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INTEGRATION OF ETHNOECOPRENEUSHIP, COLLABORATIVE, AND CREATIVE ECONOMY AS AN EFFORT FOR SUSTAINABILITY OF MANGROVE ECOTOURISM

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Highlights:

- innovation in tourism expected to support sustainable development goals;
- the concept of ecotourism supports the development of sustainable tourism that integrates ethnoecopreneuship, collaborative, creative economy in conservation and tourism;
- sustainable tourism should make the most use of available resources, take into account the socio-cultural and economic aspects of local communities, share benefits fairly among stakeholders, and safeguard future generations' interests.

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Abstract. In the face of global tourism industry challenges, innovation in tourism services is essential for achieving sustainable development goals. This research aims to address the multifaceted challenges of sustainable mangrove ecotourism in Indonesia through an integrative approach combining ethnoecopreneuship, collaborative, and creative economy. Utilizing participatory rural appraisal (PRA) and focus group discussion (FGD), data analysis combines strengths, weaknesses, opportunities, threats (SWOT) analyses and analytic hierarchy process (AHP) method. The results emphasize the importance of community involvement, ecological considerations, effective promotion, and adoption of digital technology in the sustainability of mangrove ecotourism. The research calls for collaboration among stakeholders, policy emphasis on local government responsibilities, and active involvement of local communities and non-governmental organizations in mangrove conservation and management. This research underscores the potential for sustainable development, aligning with the sustainable development goals (SDGs) and enhancing economic and social outcomes in Indonesia's mangrove ecotourism sector.

Keywords: analytic hierarchy process (AHP), conservation, ecotourism, mangrove ecosystem, SDGs, sustainability, SWOT.

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1. Introduction

Excessive tourist and recreational traffic pose a significant threats to the ecological integrity of green spaces, including forests (Dudek, 2017; Terkenli et al., 2017). Hence, it is crucial to assess the tourism and recreational capacities to establish sustainable practices and safeguard natural resources. In mangrove ecotourism, which involves fragile ecosystems, such pressures can disrupt the delicate balance required for ecological preservation. Mangrove face additional stress from uncontrolled tourism activities, which can lead to habitat degradation, biodiversity loss, and compromised ecosystem services (Afonso et al., 2021; Arfan et al., 2024a; Spalding & Parrett, 2019). Recognizing and addressing these risks is fundamental to formulating strategies that promote responsible tourism and environmental management.

The sustainability of mangrove ecotourism depends on a multifaceted approach that combines ethnoecopreneurship, collaboration, and the creative economy. As demand for sustainable tourism grows, communities around the world are exploring innovative strategies to conserve natural resources while promoting economic development (Baloch et al., 2023; Makhanyela et al., 2024). Ethnoecopreneurship, which combines traditional ecological knowledge with entrepreneurial initiatives, offers a pathway for local communities to derive economic benefits from their cultural and natural heritage (Haq et al., 2023). Collaborative efforts involving multiple stakeholders improve resource management and ensure the inclusivity of local voices in decision-making processes (Emerson et al., 2012). The creative economy, driven by cultural and creative industries, provides additional avenues for economic diversification and resilience.

The prioritization of tourism and environmental concerns has become paramount in the modern era, demanding innovation. Innovation in tourism is expected to support sustainable development goals. Contemporary

tourism literature is replete with sustainability analyses and innovative solutions for sustainable tourism, recognizing the evolving relationship between humans and nature (Martínez-Espinosa et al., 2020). In the context of environmental protection, these activities include conservation areas, national parks, wildlife sanctuaries, geoparks (Arfan, et al., 2023b; Jovanovic et al., 2022) and ecotourism. Ecotourism represents an innovation in tourism with a focus on environmental preservation by bridging the interests of natural resource conservation and tourism (Kumar et al., 2023). Developing mangrove ecotourism from an environmental perspective is expected to safeguard the mangrove ecosystem. The concept of ecotourism is not to exploit nature but to harness natural resources and community services to fulfill the intellectual, physical, and psychological needs of tourists (Askar et al., 2021).

Aligned with trends in destination management, such as mangrove ecotourism, the utilization of limited mangrove ecosystem resources while prioritizing nature and its protection remains essential to ensure sustainability (Dharmawan et al., 2016; Titisari et al., 2022). A sustainable tourism model can yield economic benefits by promoting the conservation of natural resources, enhancing environmental awareness, and sustainability as a conservative ecotourism model for coastal ecosystems (Eunike et al., 2018).

Based on a preliminary study of mangrove area changes in South Sulawesi, Indonesia, from 2001 to 2021, there has been a reduction in mangrove area by 19,739 ha (Hidayat & Dessy, 2021). The reduction is attributed to multiple factors, including land conversion for aquaculture, agricultural expansion, and unregulated tourism activities (Arfan et al., 2024a). Additionally, coastal infrastructure development and illegal logging have exacerbated habitat degradation, leading to biodiversity loss and weakened ecosystem resilience (Spalding & Parrett, 2019). Compared to other regions, such as North Sumatra, where mangrove loss is driven by palm oil expansion (Basyuni et al., 2018), South Sulawesi's degradation is more closely linked to tourism pressures and unsustainable resource extraction, necessitating targeted conservation strategies. One the efforts to mitigate this deforestation by promoting ecotourism based on business and ecology (Arfan, et al., 2023a; Tjahjono et al., 2022) by developing educational, research, conservation, and community welfare enhancement goals (Basyuni et al., 2018; Tahang et al., 2019). These efforts aim to create a sustainable economy while preserving environmental sustainability (Ahmad & Suratman, 2021; Susilo et al., 2018; Valentina & Qulubi, 2019).

Ecotourism is regarded as a conservation-based economic alternative that neither harms nor exploits nature, with no negative environmental impact. A study by Hayati and Bahtera (2020) in Bangka found that the development of mangrove ecotourism has reduced the exploitation of natural resources, such as tin mining, indicating that ecotourism plays a crucial role in environmental conservation. Through the ecotourism model, one can appreciate the beauty of nature, local culture, and history without damaging or commodifying them (Bimrah et al., 2022). Successful ecotourism management is oriented towards sustainable tourism development, applying principles such as coordinated environmental management, ecosystem management, and mangrove ecotourism development (Ketut Ginantra, 2022). Ecotourism is expected to be a solution to environmental degradation in this decade.

Ecotourism is strategically planned to achieve sustainability goals by incorporating environmental, social, and economic dimensions (Atun et al., 2019) and is capable of providing equitable benefits among stakeholders while safeguarding the interests of future generations (Kisi, 2019). However, ecotourism does not always lead to increased income for local communities. It has controversial economic impacts because conservation areas often result in low income for local residents (Ma et al., 2019). Therefore, it is crucial to consider the importance of income enhancement and poverty alleviation (Debrot et al., 2020; Rejeki et al., 2021).

The principle of sustainability ensures that current resource use for human needs does not harm the environment, allowing it to provide resources for future generations. In ecotourism, the responsibility to protect the environment, provide economic benefits to local communities, and preserve culture is paramount. This study formulates sustainable mangrove ecotourism efforts by integrating the concepts of ethnoecopreneurship, collaboration, and the creative economy.

Through ethnoecopreneurship, local communities, utilizing their indigenous knowledge, can engage in entrepreneurial activities independently while prioritizing environmental preservation (Zeng & Ren, 2022). Collaboration is defined as a cooperative effort between two or more individuals or institutions, where each party collectively understands and works together to solve common problems (Firchow & Gellman, 2021). Creative economics is a modern economic concept that prioritizes creativity and innovation in driving economic growth towards a more prosperous life (Šiljković, 2019). Creative economics can be a solution in creating economic value for communities and generating new job opportunities through the exploration of ideas from within the community (Harper, 2021). These innovative and creative ideas can lead to economic and social performance improvements.

Ethnoecopreneurship, the collaborative economy, and the creative economy are crucial frameworks for achieving sustainable mangrove ecotourism, yet their application in this context remains underexplored. Ethnoecopreneurship integrates traditional ecological knowledge with entrepreneurial initiatives, enabling local communities to derive economic benefits while preserving the mangrove ecosystem (Haq et al., 2023). However, its role in mangrove conservation is not widely examined. The collaborative economy, characterized by shared resource management, enhances ecotourism sustainability through cooperation between local communities, government, NGOs, and businesses (Emerson et al., 2012). While this concept is often discussed in urban contexts, its effectiveness in rural and coastal settings requires further substantiation. Similarly,

the creative economy fosters sustainable tourism by leveraging cultural and artistic expressions, but its direct relevance to mangrove ecotourism remains insufficiently addressed in existing literature (Šiljković, 2019). This study aims to bridge these gaps by demonstrating how these concepts can be integrated into mangrove ecotourism through case studies, community-based initiatives, and digital innovations. Future discussions should expand on empirical applications, incorporating comparative studies to validate these frameworks. Strengthening the conceptual foundation with interdisciplinary perspectives and empirical evidence will provide a clearer justification for their adoption in mangrove ecotourism.

This research concerning mangrove ecotourism and it is sustainability. While existing literature highlights the potential of ecotourism as a conservation-based economic alternative, it often lacks comprehensive integration of localized socio-cultural, ecological, and economic dimensions. Prior studies have focused predominantly on single-dimension strategies such as environmental management or economic modeling, without adequately the synergistic potential of combining traditional ecological knowledge (Ethnoecopreneurship), collaborative stakeholder engagement, and innovative creative economy practices. This study addresses these deficiencies by presenting a multifaceted approach that combines these elements into a cohesive framework.

The aim of this research is to developed an integrative model for sustainable mangrove ecotourism by combining ethnoecopreneurship, collaboration, and the creative economy. The authors intend to address the environmental, social, and economic challenges associated with mangrove conservation and tourism. By emphasizing active participation from local communities, the study seeks to empower these communities as custodians of mangrove ecosystems while enabling them to drive sustainable economic benefits. Furthermore, the research highlights the critical role of indigenous knowledge, blended with entrepreneurial initiatives, to innovative eco-friendly tourism products. Collaborative approaches involving governments, non-governmental organizations, academics, and local communities are central to this framework, ensuring inclusive decision-making and fostering trust among stakeholders.

The study contributes to the field by constructing new knowledge on integrating socio-cultural and technological dimensions into sustainable tourism. It identifies the potential of digital tools, such as social media and e-commerce, to promote ecotourism and attract environmentally conscious tourists. Capacity-building initiatives, including training on product innovation and online marketing, are proposed to diversify income sources and reduce reliance on extractive practices. This novel framework not only advances the discourse on mangrove ecotourism but also offers actionable strategies that align with the Sustainable Development Goals (SDGs), ensuring ecological preservation and socio-economic resilience.

2. Materials and methods

2.1. Research location

This study was conducted in mangrove areas in South Sulawesi Province, Indonesia (Figure 1). This province is located between 0° 12′ – 8° South latitude and between 116° 48′ – 122° 36′ East longitude and is passed by the equator which lies at 0^0. The average air temperature is 28.50 °C. This region has an area of 46,717.48 km^2 covering 21 districts and 3 cities. Topographically, the eastern part is dominantly lowland, the southern part is dominantly highland, the northern part is hilly and mountainous, and the western part is coastal. This study was carried out in the western mangrove area which includes Makassar City and the Regency of Barru and Jeneponto, where ecotourism activities are prominent.

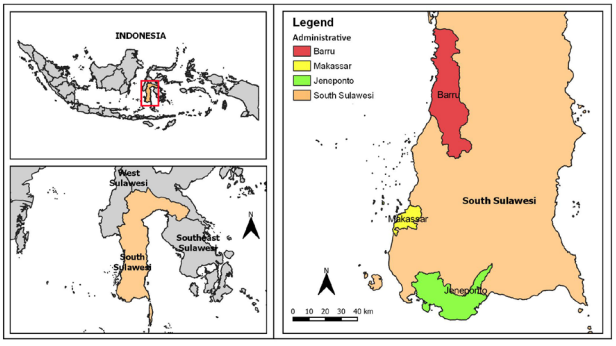

Figure 1. Research location in South Sulawesi Province, Indonesia

The study was conducted in the western mangrove areas of South Sulawesi, specifically in Makassar City, Barru Regency, and Jeneponto Regency, regions where ecotourism activities are well established. These areas are characterized by extensive mangrove ecosystems that provide critical ecological services, including coastal protection, carbon sequestration, and biodiversity conservation (Arfan et al., 2024b). Makassar City, as an urban coastal area, faces significant anthropogenic pressures, while Barru and Jeneponto, with their rural landscapes, are more influenced by traditional livelihoods such as fisheries and aquaculture. The mangrove forests in these regions vary in composition, with dominant species such as Rhizophora spp. and Avicennia spp., which play a crucial role in supporting local fisheries and maintaining water quality (Hilmi et al., 2021). The socio-economic relevance of these locations is underscored by the dependence of local communities on mangrove resources for sustainable livelihoods, particularly through ecotourism and fisheries. However, despite their ecological and economic importance, these mangrove ecosystems face degradation due to coastal development, pollution, and unregulated tourism activities. Understanding the ecological, social, and economic dynamics of these areas is essential for designing effective conservation and management strategies that integrate sustainable ecotourism practices while ensuring long-term ecosystem resilience (Arfan et al., 2024b).

2.2. Research type

This research adopted a fundamental research design to systematically map, identify, assess, and address issues associated with mangrove ecotourism. The primary goal was to develop a comprehensive strategy integrating ecological, social, and economic dimensions for sustainable mangrove management. The methodological framework combined qualitative and quantitative approaches to ensure a holistic understanding of the study area. This research adopted a fundamental research design to systematically map, identify, assess, and address issues associated with mangrove ecotourism. The study involved 50 respondents, including local government officials, community leaders, ecotourism managers, NGO representatives, and tourists, ensuring a diverse perspective on sustainability challenges. Respondents were selected using proportionate stratified random sampling, with inclusion criteria requiring direct involvement in mangrove-related activities.

2.3. Material and methods

Primary data were collected directly from informants/respondents through in-depth interviews using the Participatory Rural Appraisal (PRA) and Focus Group Discussion (FGD) approaches to gain a deeper understanding of the specific situations, potentials, and issues faced by the community (Arfan, et al., 2024b). Participatory Rural Appraisal (PRA) and Focus Group Discussion (FGD) are methodologies designed to empower communities by involving them in the identification of their own needs and solutions. PRA is a participatory approach that enables community members to analyze their conditions and prioritize issues through various tools, including mapping and ranking exercises, which facilitate collective understanding and action (Diannita et al., 2021; Ngwese et al., 2018; Rayesa et al., 2023). This method emphasizes local knowledge and encourages community ownership of development processes, making participants active researchers and planners rather than passive subjects (Triatmanto & Natsir, 2019).

PRA engaged community members in analyzing their socio-environmental conditions through tools such as mapping and ranking exercises, fostering local ownership and empowerment. FGDs provided a structured platform for diverse stakeholders–including community leaders, government officials, and representatives from non-governmental organizations–to discuss issues and collaboratively propose solutions. The target population comprised individuals aged 20–60 living near mangrove ecosystems.

A proportionate stratified random sampling technique was employed to ensure representative coverage. Stratification was based on respondents' roles, such as fishing, farming, tourism, and management activities. Inclusion criteria required participants to have direct involvement in mangrove-related activities, while exclusion criteria omitted individuals with no connection to the ecosystem. Complementary data were sourced from academic journals, research reports, institutional records, and other credible publications. These data provided contextual and comparative insights for the analysis.

This study followed a structured protocol to ensure consistency and reliability, including 1) Preparation, identification of key stakeholders and preliminary mapping of mangrove ecotourism sites in the study area; 2) PRA Implementation: Community members conducted participatory mapping and identified local challenges and opportunities using PRA tools; 3) FGDs: Facilitated discussions focused on community priorities, ecotourism management, and sustainable practices. Sessions were recorded and transcribed for analysis; 4) Data Collection: Quantitative and qualitative data were gathered concurrently through interviews, observations, and PRA/FGD activities; 5) Validation: Triangulation was used to cross-verify data from multiple sources and ensure reliability.

2.4. Data analysis

Data were analyzed using the ASWOT model, which integrates the Analytical Hierarchy Process (AHP) and SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis, ensuring a structured decision-making framework for sustainable mangrove ecotourism. AHP, developed by Saaty (1980), ranks decision alternatives based on predefined criteria, offering a quantitative assessment of qualitative factors (Jovanovic et al., 2022). This method was essential in prioritizing ecotourism sustainability strategies by assigning weighted scores to various internal and external factors. In parallel, SWOT analysis systematically evaluates strengths and weaknesses within the mangrove ecotourism system while identifying opportunities and threats in the broader environmental and socio-economic context (Sukri et al., 2022). This approach is widely used in sustainable tourism development, as demonstrated in studies on Rameswaram, Tamil Nadu (Mallick et al., 2020) and West Iran (Heshmati et al., 2022), which emphasize its utility in strategic planning.

The integration of AHP and SWOT in ASWOT modeling enhances decision-making by combining qualitative and quantitative analysis. AHP refines SWOT outcomes by prioritizing strategic alternatives through pairwise comparisons, reducing subjectivity, and ensuring a more data-driven approach to sustainability planning (Heshmati et al., 2022). This method enables the formulation of pragmatic, hierarchical strategies, facilitating evidence-based policy recommendations for ecotourism stakeholders. By employing ASWOT, this study not only assesses mangrove ecotourism viability but also proposes a robust multi-criteria decision-making framework, optimizing conservation, community engagement, and economic sustainability.

The analytical tasks were conducted using Expert Choice software, which facilitated pairwise comparisons and calculated priority weights for each factor. The reproducibility of results was ensured through detailed documentation of procedures and systematic application of AHP and SWOT methodologies. This analytical integration allowed for the development of targeted, actionable

strategies tailored to the study's ecological, social, and economic objectives.

3. Results

3.1. SWOT analysis

Mangrove Ecotourism sustainability efforts are carried out by integrating the concepts of ethnoecopreneurship, collaborative, and creative economy. AHP-SWOT was applied to analyze the integrated strategy. SWOT analysis was first conducted based on internal and external factors. In this study, these factors were obtained through in-depth interviews using PRA and FGD methods along with their scores and weights presented in Tables 1 and 2.

Eleven strength (S) factors with weights ranging from 0.015 to 0.075 were identified. Based on the weights and effective scores (2–4), five effective factors including S1, S2, S3, S8 and S9 were categorized as the most significant strength factors (Table 1). High community support, sustainable management models, environmentally friendly fishing practices, strong cooperation among local stakeholders, and internet access. These factors indicate a solid foundation for ecotourism development, particularly in fostering community-led conservation efforts.

Furthermore, eleven weakness factors (W) with weights ranging from 0.010 to 0.075 were explored. Based on the weights and effective scores (2–4), four effective factors including W1, W2, W3, W5, W7, and W8 were found to be the most important weakness factors among all (Table 1). Key concerns include the dominance of local government control (0.15), limited community participation (0.15), inadequate training for women's groups (0.15), and minimal infrastructure development (0.15).

There were nine factors related to opportunity (O), but among them, four factors with higher weights and scores were selected (Table 2). These factors include O2 (the presence of government funding and policies supporting

Table 1. Internal factors (strengths and weaknesses)

No.	Internal factors	Weight	Rating	W x R
	Strenghts			
1	Community support around the mangrove ecotourism area is very high	0.075	4	0.30
2	Sustainable community management model around mangrove ecotourism area	0.075	4	0.30
3	Communities around the mangrove ecosystem area use environmentally friendly fishing gear	0.075	4	0.30
4	Community groups play an active and participatory role if there are management activities in the mangrove ecotourism area	0.050	3	0.15
5	Characteristic and unique mangrove vegetation and wildlife	0.015	2	0.03
6	The culture of gotong royong in the community is still inherent	0.015	2	0.03
7	Activity/management around the mangrove ecotourism area is preceded by a meeting to reach consensus	0.015	2	0.03
8	Good cooperation between farmers and fishermen and groups in the community	0.075	4	0.30
9	Fast internet access in mangrove ecotourism areas	0.075	4	0.30
10	There are small businesses in the mangrove ecotourism area that provide visitor needs	0.020	3	0.06
11	There are tracking facilities, shelters, boats, photo spots that are a favorite place for visitors	0.020	3	0.06
	Sub Total	0.51		1.86
	Weaknesses			
1	Mangrove management is still fully managed and controlled by the local government	0.075	2	0.15
2	Not fully involving the community in mangrove management	0.075	2	0.15
3	Empowerment and trainings for women's groups are still very low	0.050	3	0.15
4	No mangrove ecotourism guide	0.010	4	0.04
5	Facilities and infrastructure in and around the mangrove ecotourism area are still very minimal and damaged	0.075	2	0.15
6	Educational facilities provided are only in the form of information displays of mangrove plans and areas so that visitors do not have other options to appreciate nature	0.010	4	0.04
7	The entrepreneurial interest of the community around the mangrove ecotourism area is still low	0.050	3	0.15
8	Coordination between community groups around the mangrove ecotourism area is still low	0.050	3	0.15
9	There is no common perception/understanding of ecopreneurship-based management	0.010	4	0.04
10	Lack of individual involvement if the management is based on fishermen/fishermen groups	0.015	4	0.06
11	Clean water for drinking/consumption is very limited	0.070	2	0.14
	Sub Total	0.49		1.22
	Total	1		

Table 2. External factors (opportunities and threat)

No.	Internal factors	Weight	Rating	W x R
Opportunities				
1	There is a funding agency/CSR, especially in mangrove planting	0.025	2	0.05
2	Implementation of mangrove ecotourism systems, management, and policies that support the ecotourism area	0.075	4	0.30
3	There is planning, management and development of mangrove ecotourism areas	0.050	3	0.15
4	Many researchers have visited and conducted studies	0.025	2	0.05
5	Transportation access to the ecotourism area is very easy	0.050	3	0.15
6	Allocation of funds for mangrove ecotourism development from local government	0.075	4	0.30
7	Concerns of environmental groups	0.025	2	0.05
8	The location of mangrove ecotourism is very strategic to open business opportunities	0.075	4	0.30
9	Managers provide employment opportunities for local communities and entrepreneurship around the mangrove ecotourism area	0.075	4	0.30
	Sub Total	0.475		1.65
Threat				
1	Visitors are decreasing	0.075	2	0.15
2	Plastic waste found in and around mangrove areas	0.025	4	0.10
3	Competition in the tourism business	0.025	4	0.10
4	The education level of the community is still very low	0.050	3	0.15
5	Sometimes there are conflicts of interest between local communities and mangrove ecotourism managers	0.075	2	0.15
6	Sometimes financial assistance is still focused on certain groups, causing jealousy	0.050	3	0.15
7	Many of the stalls available in the mangrove ecotourism area are not functioning	0.075	2	0.15
8	Understanding of the creative economy is still low	0.025	4	0.10
9	Community concerns about visitors who only use the ecotourism area as a place to date/free sex	0.125	4	0.50
	Sub Total	0.525		1.55
	Total	1		

ecotourism, O6 (indicates a commitment to conservation and economic development), O8 (the strategic location of the ecotourism area, and O9 (employment opportunities generated by ecotourism). Threats (T) include nine factors (Table 2), and there are four effective threats with higher weights (0.025–0.125) and scores (2–4) that can negatively affect sustainable ecotourism, including (1) inappropriate visitor behavior (T9); (2) declining number of visitors (T1); (3) low education levels (T4); (4) internal conflicts (T5); and (5) unequal financial aid distribution (T6). Furthermore, determining the selected strategy on SWOT, this can be done on the Internal Strategy Factor Analysis Summary (IFAS) and External Strategy Factor Analysis Summary (EFAS) through the SWOT chart. This is shown in Figure 2.

Figure 2 illustrates the strategic positioning derived from a SWOT (Strengths-Weaknesses-Opportunities-Threats) analysis, plotted on a cartesian coordinate system. The matrix is divided into four quadrants, each representing a different strategic approach. Quadrant I, located in the upper-right section, corresponds to the aggressive strategy where strengths and opportunities dominate. This strategy emphasizes the utilization of internal strengths to capitalize on external opportunities and is particularly suited for proactive and growth-oriented initiatives.

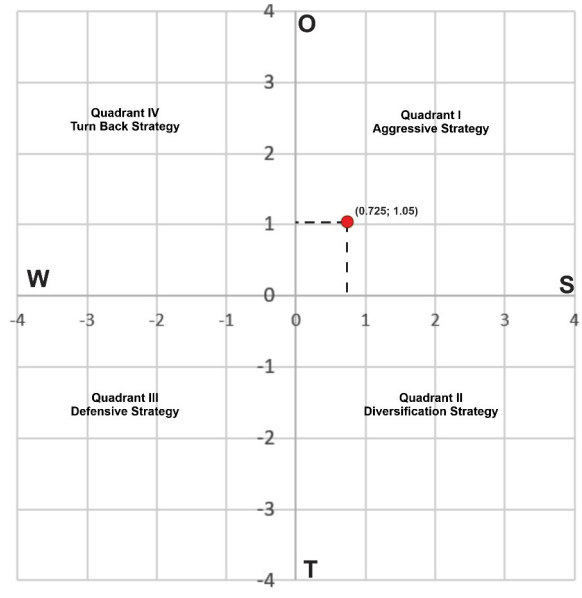

Figure 2. The SWOT analysis diagram is in Quadrant I

Quadrant II, situated in the lower-right section, represents the diversification strategy, which seeks to address internal weaknesses while leveraging external opportunities. This

approach often involves capacity building and structural improvements. Quadrant III, found in the lower-left section, indicates the defensive strategy, which focuses on minimizing threats and addressing weaknesses to stabilize operations in challenging environments. Lastly, Quadrant IV, located in the upper-left section, reflects the turnback strategy, wherein internal strengths are deployed to counter external threats, ensuring resilience against unfavorable conditions.

Based on the results depicted in the Figure 2, the selected strategy falls within Quadrant I, confirming that an aggressive approach is the most appropriate. The red marker, positioned at coordinates (0.725, 1.05), indicates that the strengths and opportunities in this context significantly outweigh weaknesses and threats. These strategies include: 1) Management of ecotourism areas fully involves local communities starting from planning, monitoring and utilization of ecotourism areas by adhering to a system of openness, collaboration and consensus (S1, S2, S3, S6, S7, S8, S11, O2, O3, O6, O7). 2) Strengthening regional regulations and policies as well as collaborative mangrove ecotourism development with the involvement of all relevant parties, including the community, government, academics and environmentalists (S2, S4, S5, O2, O4, O6). 3) Developing the potential of mangrove forest resources as an ecotourism area by highlighting the characteristics and uniqueness of mangrove vegetation and wildlife and adding supporting facilities and infrastructure that are an attraction (S3, S4, S5, S8, S10, S11, O3, O6, O8, O9). 4) Provide opportunities for community groups/NGOs/CSR/Researchers to work together with managers in the development of ecotourism while prioritizing the interests, social, cultural and economic conditions of local communities (S2, S4, S6, S10, O1, O2, O4, O6, O9). 5) Development of conventional business and sales models into online/e-commerce-based business models (S3, S4, S5, S9, S10, O2, O3, O5, O8). 6) Development of an ecotourism promotion model using an online system (using the web, tiktok, instagram, facebook) by highlighting the uniqueness of the area, facilities and infrastructure that are visitors' favorites (S4, S5, S9, S10, S11, O1, O3, O4, O5, O7). 7) Provide training and assistance to groups and individuals on how to make products from mangroves and online marketing systems (S1, S2, S8, S9, O5, O9, O10).

3.2. SWOT-AHP integration using expert choice

The results of the SWOT analysis were then integrated into AHP using the expert choice application. This process includes four branches corresponding to the SWOT criteria: Strengths, Weaknesses, Opportunities, and Threats. The results show that the highest consecutive priority is to maximize strengths with a value of 0.296, followed by taking advantage of opportunities, avoiding threats, and minimizing weaknesses (Figure 3). Each criterion also has sub-factors, each with its own priority value, and these sub-factors are used to formulate strategies. The types of strategies formed are as follows: 7 Strenght-Opportunity (SO) strategies (Figure 4), 6 Strenght-Threat (ST) strategies (Figure 5), 6 Weakness-Opportunity (WO) strategies (Figure 6), and 7 Weakness-Threat (WT) strategies (Figure 7).

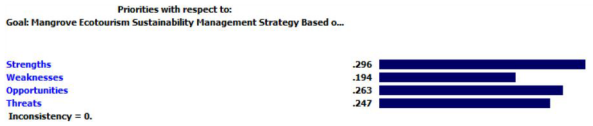

Figure 3. Comparison chart between SWOT criteria

Figure 4. Comparison chart between factors on the element of strength (strength)

In Figure 3 the comparison between SWOT criteria shows that strenght (strength) is the highest criterion followed by opportunities, threats and weaknesses with a value of 0.296, 0.263, 0.247 and 0.194 respectively. Furthermore, the comparison graph between factors on the strength element (Figure 4) seen that the strength factors that can be prioritized to be maximized are Community support around the mangrove ecotourism area is very high (S1); Sustainable community management model around the mangrove ecotourism area (S2); Communities around the mangrove ecosystem area use environmentally friendly fishing gear (S3); Good cooperation between farmers and fishermen and groups in the community (S8) and fast internet access in the mangrove ecotourism area (S9). Each value is 0.161.

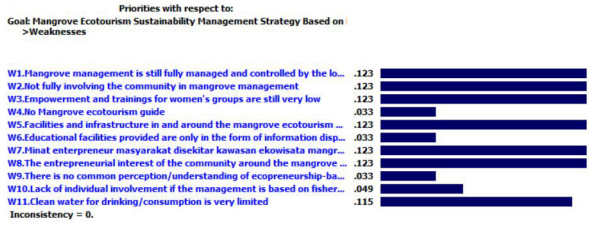

Figure 5. Comparison chart between factors on the element of weakness (weakness)

In Figure 5 show that the weakness factors that can be prioritized for minimization are mangrove management is still fully managed and controlled by the local government (W1); Has not involved the community as a whole in mangrove management (W2); Empowerment and training for women's groups is still very low (W3); Facilities and infrastructure in and around the mangrove ecotourism area are still very minimal and damaged (W5); The entrepreneurial interest of the community around the mangrove ecotourism area is still low (W8) and coordination between community groups around the mangrove ecotourism area is still low (W9). Each value is 0.123.

Figure 6. Comparison chart between factors on the opportunity element

In Figure 6 show that the opportunity factors that can be prioritized to be utilized are the implementation of systems, management, and policies for mangrove ecotourism ecosystems that support (O2); Allocation of funds for mangrove ecotourism development from local governments (O6); Mangrove ecotourism location is very strategic to open business opportunities; (O8) and managers provide employment opportunities for local communities and entrepreneurship around the mangrove ecotourism area (O9). Each acquisition value is 0.182.

Figure 7. Comparison chart between factors on the element of threats

In Figure 7 show that the threat factor that can be prioritized most to be avoided is the community's concern about visitors who only use the ecotourism area as a place to date/free sex (T9). The value is 0.323. Prioritization between strategies tries to compare between strategies obtained from the SWOT matrix. The graph of the value acquisition can be seen as in Figure 8.

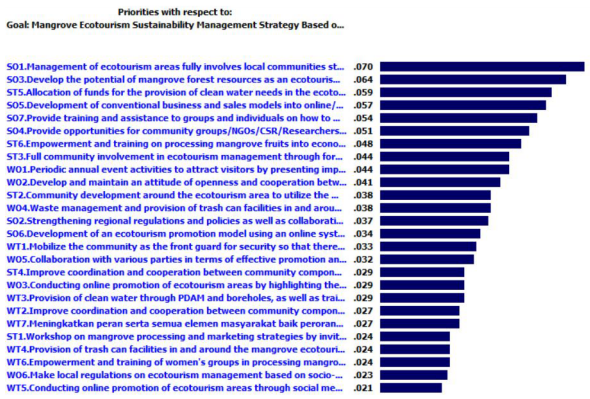

Figure 8. Comparison chart between strategies

Based on Figure 8, the best strategy that can be applied in the management of mangrove ecotourism sustainability based on ethno-ecopreneurship integration, collaborative and creative economy is the management of ecotourism areas fully involving local communities starting from planning, monitoring and utilization of ecotourism areas by adhering to a system of openness, collaboration and consensus (SO1) with a value of 0.070; Developing the potential of mangrove forest resources as an ecotourism area by highlighting the characteristics and uniqueness of mangrove vegetation and wildlife and the addition of supporting facilities and infrastructure that are an attraction (SO3) with a value of 0.064; Collaboration with various parties in terms of effective promotion and marketing by utilizing social media, websites, brochures, and other promotions (ST5) with a value of 0.059; Development of conventional business and sales models into online/e-commerce-based business models (SO5) with a value of 0.057 and Providing training and assistance to groups and individuals on how to make products from mangroves and online marketing systems (SO7) with a value of 0.054.

4. Discussion

Innovation in tourism is expected to support sustainable development goals by integrates ethnoecopreneuship, collaborative, creative economy to formulate sustainable mangrove ecotourism strategies. This study formulates the 5 best strategies, the first is the management of ecotourism areas that fully involve local communities starting from planning, supervising and utilizing ecotourism areas by adhering to a system of openness, collaboration and consensus (S01). This strategy requires the full participation of local communities in the entire ecotourism management process, starting from planning, supervision and utilization, by promoting openness, collaboration and consensus. This is in line with the study by Singgalen (2020) that a community-based ecotourism approach combined with the Higaro culture in North Halmahera has succeeded in preserving and utilizing mangrove forests to support community livelihoods. In addition, research by Chamberland-Fontaine et al. (2022) revealed that increasing local community awareness regarding the socio-ecological merits of mangrove ecosystems and company support for mangrove restoration have been effective in promoting sustainable mangrove management. However, the challenge lies in implementing the management plan and expanding collaboration and reguler communication among stakeholders (Akram et al., 2023). This underscores the need for a stronger focus on strategies to enhance communication, collaboration, and trust among diverse stakeholders.

Collaborative approaches can be formalized through legal frameworks and within mangrove management plans. At the legislative and policy level, there should be greater emphasis on the responsibilities of local governments (Cann, 2018). Local governments, endowed with power, resources, and responsibilities, should actively identify priority areas for community development and engage in cross-boundary tourism projects to effectively regulate their activities (Karpiuk et al., 2019). Moreover, the involvement of all stakeholders, including local communities and non-governmental organizations, is leading to a

more sustainable approach to mangrove management (Arfan et al., 2023a; Djosetro & Behagel, 2020). Participation of local communities can actively support conservation measures, provided these measures also support their livelihoods (Lavieren et al., 2012). Furthermore, local residents should be encouraged to participate in the tourism industry and explore careers in tourism, with the expectation of attracting young individuals to return and work in the area after completing their education (Sangchumnong, 2019).

The second strategy is to develop the potential of mangrove forest resources as an ecotourism area by highlighting the characteristics and uniqueness of mangrove vegetation and wildlife as well as the addition of supporting facilities and infrastructure that are an attraction (SO3). This strategy focuses on highlighting the characteristics of the mangrove ecosystem, showcasing mangrove vegetation, wildlife, and enhancing the visitor experience by adding supporting facilities and infrastructure. The research site has a fairly well-maintained mangrove ecosystem. Based on a study conducted by Askar et al. (2021), the ecological dimensions of mangroves in Jeneponto are categorized as sustainable and can be managed well. However, ensuring long-term sustainability necessitates stakeholder collaboration, particularly in increasing mangrove vegetation thickness. Additionally, improving service quality is crucial, as the recreational potential of ecosystems is influenced by factors such as accessibility, uniqueness, and infrastructure (Prodanova & Varadzhakova, 2022). Moreover, the development of ecotourism facilities must integrate ecological considerations, utilizing modern and environmentally friendly materials and technologies (Fattah et al., 2020). Beyond mangroves, the broader recreational potential of forests plays a crucial role in balancing social and protective functions, influenced by variables such as habitat humidity, stand age, slope, density, undergrowth presence, soil cover, and species composition (Dudek, 2017). These factors collectively determine the suitability of forests for ecotourism and recreational activities, reinforcing the need for comprehensive management strategies that align conservation goals with sustainable tourism development.

The third strategy is collaboration with various stakeholders for effective promotion and marketing through channels like social media, websites, brochures, and other promotional tools is essential for attracting visitors and raising awareness (ST5). Studi Vandarakis et al. (2019) in Rhodes Island, Greece, that factors such as the friendliness of the local population, guaranteed security, and adequate infrastructure have contributed to the increased value of tourism. Both the natural and social potencial of a tourist site need need to be promoted in a modern way for tourism promotion and development that is aligned with multidimensional social and financial aspects. The real potential for value creation through the integration of tourism experiences with creative content and concepts can attract new target groups, improve the image and competitiveness of tourist destinations, and support the growth of creative industries (Sangchumnong, 2019).

Another effective strategy involves transitioning traditional business and sales models into online and e-commerce-based models (SO5). The last, providing training and assistance to groups and individuals on how to make products from mangroves and online marketing systems (SO7). These two strategies are interlinked and underscore the importance of embracing digital technology and offering training to improve mangrove-derived products. This is in line with findings by (Arifanti et al., 2022) who proposed a SWOT sustainable mangrove development strategy to create mangrove processed commodities through awareness-raising and community training. Furthermore, studies by Titisari et al. (2022) on sustainable ecotourism strategies for achieving development goals emphasize the need to develop website networks, facilities, and mangrove forest products.

These strategies that have been formulated are supported by relevant studies and examples from different regions, highlighting the importance of community enggement, ecological considerations, effective promotion, and embracing digital technologies in sustainable mangrove ecotourism management. Digital technology in the sustainable management of mangrove ecotourism. The authors suggest that future studies are needed to design mangrove ecotourism governance models to support the SDGs.

5. Conclusions

This study highlights the importance of integrating ethnoecopreneurship, collaboration, and the creative economy in ensuring the sustainability of mangrove ecotourism in Indonesia. The findings reveal that active community participation, resource optimization, digital transformation, and strategic promotion are key drivers of sustainable development in this sector. The SWOT-AHP analysis provided a structured framework to assess internal and external factors, guiding the formulation of seven Strength-Opportunity (SO) strategies, six Strength-Threat (ST) strategies, six Weakness-Opportunity (WO) strategies, and seven Weakness-Threat (WT) strategies. The selected aggressive strategies (Quadrant I) underscore the potential of community-inclusive ecotourism management, infrastructure development, digital marketing, and entrepreneurial training to enhance resilience and sustainability.

This study contributes to existing knowledge by presenting an innovative interdisciplinary model that integrates traditional ecological knowledge with modern economic and technological advancements. Unlike previous studies that focused solely on conservation or economic benefits, this research bridges socio-cultural, ecological, and economic dimensions, providing a more holistic framework for sustainable tourism.

Despite its contributions, the study has some limitations, including its regional focus, which may affect generalizability, and the need for long-term impact assessments to validate the effectiveness of proposed strategies.

Future research should explore adaptive governance models and assess the role of digital ecosystems in optimizing ecotourism. By refining and expanding these strategies, mangrove ecotourism can serve as a model for sustainable tourism, balancing environmental conservation with economic growth and social empowerment.

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Author contributions

Conceptualization, Sukri Nyompa, Amal Arfan, and Muhammad Rakib; methodology, Amal Arfan; software, Muhammad Faisal Juanda; validation, Amal Arfan and Sukri Nyompa; investigation, Amal Arfan, Irwansyah Sukri, and Muhammad Faisal Juanda; writing-original draft preparation, Muhammad Faisal Juanda and Irwansyah Sukri; writing-review and editing, Sukri Nyompa, Amal Arfan, and Muhammad Rakib; supervision, Sukri Nyompa, and Amal Arfan; funding acquisition, Sukri Nyompa, Amal Arfan, and Muhammad Rakib. All authors have read and agreed to the published version of the manuscript.

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