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Developing Indonesia's Tangkahan Ecotourism Area: A Potential, Feasibility, and Priority Policy Analysis

Muhammad Arifin Nasution[1*], Agus Purwoko[2], Achmad Siddik Thoha[2], Jajang Sutiawan[3], Abdul Rahman Cemda[4], Jef Rudiantho Saragih[5], Mohd Nazip Suratman[6], Rahmawaty[2], Reny Khaerany Nisfiary[7], Latipah Hanum Lubis[2], Ulil Amri Daulay[8]

[1] Department of Public Administration, Faculty of Social and Political Sciences, Universitas Sumatera Utara, Medan 20353, Indonesia
[2] Department of Forestry, Faculty of Forestry, Universitas Sumatera Utara, Deli Serdang 20155, Indonesia
[3] Research Center for Biomass and Bioproducts, National Research and Innovation Agency, Jakarta 16911, Indonesia
[4] Agribusiness Study Program, Faculty of Agriculture, Universitas Muhammadiyah Sumatera Utara, Medan 20238, Indonesia
[5] Department of Regional and Urban Planning, Graduate School, Universitas Simalungun, Pematang Siantar 21142, Indonesia
[6] Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam 40450, Malaysia
[7] Department of Psychology, Faculty of Business and Humanities, Universitas Tjut Nyak Dhien, Medan 20123, Indonesia
[8] Department of Forest Management, Faculty of Agriculture and Forestry, Universitas Satya Terra Bhinneka, Medan 20128, Indonesia

Corresponding Author Email: m.arifin.nasution@usu.ac.id

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ABSTRACT

This study examines the potential, feasibility, and priority of developing tourism objects in the Tangkahan Ecotourism Area, Gunung Leuser National Park, Indonesia. The potential and development of natural tourism objects are examined quantitatively. The feasibility and priority of development are analyzed using the guidelines for the Analysis of the Operational Area of Natural Tourism Objects and Attractions. A sample of 100 people was taken using the Slovin formula. The results of the study indicate that the Tangkahan Ecotourism Area has several categories of tourism object potential, namely the beautiful natural scenery and microclimate, the exoticism of clear rivers and waterfalls, natural hot springs, and the exoticism of flora and fauna. By examining the six main aspects (attractiveness, accessibility, community socio-economic, accommodation, facilities and infrastructure, and availability of clean water), the level of feasibility of tourism object development falls within the "feasible" category, with an overall index of 81.34. The feasibility aspects that are sorted include attractiveness (80.55), accessibility (62.5); socio-economic and environmental conditions (66.67), accommodation (91.66), infrastructure (90), availability of clean water (96.66); almost all are considered "adequate", except for the accessibility aspect which is "not yet adequate". Thus, the development of Tangkahan ecotourism must include the development of facilities, increase the attractiveness of existing potential objects, and improve the quality of tourism services. Meanwhile, the priority areas are improving accessibility and the socio-economic conditions of the community in and around the tourist area.

1. INTRODUCTION

Indonesia boasts diverse cultures and natural beauty that can contribute to the country's foreign exchange through various business sectors. One such driver is the tourism sector, which is the country's top source of foreign exchange [1]. Cultural potential and natural beauty are complementary elements of great importance. In Indonesia, sustainable tourism is developed based on local culture, aiming to enhance economic, social, and environmental conservation [2].

Ecotourism is a form of tourism that fosters learning experiences and an appreciation of the natural environment or its components within a related cultural context [3]. Ecotourism is defined as a trip to an area that is still relatively natural and undisturbed, with the specific purpose of studying, admiring, and enjoying the wild natural scenery, animals, and plants [4]. Ecotourism is nature-based tourism that involves education, interpretation of the natural environment, and ecologically sustainable management [5]. This definition acknowledges that the natural environment encompasses cultural components, and that the term 'ecologically sustainable' incorporates elements of a meaningful contribution to local communities and the long-term conservation of natural resources. This is related to the sustainable management of the natural and sociocultural environments. The shift in global tourism to an ecotourism

model is due to the saturation of tourists visiting forest tourism sites [6]. Ecotourism should be conducted to increase the destination's resources while prioritizing the economic feasibility of its operations. This is consistent with the goals of sustainable development, which is to encourage development, particularly by reducing unemployment and poverty [7]. Emphasized a powerful relationship between tourism development and a region's economic growth [8].

Planning, utilizing, controlling, institutional strengthening, and community empowerment strategies should consider social, economic, and ecological principles, and involve stakeholders to develop ecotourism in a region optimally [9]. The high economic orientation of society and government is a crucial determinant in maintaining ecological and socio-cultural order, thereby providing a positive energy to develop comprehensive, integrated ecotourism [10].

In Indonesia's North Sumatra Province, the Gunung Leuser National Park (GLNP) has high potential in the ecotourism sector. For example, the Tangkahan Ecotourism Area in Langkat Regency, North Sumatra (17,000 ha) is a wildlife habitat [11]. Topographically, hills with several steep slopes comprise up to 45% of Tangkahan [12]. Tangkahan, which opened in 2001 and was inaugurated in February 2004, is an example of an ecotourism area with local community participation in nature conservation [13]. Community involvement was initiated in several conservation forest areas prior to the development of the social forestry model, such as community participation in the development of Tangkahan, which can significantly contribute to the conservation of the GLNP area [14]. Twenty years have passed since the ecotourism area began operating under the auspices of the Tangkahan Tourism Institute (TEI). More than 32,000 local tourists visited Tangkahan [15].

