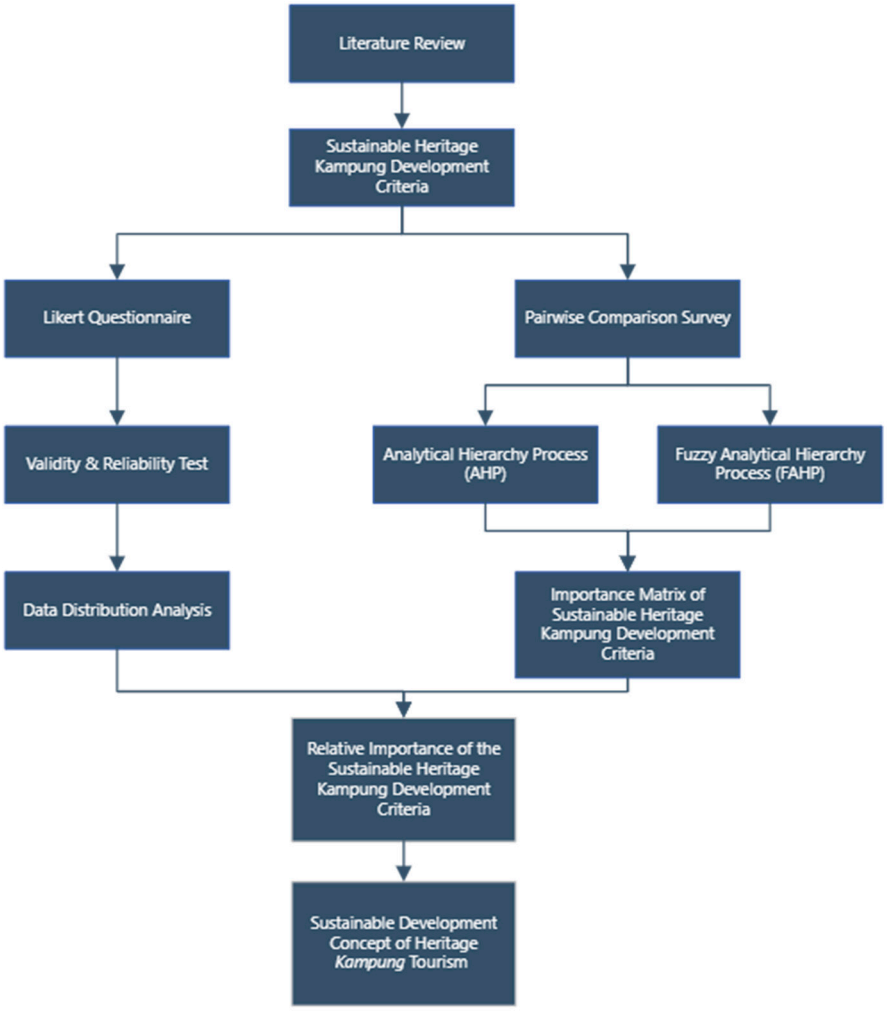

Figure 2. Research flowchart. Source: analysis.

After the validity and reliability tests, the data are subjected to descriptive statistical analysis. This includes measures such as mean, median, mode, and standard deviation. The resulting charts will provide researchers the tourists' opinions regarding the heritage *kampung* sustainability through both central tendency and dispersion analysis.

3.2. Analytical Hierarchy Process (AHP) and Fuzzy AHP (FAHP)

Analytical Hierarchy Process (AHP) is a multi-criteria decision-making (MCDM) analysis normally used to systematically evaluate, prioritize, and analyze complex criteria such as sustainable development in heritage *kampung* tourism. After identifying key criteria, the hierarchical structure is established to ensure every aspect of sustainability is captured. AHP proposes a pairwise comparison matrix ($n \times n$) between every criterion where n represents the amount of criterion. Pairwise comparison shall be conducted by experts/key persons by systematically comparing each criterion against every other criterion in terms of their importance. The importance is expressed in scales of relative importance as observed in Table 2. Therefore, the data are read as a matrix and normalized. The matrix normalization establishes value alignments of the variables.

Table 2. Scales of relative importance interpretation.

Scales of Relative Importance	Interpretation
1	Item i is equally important to item j
3	Item i is slightly more important than item j
5	Item i is more important than item j
7	Item i is much more important than item j
9	Item i is substantially more important than item j
2, 4, 6, 8	Intermediate scales

Human nature and the usage of perception are normally distorted by inconsistencies because humans are more likely to be cardinally inconsistent than cardinally consistent [97]. Therefore, AHP is equipped with a mechanism to decide whether the experts' judgement and perception are consistent or not. This concept is described as the consistency index (CI) and represented in Formula (1) [98,99].

$$CI = \frac{t - n}{n - 1} \quad (1)$$

In Formula (1), t is the most considerable normalization value of an ordered matrix n and n is the order matrix. The matrix is considered consistent if the value of the CI is zero (0). The inconsistency has limits set by using a consistency ratio (CR) and is represented in Formula (2).

$$CR = \frac{CI}{IR} \quad (2)$$

The CR is a comparison between the CI and random index (RI) values. The metric value for RI can be observed in Table 3, which can be concluded that the RI value for a 9×9 matrix is 1.45. The CR limit is capped at 0.1 ($CR \leq 0.1$). If inconsistencies found in the decision-making are still acceptable, then the analysis can be continued. Alternatively, if the analysis is not suitable, then iteration and reprocessing are needed. The principal eigenvector, known to be unique to within a positive multiplicative constant (thus defining a ratio scale) and made unique through normalization, is the only plausible candidate for representing priorities derived from a positive reciprocal near a consistent pairwise comparison matrix.

Table 3. Metric measure for random index [97].

N	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.98	1.12	1.24	1.32	1.41	1.45	1.49

The inconsistency rate tends to be higher when the research requires more than three criteria [100]. By integrating fuzzy logic into the AHP framework, FAHP provides a more flexible and robust approach to decision-making, especially in situations where decision-makers' preferences are uncertain or vague. Enhanced AHP analysis using FAHP helps reduce the inconsistency rate down to 0.1, therefore allowing researchers to capture and model the inherent uncertainties and subjectivities in decision-making processes, leading to more reliable and informed decisions. The FAHP method is chosen because it can decide the weight of each criterion easier and propose a single solution in the comparison matrix. The weight calculation process occurs in accordance with CR values using the Buckley FAHP method. The FAHP process includes two important steps, which are converting the relations between criteria into Triangular Fuzzy Numbers (TFNs) and calculating the degree of probability. The weight (*Wi*) can be calculated using the geometric average in positive reciprocal matrices $\bar{A}$ [101], producing feedback matrix A = [aij]. The fuzzy scale in pairwise comparison is provided in Table 4.

Table 4. Fuzzy scale in pairwise comparison.

