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ANALYSIS OF THE SUITABILITY AND CARRYING CAPACITY OF MANGROVE ECOTOURISM DUALAUS VILLAGE BELU REGENCY EAST NUSA TENGGARA PROVINCE

LUDGARDIS LEDHENG*), NI PUTU YUNI A. DEWI, AND MARIA HALE

Biology Education Study Program, Faculty of Educational Sciences, Universitas Timor, Kefamenanu, 85613, Indonesia

**Email: ludgardisledheng12@gmail.com*

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ABSTRACT

Ecotourism is a form of tourism that contains conservation principles. The establishment of mangrove areas in Dualaus Village for ecotourism activities is the right strategy for ecosystem sustainability because it is ecologically and economically beneficial for the local community. However, efforts as an ecotourism area require an assessment of the suitability of ecotourism and the carrying capacity of the area. The purpose of this study is to assess the suitability of ecotourism and physical carrying capacity, so it can be used as a guideline for mangrove ecotourism management policies. Data collection is done through surveys and observations. Data are analyzed spatially with a Geographic Information System (GIS) approach that refers to the mangrove ecotourism suitability matrix. Furthermore, it proceeds with an assessment of the carrying capacity of the area to determine the number of visitors that can be accommodated. The results show that the ecotourism suitability index at the research site is a suitable category of 23.5 hectares, consisting of ESI 82.33% covering 15.5 ha and ESI 69.67% covering 8 ha. While an area of 5 ha is categorized as conditionally suitable with an ESI of 44.67%. Based on physical conditions, the carrying capacity for tracking activities is of 45 people/day, fishing of 199 people/day, picnicking of 158 people/day, and bird watching of 9 people/day. The total calculation of the carrying capacity of the ecotourism area is 459 people/day. Meanwhile, the real conditions in the field show 260 people/day. This informs that the number of tourists in the Dualaus Village ecotourism area does not exceed the maximum threshold. With this concept, it will be able to reduce the occurrence of damage to natural resources and the environment.

Key words: *Carrying capacity, Suitability, Mangrove Tourism*

INTRODUCTION

Mangrove forests have a strategic role, both ecologically and economically (Harahap et al. 2018). Ecological functions of mangrove forests include nutrient providers and breeding grounds for marine biota (Purwanti et al. 2018). The economic function of mangrove forests is as a place of attraction for ecotourism activities (Tuwo 2011). Given the importance of ecological and economic aspects, the mangrove forest ecosystem area must be preserved and maintained, both in terms of quality and quantity.

Mangrove forests on the north coast of Belu Regency extend along parts of the northern coastline of Timor Island, East Nusa Tenggara Province. The density and population of mangrove species in the area are in critical condition. The latest data obtained from the Belu Regency Environment Agency shows a decline from 9,193 ha to 4,836.31 ha (Belu Regency Environment Agency [BLH Kab. Belu], 2009). More than 50% of the mangrove forests in Belu Regency are in a severely damaged condition, ranging from 50-75%. Mangrove vegetation with relatively good conditions found in Dualaus Village, Kakuluk Mesak Subdistrict include: *Avicennia marina, Bruguiera cylindrical, Bruguiera gymnorrhiza, Bruguiera sexangula, Excoecaria agallocha, Lumnitzera racemosa, Rhizophora apiculata, Rhizophora mucronata, Sonneratia alba, Ceriops tagal* and *Ceriops decandra* species whose existence is globally rare (Jamaludin et al. 2020).

The main threats to mangroves in Belu Regency are the conversion of mangrove forests into ponds and forest exploitation activities such as logging for firewood (BLH Kab. Belu 2009). In addition, there is a conflict of interest between conservation and exploitation in mangrove forests, which creates a dilemma because both interests aim to fulfill the needs of the community, directly or indirectly (Suryaperdana 2012). In 2018, the Dualaus Village mangrove area was developed into a mangrove ecotourism area aimed at achieving sustainable management for conservation and rehabilitation while, at the same time, encouraging the economy of the local community (Kominfo Kab. Belu, 2019). According to Nadiasa et al (2010), ecotourism is a tourism activity that aims to integrate economic development and conservation by generating funds to preserve ecological elements through the presentation of nature as the main attraction. Ecotourism aspects generally consist of: traveling to areas where the natural environment is pristine, respecting cultural and natural heritage, supporting conservation efforts, not causing negative impacts, providing socio-economic benefits, and involving the participation of local residents (Sukuryadi et al. 2020).

Based on the concept of ecotourism, the community will act as the main actors and beneficiaries because the concept includes: local resource potential,

social and cultural order of the community (Sukuryadi et al 2020). Thus, it will support sustainable economic development efforts because it provides employment opportunities. Therefore, according to Saparinto (2007), the utilization of mangrove ecosystem through ecotourism needs to be maintained to maintain the integrity of its function and sustainability, so it can support local income. This is in line with Buckley's research (2004) which states that the presence of visitors in the tourist area will increase economic growth or alternative livelihoods for local communities. However, in the context of Dualaus Village, the implementation of mangrove ecotourism has not been fully supported by the availability of physical data, especially information on the suitability and carrying capacity of the area.

In an effort to preserve the potential in the Dualaus Village ecotourism area, a study of the ability of the mangrove ecosystem to support all ecotourism activities developed is needed. This is because mangrove ecosystem resources have limitations and are vulnerable to both internal and external pressures that can reduce the quality and quantity of the ecosystem. Therefore, this study aims to analyze the suitability of ecotourism and physical carrying capacity in the mangrove tourism area of Dualaus Village, Kakuluk Mesak Subdistrict, Belu Barat Regency, East Nusa Tenggara Province. The results of this study are expected to serve as basic information for ecotourism-based mangrove ecosystem management that can preserve the ecosystem and economy of coastal communities in the area.

RESEARCH METHOD

This research was conducted from March to August 2021 in the mangrove ecotourism area of Dualaus Village, Kakuluk Mesak Subdistrict, Belu Regency, East Nusa Tanggara Province. This research area was chosen because it is mangrove ecotourism area that requires monitoring and evaluation based on ecological suitability aspects and area carrying capacity. Sampling was divided into 3 stations based on the river flow from the sea (Figure 1). Determination of the station point was made by purposive sampling method.

Data collected to determine the carrying capacity of the area are data on the area and length of the mangrove tracking track area obtained from direct measurements in the field, data on the area and length of the area for certain categories (fishing, picnicking and recreation, and bird watching) and data on the number of tourist visitors obtained from in-depth interviews with area operators (Belu Regency Tourism Agency). Meanwhile, on the standard data on the ecological potential of visitors per unit area of each attraction, the area for certain tourist attractions and the standard time provided and spent by tourist visitors refers to Hutabarat et al (2009) (Table 3). Data collected to determine the suitability of ecotourism include: (1) tidal data obtained from MIKE 21 software, (2) mangrove thickness and area obtained through satellite image analysis (Landsat 8 OLI (path: 110, row: 66) on the recording date of August 19, 2021, and (3) density data, mangrove species, and biota species obtained through the quadrat transect method (Nugroho et al. 2018). There are 2 transects at each station. Transects consist of plots (10 x 10) m^2 (for tree observation), plots (5 x 5) m^2 (for stake observation), and plots (2 x 2) ^{m2} (for seedling observation). There are 3 mangrove observation stations in the study area (Figure 1 and Table 1).

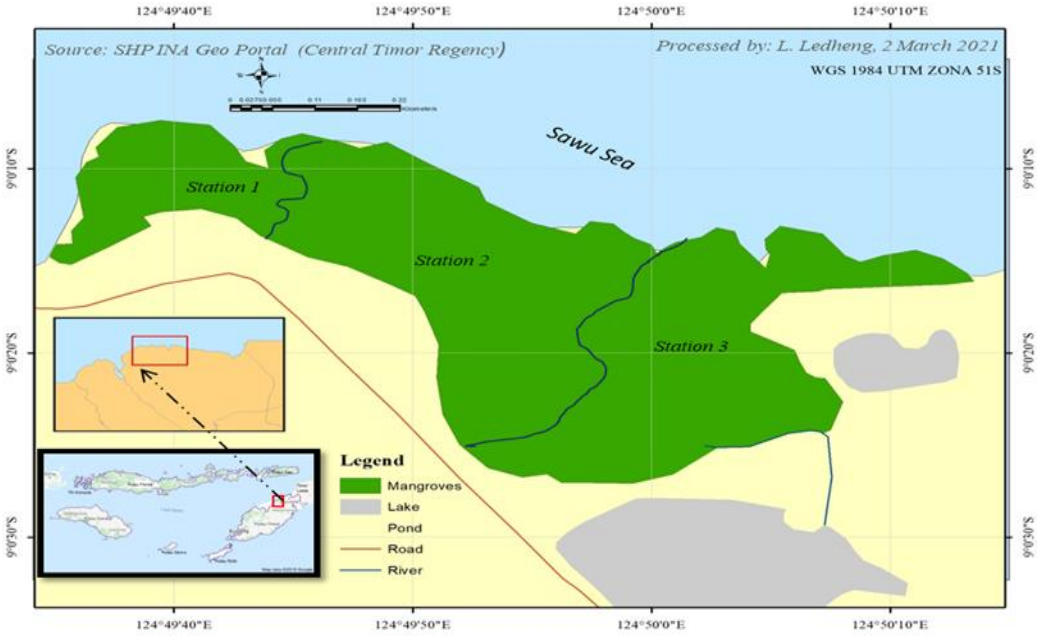


Figure 1. Map of the Research Location

Ecotourism Suitability Index (ESI)

The analysis of suitability for mangrove ecotourism is conducted spatially using a Geographic Information System (GIS) approach. Hossain et al. (2008) stated that GIS can function to process spatial data and visualize the results of suitability analysis. The steps taken include: (1) delineating Landsat 8 Oli images with a spatial resolution of 10 m for land and water boundaries, (2) spatially analyzing the location points obtained during the survey, (3) inputting in situ data into the map, (4) then entering the value of the multiplication result between the weight and score on the attributes of each feature that has been formed to obtain a suitable location. Spatial analysis is carried out using ArcGIS 10.4.1 software with spatial overlay modeling techniques that use weighting and suitability scores on each parameter that refers to the mangrove ecotourism suitability matrix according to Hutabarat et al (2009). Mangrove ecotourism suitability assessment using the formula (Hutabarat et al, 2009):

$$ESI = \sum \left(\frac{Ni}{Nmax}\right) x\ 100\%$$

……..(1)

Where:
ESI = Ecotoutism Suitability Index,
Ni = Parameter value (weight x score)
Nmax = Maximum value of mangrove ecotourism category (45) (Hutabarat et al 2009)

Parameters measured in tourism suitability include mangrove thickness (m), mangrove density (ind/100 m2), mangrove species, tides (m), biota objects are determined using a suitability matrix and classified into 3 (three) suitability classes namely suitable (S1), conditionally suitable (S2), and not suitable (S3) (Hutabarat et al. 2009) (Table 2).

The assessment is made based on the ratio between the weight and score, which is then combined with several variables to determine the suitability class. The value of Ecotourism Suitability Index (ESI) obtained is then adjusted to the category, ESI 66.67 - 100% = suitable; 33.34 - 66.66% = conditionally suitable, and 0 - 50% = not suitable.

Carrying capacity of the area (CCA)

The calculation of the Carrying Capacity of the Area (CCA) is needed to determine the maximum number of visitors that can be accommodated in the area provided without causing disturbances to nature and humans. The CCA calculation uses the formula of Hutabarat et al. (20090):

$$= K\ x \left(\frac{Lp}{Lt}\right)\ x\ \left(\frac{Wt}{Wp}\right)$$

CCA ….....(2)

Remarks: CCA= Tourism Area Carrying Capacity (people/day), *K*= ecological potential of visitors per unit area (people), *Lp*= Area area (m^2) or area length (m) that can be utilized, *Lt*= Unit area for certain categories (m^2 or m), *Wt*= Time provided by the area for tourism activities in 1 day (hours), *Wp*= Time spent by visitors for each tourism attraction (hours). Visitor activity time (*Wp*) is calculated based on the length of time spent by visitors to enjoy the beauty offered by the resource. Visitor time is calculated to minimize disturbance to natural resources with the time provided by the area (Wt), which is the length of time the area is open in one day for tourism activities (Table 3).

Table 1. Mangrove observation stations in the Dualaus village mangrove ecotourism area

	Locations	Coordinates (UTM)	
Station 1	Mangrove areas close to settlements	701103.435	-995596.32
Station 2	The central area of the mangrove forest	701370.136	-995786.82
Station 3	Mangrove areas close to ponds	7011547.936	-995856.671

Table 2: Suitability matrix for mangrove ecotourism

Parameters	***Value***	***Category*** **S1**	**(** ***Score*** **)**	**(** ***Category*** **) S2**	**(** ***Score*** **)**	**(** ***Category*** **) S3**	**(** ***Score*** **)**
Mangrove thickness (m)	3	> 200	5	100-200	3	< 100	1
Mangrove density (100 m^2)	2	> 10-25	5	5-10	3	< 5	1
Mangrove species	2	> 6	5	3-6	3	< 3	1
Tides (m)	1	0-1	5	> 1-2	3	> 2	1
Biota objects	1	>3	5	2-3	3	1	1

RESULT AND DISCUSSION

1. Mangrove ecotourism suitability

Based on density observations, it is known that each station has a different density level. Differences in mangrove density indicate that mangrove ecosystem communities grow at different levels of fertility (Yulius et al. 2018). Mangrove density of each observation station is presented in Table 4.

The highest tree density is found at station 2, while the lowest is at station 1. The high and low density of mangroves is influenced by the position of mangroves from the activities of local residents. Station 1 is close to the settlement, allowing people to utilize mangrove resources. While station 2 is in the middle of the area away from the activities of local residents, so the potential for population loss is more controllable, given the location that is difficult to reach. The study of Susi et al. (2018) suggests that the pattern of adaptation and human involvement in resource utilization have caused the mangrove population to decline. Based on Table 4, it is known that the average number of individuals in 1 (one) square meter of the tree category is generally in the range of 3-17 individuals; for the stake category of 5-12 individuals, while the seedling category of 9-15 individuals. In general, individual regeneration at the study site is in good condition because the number of seedling level individuals exceeds the stake to tree strata. According to Damayanti (2017), the density level dominated by the seedling phase followed by stakes and trees indicates normal budding conditions. Normal budding conditions are very important for maintaining the ability of forest regeneration because it is related to the provision of new stands in natural forest rejuvenation (Damayanti et al. 2017). The assessment of mangrove density suitability uses stake to tree data. Based on Hutabarat's (2009) suitability matrix, the mangrove density of stations 2 and 3 are categorized as suitable, while the mangrove density of station 1 is categorized as conditionally suitable.

The species identified in the mangrove ecotourism area in Dualaus Village are: *Avicennia marina, Rhizophora apiculata, Rhizophora mucronata, Sonneratia alba, Cerios tagal and Ceriops decandra* which are globally rare according to Giesen, Wulffraat, Zieren, Scholten, (2007). All species are found at stations 2 and 3, while at station 1 are found 2 species namely *Avicennia marina* and *Sonneratia alba*. The density level of stakes and trees of each species is presented in Figure 2.

The highest species density is found at station 2, namely *Rhizophora mucronata*. *Rhizophora mucronata* species can adapt well to the mangrove tourism area of Dualaus Village on a fine muddy substrate. The study of Halidah (2010) states that *Rhizophora mucronata* is easy to plant naturally and adapt to the highest and lowest tides, besides it can grow well on soft muddy sand substrates. While at station 1 close to residential areas is dominated by *Avecenia marina*. The condition of station 1, which is slightly dry and sandy, it is found *A. marina* species with more numbers than other species. From some research results, it is known that *A. marina* can grow on coarse, sandy and slightly muddy substrates (Halidah, 2013). The species of A. marina grows at an altitude of 0-50 m from sea level, has a light texture, and grows in dry areas with temperatures ranging from 29-30ºC (Halida, 2014). At station 3, the highest density is occupied by *R. mucron*ata and *R. apiculata* species thrived on fine muddy substrates. Study of Ledheng et al. (2022) states that the types of *R. apiculata* and *R. mucronata* are generally found in fine silty clay sediments. The existence of various species of mangroves is one of the attractions for visitors to conduct tours and educational activities related to ecosystems. According to Susi et al. (2018), the diversity of mangrove species is beneficial in balancing the ecosystem. The number of species found in the conditionally suitable category based on the suitability matrix (Hutabarat et al (2009).

Table 3. Mangrove Ecotourism Carrying Capacity Standards.

Type of activity	K	Lt	Wt	Wp
Tracking	1	50 m	8	2
Fishing	1	10 m	6	3
Picnic or recreation	1	16 m^2	8	2
Bird watching	1	67 m^2	8	2

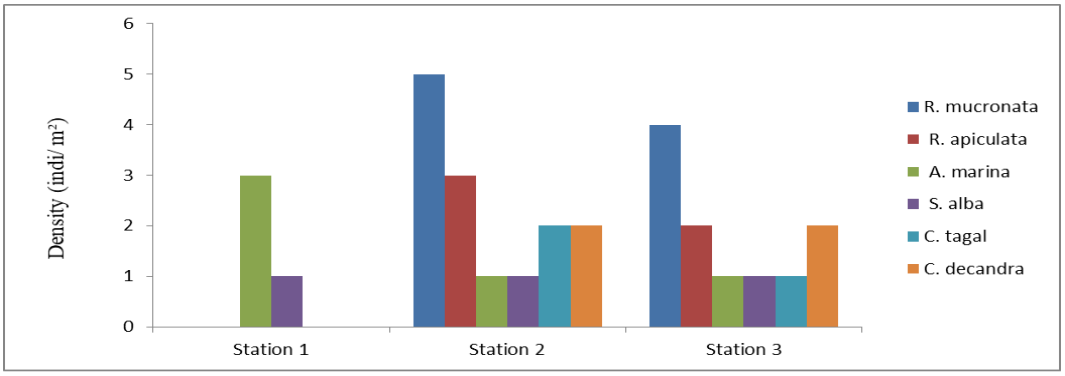
Source: Hutabarat et al (2009)

Table 4. Mangrove density in growth strata.

Growth strata	Density (ind /m^2)		
	Station 1	Station 2	Station 3
Trees	3	17	9
Stakes	5	11	12
Seedlings	9	10	15
Average	6	13	12

The area of mangrove ecotourism area based on the results of observations and analysis of satellite images with GIS measurements is 28.5 ha. Based on observations in the ecotourism area, it is found association trees that grow around mangroves such as *Hibiscus tiliaceus*, *Pandanus amaryllifolius*, and *Terminalia catappa*, especially those close to residential areas and ponds. In general, the distribution of mangroves in Dualaus Village based on GIS can be seen in Figure 3.

Based on observations of station 1 which is adjacent to residential areas, the mangrove thickness is 99.45 m; at station 2 (two) located in the middle of the forest, the mangrove thickness is 396.69 m; while station 3 (three) adjacent to the tracking path and pond, the mangrove thickness is 304.80 m. The difference in mangrove thickness is also influenced by the diversity of texture classes in each observation location. At station 2 with the highest thickness, it is found blackish muddy fine substrate, while at the location with a low thickness at station 1, it is found a slightly muddy sandy substrate. According to Setiawan (2013), high mangrove thickness tends to have a dusty clay loam texture class, which is due to the decomposition of litter that helps determine the class of soil texture and the binding of dust and clay particles by mangrove roots, so over time, the particles will settle and form mud. Meanwhile, in areas with low vegetation thickness, the texture class tends to be sandy because of the small population that binds mud particles. Mangrove thickness at station 1 is included in the conditionally suitable category (S2), while the thickness of mangroves at stations 2 and 3 belongs to suitable category (S1) based on the criteria of Hutabarat et al. (2009) (Table 2). The difference in mangrove thickness at each observation station can have an impact on the ecological aspects of the substrate and biota in mangrove areas.



Jenis	*R. mucronata*	*R. apiculata*	*A. marina*	*S. alba*	*C. tagal*	*C. decandra*
Station 1	0	0	3	1	0	0
Station 2	5	3	1	1	2	2
Station 3	4	2	1	1	1	2

Figure 2. Density of mangrove species at the stake and tree level in the study location.

Figure 3. Distribution of mangrove vegetation in Dualaus Village

The biota species found in the observation site of the Dualaus Village mangrove tourism area include long-tailed macaques, sea eagles, crows, storks, sparrows, mangrove crabs, batik snails, sea snails, cone snails, cork fish and milkfish. Data on mangrove biota in the ecotourism area are presented in Table 4.

The differences in the species and populations of biota at each station observed are influenced by differences in the stretch of vegetation at each observation station because according to Susi et al. (2018), covered with high mangrove thickness will provide abundant organic matter, macrobenthos, and plankton (Susi et al. 2018). These conditions can affect the presence of biota living in mangrove areas. As shown by Komiyama et al. (2008), mangrove ecosystems are very productive in preserving the biota that lives in them.

Biota observations of bird species are carried out directly on each species of bird that passed or landed on trees based on their morphological characteristics. There are 4 species of birds at the observation station including the Chordata, Ciconiidae, Passeridae, Accipitridae. Some aquatic biota found are milkfish, which is found at station 3 near the pond and tracking location area. While cork fish is found in station 2 on substrates with high mud content. Muhtadi (2016) states that cork fish is one of the aquatic biota that lives in a unique mangrove ecosystem with high adaptability to muddy areas. Crab species are found at each station, and the dominant species is Scylla serrata. The species of Scylla serrata is most commonly found at station 2 which has a high mangrove density, while the least is found at station 1 near settlements and ponds. According to Siringoringo et al. (2017), high mangrove vegetation density provides better protection for mud crabs. In contrast, the population of long-tailed macaques at stations 1 and 2 is the lowest compared to station 3, which is an open space. According to Supartono (2001), long-tailed macaques prefer areas with less dense vegetation because they are considered the perfect playground. The existence of biota species at the observation location of the Dualaus Village mangrove ecotourism area is in the appropriate category in supporting the sustainability of mangrove ecotourism.

In addition, tidal conditions in the Dualaus Village mangrove ecotourism area are strongly influenced by the propagation of Sawu sea waves. By using the equation proposed by Nugroho et al (2018), it is known that the Formzahl value of the Dualaus Village mangrove ecotourism area is 0.49. The tides are mixed type with the dominance of double tides, where high and low tides occur twice a day. The first tidal waveform is not the same as the second tidal wave (asymmetrical) with a semi-diurnal oblique shape. Forecasted tides on March 20 to May 4, 2021 are 2 (two) times a day. The highest high tide and the lowest low tide occurred on March 20 at 07.00 WIB until 18.00 WIB (0.79 m - 0.05 m); then the highest and lowest high tide occurred at 20.00 WIB until 21.00 WIB (0.15 m - 0.02 m). The tidal forecast for March 20 to May 4, 2021 can be seen in Figure 4.

The height of the tides ranges from 0.02 to 0.79 m. The data show that the average height of tides in the Dualaus Village mangrove ecotourism area from March to April in 2021 is 0.3 m. Tidal changes in the Mangrove ecotourism area every month in 2021 as per Mike 21 predictions as presented in Figure 5.

Tidal assessment is necessary for planning tracking activities. Mangrove ecosystems will be an unpleasant place for tourists to visit at high tide, but high tide is a challenge for mangrove tracking activities such as photography activities. Conversely, during low tide, tracking will be less challenging. Based on tidal data, the Dualaus Village Mangrove Area is included in the suitable category (S1), which indicates that the area is suitable for mangrove tourism. Five parameters of ecotourism suitability are namely: mangrove type, mangrove fragility, mangrove thickness, mangrove biota species, and suitbale tidal conditions will be a potential attraction for sustainable ecotourism. The results of the analysis of the suitability of mangrove ecotourism in Dualaus Village are presented in table 5.

Table 4. Species of mangrove biota in the Dualaus Village Mangrove ecotourism area.

Number	Scientific Name	Nama yang umum General name	Sites		
			Station 1	Station 2	Station 3
1	*Macca fascicularis*	Long-tailed monkey	+	+	+
2	*Corvus*	Crow	+	+	+
3	*haliaetus leukogaster*	Sea Eagle	-	+	+
4	*Passer montanus*	Sparrows	+	+	+
5	*Ciconia ciconia*	Storks	+	+	+
6	*Scylla serrata*	Mud Crab	+	+	+
7	*Vexillum curviliratum*	Batik Snail	+	+	+
8	*Nerita lirellata*	Sea snail	+	+	+
9	*Vexillum costatum*	Cone snail	+	+	+
10	*Channa striata*	Cork Fish	-	+	-
11	*Chanos chanos*	Milkfish	-	-	+

Table 5 shows that ecotourism areas at Stations 3 and 2 are classified as suitable with an ecotourism suitability index (ESI) value of 69.67% on a mangrove area of 8 ha and 82.33% on a mangrove area of 15.5 ha, respectively, while Station 1 is categorized as conditionally suitable with an ecotourism suitability index of 44.67% on a mangrove area of 5 ha based on GIS measurements. Thus, the overall area of mangrove forests in the Dualaus Village mangrove ecotourism area can be categorized as suitable for the development of ecotourism on an ongoing basis. The spatial distribution of the level of suitability of Dualaus Village mangrove ecotourism potential based on GIS is presented in Figure 6.

Based on the suitability analysis, Dualaus Village mangrove tourism is suitable for ecotourism with some areas suitable while others are conditionally suitable (Table 5). These results suggest that intensive management measures are needed to make the mangrove tourism area a sustainable nature tourism destination.

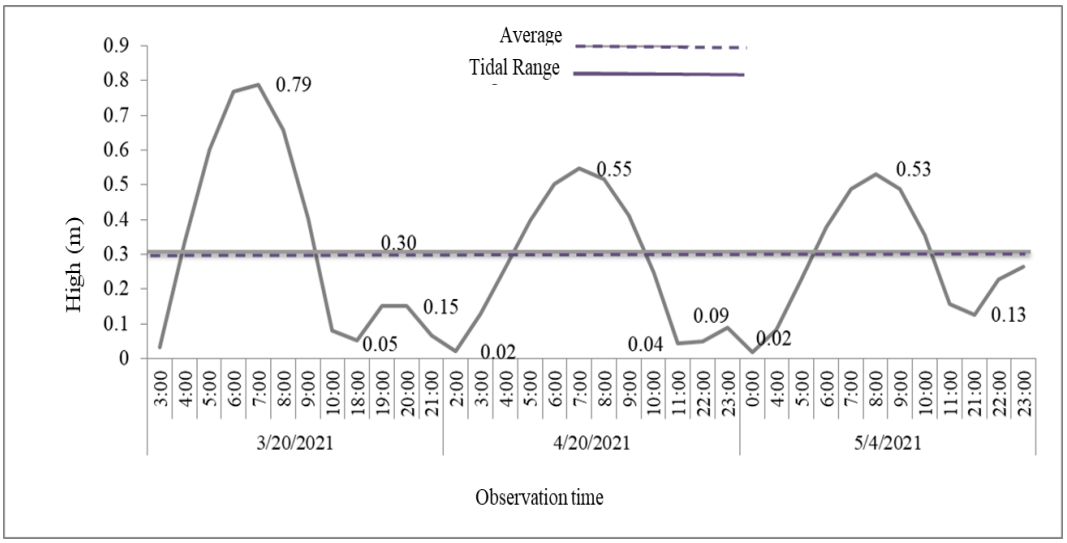


Figure 4. Tides in Dualaus Village Waters from March 10 to May 4, 2021

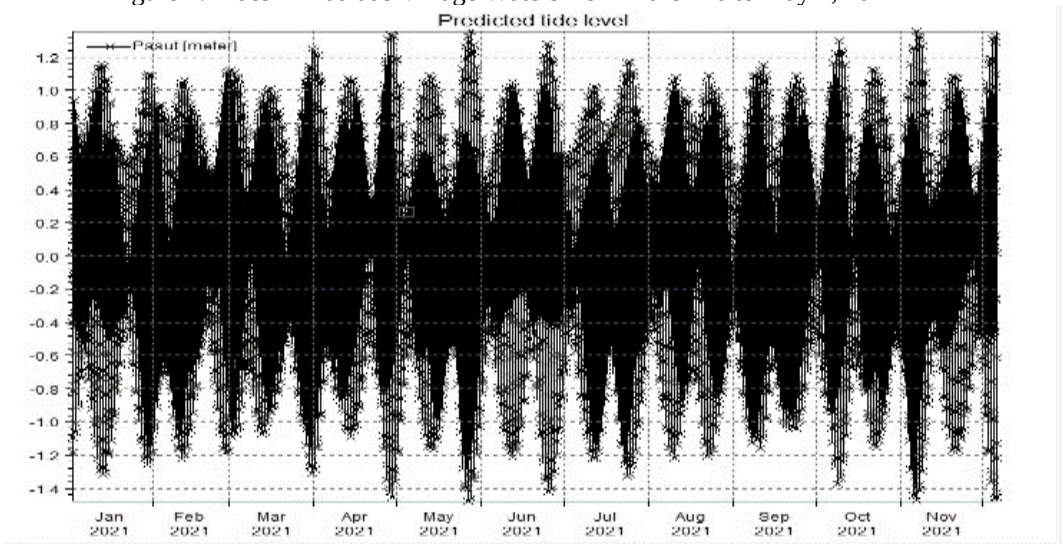


Figure 5. Tidal Changes in 2021

Table 5. Tourism Suitability Index.

Station	Tourism Suitability Index (ESI) (%)	Category
1	44.67 %	Conditional Suitable
2	82.33 %	Highly Suitable
3	69.67 %	Suitable

Carrying Capacity of the Area

Utilization of an area for ecotourism activities needs to pay attention to its carrying capacity in order to remain sustainable. Activities that can be carried out in the mangrove ecotourism area of Dualaus Village are mangrove tracking, fishing, picnicking, and bird watching. The results of the analysis of the carrying capacity of mangrove ecotourism in Dualaus Village are presented in Table 5.

Based on the results of the calculations that have been carried out, the length of the tracking track for Dualaus Village ecotourism is 560 m (Lp). According to Hutabarat et al. (2009), the ecological potential of visitors (K) per unit area for mangrove tourism is 1 person for 50 m tracking (Lt). The time spent by each visitor is 2 hours (Wp). The length of time provided by the area for a one-day tour is 8 hours (Wt). Thus, the number of visitors for tracking activities in the Dualaus Village ecotourism area is 45 people/day. The time provided by the area for fishing activities is 6 hours. The average time for fishing activities is 3 hours. The ecological potential of visitors for fishing activities for 1 person requires an area of 10 m long. The length of the fishing area provided by the tourist area is 995 m, so the carrying capacity of the area for the fishing category is 199 people/day. Average picnicking and recreation time utilized by visitors is 2 hours. The time provided by the area for picnicking and recreation is 8 hours. The ecological potential of visitors for picnicking and recreation activities of 1 person requires an area of 16 m2. The length of the picnic area provided by the area is 630 m. Thus, the carrying capacity for picnicking and recreational activities is 158 people/day. The time provided by the area for birdwatching activities is 8 hours. The average time spent by visitors for bird watching is 2 hours. