

**SUSTAINABLE ECO-FRIENDLY AGROTOURISM DEVELOPMENT STRATEGY
ANALYSIS IN TOMOHON CITY**

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Abstract

The tourism sector has become a significant contributor to economic growth in various regions, including Tomohon City. The development of the tourism industry, especially the agrotourism sector, has become a trend favored by business actors. To take advantage of this trend, a mature strategy is very important to increase the growth and development of agrotourism in Tomohon City. This study aims to analyze the industry development strategy to encourage sustainable and environmentally friendly agrotourism growth. Quantitative methods based on SWOT analysis and the QSPM method as methods that allow objective evaluation of alternative strategies based on internal and external key success factors. The results of the research reviewed produced a concept for designing agrotourism development in the Agrotourism Area that prioritizes the arrangement and restoration of forest functions to maintain environmental sustainability. By implementing a community empowerment system in agrotourism locations, it will provide benefits to the surrounding community in line with the principles of sustainable tourism development. Its novelty value is by combining an environmentally based agrotourism development strategy by considering elements of local wisdom and the socio-cultural conditions of the community. Furthermore, it has implications for the development of interdisciplinary studies between strategic management, ecotourism, and environmental sustainability, and can be used as a model for similar research in other areas. The ecological implications of this strategy lead to the preservation of agrarian landscapes and local biodiversity, while reducing the pressure on the environment from uncontrolled mass tourism.

Keywords: Agrotourism Areas, Sustainable Environment, Tourism Development.



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INTRODUCTION

The tourism sector has emerged as a vital catalyst for regional development, offering pathways to bridge cultural diversity and stimulate inclusive and sustainable economic growth (Haigh, 2020; Budiarti & Suryani, 2021; Sari et al., 2022; Yudhistira & Febrianti, 2023). The interaction between tourists and local communities establishes a synergistic relationship that enhances skill development, job creation, community welfare, and the conservation of both cultural values and environmental assets (Pangemanan et al., 2021; Suryanto & Putri, 2022; Utami & Hidayat, 2023; Rahayu et al., 2022; Indriani & Pramono, 2023; Taufik et al., 2023).

Recent research emphasizes the transformative potential of tourism in revitalizing rural and remote areas by more equitably distributing economic activities and enhancing regional competitiveness (Yulianti & Nugroho, A. 2021; Tanti et al., 2021; Rahman & Astuti, 2022; Persaud et al., 2023; Hartati, & Yusran, 2024). A particularly promising form is agritourism, which integrates agriculture and tourism, allowing visitors to engage in farming activities while fostering appreciation for rural traditions and environmental sustainability (Yulianti & Nugroho, 2021; Tanti et al., 2021; Nguyen & Dang, 2022; Firdaus et al., 2023; Hartati & Yusran, 2024). From an Environmental Engineering Management perspective, agrotourism is not merely viewed as a tourism product, but as an integrated system encompassing natural resource management, land-use planning, environmental infrastructure, waste management, energy systems, and stakeholder engagement. This approach places ecological sustainability as a core variable that must be systematically planned, measured, and controlled (Tanti et al., 2020; Gozali et al., 2023; Diplan, 2025). Despite its potential, agritourism in Indonesia especially in rural areas like Tomohon—remains underdeveloped. Although endowed with natural resources such as Lake Pangolombian and extensive agricultural landscapes, Tomohon lacks strategic integration and community-based management frameworks for agritourism (Nugroho & Astuti, 2020; Maulidiyah & Susilowati, 2021; Yusuf & Setyawati, 2022; Prasetyo et al., 2023; Tanti et al., 2025). This condition indicates a research gap, particularly in integrating an Environmental Engineering Management approach into sustainable agrotourism development strategies (Nguyen & Phan, 2021; Astuti & Darma, 2022).

Current literature often highlights tourism potential in general terms but fails to explore strategic, socio-cultural, and environmental aspects essential for implementing sustainable agritourism. This represents a substantial research gap (Nguyen & Phan, 2021). Given the increasing competition among ASEAN destinations, Tomohon must adopt alternative tourism models. Agritourism could serve as a key mechanism for promoting rural inclusivity, mitigating environmental degradation, and countering the uneven distribution of tourism benefits (Kurniawan et al., 2022; Wijaya et al., 2022; Muhamad et al., 2025). Strategic alignment with the Sustainable Development Goals (SDGs), local wisdom, and ecological principles is imperative.

To address this, the present study proposes a strategic development model using SWOT analysis integrated with the Quantitative Strategic Planning Matrix (QSPM). These tools enable evidence-based prioritization of internal strengths and external opportunities, producing tailored and practical development strategies for Tomohon.