The Tangkahan Ecotourism Area has the potential for continued development and supporting community welfare improvement. However, development efforts must consider the landscape's potential and its natural carrying capacity, focusing on priority areas that require intervention. To provide an empirical, evidence-based reference for development policies and their priorities, this research analyzed the potential of tourist attractions that can be developed, the level of feasibility, and the priorities for the development of the Tangkahan Ecotourism Area.

2. METHODS

This research was conducted in the Tangkahan Ecotourism Area of GLNP, Langkat Regency, North Sumatra, from 2021 to 2023. Based on Minister of Forestry Regulation No. P.19/Menhut-II/2004, the Tangkahan Ecotourism Area is located at 3°05'30'' North Latitude and 98°04'26.8'' East Longitude. Tangkahan is an area located on the border of the GLNP on the North Sumatra side of Indonesia, situated at an altitude of 130-200 meters above sea level. The research location is shown in Figure 1.

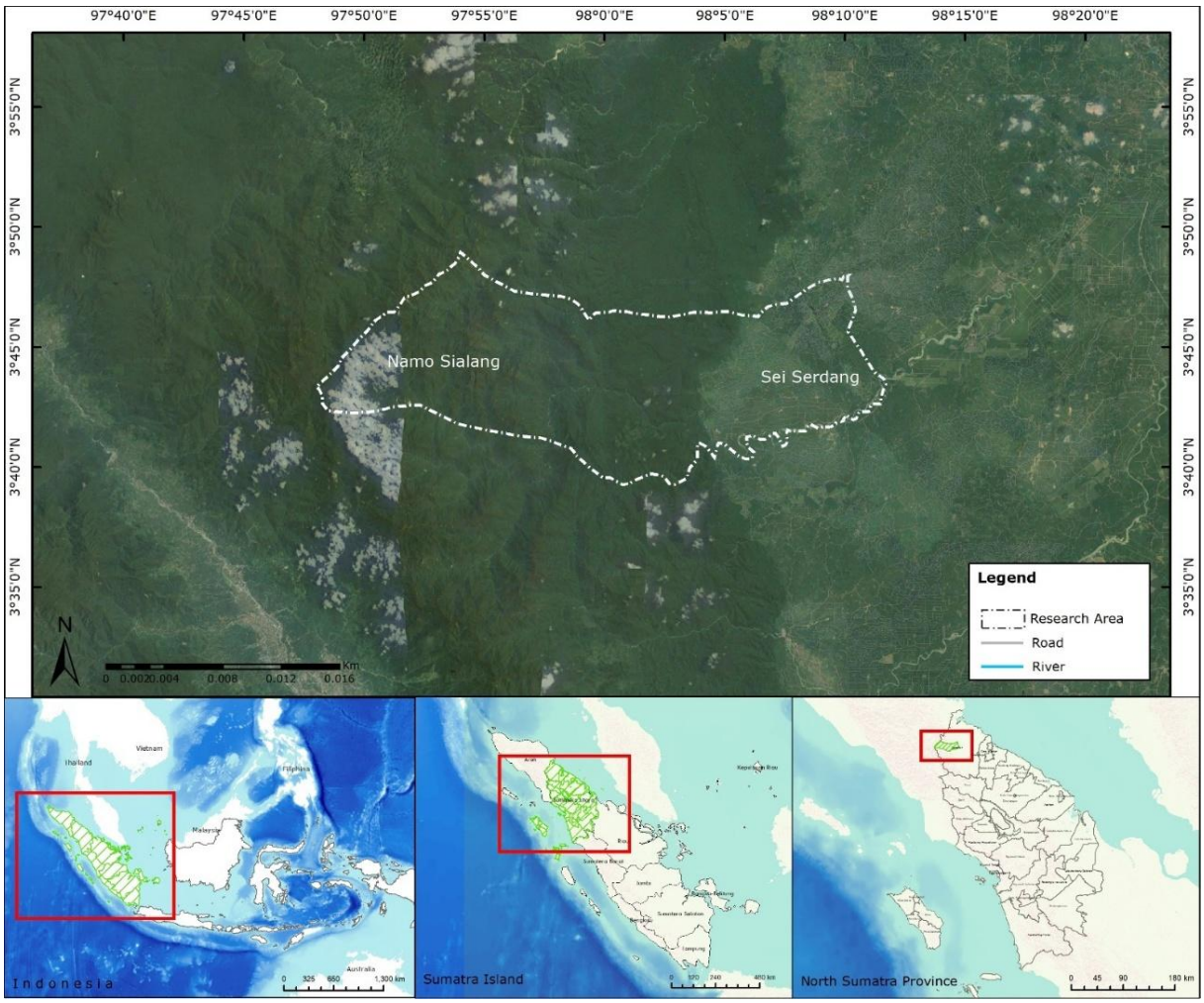

Figure 1. Research area map

2.1 Population and sample

The population comprises all tourists who visit the Tangkahan Ecotourism Area annually. A purposive sampling method was adopted, with accidental sampling. The samples were obtained using the Slovin formula [16]. The error tolerance limit was set at 10%. If the population exceeds 100 people, the value is set between 10% and 15% or 20% and 25% [17]. The Slovin formula is as follows [18]:

$$n = \frac{N}{1 + N\,(e)^2} \quad (1)$$

where,
n = number of samples
N = total population
e = tolerance limit (0.1)