Verbal Judgments of Preferences between Criterion *i* and Criterion *j*	Triangular Fuzzy Numbers	Reciprocals
Equally important	$\tilde{1}$ =(1, 1, 1)	$\tilde{1}^{-1}$ = (1, 1, 1)
Judgment values between equal and moderate	$\tilde{2}$ =(1, 2, 3)	$\tilde{2}^{-1}$ = (1/3, 1/2,1)
Moderately more important	$\tilde{3}$ =(2, 3. 4)	$\tilde{3}^{-1}$ = (1/4, 1/3, 1/2)
Judgment values between moderate and strong	$\tilde{4}$ =(3. 4. 5)	$\tilde{4}^{-1}$ = (1/5, 1/4, 1/3)
Strongly more important	$\tilde{5}$ =(4. 5, 6)	5^{-1} = (1/6, 1/5, 1/4)
Judgment values between strong and very strong	$\tilde{6}$ =(5, 6, 7)	$\tilde{6}^{-1}$ = (1/7, 1/6, 1/5)
Very strongly more important	$\tilde{7}$ =(6, 7, 8)	$\tilde{7}^{-1}$ = (1/6, 1/7, 1/8)
Judgment values between very strong and extreme	$\tilde{8}$ =(7, 8, 9)	$\tilde{8}^{-1}$ = (1/9, 1/8, 1/7)
Extremely more important	$\tilde{9}$ =(8, 9, 9)	$\tilde{9}^{-1}$ = (1/9, 1/9, 1/8)
If factor *i* has one of the above numbers assigned to it when compared to factor *j*, then *j* has the reciprocal value when compared with *i*		Reciprocals of above $\tilde{M_1}^{-1} = (1/u_1, 1/m_1, 1/l_1)$

AHP and FAHP require purposive sampling to represent the stakeholder involved in the development of the heritage *kampung* Kayutangan. Three (3) experts in heritage tourism and *kampung* management were chosen as the respondents for the pairwise comparison survey. The experts were required to have the necessary expertise and experience (of minimum 10 years) regarding the management and development of the heritage *kampung* Kayutangan. The first expert was a scholar in heritage conservation, the second was the leader of *Pokdarwis* in the heritage *kampung* Kayutangan, and the third expert was a supervisor in the Department of Culture and Tourism of Malang city.

4. Results

The results of this research are presented in three sections in accordance with the three pillars of sustainability: environmental, social, and economic. Each factor was analyzed using data distribution analysis, AHP, and Buckley FAHP, resulting in a novel prioritization technique in the sustainable development of heritage *kampung* tourism. The novel priorities of each factor are presented using a radar chart at the end of analysis section to provide a holistic understanding regarding sustainable development in heritage *kampung* tourism in Kayutangan. Furthermore, the sustainable development directives in the heritage *kampung* Kayutangan are established in the discussion section.

4.1. Environmental Assessment

4.1.1. Built Attractions

All variables in the Likert-scale questionnaires obtained a minimum score of 3 and maximum score of 5. The variable with the highest mean score is building authenticity (BA), averaging 4.93 with 0.256 deviation, while the lowest is building uniqueness with an average of 4.17 and 0.814 deviation. All the variables are valid because their R_{xy} scores are higher than the R_{table} (0.212). In retrospect, 53.5% of 86 respondents acknowledged the Antiquities' Exhibition as an important built attraction. Respondents are mostly neutral (40.7%) regarding the importance of building performance and maintenance. Data distribution of the built attractions factor can be observed in Figure 3.

Second, AHP analysis was conducted. The three selected experts systemically compared all the variables, and the comparisons were raised to the power of $\frac{1}{5}$ where five represents the number of items and were arranged in a square matrix. The geometric average was employed specifically when deriving the eigenvector of the matrix resulting from the pairwise comparisons. The geometric average of the built attractions factor can be observed in Table 5.

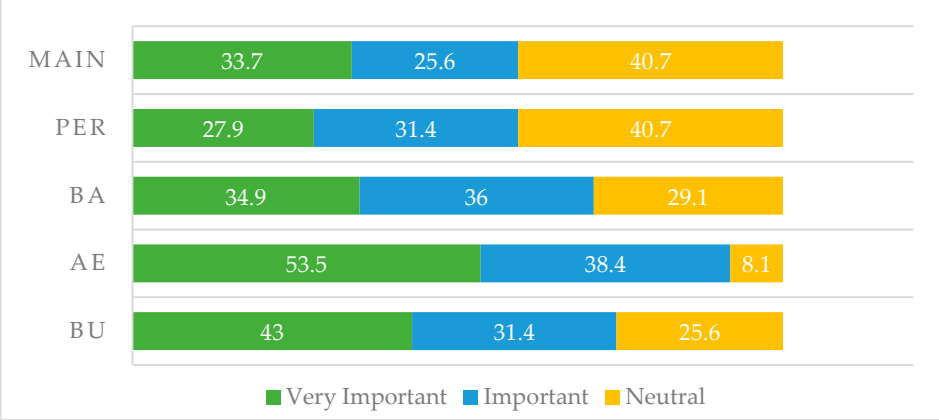

Figure 3. Data distribution of built attractions factor (percentage).

Table 5. Pairwise comparison of built attractions factor.

Factors	Geometric Average				
	BU	**AE**	**BA**	**PER**	**MAIN**
BU	1	1.90	0.64	1.55	1.55
EA	0.46	1	0.36	0.46	0.46
BA	1.93	2.77	1	2.19	1.90
PER	0.64	2.18	0.46	1	1.32
MAIN	0.64	2.18	0.53	0.76	1
Total	4.681	10.018	2.988	5.956	6.234

Afterwards, the pairwise comparison matrix is normalized by dividing each variable in the column by the sum of variables in that column. The process can be observed in Formula (S1) (Supplementary Materials). Each score is then summarized in a table; afterwards, the score is divided by five (the number of criteria). The last step is to calculate eigenvalue or Max = 5.089 and determine the value of CR = CI/IR, where the CI = (λ Max − 5)/(5 − 1) = 0.022162 and the IR score 1.12, resulting in a CR = 0.022162/1.12 = 0.019787 or 2%. The CR is less than 0.1, indicating that the matrix is consistent. The final three-experts' priority matrix of the built attractions factor can be observed in Table 6.

Table 6. Final three-experts' priority matrix (built attractions).

Normalization Vector Matrix					Row	Weight	Eigenvalue
BU	**AE**	**BA**	**PER**	**MAIN**			
0.214	0.189	0.216	0.261	0.249	1.128	0.226	1.056
0.098	0.100	0.121	0.077	0.074	0.470	0.094	0.941
0.413	0.276	0.335	0.367	0.305	1.696	0.339	1.014
0.138	0.217	0.153	0.168	0.212	0.888	0.178	1.057
0.138	0.217	0.176	0.127	0.160	0.818	0.164	1.021
1	1	1	1	1	5	1	5.089

The last analysis is FAHP, where it acts as the iteration of the previous AHP analysis. This analysis consists of Triangular Fuzzy Number (TFNs) and reciprocals. A TFN score of (1, 1, 1) and a reciprocal score of (1, 1, 1) indicate the comparison of the same variable, whereas a TFN score of (1/2, 1, 3/2) and a reciprocal (2/3, 1, 2) indicate intermediate. A TFN score of (1, 3/2, 2) and a reciprocal (1/2, 2/3, 1) indicate that one variable is moderately more important than the other (Moderately Important). A TFN score of (3/2, 2, 5/2) and a reciprocal (2/5, 1/2, 2/3) indicate one variable is intermediately more important than the other. A TFN (2, 5/2, 3) and a reciprocal (1/3, 2/5, 1/2) indicate one variable is strongly more important than the other. The CR values of each expert are as follows:

CRm: 0.032 and CRg: 0.087 (expert 1); CRm: 0 and CRg: 0 (expert 2); and CRm: 0.032 and CRg: 0.087 (expert 3). All the matrices are consistent. The mean matrix as a combined result of all the three experts can be observed in Table 7.

Table 7. Mean matrix of pairwise comparison (built attractions).