RESEARCH METHOD

This study employs a mixed-method approach (quantitative and qualitative) to obtain a comprehensive understanding of sustainable agrotourism development strategies based on Environmental Engineering Management in Tomohon City. This approach enables analyses that are not only descriptive, but also analytical and oriented toward strategic decision-making. The study is structured within an Environmental Engineering Management framework, which conceptualizes agrotourism development as a system influenced by the interrelationships among social, economic, and environmental aspects. The dependent variable in this study is the design of sustainable agrotourism development strategies, which is influenced by several independent variables, namely:

1. Rural communities are often characterized by low population density, simple infrastructure, and land use dominated by agriculture, plantations, and forestry (Ciolac et al., 2020) (Pantiyasa, et al. 2023).
2. Agriculture is a primary economic activity for rural residents, providing a source of income through the cultivation of rice, secondary crops, and fruits. (Nguyen & Phan, 2021).

3. The development of rural tourism, including agrotourism, can contribute to the sustainable growth of these communities by leveraging their agricultural resources. (Nguyen & Phan, 2021).
4. Agrotourism, in particular, relies on agricultural activities as a core component of the tourism products and experiences.
5. This form of tourism can provide rural communities with opportunities for income diversification, infrastructure development, skill-building, and environmental protection, among other benefits (Nguyen & Phan, 2021)

The dependent variable in this research is the agrotourism development design which is studied within the conceptual framework and theoretical framework of agrotourism development.

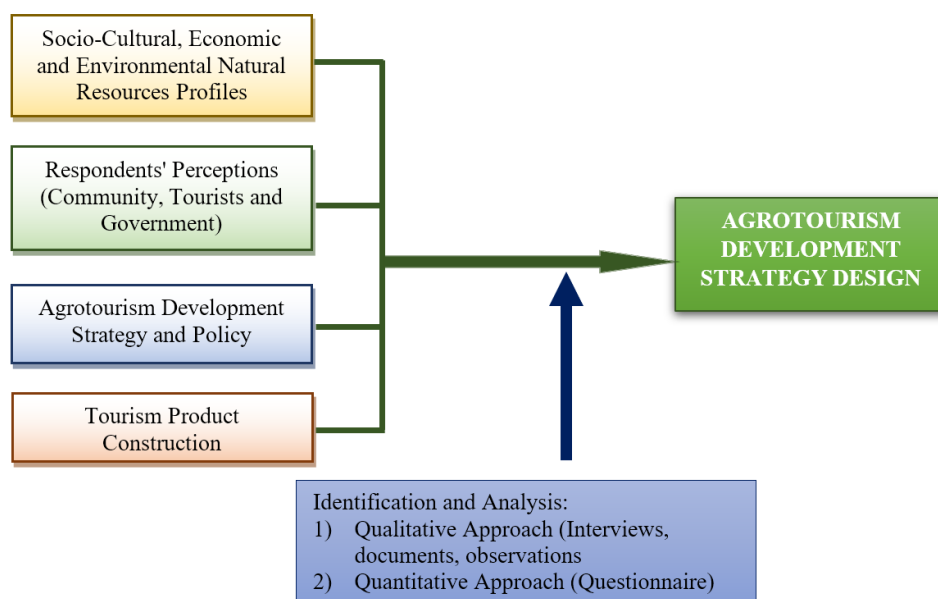


Figure 1. Research Conceptual Framework

This study uses a quantitative and qualitative approach (mix-method) to obtain comprehensive data. Data collection techniques are carried out through:

1. Field Observation: To identify the potential and existing conditions of agrotourism in Tomohon City.
2. Structured and Semi-structured Interviews: Conducted with key stakeholders, such as the Tourism Office, farmer groups, tourism managers, and local communities.
3. Questionnaire: Given to respondents selected based on certain criteria to assess perceptions, readiness, and support for agrotourism development strategies with a Likert Scale of 1-5.
4. Documentation Study: Includes secondary data collection from city planning documents, tourism reports, RPJMD, and environmental documents.

Qualitative Analysis: Data from interviews and observations were analyzed using data reduction techniques, data presentation, and drawing conclusions according to the Miles and Huberman model. Quantitative Analysis: Questionnaire data were analyzed using descriptive and inferential statistical methods, including: (1) Reliability and Validity Tests, (2) SWOT Analysis to map strengths, weaknesses, opportunities, and threats, (3) Analytical Hierarchy Process (AHP) to determine strategic priorities, and (4) QSPM (Quantitative Strategic Planning Matrix) to select the best strategy. The number of samples in this study was 315 respondents consisting of agrotourism farmers, MSME actors, local tourists, and government representatives. Based on these measurements, using the Slovin approach ($n = N / (1 + Ne^2)$), and an estimated population of 1,000 relevant actors in the agrotourism sector, this sample size has met the minimum threshold with a margin of error of 10%, so that the results obtained are quite representative and can be generalized to a limited extent for policy making at the city level. Statistical analysis in this study focused on quantitative data processing using SPSS and Expert Choice software. Validity and reliability tests were carried out on all instrument items with the results of $r_{count} > r_{table}$, and a

Cronbach's Alpha value of 0.87 which indicates a high level of reliability. Furthermore, the Analytical Hierarchy Process (AHP) technique was used to weight the strategy criteria, while QSPM was used to assess the relative attractiveness of each alternative strategy. The results of these two approaches are processed to formulate the main strategy for developing sustainable agrotourism, which is in line with the principles of the environment and local economy in Tomohon City. Data collection was carried out in May 2024.