The total number of visitors to the Tangkahan Ecotourism Area was 31,200 per year, as reported by Lembaga Pariwisata Tangkahan (Tangkahan Ecotourism Institut/TEI) [19]. Hence, considering a 10% error tolerance limit, the required sample size was:

$$n = \frac{31{,}200}{1 + 31{,}200\,(0.1)^2} \quad (2)$$

$$n = \frac{31{,}200}{313} \quad (3)$$

$$n = 99.68 \quad (4)$$

The final number of required samples (i.e., respondents) was 100. Thus, the final number of samples needed (i.e., respondents) is 100. To increase its representativeness, respondents were selected from various groups based on visitor categories, as determined by visit data. Respondents were selected using an accidental sampling approach, where they were chosen unintentionally by utilizing visitors who came to the tourist attraction at the time the data were collected.

2.2 Research variable

The variables analyzed, indicators, scores, and assessment criteria used refer to the Operational Area Analysis of Natural Tourism Objects and Attractions (AOA-NTOA) guidelines, issued by the Director General of Forest Protection and Nature Conservation, Ministry of Forestry, Republic of Indonesia, in 2003 [20].

2.3 Data analysis

Data analysis was performed using the following methods:

A descriptive qualitative analysis that aimed to describe and explain the potential of ecotourism objects obtained through field observations and interviews with informants. The instrument used here was an interview guide, which served as a framework for gardening and interviews with ecotourism managers.

The feasibility study for ecotourism development employed assessment criteria based on the AOA-NTOA guidelines, as outlined by the Ministry of Forestry of Indonesia, with predetermined values for each criterion [20].

For each criterion, the numbers obtained from the respondents' assessments were first tabulated. Then, the assessment results were assigned different weights based on the National Tourism Objects and Attractions (NTOA) assessment. Finally, the total score for one NTOA assessment criterion was calculated using the following formula:

$$S = V \times W \quad (5)$$

where,
S = score of a criterion
V = value of the elements on a criterion
W = value weight

Based on the AOA-NTOA guidelines of the Director General of Forest Protection and Nature Conservation [20], the criteria for the attractiveness and availability of clean water are assigned a score of 6 because they are the primary factors influencing someone's decision to engage in tourism activities. Accessibility and Socio-Economic Environmental Conditions are given a weight of 5 because they are important factors that support tourists in carrying out tourism activities. Accommodation and facilities/infrastructure are given a weight of 3 because they are supporting factors in tourism activities. The results of the data processing are then described descriptively.

To determine eligibility, the scores obtained are then compared with the total potential score of a criterion, namely the score obtained if all sub-criteria get the maximum value. The eligibility category of each criterion or the overall eligibility category is determined based on the eligibility index using the following Eq. (6):

$$\text{Object feasibility index value} = \frac{A}{B} \times 100\% \quad (6)$$

where,
A = score of the criterion/overall
B = total maximum score of the criterion/overall

Following the categorization criteria [16], after performing a comparison, a percentage feasibility index was obtained, and feasibility was classified as follows:

1) Feasibility level > 66.6%: Feasible to develop;
2) Feasibility level 33.3%–66.6%: Not feasible yet to develop;
3) Feasibility level <33.3%: Not feasible to develop.

3. RESULTS AND DISCUSSION

3.1 Potential tourism objects in the Tangkahan Ecotourism Area

Ecotourism potential represents the potential for various resources in a particular area, considering economic, environmental, and socio-cultural benefits, which can be developed into tourist attractions [21-23]. Potential tourist attractions in the Tangkahan Ecotourism Area include the beauty of its natural scenery, exotic rivers, diverse flora and fauna, waterfalls, and hot springs.

The potential beauty of the natural scenery and microclimate

The natural scenery that can be enjoyed in the Tangkahan Ecotourism Area is its beauty, coolness, and stunningly

beautiful location at the confluence of two rivers: the Batang Serangan and Buluh (Figure 2). Likewise, the green scenery offered by the expansive forests of the GLNP attracts visitors.

Visitors can also carry out activities along the river using tires (river tubbing) guided by a local guide. The microclimate in this tourist attraction supports ecotourism activities, as the air temperature is not too high at medium altitudes, ranging from 130 to 200 meters above sea level [24]. The air is cool due to the extensive green cover provided by the trees.

(a) (b)

Figure 2. (a) The beauty of Tangkahan's natural scenery, (b) Exotic Sungai Buluh with GLNP forest area background

-The potential of flora and fauna

Tangkahan area, as part of the GLNP, has a rich diversity of flora and fauna [25]. Most of the Tangkahan area is comprised of tropical rainforest, featuring primary Dipterocarpaceae and mixed forests. This area is generally dominated by plants belonging to the Dipterocarpaceae, Meliaceae, Burseraceae, Euphorbiaceae, and Myrtaceae families [26]. The tualang tree is also endemic to this area. In North Sumatra, tualang (*Koompassia excelsa*) trees are only found in Tangkahan [27]. Crucially, this tree can protect the forest ecosystem because its presence reduces the risk of landslides.