Built Attractions	BU	AE	BA	PER	MAIN
BU	(1.000, 1.000, 1.000)	(1.000, 3.659, 8.000)	(0.250, 0.381, 1.000)	(1.000, 1.588, 3.000)	(1.000, 1.588, 3.000)
AE	(0.125, 0.273, 1.000)	(1.000, 1.000, 1.000)	(0.111, 0.199, 1.000)	(0.200, 0.397, 1.000)	(0.200, 0.397, 1.000)
BA	(1.000, 2.625, 4.000)	(1.000, 5.025, 9.009)	(1.000, 1.000, 1.000)	(1.000, 2.001, 3.000)	(1.000, 2.001, 3.000)
PER	(0.333, 0.630, 1.000)	(1.000, 2.519, 5.000)	(0.333, 0.500, 1.000)	(1.000, 1.000, 1.000)	(1.000, 1.000, 1.000)
MAIN	(0.333, 0.630, 1.000)	(1.000, 2.519, 5.000)	(0.333, 0.500, 1.000)	(1.000, 1.000, 1.000)	(1.000, 1.000, 1.000)

Afterwards, the fuzzy geometric mean value is calculated using the Buckley algorithm. The final normalized fuzzy AHP weight of the built attractions factor can be seen in Table 8. The highest priority belongs to building authenticity with a score of 0.347, while the lowest priority belongs to antiquity exhibition with a score of 0.097.

Table 8. Final FAHP priorities (built attractions).

Built Attractions	Fuzzy AHP Geometric Mean Value			Weight	Normalized Weight
	L	M	U		
BU	0.0815841	0.2250937	0.6928877	0.24368712	0.24368712
AE	0.0380268	0.0663660	0.2945753	0.09726565	0.09726565
BA	0.1076509	0.3801701	0.9360635	0.34713318	0.34713318
PER	0.0690913	0.1641851	0.4064343	0.15595702	0.15595702
MAIN	0.0690913	0.1641851	0.4064343	0.15595702	0.15595702
Total	0.365	1	2.736	1.367280	1

4.1.2. Non-Building Attractions

The first analysis is descriptive statistical analysis. All variables obtained a minimum score of 2 (not important) and a maximum score of 5 (very important). The variable with the highest mean score is sewer system (SS), averaging 4.30 with 0.813 deviation, while the lowest is sacred tomb (MMH) with an average of 3.52 and 0.904 deviation. All the variables are valid because their R_{xy} scores are higher than the R_{table} (0.212). In retrospect, 53.5% of the 86 respondents acknowledged antiquities' exhibition as an important built attraction. Respondents are mostly neutral (40.7%) regarding the importance of building performance and maintenance. Data distribution of the non-building factor can be observed in Figure 4.

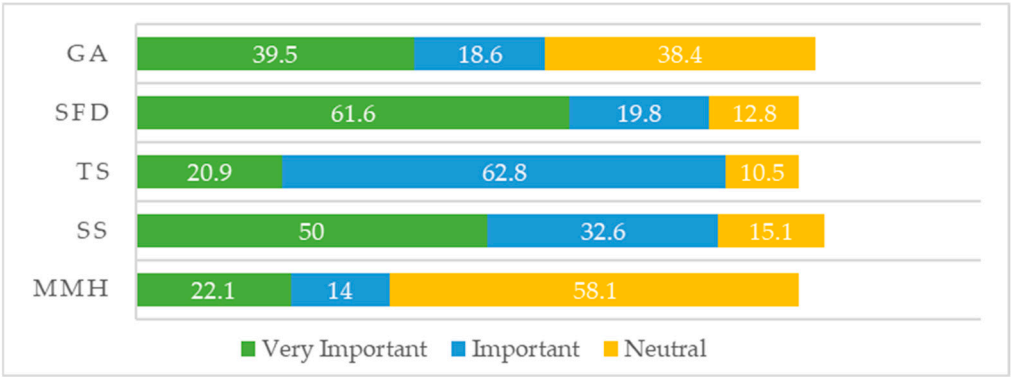

Figure 4. Data distribution of non-building factor (percentage).

The second analysis is AHP. The geometric average is employed specifically when deriving the eigenvector of the matrix resulting from the pairwise comparisons. The geometric average of the non-building factor can be observed in Table 9.

Table 9. Pairwise comparison of non-building.

Non-Building	Geometric Average				
	MMH	**SS**	**TS**	**SFD**	**GA**
MMH	1	1.896	1.149	0.758	0.758
SS	0.527	1	0.696	0.572	0.459
TS	0.871	1.437	1	0.758	0.758
SFD	1.320	1.748	1.320	1	1
GA	1.320	2.178	1.320	1	1
Total	5.037	8.259	5.484	4.088	3.975

Afterwards, the pairwise comparison matrix is normalized by dividing each variable in a column by the sum of variables in that column. The process can be observed in Formula (S6) (Supplementary Materials). Each score is then summarized in a table; afterwards, the score is divided by five (the number of criteria). The last step is to calculate the eigenvalue or λ Max = 5.089 and determine the value of CR = CI/IR, where the CI = (λ Max − 5)/(5 − 1) = 0.002938 and the IR score 1.12, resulting in a CR = 0.002938/1.12 = 0.002624. Because the CR is less than 0.1, the matrix is consistent. The final priority matrix of the non-building factor can be observed in Table 10.

Table 10. Final three-experts' priority matrix (non-building).

Normalization Vector Matrix					Row	Weight	Eigenvalue
MMH	**SS**	**TS**	**SFD**	**GA**			
0.199	0.230	0.209	0.185	0.191	1.014	0.203	1.021
0.105	0.121	0.127	0.140	0.116	0.608	0.122	1.005
0.173	0.174	0.182	0.185	0.191	0.905	0.181	0.993
0.262	0.212	0.241	0.245	0.252	1.210	0.242	0.990
0.262	0.264	0.241	0.245	0.252	1.263	0.253	1.004
1	1	1	1	1	5	1	5.012

The last analysis for the non-building factor is Fuzzy AHP. The CR values of each expert are as follows: CRm: 0.012 and CRg: 0.019 (expert 1); CRm: 0.014 and CRg: 0.025 (expert 2); and CRm: 0.012 and CRg: 0.019 (expert 3). All the matrices are consistent. The mean matrix as a combined result of all the three experts is provided in Table 11.

Table 11. Mean matrix of pairwise comparison (non-building).

Non-Building	MMH	SS	TS	SFD	GA
MMH	(1.000, 1.000, 1.000)	(0.333, 2.904, 8.000)	(1.000, 1.000, 1.000)	(0.333, 0.630, 1.000)	(0.333, 0.630, 1.000)
SS	(0.125, 0.344, 3.003)	(1.000, 1.000, 1.000)	(0.125, 0.273, 1.000)	(0.111, 0.315, 3.000)	(0.111, 0.315, 3.000)
TS	(1.000, 1.000, 1.000)	(1.000, 3.663, 8.000)	(1.000, 1.000, 1.000)	(0.333, 0.630, 1.000)	(0.333, 0.630, 1.000)
SFD	(1.000, 1.587, 3.003)	(0.333, 3.175, 9.009)	(1.000, 1.587, 3.003)	(1.000, 1.000, 1.000)	(1.000, 1.000, 1.000)
GA	(1.000, 1.587, 3.003)	(0.333, 3.175, 9.009)	(1.000, 1.587, 3.003)	(1.000, 1.000, 1.000)	(1.000, 1.000, 1.000)

The final normalized fuzzy AHP weight of the non-building factor can be seen in Table 12. The highest priority belongs to SFD and GA with a score of 0.254, while the lowest priority belongs to sewer system (SS) with score of 0.161. Compared to built attractions, the non-building factor has a relatively more even weight distribution with only a 0.093 gap between the most and the least important variable.

Table 12. Fuzzy geometric mean values and priorities (non-building).