Table 1. Distribution of Respondents

Respondents	Amount	Percentage (%)
Tomohon City Government, South Tomohon District, and Pangolombian and Tondangow Subdistrict Governments	51	16.19
Tourists at the Lake Linow Tourist Attraction	49	15.56
Communities in Pangolombian and Tondangow	215	68.25
Amount	315	100.00

The research process involved three stages: the first stage focused on identifying the internal and external factors, the second stage explored the perceptions of respondents, and the third stage examined the policy strategies for development. (Pesimo-Abundabar, 2022). Respondents were determined using the Accidental Sampling technique, considering that they are stakeholders, both individuals and institutions, who directly or indirectly influence policy making. (Chen & Bao, 2014). The data obtained from the interview process was then discussed to establish a common understanding regarding the desired agrotourism development strategy design. Interviews are recommended when the research design involves exploring how participants understand a particular issue in their own words, especially for non-literate populations or groups with physical limitations that impact their ability to participate in other data collection methods (Dunwoodie et al., 2022). Developing an agrotourism strategy requires a comprehensive understanding of the socio-cultural, economic and natural-environmental resource profile in the target area (Mora, 2019; Kurniawan & Khademi, 2024). Pangolombian-Tondangow, which is located in the city of Tomohon, is the focus of this research.

Validity is a multifaceted concept that covers various aspects of research instruments, including construct validity, content validity, and criterion-related validity (Ntumi & Antwi-Agyakwa, 2022). Construct validity tests the extent to which an instrument measures the theoretical construct underlying the instrument it wishes to measure. Reliability is related to the consistency and stability of measurements obtained from a research instrument. Cronbach's Alpha Formula and Interpretation (Kotian et al., 2022).

$$\alpha = \left(\frac{K}{K - 1} \right) \left(\frac{s_r^2 - \sum s_i^2}{s_x^2} \right) \dots (1)$$

If $\alpha > 0.7$, the reliability is considered acceptable (Hidayati & Rachman, (2021). If $\alpha > 0.8$, the reliability is considered strong, suggesting that the items within the scale are highly reliable and the entire testing process is stable and reliable (Lestari dan Adnyana, (2023). On the other hand, if the Cronbach's alpha value is low, it indicates that some of the items may not be reliable, and further investigation is needed to identify and potentially remove those items (Permana & Santosa 2021). Data in the field shows the validity and reliability of the question instruments that can be used, as shown in Table 2.

Table 2. Degree of Validity and Reliability of Research Questionnaire Instruments on Respondents' Perceptions

Question	r	Critical value	Remarks
Is the Pangolombian-Tondangow area an agrotourism area?	0.78	0.122	Valid
To what extent are protected forests and lakes an integral part of agrotourism development?	0.65	0.122	Valid
To what extent are protected forests and lakes an integral part of agrotourism development?	0.76	0.122	Valid

Question	r	Critical value	Remarks
How important is capital and investment to support agrotourism objects?	0.75	0.122	Valid
How important is infrastructure planning and environmental planning?	0.74	0.122	Valid
Is industrial development for agrotourism development accompanied by an increase in Human Resources?	0.73	0.122	Valid
Can the existence of an integrated agrotourism park support this?	0.70	0.122	Valid
How to ensure the rules/regulations to ensure sustainability	0.59	0.122	Valid
To what extent are the program plans and activities carried out?	0.61	0.122	Valid
Is support from various related parties going well?	0.76	0.122	Valid
Alpha	0.89	0.700	reliabel

Source: Questionnaire Data Processing Results, 2024

From the results of the analysis of the question items obtained, the validity and reliability of the questions tested to describe agrotourism development strategies in the Pangolombian-Tondangow area are given in Table 3.

Table 3. Validity Test Values and Validity of Product Construction Aspects Related to Agrotourism Development Strategy in the Pangolombian-Tondangow Area

Aspect	Question	R table	Critical Values	Description	Alpha	R	Description
Green open space	Agricultural Technology Garden		0.74	Valid	0.95	0.228	Reliabel
	Environmentally friendly livestock village		0.73	Valid			
	Protected forest		0.72	Valid			
	The charm of the lake		0.77	Valid			
	Natural acoustics		0.80	Valid			
Programs and attractions	Museum	0.23	0.80	Valid	0.72	0.228	Reliabel
	Culinary tour		0.68	Valid			
	Horse riding		0.79	Valid			
	Farming studio and learning		0.69	Valid			
	Art		0.65	Valid			
Infrastructure Green open space	Worship place		0.70	Valid	0.84		Reliabel
	Playground		0.76	Valid			
	Swimming pool		0.76	Valid			
	Lodging		0.71	Valid			
	Souvenir center		0.81	Valid			

Table 3 shows that the validity and reliability values have met the provisions that apply to aspects of production construction related to the agrotourism development industry.