Large trees with a diameter greater than one meter, such as damar, meranti, raja, and sandalwood species, can still be seen on relatively easy-to-access paths in beautiful forest areas. Moreover, trees are planted on both sides of the road where the accommodation is located, with hibiscus flowers (*Hibiscus rosasinensis*), lime (*Citrus aurantifolia*), and durian (*Durio zibethinus*).

(a) (b)

Figure 3. (a) Elephant bathing attraction under the supervision of animal handlers, (b) Diversity and beauty of flora in the Tangkahan Ecotourism Area

The Tangkahan Ecotourism Area is renowned for its conservation efforts, which involve the Sumatran elephant (*Elephas maximus Sumatranus*) (Figure 3). The presence of elephants in Tangkahan makes it one of the main destinations for visitors [28-30]. Both local and foreign tourists enjoy the presence of elephants. Forest tracking tours with elephants exploring riverbanks and GLNP together are the most interesting attractions. Another interesting nature-based attraction is the observation and identification of the diversity of flora and fauna found in the TNGL [31]. Other types of fauna found in the Tangkahan Ecotourism Area include small squirrels (Tupai minor), hornbills (Buceros rhinoceros), eagles (*Haliastur sp.*), and long-tailed macaques (*Macaca fascicularis*), which can be easily seen in and around the forest area.

-Potential rivers and waterfalls

One of the main attractions of the Tangkahan Ecotourism Area is a stream with clear, year-round water, which originates from the healthy forest ecosystem of the GLNP. The Tangkahan Ecotourism Area boasts clear river views and beautiful, incredible waterfalls that serve as ideal spots for relaxation. Several waterfall attractions also exist: the Sungai Buluh, Sungai Garut, Tala Tala, Grogoh Kiri Batak, Cengkeh Cengkeh, Murbe, Alor Grogoh Kanan, Sungai Gambir, and Alur Simpang Kanan Waterfall. The waterfall, frequented by visitors, is located near the Buluh River, which has a height of approximately 5 meters. Hence, it is often referred to as a small waterfall. Visitors enjoy the presence of Sungai Buluh Waterfall, which is covered by trees with wide crowns that add coolness. This tourist attraction is also a popular photo spot for visitors (Figure 4).

(a) (b)

Figure 4. (a) River tubbing, one of the most popular ecotourism attractions for visitors; (b) Clear and soothing Sungai Buluh Waterfall, 1 of 9 waterfalls in the Tangkahan Ecotourism Area

-Potential hot springs

The Tangkahan area has natural formations that can become potential tourist attractions, particularly for ecotourism. One of them is a hot spring, as reported [24, 32]. The Tangkahan Ecotourism Area features three hot springs: Buluh River, Sekucip, and Glugur River. The hot spring in Buluh River comes from a rock crevice on its outskirts. Small hot springs are popular tourist attractions that invite visitors.

Visitors to the Tangkahan Ecotourism Area usually soak their feet to enjoy the warm sensation of hot springs. As the manager, the TEI continues to identify natural tourism objects and other special-interest tourism in the Tangkahan area.

3.2 Assessment of the development feasibility level of the Tangkahan tourism object

The components assessed for the development feasibility of tourism objects in the Tangkahan Ecotourism Area are the attractiveness of tourist sites, accessibility, socioeconomic and environmental conditions, accommodation, supporting facilities, infrastructure that supports the development of tourist objects, and availability of clean water. The components are included in the AOA-NTOA guidelines.

Table 1. Attraction assessment results

No.	Elements/ Sub Elements	Description	Weight	Value	Score
1.	The uniqueness of Natural Resources	Hot springs and waterfalls. Fauna found at tourist attraction locations includes elephants, long-tailed monkeys, small squirrels, hornbills, and eagles, as well as flora dominated by plant families such as *Dipterocarpaceae, Meliaceae, Burseraceae, Euphorbiaceae,* and *Myrtaceae.*	6	25	150
2.	Variations of ecotourism activities	Enjoying the beauty of nature, seeing flora and fauna, as well as educational/research activities	6	15	90
3.	Number of prominent natural resources	Large rocks and water are from the Buluh River and Batang Serangan River. The fauna at tourist attraction locations includes elephants, long-tailed monkeys, small squirrels, hornbills, and eagles. The flora found at tourist attraction locations is generally dominated by plant families *Dipterocarpaceae, Meliaceae, Burseraceae, Euphorbiaceae, and Myrtaceae.*	6	25	150
4.	Cleanliness of the ecotourism objects	There is no influence from industry, busy roads, residential areas, garbage, vandalism (scribbling), and other pollution	6	30	180
5.	Security	No illegal logging and forest encroachment, no theft, no disturbing beliefs, and free from dangerous diseases such as malaria	6	25	150
6.	Comfortability	The air is cool and clean, free from disturbing odors, no public traffic, and free from noise	6	25	150
		Total Score of Attractiveness		**145**	**870**

-Attractiveness

The attractiveness of a tourist attraction location is the main reason why people visit it. The Tangkahan Ecotourism Area attracts many visitors through its existing natural resources, including hot springs, waterfalls, flora, and fauna, as well as variations in ecotourism activities, diverse natural attractions, the cleanliness of the tourist attraction location, and the safety and comfort of the tourist destination.

The first criterion of the attractiveness of a tourist attraction is the uniqueness of its natural resources. In Table 1, the criterion of uniqueness of natural resources receives a score of 25 because the Tangkahan Ecotourism Area has four components: hot springs, waterfalls, flora, and fauna. Visitors can enjoy the sight of water falling from large rocks approximately 5 meters high and warm hot springs located between the rocks on the edge of the Buluh River. This criterion weights 6 [20], so the score for this sub-criterion is 150 (weight × value). The scores for all criteria in the attractiveness criterion are added up, resulting in a total score of 870 for this criterion. The level of eligibility for this criterion is determined by comparing the scores on the criteria with the highest score, which is 1080 for the attractiveness criterion. Thus, the eligibility value for the attractiveness criterion is 80.55, placing it in the 'feasible' category.

The second criterion is the variations in ecotourism activities. This criterion had a score of 15 because three components were included in the assessment (Table 1). First, visitors can enjoy the beauty of the Buluh and Batang Serangan rivers, which flow through lush vegetation and rocky terrain. Second, they can see a variety of flowers, including hibiscus (*Hibiscus rosasinensis L.*) planted by the community on either side of the paths going towards tourist attractions and lodging, and large-diameter trees, such as durian (*Durio zibethinus*), sandalwood (*Santalum album*), and ketapang (*Terminalia catappa*) trees. Third, visitors can easily observe fauna, such as long-tailed macaques (Macaca fascicularis), that roam the riverside in search of food left by visitors and engage in related educational and research activities.

The third criterion is the prominent natural resources. This criterion was scored on 25 because the Tangkahan Ecotourism Area has four components included in the assessment. First, it features exotica from a vast expanse of large rocks and water from the Buluh and Batang Serangan rivers. The fauna consists of elephants (E. *maximus sumatranus*) and long-tailed monkeys (M. fascicularis). The flora consists of large trees with a diameter greater than one meter, such as resin trees (*Shorea javanica*), meranti (*Shorea sp.*), king (*S. curtisii*), rubber (*Hevea braziliensis*), durian (*D. zibethinus*), ketapang (*T. catappa*), and sandalwood (*S. album*), which can still be seen on paths that are relatively easy to access in beautiful forest areas.

The fourth criterion is the cleanliness of ecotourism object locations. This was scored on 30 because six components were included in the assessment. The Tangkahan Ecotourism Area remains unaffected by industrial activities, busy roads, residential areas, garbage, vandalism (including graffiti), or other forms of pollution. However, visitors' awareness of maintaining cleanliness and not throwing garbage into rivers is crucial, as they can play a significant role in preserving the beauty of tourist attractions.

The fifth criterion is ecotourism safety, a crucial factor that visitors expect to ensure they can visit the location without worry. This criterion was scored 25 because four components were included in the assessment. Tangkahan Ecotourism Area is protected from illegal logging, forest encroachment, theft, and disturbing beliefs, and is free from dangerous diseases such as malaria.

The sixth criterion is ecotourism leisure. Convenience influences visitors to linger, who enjoy their tours and are then interested in revisiting ecotourism sites. This criterion was scored on 25 because four components were included in the assessment. The Tangkahan Ecotourism Area offers cool and clean air, free from disturbing odors, public traffic, and noise; therefore, it is an ideal place to relax and have fun.

-Accessibility

Accessibility is an essential factor that must be considered to make it easier for visitors to travel from their residence to the tourist attraction's location. In ecotourism, accessibility is often the primary attraction for tourists. If the ecotourism area can be easily accessed with impressive views along the way, this will be the driving force for tourist visits. The main entrance to a natural tourist destination is a crucial factor influencing access to natural tourism activities [33]. Research in Malaysia and Romania has also highlighted the importance

of accessibility level [34, 35]. Tourism service activities essentially aim to provide convenience, comfort, and safety to tourists during their stay and visit to tourist areas. Accessibility refers to the condition and distance of the road, the type of road, and the travel time required to arrive at the tourist attraction's location.

According to the NTOA criteria, the road, approximately 30 km from the nearest city (Batang Serangan District), is categorized as too far to attract tourists. Some of the access roads to the ecotourism area are paved, while others are still gravel roads taken from the river. The travel time required to reach the Tangkahan Ecotourism Area is approximately 2 hours and 30 minutes by land using public or private vehicles. With these conditions, the accessibility criteria are listed as in Table 2.

Table 2. Accessibility assessment results

No.	Elements/Sub Elements	Description	Weight	Value	Score
1	Road conditions and distance	> 15 km from Batang Serangan District	5	30	150
2	Road type	Moderate	5	20	100
3	Travel time from the main city	2-3 hours from the Tanjung Beringin intersection	5	25	125
The Total Score of Accessibility				**75**	**375**

The assessment results, as shown in Table 2, reveal a total score of 375. This value was obtained from the assessment of each element or sub-element. The criteria for the condition and distance of the land road were scored 30 because the road conditions were not very good. This area is located approximately 30 km from Batang Serangan Regency and about 60 km from Langkat Regency. The road type received a score of 20 because it was not very good. Referring to the travel time above, this criterion has a score of 25. Visitors sometimes complain about the conditions of the cobblestone road and a few potholes in the plantation area going to the Tangkahan Ecotourism Area.