Non-Building	Fuzzy Geometric Mean Value			Weight	Normalized Weight
	L	**M**	**U**		
MMH	0.0528366	0.1860345	0.5143353	0.16298384	0.163
SS	0.0184655	0.0709784	0.6561270	0.16133163	0.161

Table 12. *Cont.*

Non-Building	Fuzzy Geometric Mean Value			Weight	Normalized Weight
	L	M	U		
TS	0.0658334	0.1948774	0.5143353	0.16770966	0.168
SFD	0.0820271	0.2740548	0.8176845	0.25398744	0.254
GA	0.0820271	0.2740548	0.8176845	0.25398744	0.254
Total	0.301	1	3.320	1.5405	1

4.2. Social Assessment

4.2.1. Activities

The first analysis is descriptive statistical analysis. All variables obtained a minimum score of 2 (not important) and a maximum score of 5 (very important). The variable with the highest mean score is *Pokdarwis*, averaging 4.37 with 0.921 deviation, while the lowest is women's organization (WO) with an average of 3.52 and 0.904 deviation. All the variables are valid because their R_{xy} scores are higher than the R_{table} (0.212). In retrospect, 66.3% of the 86 respondents acknowledged events as an important activity. Respondents are neutral (29.1%) regarding the importance of *Pokdarwis*. Data distribution of the activities factor can be observed in Figure 5.

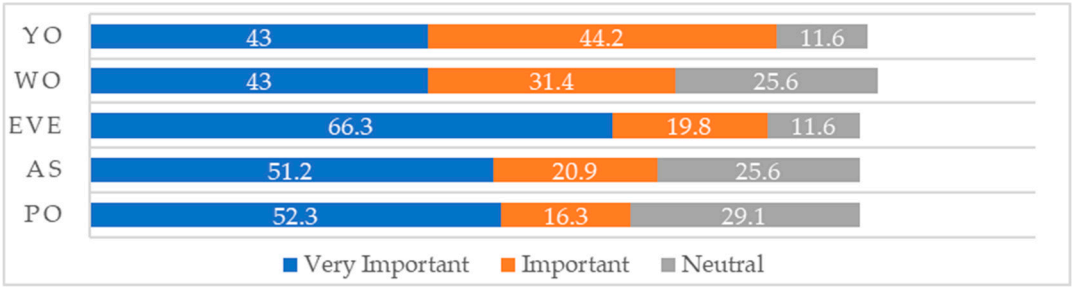

Figure 5. Data distribution of activities factor (percentage).

The second analysis is AHP. The geometric average is employed specifically when deriving the eigenvector of the matrix resulting from the pairwise comparisons. The geometric average of the activities factor can be observed in Table 13.

Table 13. Pairwise comparison of activities factor.

Activities	Geometric Average				
	POK	AS	EVE	WO	YO
POK	1	1.90	0.64	1.55	1.55
AS	0.46	1	0.36	0.46	0.46
EVE	1.93	2.77	1	2.19	1.90
WO	0.64	2.18	0.46	1	1.32
YO	0.64	2.18	0.53	0.76	1
Total	4.681	10.018	2.988	5.956	6.234

Afterwards, the pairwise comparison matrix is normalized by dividing each variable in a column by the sum of variables in that column. The process can be observed in Formula (S11) (Supplementary Materials). Each score is then summarized in a table; afterwards, the score is divided by five (the number of criteria). The last step is to calculate the eigenvalue or λ Max = 5.038 and determine the value of CR = CI/IR, where the CI = (λ Max − 5)/(5 − 1) = 0.009561 and the IR score 1.12, resulting in a CR = 0.009561/1.12 = 0.008536. Because the CR is less than 0.1, the matrix is consistent. The final priority matrix can be observed in Table 14.

Table 14. Final three-experts' priority matrix (activities).

Normalization Vector Matrix					Row	Weight	Eigenvalue
POK	AS	EVE	WO	YO			
0.372	0.404	0.372	0.342	0.342	1.831	0.366	0.985
0.158	0.172	0.158	0.226	0.226	0.939	0.188	1.093
0.245	0.267	0.245	0.226	0.226	1.208	0.242	0.985
0.113	0.079	0.113	0.104	0.104	0.511	0.102	0.987
0.113	0.079	0.113	0.104	0.104	0.511	0.102	0.987
1	1	1	1	1	5	1	5.038

The last analysis for the activities factor is FAHP. The CR values of each expert are as follows: CRm: 0.022 and CRg: 0.054 (expert 1); CRm: 0 and CRg: 0 (expert 2); and CRm: 0.022 and CRg: 0.054 (expert 3). All the matrices are consistent. The mean matrix as a combined result of all the three experts can be observed in Table 15.

Table 15. Mean matrix of pairwise comparison (activities factor).

Activity	POK	AS	EVE	WO	YO
POK	(1.000, 1.000, 1.000)	(2.000, 4.159, 9.000)	(2.000, 4.159, 9.000)	(6.000, 7.319, 9.000)	(6.000, 7.319, 9.000)
AS	(0.111, 0.240, 0.500)	(1.000, 1.000, 1.000)	(1.000, 1.000, 1.000)	(1.000, 2.924, 6.000)	(1.000, 2.924, 6.000)
EVE	(0.111, 0.240, 0.500)	(1.000, 1.000, 1.000)	(1.000, 1.000, 1.000)	(1.000, 2.924, 6.000)	(1.000, 2.924, 6.000)
WO	(0.111, 0.137, 0.167)	(0.167, 0.342, 1.000)	(0.167, 0.342, 1.000)	(1.000, 1.000, 1.000)	(1.000, 1.000, 1.000)
YO	(0.111, 0.137, 0.167)	(0.167, 0.342, 1.000)	(0.167, 0.342, 1.000)	(1.000, 1.000, 1.000)	(1.000, 1.000, 1.000)

The final normalized fuzzy AHP weight of the activities factor can be seen in Table 16. The highest priority belongs to *Pokdarwis* with a score of 0.551, while the lowest priority belongs to both the women's organization and youth organization with a score of 0.061. It is important to note that *Pokdarwis* accounts for more than half of the total weight for the activities factor.

Table 16. Fuzzy geometric mean value and priorities of activities factor.

Item	Fuzzy Geometric Mean Value			Weights (Wi)	Normalized Weight
	L	M	U		
POK	0.25	0.56	1.26	0.69	0.551
AS	0.06	0.17	0.39	0.21	0.164
EVE	0.06	0.17	0.39	0.21	0.164
WO	0.03	0.05	0.15	0.08	0.061
YO	0.03	0.05	0.15	0.08	0.061
	0.429	1	2.330	1.253	1

4.2.2. Partnership

The first analysis is descriptive statistical analysis. All variables obtained a minimum score of 3 (neutral) and a maximum score of 5 (very important). The variable with the highest mean score is community's involvement in decision-making (DM), averaging 4.65 with 0.526 deviation, while the lowest is government involvement with an average of 4.35 and 0.779 deviation. All the variables are valid because their R_{xy} scores are higher than the R_{table} (0.212). In retrospect, 67.4% of the 86 respondents acknowledged community's involvement in decision-making as very important. Respondents are mostly neutral (40.7%) regarding the importance of NGOs in heritage tourism management and development. Data distribution of the partnership factor can be observed in Figure 6.

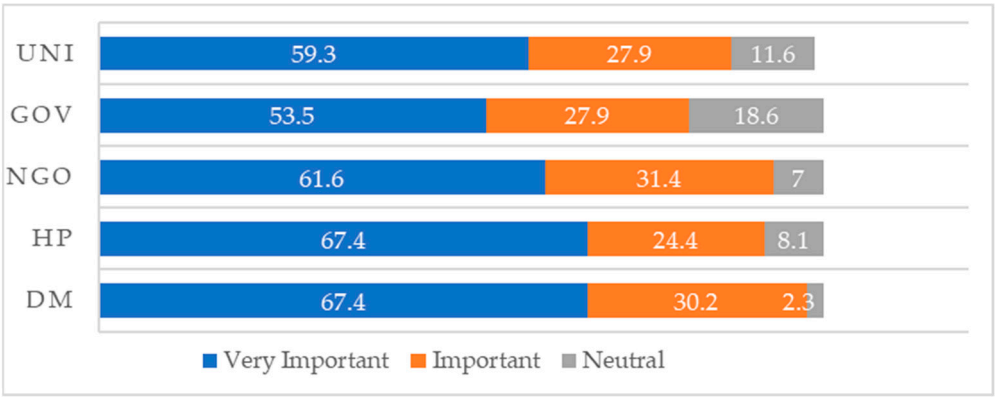

Figure 6. Data distribution of partnership factor (percentage).

The second analysis is AHP. The geometric average is employed specifically when deriving the eigenvector of the matrix resulting from the pairwise comparisons. The geometric average of the partnership factor can be observed in Table 17.

Table 17. Pairwise comparison of partnership factor.

Activities	Geometric Average				
	DM	**HP**	**NGO**	**GOV**	**UNI**
DM	1	1.90	0.64	1.55	1.55
HP	0.46	1	0.36	0.46	0.46
NGO	1.93	2.77	1	2.19	1.90
GOV	0.64	2.18	0.46	1	1.32
UNI	0.64	2.18	0.53	0.76	1
Total	4.681	10.018	2.988	5.956	6.234

Afterwards, the pairwise comparison matrix is normalized by dividing each variable in a column by the sum of variables in that column. The process can be observed in Formula (S16) (Supplementary Materials). Each score is then summarized in a table; afterwards, the score is divided by five (the number of criteria). The last step is to calculate the eigenvalue or λ Max = 5.060 and determine the value of CR = CI/IR, where the CI = (λ Max − 5)/(5 − 1) = 0.014995 and the IR score 1.12, resulting in a CR = 0.014995/1.12 = 0.013389. Because the CR is less than 0.1, the matrix is consistent. The final priority matrix of the partnership factor can be observed in Table 18.

Table 18. Final three-experts' priority matrix (partnership).

Normalization Vector Matrix					Row	Weight	Eigenvalue
DM	**HP**	**NGO**	**GOV**	**UNI**			
0.363	0.340	0.426	0.362	0.331	1.822	0.364	1.004
0.291	0.273	0.263	0.275	0.218	1.320	0.264	0.968
0.126	0.153	0.148	0.170	0.218	0.815	0.163	1.104
0.110	0.109	0.095	0.110	0.132	0.556	0.111	1.014
0.110	0.125	0.068	0.083	0.100	0.486	0.097	0.971
1	1	1	1	1	5	1	5.060

The last analysis for the partnership factor is Fuzzy AHP. The CR values of each expert are as follows: CRm: 0.035 and CRg: 0.082 (expert 1); CRm: 0.021 and CRg: 0.054 (expert 2); and CRm: 0.035 and CRg: 0.082 (expert 3). All the matrices are consistent. The mean matrix as a combined result of all the three experts can be observed in Table 19.

Table 19. Mean matrix of pairwise comparison (partnership).

Partnership	DM	HP	NGO	GOV	UNI
DM	(1.000, 1.000, 1.000)	(1.000, 1.442, 4.000)	(4.000, 5.848, 9.000)	(6.000, 7.319, 9.000)	(7.000, 8.000, 9.000)
HP	(0.250, 0.693, 1.000)	(1.000, 1.000, 1.000)	(1.000, 3.683, 6.000)	(1.000, 4.610, 8.000)	(1.000, 5.040, 9.000)
NGO	(0.111, 0.171, 0.250)	(0.167, 0.272, 1.000)	(1.000, 1.000, 1.000)	(1.000, 2.080, 4.000)	(1.000, 3.173, 5.000)
OOV	(0.111, 0.137, 0.167)	(0.125, 0.217, 1.000)	(0.250, 0.481, 1.000)	(1.000, 1.000, 1.000)	(1.000, 2.001, 3.000)
UNI	(0.111, 0.125, 0.143)	(0.111, 0.198, 1.000)	(0.200, 0.315, 1.000)	(0.333, 0.500, 1.000)	(1.000, 1.000, 1.000)

The final normalized fuzzy AHP weight of the activities factor can be seen in Table 20. The highest priority belongs to *Pokdarwis* with a score of 0.551, while the lowest priority belongs to both women's organization and youth organization with a score of 0.061. It is important to note that *Pokdarwis* accounts for more than half of the total weight in the activities factor.

Table 20. Fuzzy geometric mean value and priorities (partnership).

Partnership	Fuzzy Geometric Mean Value			Weights (Wi)	Normalized Weight
	L	M	U		
DM	0.25	0.47	1.08	0.60	0.466
HP	0.07	0.31	0.74	0.37	0.288
NGO	0.04	0.11	0.30	0.15	0.116
GOV	0.03	0.07	0.19	0.10	0.074
UNI	0.02	0.04	0.15	0.07	0.056
Total	0.407	1	2.457	1.288	1

4.3. Economic Assessment

4.3.1. Non-Farebox Revenue

The first analysis is descriptive statistical analysis. The variables obtained a minimum score of 2 (not important) and 3 (neutral) with a maximum score of 5 (very important). The variable with the highest mean score is antiquities, averaging 4.19 and a deviation of 0.744, while the lowest is that of roadside stall (RS), averaging 3.93 with a 0.930 deviation. All the variables are valid because their R_{xy} scores are higher than the R_{table} (0.212). In retrospect, 46% of the 86 respondents acknowledged selfie spot (SLF) as important. Respondents are mostly neutral (36%) regarding the importance of roadside stall (RS). Data distribution of the non-farebox revenue factor can be observed in Figure 7.

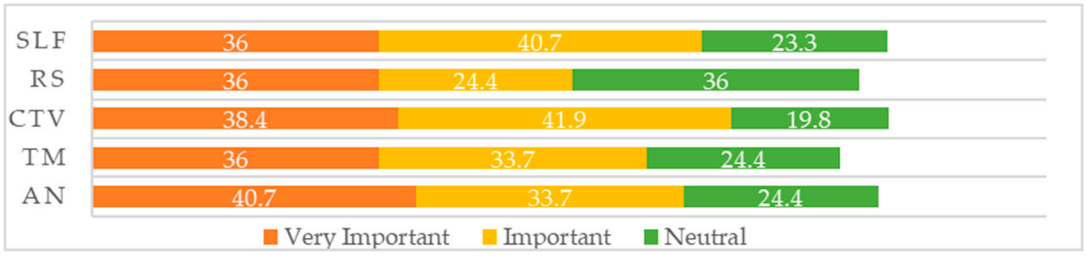

Figure 7. Data distribution of non-farebox revenue factor (percentage).

The second analysis is AHP. The geometric average is employed specifically when deriving the eigenvector of the matrix resulting from the pairwise comparisons. The geometric average of the non-farebox revenue factor can be observed in Table 21.

Afterwards, the pairwise comparison matrix is normalized by dividing each variable in a column by the sum of variables in that column. The process can be observed in Formula (S21) (Supplementary Materials). Each score is then summarized in a table; afterwards, the score is divided by five (the number of criteria). The last step is to calculate the eigenvalue or λ Max = 5.041 and determine the value of CR = CI/IR, where the CI = (λ Max − 5)/(5 − 1) = 0.01024 and the IR score 1.12, resulting in a CR = 0.01024/1.12 = 0.009143. Because the CR is less than 0.1, the matrix is consistent. The final priority matrix can be observed in Table 22.

Table 21. Pairwise comparison of non-farebox revenue factor.

Item	Geometric Average				
	AN	**TM**	**CTV**	**RS**	**SLF**
AN	1	1.904	1.149	2.178	0.517
TM	0.525	1	0.525	0.644	0.287
CTV	0.871	1.904	1	1.896	0.425
RS	0.459	1.552	0.527	1	0.303
SLF	1.933	3.482	2.352	3.301	1
Total	4.788	9.841	5.554	9.019	2.533

Table 22. Final three-experts' priority matrix (non-farebox revenue).

Normalization Vector Matrix					Row	Weight	Eigenvalue
AN	**TM**	**CTV**	**RS**	**SLF**			
0.363	0.340	0.426	0.362	0.331	1,055	0.211	1.010
0.291	0.273	0.263	0.275	0.218	0.491	0.098	0.966
0.126	0.153	0.148	0.170	0.218	0.933	0.187	1.037
0.110	0.109	0.095	0.110	0.132	0.579	0.116	1.045
0.110	0.125	0.068	0.083	0.100	1.942	0.388	0.984
1	1	1	1	1	5	1	5.041

The last analysis for the non-farebox revenue factor is FAHP. The CR values of each expert are as follows: CRm: 0.032 and CRg: 0.071 (expert 1); CRm: 0.006 and CRg: 0.006 (expert 2); and CRm: 0.032 and CRg: 0.071 (expert 3). All the matrices are consistent. The mean matrix as a combined result of all the three experts can be observed in Table 23.

Table 23. Mean matrix of pairwise comparison (non-farebox revenue).

Non-Farebox Revenue	AN	TM	CTV	RS	SLF
AN	(1.000, 1.000, 1.000)	(2.000, 5.768, 9.000)	(1.000, 1.000, 1.000)	(2.000, 4.763, 7.000)	(0.333, 0.500, 1.000)
TM	(0.111, 0.173, 0.500)	(1.000, 1.000, 1.000)	(0.111, 0.174, 0.500)	(0.250, 0.480, 1.000)	(0.111, 0.146, 0.333)
CTV	(1.000, 1.000, 1.000)	(2.000, 5.747, 9.009)	(1.000, 1.000, 1.000)	(2.000, 4.763, 7.000)	(0.333, 0.500, 1.000)
RS	(0.143, 0.210, 0.500)	(1.000, 2.083, 4.000)	(0.143, 0.210, 0.500)	(1.000, 1.000, 1.000)	(0.111, 0.158, 0.333)
SLF	(1.000, 2.000, 3.003)	(3.003, 6.849, 9.009)	(1.000, 2.000, 3.003)	(3.003, 6.329, 9.009)	(1.000, 1.000, 1.000)

The final normalized FAHP weight of the non-farebox revenue factor can be seen in Table 24. The highest priority belongs to selfie spots (SLF) with a score of 0.390. while the lowest priority belongs to traditional market (TM) with a score of 0.056.

Table 24. Fuzzy geometric mean value and priorities (non-farebox revenue).

Non-Farebox Revenue	Fuzzy Geometric Mean Value			Weight	Normalized Weight
	L	**M**	**U**		
AN	0.11	0.25	0.57	0.31	0.241
TM	0.02	0.04	0.15	0.07	0.056
CTV	0.09	0.24	0.57	0.30	0.237
RS	0.03	0.06	0.20	0.10	0.076
SLF	0.16	0.41	0.93	0.50	0.390
	0.414	1	2.414	1.276	1.000

4.3.2. Farebox Revenue

The first analysis is descriptive statistical analysis. All variables obtained a minimum score of 1 (not important at all) and 2 (not important) with a maximum score of 5 (very important). The variable with the highest mean score is art performance (AP), averaging 4.48 with 0.793 deviation, while the lowest is sponsorship (SP) with an average of 4.19 and

0.952 deviation. All the variables are valid because their R_{xy} scores are higher than the R_{table} (0.212). In retrospect, 60.5% of the 86 respondents acknowledged art performance and ticketing as an important source of farebox revenue. Respondents are mostly neutral (51.2%) regarding the importance of tourism packages. Data distribution of the farebox revenue factor can be observed in Figure 8.

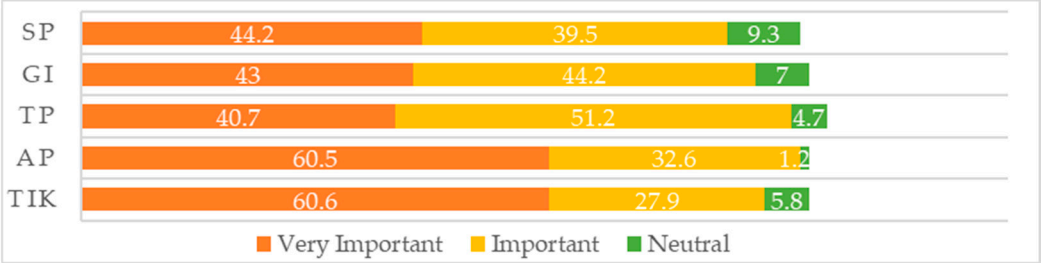

Figure 8. Data distribution of farebox revenue factor (percentage).

The second analysis is AHP. The geometric average is employed specifically when deriving the eigenvector of the matrix resulting from the pairwise comparisons. The geometric average of the farebox revenue factor can be observed in Table 25.

Table 25. Pairwise comparison of farebox revenue factor.

Farebox	Geometric Average				
	TIK	**AP**	**TP**	**GI**	**SP**
TIK	1	2.4082	2.5119	3.3798	1.5518
AP	0.4152	1	1.2457	1.5518	1
TP	0.3981	0.8027	1	2.5119	1.1487
GI	0.2959	0.6444	0.3981	1	0.5253
SP	0.6444	1	0.8706	1.9037	1
Total	2.7536	5.8554	6.0263	10.3472	5.2259

Afterwards, the pairwise comparison matrix is normalized by dividing each variable in a column by the sum of variables in that column. The process can be observed in Formula (S26) (Supplementary Materials). Each score is then summarized in a table; afterwards, the score is divided by five (the number of criteria). The last step is to calculate the eigenvalue or λ Max = 5.076 and determine the value of CR = CI/IR, where the CI = (λ Max − 5)/(5 − 1) = 0.019022 and the IR score 1.12, resulting in a CR = 0.019022/1.12 = 0.016984. Because the CR is less than 0.1, the matrix is consistent. The final priority matrix can be observed in Table 26.

Table 26. Final three-experts' priority matrix (farebox revenue).

Normalization Vector Matrix					Row	Weight	Eigenvalue
TIK	**AP**	**TP**	**GI**	**SP**			
0.3632	0.4113	0.4168	0.3266	0.2970	1.8149	0.3630	0.999
0.1508	0.1708	0.2067	0.1500	0.1914	0.8696	0.1739	1.018
0.1446	0.1371	0.1659	0.2428	0.2198	0.9102	0.1820	1.097
0.1075	0.1101	0.0661	0.0966	0.1005	0.4807	0.0961	0.995
0.2340	0.1708	0.1445	0.1840	0.1914	0.9246	0.1849	0.966
1	1	1	1	1	5	1	5.076

The last analysis for the farebox revenue factor is Fuzzy AHP. The CR values of each expert are as follows: CRm: 0.017 and CRg: 0.041 (expert 1); CRm: 0.018 and CRg: 0.034 (expert 2); and CRm: 0.017 and CRg: 0.041 (expert 3). All the matrices are consistent. The mean matrix as a combined result of all the three experts is provided in Table 27.

Table 27. Mean matrix of pairwise comparison (farebox revenue).

Item	TIK	AP	TP	GI	SP
TIK	(1.000, 1.000, 1.000)	(2.000, 6.000, 9.000)	(1.000, 2.080, 9.000)	(2.000, 5.451, 9.000)	(0.333, 1.310, 9.000)
AP	(0.111, 0.167, 0.500)	(1.000, 1.000, 1.000)	(0.111, 0.437, 3.000)	(0.250, 0.874, 3.000)	(0.111, 0.303, 1.000)
TP	(0.111, 0.481, 1.000)	(0.333, 2.288, 9.009)	(1.000, 1.000, 1.000)	(1.000, 2.620, 7.000)	(0.333, 0.500, 1.000)
GI	(0.111, 0.183, 0.500)	(0.333, 1.144, 4.000)	(0.143, 0.382, 1.000)	(1.000, 1.000, 1.000)	(0.111, 0.250, 1.000)
SP	(0.111, 0.763, 3.003)	(1.000, 3.300, 9.009)	(1.000, 2.000, 3.003)	(1.000, 4.000, 9.009)	(1.000, 1.000, 1.000)

The final normalized fuzzy AHP weight of the activities factor can be seen in Table 28. The highest priority belongs to ticketing (TIK) with a score of 0.424, while the lowest priority belongs to art performance (AP) with a score of 0.061. Currently ticketing is accountable for the highest percentage of income in the heritage *kampung* Kayutangan, therefore allowing it to become a factor with the best performance in the farebox revenue factor.

Table 28. Fuzzy geometric mean value and priorities (farebox revenue).

Item	Fuzzy Geometric Mean Value			Weights (Wi)	Normalized Weight
	L	M	U		
TIK	0.08	0.41	2.28	0.92	0.424
PER	0.01	0.08	0.53	0.21	0.096
PW	0.03	0.18	0.90	0.37	0.170
GI	0.02	0.08	0.45	0.18	0.084
SP	0.05	0.25	1.18	0.49	0.225
	0.187	1	5.336	2.174	1

According to novel prioritization results, there are different priorities between each method and therefore between tourists and experts. Scores for each variable can be observed in Table 29. The relative importance indicates that the most important factors in environmental criteria are building authenticity (BA) and street furniture, signs, and decorations (SFD); public events (EVE) and community involvement in decision-making (DM) for social criteria; and lastly selfie spots (SFS) as well as ticketing (TIK) for economic criteria.

Table 29. Final prioritization of sustainable heritage *kampung* criteria.

Factors		Final Score (Statistics)	Rank	Final Weight AHP	Rank	Final Weight F-AHP	Rank
Built attractions	BU	417.4	2	0.226	2	0.244	2
	AE	445.4	1	0.094	5	0.097	5
	BA	405.8	3	0.339	1	0.347	1
	PER	387.2	5	0.178	3	0.156	3
	MAIN	393	4	0.164	4	0.156	3
	MMH	352.4	5	0.203	3	0.163	3
Non-building	SS	430.3	2	0.122	5	0.161	4
	TS	398.8	3	0.181	4	0.168	2
	SFD	437.2	1	0.242	2	0.254	1
	GA	394.1	4	0.253	1	0.254	1
Activity	POK	418.6	5	0.366	1	0.551	1
	AS	421	3	0.188	3	0.164	2
	EVE	450.1	1	0.242	2	0.164	2
	WO	417.4	4	0.102	4	0.061	3
	YO	429	2	0.102	4	0.061	3
Partnership	DM	464.7	1	0.364	1	0.466	1
	HP	458.9	2	0.264	2	0.288	2
	COM	433.6	5	0.163	3	0.116	3
	GOV	434.9	4	0.111	4	0.074	4
	UNI	445.3	3	0.097	5	0.056	5

Table 29. *Cont.*

Factors		Final Score (Statistics)	Rank	Final Weight AHP	Rank	Final Weight F-AHP	Rank
Non-farebox revenue	AN	413.9	2	0.211	2	0.241	2
	TM	399.6	4	0.098	5	0.056	5
	CTV	419	1	0.187	3	0.237	3
	RS	392.6	5	0.116	4	0.076	4
	SLF	412.7	3	0.388	1	0.390	1
	TIK	443.6	2	0.363	1	0.424	1
Farebox revenue	AP	448.1	1	0.173	4	0.096	4
	TP	429.4	3	0.182	3	0.170	3
	GI	422.1	4	0.096	5	0.084	5
	SP	418.6	5	0.184	2	0.225	2

As an illustration, the comparison of each variable on each factor can be observed in Figure 9.

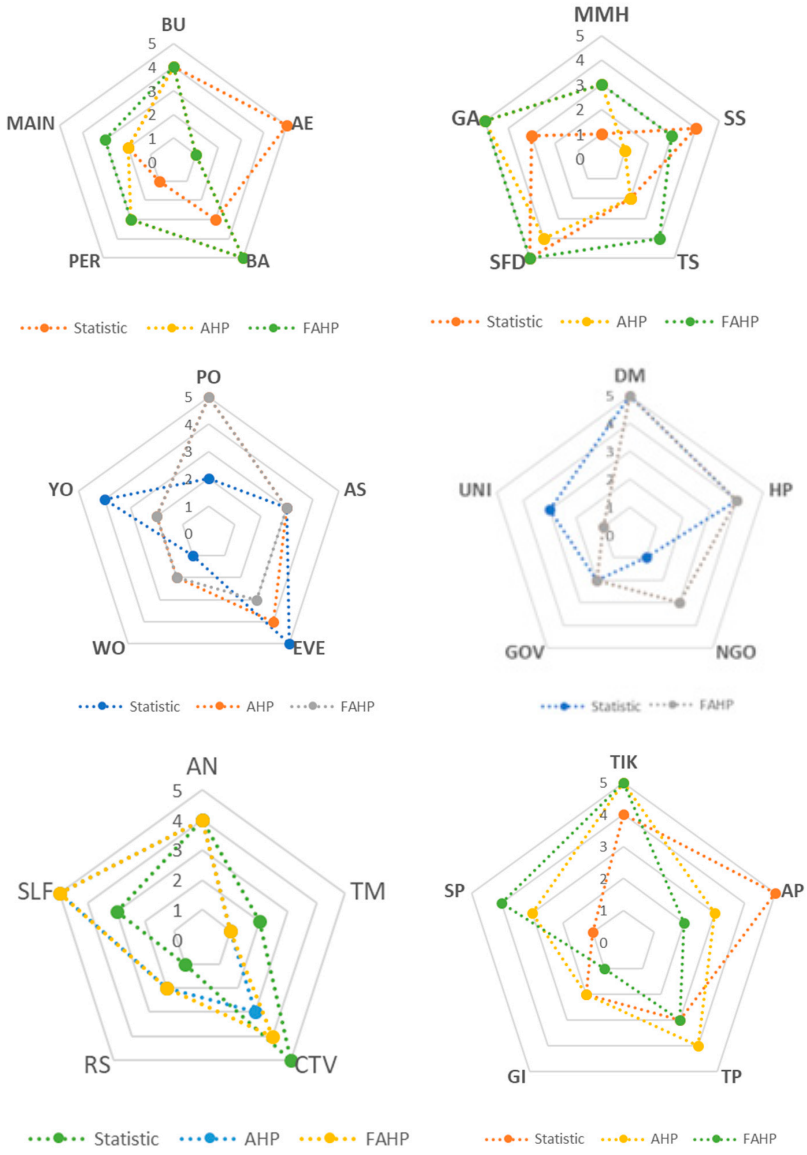

Figure 9. Radar chart indicating the relative importance of each variable in each factor of sustainable heritage *kampung* tourism in Kayutangan.

5. Discussion

It can be observed from the prioritization analysis that even though the *kampung* Kayutangan possesses every element of sustainability, the elements are not equal in terms of function and importance. This contradicts the concept of sustainability itself where all the pillars, which are economic, social, and environmental need to be of equal importance. Therefore, the directives for sustainable development in the heritage *kampung* Kayutangan are created in accordance with its current condition.

To maintain building authenticity in the heritage *kampung* Kayutangan, the government needs to establish a building code that accommodates both the preservation and necessary changes to allow the building to perform other functions aside from residential purposes. Furthermore, it is better to perform the preservation and revitalization in accordance with the era when the building was built, allowing the tourists to understand the historical layer of the heritage *kampung* Kayutangan. The same preservation should be applied to street furniture, signs, and decorations as well. Original furniture and decorations shall be preserved to function according to their original intention. When they can no longer serve their purpose, they can be displayed as antiquities and still serve as a non-farebox revenue for the *kampung*.

The community's involvement plays a significant role in the development of the heritage *kampung* Kayutangan. Community engagement can be increased through various means by the government, NGOs, and universities, namely, by workshops and skill-development programs. On the other hand, public events should be held more regularly to provide a more wholesome experience for the tourists. Women's organizations, youth organizations, and tourism-awareness groups can play significant roles in revitalizing heritage *kampung* (village) tourism by contributing their unique perspectives, skills, and resources. Through collaborative efforts, these organizations can create a holistic approach to heritage *kampung* tourism. This collaborative effort enhances the overall tourist experience, promotes sustainable practices, and contributes to the long-term vitality of the heritage *kampung*.

Last, in terms of non-farebox revenue, selfie spots are among the most important factors to ensure a sustainable income for the *kampung*. Selfie spots represent advertising and campaigning in the social media era, where tourist engagement can be seen through their feed in their social media page. Unique and shareable experiences, and designated selfie spots can become highlights of their visit, promoting a positive word-of-mouth marketing. Hashtags associated with selfie spots can promote a social media buzz and increase the visibility of the *kampung* as a heritage tourism destination. Furthermore, involving the local community in the creation and maintenance of selfie spots can foster a sense of pride and ownership. In return, these spots will be well-maintained and visually appealing, contributing to the overall success of heritage *kampung* tourism. Aside from providing farebox revenue, ticketing in the heritage *kampung* Kayutangan should be conducted both offline (on-the-spot) and online to make it more accessible for potential tourists. Ticketing is important to collect valuable insights into visitor numbers, demographics, and behavior. This information is crucial for effective tourism management, allowing authorities to plan for crowd control, infrastructure development, and marketing strategies.

In summary, preservation efforts should align with the era of the building's construction, extending to street furniture and decorations. Community involvement is deemed crucial, with recommendations for workshops, skill-development programs, and regular public events to enhance tourist experiences. Women's organizations, youth groups, and tourism-awareness organizations are encouraged to collaborate for a holistic approach to revitalize heritage *kampung* tourism. Additionally, selfie spots are highlighted as essential for generating non-farebox revenue, providing unique and shareable experiences. The involvement of the local community in creating and maintaining these spots is emphasized. Lastly, the importance of ticketing, both offline and online, is stressed for revenue collection and obtaining valuable insights for effective tourism management and planning.

The sustainable concept in heritage *kampung* utilizing novel prioritization methods diverges from conventional *kampung* improvement programs in Indonesia through several

key distinctions. First, it integrates innovative decision-making frameworks like AHP and FAHP, facilitating a systematic and data-driven approach to development interventions. Secondly, it places a strong emphasis on preserving cultural heritage alongside sustainability, aiming to maintain the *kampung*'s unique identity while ensuring long-term viability. Additionally, this concept prioritizes community engagement and empowerment, fostering residents' active participation in decision-making processes and project implementation. Furthermore, they adopt a holistic and adaptive planning approach, considering the intricate interplay of social, cultural, economic, and environmental factors for resilient strategies. In contrast, conventional programs often rely on traditional planning methods, potentially overlooking nuanced considerations and long-term sustainability. The overall sustainable concept for the heritage *kampung* Kayutangan can be observed in Figure 10.

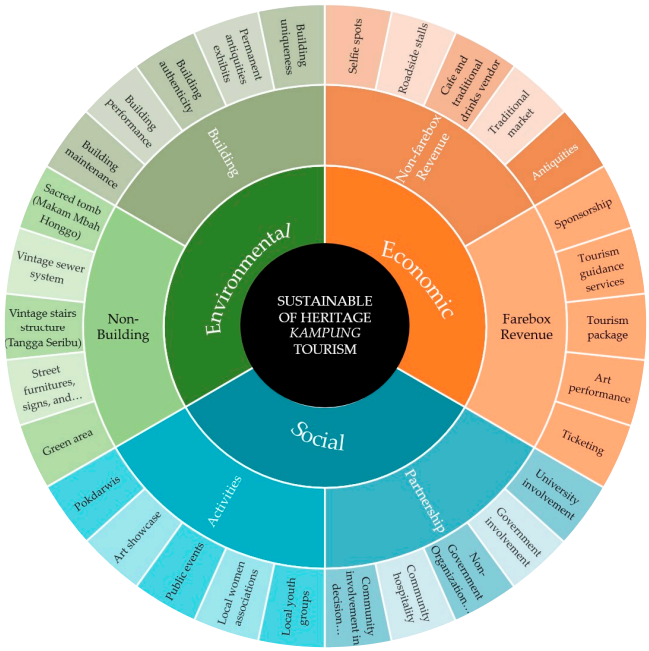

Figure 10. Sustainable heritage *kampung* tourism concept in Kayutangan. Source: analysis.

6. Conclusions

Sustainable development at the micro scale is exemplified by the historical success of sustainable *kampungs*, such as the heritage *kampung* Kayutangan in Malang city. Utilizing novel prioritization methods such as AHP and FAHP is essential in crafting effective sustainable development strategies for heritage urban *kampungs*, given their complexity and multidimensional sustainability goals. While the *kampung* Kayutangan embodies sustainability, variations in the importance of elements necessitate the alignment of directives with its current state, alongside efforts to preserve building authenticity, enhance community engagement, establish selfie spots, and implement ticketing systems for effective tourism management, collectively ensuring a comprehensive and sustainable revitalization of the heritage *kampung*.

While the methods employed in this research are able to create sustainable development directives in the heritage *kampung* Kayutangan, they also come with certain limitations. In terms of cultural sensitivity and contextual relevance, novel prioritization methods may not always adequately capture the cultural, historical, and social nuances of heritage urban *kampungs*. Urban *kampungs* in Indonesia possess different characteristics, leading to prioritized strategies that lack contextual relevance or fail to resonate with local communities when applied in locations other than Kayutangan. Ensuring cultural sensitivity and community engagement throughout the prioritization process is essential for promoting inclusive and sustainable development. Future studies may explore the impact assessment

of the sustainable heritage tourism framework, therefore allowing improvements to be made in cultural heritage management as well as sustainable tourism practices.

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