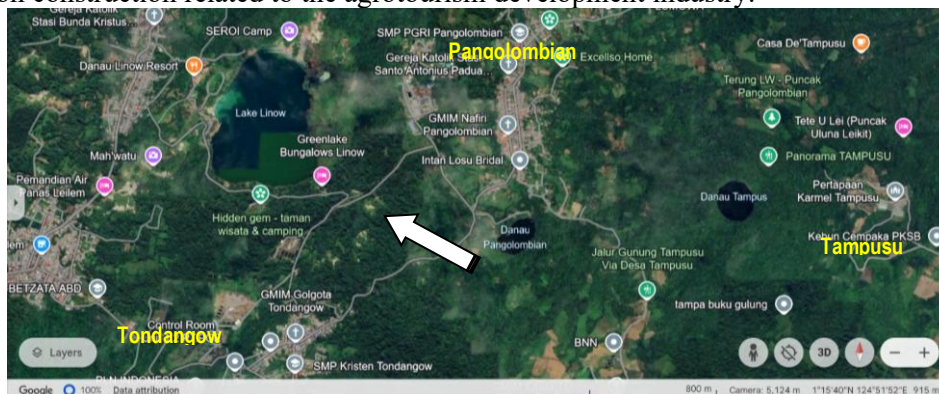


Figure 2. Research Location (Source: Google Earth, 2024)

The study employed a qualitative approach, gathering data through interviews, observations, and document analysis. Mountain, and cultural conservation tourism have become increasingly popular tourist attractions, and the economic impact of tourism is significant in enhancing local livelihoods (Wahono et al., 2019). The research collected data through a questionnaire survey to explore public perceptions, using quantitative descriptive analysis techniques. To ensure consistent analysis, this study adopted a Likert scale approach. The Summated Rating method to determine the Likert scale measurement score, with the highest and lowest scores given for each answer choice.

$$A_i = \frac{(a.5) + (b.4) + (c.3) + (d.2) + (e.1)}{a + b + c + d + e} \dots (2)$$

The Pangolombian-Tondangow area has considerable potential for agrotourism development, considering its rich socio-cultural, economic and natural resources. The approach used is qualitative and quantitative analysis, SWOT assessment, and the QSPM method. Quantitative descriptive analysis provides insight into public perceptions of the development of the tourism industry and development of tourism products in the Pangolombian-Tondangow area (Rojabi et al., 2023). SWOT analysis to formulate a systematic policy strategy for the development of the tourism and agrotourism industry in the region (Rojabi et al., 2023). QSPM method, to evaluate alternative strategies objectively based on key success factors identified both internally and externally (Permana & Santosa, 2021); Wicaksono et al. 2023). SWOT analysis to be used as preparation material in four quadrants as follows figure 3.



Figure 3. SWOT Analysis

SWOT analysis examines the current conditions by evaluating the strengths, weaknesses, opportunities, and threats associated with the agrotourism sector. The SWOT analysis framework provides a structured approach to identifying the internal and external factors influencing agrotourism development. (Rojabi et al., 2023) Internally, the strengths and weaknesses of agrotourism enterprises and destinations can be evaluated, while externally, the opportunities and threats posed by the broader environment can be examined. (Мандражи, 2021). Analysis of agrotourism destination development reveals four main strategies. The first strategy, known as the S-O strategy, involves leveraging the destination's existing strengths to take advantage of existing opportunities. The second strategy, the S-T strategy, aims to use the destination's strengths to minimize or mitigate threats that may arise. The third approach, the W-O strategy, focuses on minimizing destination weaknesses by exploiting existing opportunities. The final strategy, the W-T strategy, seeks to address the destination's weaknesses while reducing or eliminating any threats. Implementing this strategy can pave the way for the development of sustainable agrotourism destinations. The research delves into the interplay between internal and external conditions, and its subsequent translation into a SWOT matrix (Purnomo, et al. 2024). This analysis serves as a foundation for the application of the Quantitative Strategic Planning Matrix method, which enables strategists to objectively evaluate strategic alternatives based on previously identified key internal and external success factors. SWOT analysis is a widely recognized tool for analyzing internal and external environments, providing a systematic approach to decision-making. It involves the identification and evaluation of an organization's Strengths, Weaknesses, Opportunities, and Threats, allowing for a comprehensive understanding of the strategic landscape. To address this limitation, the Quantitative Strategic Planning Matrix method is employed, which enables strategists to evaluate strategic alternatives objectively, based on the previously identified key internal an external success factors (Elezaj & Kuqi,

2023) (Astachova et al. 2021) (Haekal, dkk. 2022). The QSPM Method development process consists of six main steps, as outlined below:

Step 1: Conduct a comprehensive analysis of the organization's internal and external environments. This involves identifying the company's strengths, weaknesses, opportunities, and threats (Wulandari & Widiyanto, 2014). Step 2: Determine Key Internal and External Factors; the next step is to identify the key internal and external factors that will be used to evaluate the strategic alternatives. Step 3: Assign; Weights to Each Key Factor. Step 4: Identify; Possible Strategic Alternatives. The fourth step is to identify the possible strategic alternatives that the organization can pursue. Step 5: Evaluate; The Strategic Alternatives. The fifth step is to evaluate each of the strategic alternatives identified in step 4. This evaluation should be based on the key factors identified in step 2 and the weights assigned in step 3. Step 6: Select the; Optimal Strategy. The final step in the process is to select the optimal strategy based on the evaluations conducted in step 5. There are 3 aspects related to agrotourism development, namely: 1) Aspects of utilizing Green Open Space (RTH), 2) Aspects of artificial tourist attractions and programs, and 3) Aspects of facilities and infrastructure.

RESULTS AND DISCUSSION

Agrotourism Development Strategy in the Pangolombian-Tondangow Area

The Pangolombian–Tondangow area demonstrates strong potential for sustainable agrotourism development when examined from an Environmental Engineering Management (EEM) perspective. Agrotourism can provide a valuable addition to traditional agricultural income streams while encouraging environmental conservation and community empowerment (Malkanathi et al., (2015).

Position Analysis of Agrotourism Development Design

Through SWOT analysis, this potential can be clearly identified and positioned for future growth. Internal factors show strong superiority, with the total strength score exceeding the total weakness score by a significant difference of 27 points (Rojabi, Budiatiningsih, & Pratama, 2023). This shows that the area has a strong foundation of resources and capabilities that can be utilized to encourage agrotourism. On the external side, growth opportunities outweigh threats with a score of 18, indicating that the broader environment is conducive to agrotourism development in the region (Rojabi, Budiatiningsih, & Pratama, 2023). Agrotourism offers the potential to improve the rural economy while encouraging environmental conservation, but requires a strategic approach to ensure its sustainability (Trianita, Djatna, & Fauzi, 2019). By using quantitative modeling techniques, researchers can gain valuable insights into the main drivers of agritourism development and formulate effective strategies to address them. A quantitative modeling framework for developing agritourism design strategies, based on insights from relevant literature, as in Figure 4.

	STRENGTH (S)	WEAKNESSES (W)
INTERNAL	<ol style="list-style-type: none"> Has natural resource potential with appropriate support for the development of agrotourism Community support for local cultural & culinary attractions. The community's culture of life is "Mapaha" (mutual cooperation). The hospitality of the local community. The community still maintains traditional culture. Have adequate communication facilities. The desire of society to progress. Has adequate transportation facilities The level of security in the area is guaranteed 	<ol style="list-style-type: none"> The government's role has not been optimal in tourism development efforts. Weak cross-sectoral coordination. The role of the community is still lacking in tourism development efforts because people are still found throwing rubbish carelessly. Lack of competent human resources in the tourism sector. The condition of road infrastructure is not yet in good condition. There are no accommodation facilities (lodging and restaurants) yet. Capital sources are inadequate.
EXTERNAL		
OPPORTUNITY (O)	STRATEGY (STRENGTH - OPPORTUNITY; S-O)	STRATEGY (WEAKNESSES - OPPORTUNITY; W-O)
<ol style="list-style-type: none"> The development of tourism potential can influence the economic growth of the community. Tourist attractions that offer high appeal. Support for government programs & AEC, as well as the North Sulawesi government program with the "Marjo torang ka Manado" program regarding tourism. Increase in Original Regional Income. Investors who are interested in the potential of agrotourism. The increasing interest in travel by both foreign tourists & domestic tourists There is the development of an agricultural technology park The higher the level of public education. 	<ol style="list-style-type: none"> Encourage the community to take an active role as tourism business actors (for example in home industry activities) and strive to maintain good social values (S-1.2,3,4,5,7,8,9; O-1.2,5,6,7). Improving the quality of tourist attractions supported by good and adequate facilities and infrastructure (S-1,6,8; O-2,4,7). The government is paying more serious attention to developing tourism potential (S-1,5,6,7,8,9; O-1,2,3,4,5,6,7,8). 	<ol style="list-style-type: none"> Continuous outreach and training by the government for the community in an effort to improve the quality of tourism (W1,3,4; O1,3,4,5,6,7,8). Establish good communication between government, private sector and society (W1,2,3,6,7; O1,3,4). Striving to improve and increase facilities and infrastructure as well as good relations between related parties as tourism business actors (W1,2,3,4,5,6,7; O2,3,6,8).
THREAT (T)	STRATEGY (STRENGTH - THREAT; S-T)	STRATEGY (WEAKNESSES - THREAT; W-T)
<ol style="list-style-type: none"> Government capital is not sufficient to support agrotourism development. The entry of negative foreign cultural influences. The higher the crime rate. There are still tourists who feel unsafe. The higher the pollution and environmental damage. 	<ol style="list-style-type: none"> The government seeks cooperation with the private sector to become investors in the tourism business (S1,2,3,4,5,6,7,8,9; T1,5). Instilling strong local ethics and cultural values in the community (S2,3,4,5,7,9; T2,3,4,5). 	<ol style="list-style-type: none"> The government needs to build and maintain strong and mutually beneficial business relationships (W1,2,3,7; T1). Making efforts to procure waste transport vehicles and requiring strict legal regulations regarding sanctions for pollution and damage to the environment (W1,3; T5). The government needs to provide outreach, training and facilitate marketing networks on an ongoing basis to utilize crafts or other products from the surrounding community (W1,2; T1). The government needs to collaborate with to create quality and resilient human resources to respond to competition and tourism development (W1,4; T2,3,4). Capital loans are needed by the government to external parties for physical and non-physical development at agrotourism locations (W1,5,6,7; T1,3).

Figure 4. SWOT Matrix Model for Agrotourism Development Design Strategy

Based on the strategy matrix model in Figure 4 above, the agrotourism development design strategy can be formulated as follows:

- 1) Encourage the community to take an active role as tourism business actors (for example, maximizing local potential with environmentally friendly home industry businesses) and strive for good social values to be maintained continuously.
- 2) Improving the quality of tourist attractions supported by good and adequate facilities and infrastructure.
- 3) The government's attention to being more serious about developing tourism potential.
- 4) Continuous outreach and training by the government for the community in an effort to improve the quality of tourism.
- 5) Establish communication between the government, private sector and the community.
- 6) Strive for improvements and improvements in facilities and infrastructure as well as good relations between related parties as tourism business actors.
- 7) The government seeks cooperation with the private sector to become investors in the tourism business.
- 8) Instill strong local ethics and cultural values in the community.
- 9) The government needs to build and maintain strong and mutually beneficial business relationships.
- 10) Make efforts to procure waste transport vehicles and require strict legal regulations regarding sanctions for pollution and damage to the environment.
- 11) The government needs to provide outreach, training and facilitate sustainable marketing networks to utilize crafts or other products from the surrounding community.
- 12) The government needs to collaborate with Formal Education Institutions in the tourism sector to create quality and resilient human resources to respond to competition and tourism development.
- 13) There is a need for capital loans by the government to external parties for physical and non-physical development at tourism locations.

Strategy Analysis Based on the Quantitative Strategy Planning Matrix Method

The results of the analysis stated that the internal factor analysis consisting of strength factors and weakness factors obtained a total score of 50, while the external factor analysis consisting of opportunity factors and threat factors obtained a total score of 43. From the results of the analysis rating it was found that the internal factors (strengths and weaknesses) has a higher value than external factors (opportunities and threats), so it appears that the design of agrotourism development strategies will be greatly influenced by the influence of strengths and weaknesses. Strong internal factors can be correlated with regional development potential. Internal conditions provide the basis for progress. The main strengths related to the modalities of the Pangolombian-Tondangow agrotourism area must be strengthened, while the weaknesses must be minimized as much as possible. Planning improvements must start with strengthening the capacity and role of government (Rojabi, Budiatiningsih, & Pratama, 2023). Weak government involvement is a common problem in developing countries, and is often related to complex socio-political factors. However, these obstacles can be overcome through cooperation and mutually beneficial relationships. Based on this basic analysis, the next step is to carefully examine potential policy strategies and identify those that promise the greatest impact. The results of the evaluation of internal and external factors can be seen in Figure 3 and Figure 4 below.

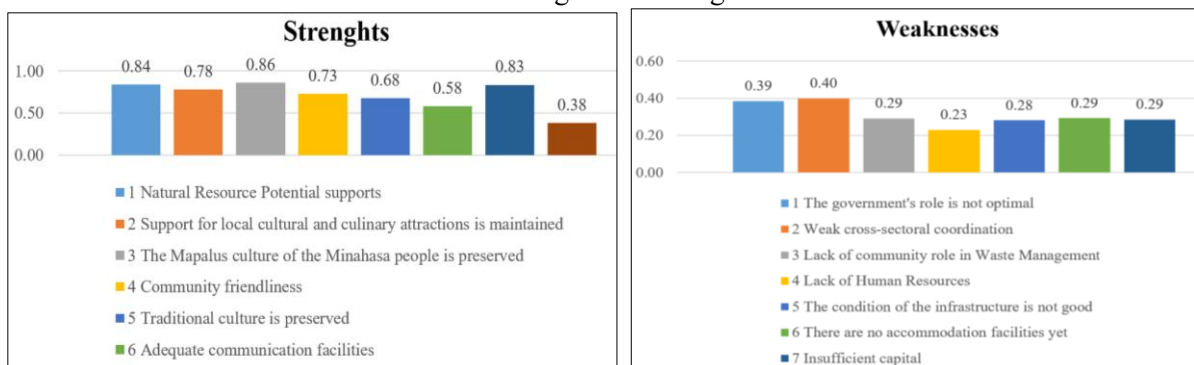


Figure 5. Internal Strategic Factors (Strengths and Weaknesses)

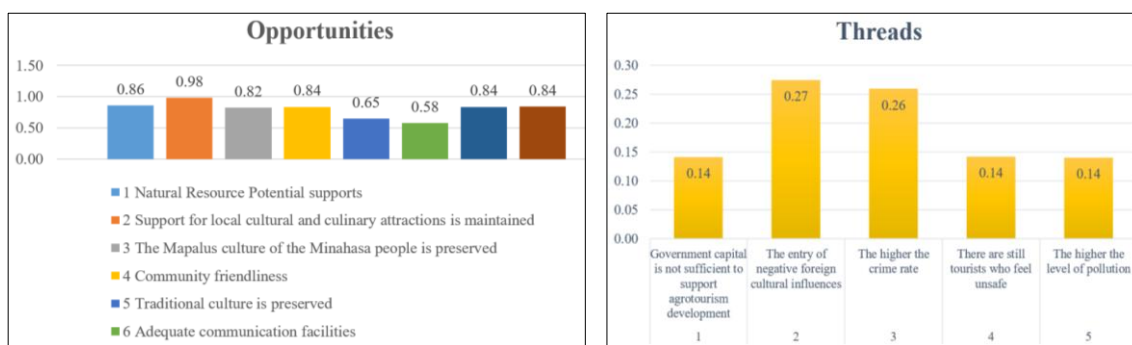


Figure 6. External Strategic Factors (Opportunities and Threads)

The results of the analysis state that strategy 1 is to encourage the community to play an active role as tourism business actors (for example maximizing local potential with environmentally friendly home industry businesses) and ensuring that good social values are maintained. Strategies 2 and 3 consist of improving the quality of tourist attractions supported by good and adequate facilities and infrastructure as well as government attention to more seriously develop tourism potential. Strategy 9: The government needs to build and maintain strong and mutually beneficial business relationships. From the results of the previous analysis, it is known that the SO.1 strategy is the strategy that has the highest value compared to other strategies, followed by the ST.2 strategy, then the W-T.1 and WT.2 strategies.

Development Design in the Pangolombian-Tondangow Area as a Sustainable Agrotourism Area

In the context of tourism space management policies, the Pangolombian-Tondangow Agrotourism Area is a strategic area for the development of the Tondono-Tomohon National Tourism Strategic Area in North Sulawesi Province (Siswahto, & Muryani, 2020). Compared to other provinces in Sulawesi, North Sulawesi Province has the largest number of KSPN which shows the important role of this province in the national tourism industry (Ginting, & Michaela, 2020). In the context of tourism space management policies, the Pangolombian-Tondangow Agrotourism Area is a strategic area for the development of the Tondono-Tomohon National Tourism Strategic Area in North Sulawesi Province (Siswahto, & Muryani, 2020; (Ginting, & Michaela, 2020). This area is also strategically connected to two other National Tourism Strategic Areas in North Sulawesi, namely the Bunaken National Tourism Strategic Area. Agrotourism, a combination of agricultural and tourism activities, has emerged as a promising strategy for rural development. To ensure the success of creating an agrotourism destination, multi-stakeholder and community support is very important in providing the necessary infrastructure and integrated destination components. (Giaccio et al., 2018) (Bhatta & Ohe, 2020) Central and provincial governments play an important role in this process, especially regarding accessibility. Providing adequate infrastructure, such as transport links and visitor facilities, is critical to attracting and accommodating tourists. Apart from that, the government's task of regulating and facilitating is very important in creating an environment that supports the development of agrotourism. Research has highlighted the importance of government involvement, particularly in the early stages of tourism development (Hussin & Buchmann, 2018) This is due to the fact that achieving socio-economic development through tourism depends on various factors that are beyond the control of the industry itself. Key stakeholders in Malaysia's tourism policy include the federal government, state governments, and local tourism professionals, each of whom has a unique role. (Hussin & Buchmann, 2018).

Understanding the operational design of agrotourism development in the Pangolombian-Tondangow area requires considering a broader perspective, including basic perceptions and tourism industry players in developing tourist destinations. This tourist destination development perspective is understood from a market perspective or tourism product marketing perspective (Oka et al., 2021). So what is the branding here is the tourist product Agricultural Technology Park, Livestock Village and Memories Forest which is a unique tourism combination in the Tomohon City area. This is important so that it can be taken into consideration when making decisions to buy or even visit agro-tourism destinations developed in the Pangolombian-Tondangow area. Sumaningrum & Wachyuni (2020) entitled "The shifting trends in traveling after the COVID-19 pandemic" describes changes in tourist preferences, including the increasing demand for natural tourist destinations (Şahin et al., 2020; Kusumaningrum & Wachyuni). The challenge of branding destinations lies with the complexity of the decision process on the part of tourists. Destination branding is regarded as a strong marketing means for

constructing the place's positive image creating emotional bonds with the place's visitors. (Şahin et al., 2020).

Research based on SWOT analysis found:

1. Strengths (S): Biodiversity, local community support, and aesthetic natural potential.
2. Weaknesses (W): Lack of adequate tourism infrastructure, limited promotion, and minimal farmer training.
3. Opportunities (O): Increasing nature-based tourism trends, support from local government policies, and potential ecotourism markets.
4. Threats (T): Climate change, uncontrolled urbanization, and threats of environmental pollution.

Furthermore, QSPM identified that the most feasible strategy to implement is the development of an educational agrotourism model based on a circular economy with the highest total attraction value (TAS = 6.38). These results indicate that the approach to developing agrotourism in Tomohon must not only be nature-based, but also community-based and local knowledge-based. This finding is in line with Sutanto's research (2021) which emphasizes the importance of community participation in the sustainability of ecotourism. However, this study further proposes the integration of a circular economy, which has not been widely discussed in the context of local agrotourism. This study examines the interaction between socio-ecological and institutional aspects, thus providing a more comprehensive picture. Although the main focus of this study is Tomohon City, the results of the study can be conceptually generalized to other areas with similar characteristics, namely highland areas with agricultural and nature tourism potential. However, this generalization is limited because it considers different cultural, geographic, and local policy contexts. Implications of the Research Results will contribute to the literature on agrotourism development strategies. Provide implementation guidelines for stakeholders in Tomohon City to design sustainable agrotourism policies and activities and can be used by local governments to prepare a roadmap for developing organic farming and environmental conservation-based tourism areas. Data collection was carried out at a certain time that may not reflect the seasonal conditions of agrotourism, where the number of respondents was limited to the main actors around the tourist area, so it has not reached foreign tourists or private sector investors, there are several indicators of environmental sustainability that cannot be measured directly and are only based on respondent perceptions. Thus, the study will be the local government in supporting fiscal and technical incentives for environmentally based agrotourism actors. In addition, training and capacity building are needed in waste management, renewable energy, and educational tourism packaging. Can develop spatial-based models (GIS-based agrotourism mapping) and long-term environmental impact measurements and encourage the formation of agrotourism cooperatives that manage activities collectively and sustainably Maymuna, et al (2025).

CONCLUSION

The results of this study confirm that the most effective strategy in developing sustainable and environmentally friendly agrotourism in Tomohon City is the Circular Economy-based Educational Agrotourism Development model. Within an Environmental Engineering Management (EEM) framework, the Participatory Circular Agrotourism model places local farmers as key actors, utilizes organic waste as a resource, and provides educational tourism experiences that promote environmental awareness. This strategy synergizes environmental conservation, local community empowerment, and the use of green technology in an integrated manner. This model is called "Participatory Circular Agrotourism", which conceptually positions local farmers as the main actors, utilizes organic waste as a resource, and presents a sustainable educational experience for tourists. This model is not only limited to providing tourism products, but contains transformative content that invites tourists, communities, and business actors to be involved in a regenerative development cycle. However, this study adds aspects of circular economy and green technology, and places Minahasa local wisdom as an integral component, which has not been widely explored in the literature on agrotourism in eastern Indonesia. The concept of Participatory Circular Agrotourism can be generalized to other mountainous areas in Indonesia that have similar geographical characteristics, socio-cultural, and environmental challenges. This model is adaptive and can be applied to integrated agricultural areas, especially those facing ecological and social pressures due to the growth of conventional tourism.

The practical implication of this study is that agrotourism development is not sufficient to rely solely on physical development (roads, tourism facilities), but requires institutional transformation,

increased community capacity, and cross-sector policy support (agriculture, tourism, environment, and education). For local governments and stakeholders, these findings encourage the birth of regulations and incentives that support the circular economy model in tourism. Meanwhile, MSMEs and local communities can use these results as a framework for creating value-based and sustainable tourism products. The novelty of this study lies in the integration of circular economy and educational agrotourism in one strategic model, a participatory approach that makes farmers not only as objects, but as subjects of tourism, strengthening local Minahasa values as part of attractions and education, and the use of SWOT-QSPM in selecting priority strategies based on local data. This study has limitations, including: Limited geographic scope in Tomohon City, Focus of respondents on local communities, without involving many foreign tourists, Has not tested the effectiveness of concept implementation through longitudinal studies or direct trials (pilot projects). The results of this study are recommended for Further research is recommended to test this model in other areas and on an implementative scale; The Tomohon City Government is expected to integrate these results in the RPJMD and Regional Tourism Master Plan (RIPARDA); Universities can use this concept as a basis for developing community service programs and innovations in agricultural-based tourism villages; and Collaboration between sectors (agriculture, environment, tourism, cooperatives, and education services) needs to be improved so that the transition to sustainable agrotourism can run holistically.

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AUTHOR CONTRIBUTIONS

Author Contributions involved in this study, namely Author 1 (Team Leader): Designing the research design, formulating the background, objectives, novelty, and compiling the theoretical framework and research methodology. Leading the process of collecting and validating field data. Author 2: Responsible for compiling the questionnaire instrument, implementing the field survey, and processing quantitative data. Author 3: Conducting in-depth interviews with stakeholders, and conducting qualitative analysis of interview data and documentation. Author 4: Explaining the strategy model using the QSPM approach and formulating practical and technical policy recommendations based on the results of the analysis. Author 5: Compiling the discussion section, interpretation of the results, and comparing them with theories and previous research findings. Compiling the novelty and limitations of the study. Author 6: Editing and revising the entire manuscript, compiling conclusions and applications, and ensuring that the writing style is in accordance with the format and template Jurnal Ilmiah Ilmu Terapan Universitas Jambi.

CONFLICTS OF INTEREST

The author(s) declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the generation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried out entirely by the authors without the assistance of AI-based technologies.

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