-Socio-economic and environmental conditions

The community is an important element in managing an ecotourism area. Its involvement can encourage and improve community welfare, as well as the development of ecotourism itself. The community plays a crucial role in managing and delivering quality services to visiting tourists. As tourist visits increase, the community's role as a recipient of tourists is increasingly incorporated in regional development [33]. Then, the community can play a more active role in providing facilities such as accommodations, souvenirs, and others, thereby enhancing its economic potential.

The total possible score for this aspect is 400. This score was obtained because there is no clear road quality improvement program for the tourist attraction. Currently, there is only a development plan sourced from the master plan, so it is given a score of 5. The land status of the Tangkahan Ecotourism Area is state forest, with a score of 30. The residents around the tourist attraction are oil palm and rubber farmers, with a score of 20. The education level of the residents is mainly junior high school graduates and above, with a score of 25 (Table 3). In the environmental assessment, the economic conditions of the community around the ecotourism location are considered good.

Table 3. Communities' socio-economic assessment results

No.	Elements/Sub Elements	Description	Weight	Value	Score
1	The layout of the object area	There is not any	5	5	25
2	Land status	State forest	5	30	150
3	People's livelihood	Most are farmers	5	20	100
4	Education	Most of them graduated from junior high school and above	5	25	125
Total Score of the Community's Socio-Economic				**80**	**400**

Interviews with the community revealed that they generally supported efforts to develop ecotourism. Additionally, ecotourism development can provide opportunities for local people living in tourist areas to become tourism actors. Communities surrounding the Tangkahan Ecotourism Area are directly involved in implementing ecotourism in the area. They offer their homes as homestays, helping visitors who want to experience the area's beauty and uniqueness by renting out transportation equipment. Visitors' daily expenditure directly becomes a source of income for visitors. Visitors can also purchase souvenirs made from community handicrafts, including bracelet accessories, bags, clothing, and wooden carvings.

-Accommodation

Accommodation is a key aspect of tourism activities, especially for tourists from faraway places, providing a place to stay or even a temporary residence for those traveling. The accommodation assessment results are listed in Table 4.

Besides working as farmers, communities around the Tangkahan Ecotourism Area also open lodging businesses (homestays) for tourists. By staying in a homestay, tourists can gain insight into the local nature, culture, and daily life of that location. The accommodation provided is well-maintained yet straightforward, ensuring that tourists staying overnight feel comfortable and safe during their rest. The Tangkahan Ecotourism Area features 13 inns, all of which are managed by the local community, offering a variety of rooms within each establishment. Homestays can include various types of accommodations, ranging from simple lodging managed directly by the family to staying with a local family in their own home. Ecotourism does not demand comfortable accommodations or complete facilities. Still, having more homestays than visiting tourists is better. True ecotourists do not need comfort or knowledge if it burdens the population's resources at tourist attractions. Rather, appreciation for a high quality of life is more important than a high material standard of living [36]. Nonetheless, many ecotourists demand luxury accommodation, as reported in Turkey and South Africa [37, 38].

Table 4. Accommodation assessment results

No.	Elements/Sub Elements	Description	Weight	Value	Score
1.	Number of lodgings	There are 13 inns: Jugle Loot, Dreamland, Tangkahan Inn, Linea Resort, Bamboo River, Mega Inn, Masta Inn, Egi Inn, Homestay, Green Forest, Montai View, Green Loots, and Teratori.	3	30	90
2.	Number of rooms	There are almost 100 rooms available	3	25	75
	Total Score of Accommodation			**55**	**165**

Table 5. Facilities and infrastructure assessment results

No.	Elements/Sub Elements	Description	Weight	Value	Score
1	Infrastructure	There are pedestrian bridges, roads, parking areas, and electricity networks	3	50	150
2	Supporting facilities	There are restaurants, souvenir shops, and public transportation	3	40	120
	The Total Score of Facilities and Infrastructure			**90**	**270**

Table 6. Availability of clean water assessment results

No.	Elements/Sub Elements	Description	Weight	Value	Score
1	Volume	Abundant	6	30	180
2	The distance of the water source from the tourism object location	Less than 1 km	6	30	180
3	Ease of being distributed to the tourism object location	Very easy	6	30	180
4	Suitability for consumption	Need simple treatment	6	25	150
5	Continuity	available all year round	6	30	180
	Total Score of Clean Water Availability			**145**	**870**

-Facilities and infrastructure

To support ecotourism development, an area's potential or attractiveness must be followed by good development and management, as well as the availability of adequate supporting facilities and infrastructure. In general, tourists not only come to enjoy the attraction but also want to enjoy facilities that can provide satisfaction. The importance of providing good facilities for tourists is evident; specifically, tourists' level of interest in a destination is influenced by the available facilities [39]. Table 5 presents the results of the facilities and infrastructure assessment. Such facilities can help visitors enjoy tourist attractions.

The total assessment score was 50 because four elements were included in the Tangkahan Ecotourism Area: crossing bridges, roads, parking areas, and electricity networks. The supporting facilities had a score of 40 because three elements were included in the assessment. The criteria include restaurants, souvenir shops, and public transportation. Several facilities and infrastructures require further improvement, and their availability needs to be enhanced. The lack of adequate facilities and infrastructure can decrease tourist interest. Future development efforts must consider this. Furthermore, ecotourism facilities and other supporting activities must be tailored to visitors' needs.

-Availability of clean water

Clean water is an essential resource that managers must provide to visitors to enhance their comfort while enjoying tourist attractions. Table 6 shows that the total score of this aspect was 870. Within its components, the volume assessment received a value of 30 because the volume of water available in this area was sufficient for use by visitors, citizens, and tourism object managers. Next, the distance to the water source that can be channeled is not too far away, at approximately 1 km, yielding a value of 30. The ease of water flow to tourist attractions had a value of 30 because one of the potentials possessed by Tangkahan is the existence of clean river water. The feasibility of consuming water received a score of 25 because the water available in the area requires only simple treatment, such as boiling. The continuity of the water supply was rated 30 due to the availability of clean water throughout the year.

The importance of natural clean water availability greatly supports the attractiveness of ecotourism sites and vice versa. Research on various other ecotourism sites in Indonesia (Bone Balango, Gorontalo and Manado Province, North Sulawesi Province, and Liwa Botanic Gardens, Lampung Province) has also reported the same [40, 41]. Similar observations have been reported in other countries, such as Turkey [42] and Thailand [43].

3.3 Development feasibility assessment results

Ecotourism is a sub-component of sustainable tourism. Ecotourism's perceived potential as an effective tool for sustainable development is why developing countries are embracing and incorporating it into their economic growth and conservation strategies. As an alternative form of tourism, ecotourism involves visiting natural areas to study, learn, or undertake environmentally friendly activities. Based on experience, tourism enables local economies and societies to develop [44].

The components assessed from the Tangkahan Ecotourism Area include the attractiveness of the location, accessibility of the location, availability of accommodation around the ecotourism site, socio-economic and environmental conditions of the surrounding community, supporting infrastructure that facilitates the development of ecotourism sites, and the availability of clean water in the Tangkahan Ecotourism Area. The assessment results were obtained through direct observations in the ecotourism area.

Table 7. Results of the development feasibility level assessment of Tangkahan Ecotourism Area

No.	Aspects/Criteria	Weight (W)	Value (*)	Score (**)	Max Score (***)	Index (****)	Appropriateness
1	Attractiveness	6	145	870	1,080	80.55	Feasible
2	Accessibility	5	75	375	600	62.50	Not feasible yet
3	Communities socio-economic	5	80	400	600	66.66	Feasible
4	Accommodation	3	55	165	180	91.66	Feasible
5	Facilities and infrastructure	3	90	270	300	90.00	Feasible
6	Availability of clean water	6	145	870	900	96.66	Feasible
	Overall Eligibility Rate					**81.34**	**Feasible**

Note: * Assessment results for tourist objects and attractions; ** Multiplication between weight and value;
*** Highest score for each aspect; **** Feasibility index of score comparison with the highest score in %.

Table 7 shows that the Tangkahan Ecotourism Area was considered "worthy of development" as a tourist object with an index value of 81.34. Tangkahan Ecotourism Area has potential and is feasible for development. Within the assessment components, the attractiveness of the ecotourism area was rated 80.55 (feasible), accessibility was 62.50 (not yet feasible), socio-economic and environmental conditions were 66.66, accommodation was 91.66 (appropriate), facilities and infrastructure were 90 (decent), and the availability of clean water was rated 96.66 (feasible) [16]. Meanwhile, using a different method, prior research has also stated that the Tangkahan Ecotourism Area has great potential and is feasible for development [10]. A vital eligibility criterion is economic feasibility [45]. One of the various tourist attractions in Tangkahan is the Sumatran elephant attraction. Elephant tourism in Tangkahan is also reported to be financially feasible. Indeed, the management's financial income from using Sumatran elephants as a tourist attraction in Tangkahan reached IDR 1,856,086,250 (equal to USD 124,569.6) per year and served as a source of income for the people involved as ecotourism managers at IDR 697,214,755 (equal to USD 46,792.9) per year, thereby improving the welfare of the people around GLNP [24].

Furthermore, the more potential tourist attractions an area has, the more tourists visit it. The assessment results showed that almost all criteria fell into the "feasible" category, with accessibility being the only criterion that fell into the "not feasible" category. Further attention and improvements are still needed on accessibility due to poor and uncomfortable road conditions. Moreover, the long distance is a factor that reduces one's interest in returning to the Tangkahan Ecotourism Area.

There is only one other research article that uses the AOA-NTOA analysis method in the Tangkahan area [46]. Ringo [46] conducted the same study in the Tangkahan Ecotourism Area, but only measured aspects of tourist attraction, accessibility, accommodation, supporting facilities, and infrastructure. Ringo [46] reported that accommodation and supporting facilities and infrastructure were categorized as 'very potential', tourist attraction was categorized as 'potential', but accessibility was categorized as 'less potential'. Several studies have been conducted to measure the potential and feasibility of Tangkahan ecotourism, but employing different methods and approaches [24, 25, 30, 47, 48]. Overall, the Tangkahan Ecotourism Area has great potential and can be feasibly developed into a great ecotourism area. Overall, the Tangkahan Ecotourism has great potential and can be feasibly developed into a great ecotourism area.

3.4 Ecotourism development

Ecotourism has six characteristics: a) it involves travel to relatively undisturbed natural areas and archaeological sites; b) focuses on learning and quality of experience; c) economically benefits local communities; d) seeks to explore rare species, spectacular views, and unusual and exotic views; e) does not consume resources but rather maintains the environment, contributes to sustainable development, or helps prevent environmental damage; and f) values and respects local cultures, traditions, and others [49]. Therefore, ecotourism development should consider various aspects related to and affecting its development. As shown in the previous section, some aspects of the Tangkahan Ecotourism Area require further development. Some potential actions are described below.

3.4.1 Facilities and infrastructure development

The facilities and infrastructure available at the ecotourism location will influence the interest of visitors in traveling to and supporting the smooth operation of activities at the ecotourism location. The development of supporting infrastructure is a crucial aspect that can provide tourists with satisfaction [50, 51]. Furthermore, supporting facilities must be adjusted to meet the preferences and expectations of visitors. Infrastructure development must prioritize naturalness and environmental sustainability to provide a beautiful impression to the Tangkahan Ecotourism Area.

The observations and interviews revealed that the facilities and infrastructure that need to be developed are places: 1) to relax (joglo), 2) to change clothes besides bathrooms, and 3) for worship, such as prayer rooms. Additionally, trash cans and warnings or slogans should be added to remind people to avoid throwing away and leaving trash when traveling. Additionally, it is essential to provide suitable and strategic places to eat and drink, enhancing the enjoyment of the food and views, as well as offering directions to the locations of tourist attractions. Finally, for ease of communication, all actors require a stable and adequate internet connection.

3.4.2 Tourism attractions development

Attractiveness is a crucial factor that entices visitors to visit ecotourism areas. Tourism object managers need to increase the attractiveness of tourist objects by maintaining and preserving the ecotourism area. Wherein attractiveness emerged as one of the primary assets used to enhance and develop tourist attractions [52]. This development can be achieved by preserving tourist attractions and objects, and maintaining cleanliness for all potential objects within the Tangkahan Ecotourism Area. Specifically, creative attractions based on the beauty of the landscape and the richness of flora and fauna can be added. Furthermore, technology can be utilized to enhance conservation and educational functions. Tourism renewal can also be achieved by enriching the types of aesthetic vegetation around tourist attractions and adding information boards and tourist attraction instructions. The information board can help visitors interpret the flora and

fauna, serving as a medium for conservation education.

3.4.3 Ecotourism services development

Service development is necessary to enhance the quality of ecotourism and meet the needs of tourist visitors. Visitors may want to consider services to help them assess their decision to visit again. Service facilities that must be developed include adding information boards and directional signs around the ecotourism area [53]. Next, culinary services can be improved by adding more restaurants in the area, making visitors feel more comfortable and satisfied. Similar research in various countries has reported that the management of tourist attractions and services needs improvement, as it directly affects tourist satisfaction and the preservation of these attractions [54, 55]. Additionally, the development of Tangkahan tourism objects requires support from professionals engaged in natural tourism, who can effectively communicate with both local and foreign tourists, such as guides. Community participation is essential for good tourism management [56]. In the context of this study, the community's role begins with maintaining cleanliness and preserving flora and fauna, ensuring the preservation of the Tangkahan Ecotourism Area's beauty.

4. CONCLUSIONS

The Tangkahan Ecotourism Area has four categories of potential tourist attractions: natural scenic beauty and microclimate, rivers and waterfalls, hot springs, and exotic flora and fauna. The flora is dominated by the Dipterocarpaceae, Meliaceae, Burseraceae, Euphorbiaceae, and Myrtaceae families. Fauna, such as the Sumatran elephant (Elephas maximus sumatranus), long-tailed macaque (Macaca fascicularis), small squirrel (Tupai minor), hornbill (Buceros rhinoceros), and eagle (Haliaeetus sp.), can be easily seen throughout the area and in the forest. The feasibility assessment results show that the Tangkahan Ecotourism Area is generally feasible for development, with a feasibility level index of 81.34. All ecotourism aspects are partially feasible, including attractiveness (80.55%), socio-economic and environmental conditions (66.67%), accommodations (91.66%), infrastructure (90%), and the availability of clean water (96.66%). Only accessibility is considered inadequate, with an index of 62.50. While developing ecotourism, it is essential to develop facilities, enhance the attractiveness of existing potential objects, and improve the quality of tourism services. Meanwhile, priority areas for developing ecotourism in Tangkahan include upgrading transportation infrastructure facilities within and around the object, followed by improving the socio-economic conditions of the community in and around the tourist site. Future studies are needed to examine the long-term impacts of improving accessibility (including road conditions, road types, road distance and travel time from the nearest city center) and socio-economic aspects (including aspects of the spatial planning of the object area, land status, community livelihoods, and education) on the development of productive and sustainable ecotourism.

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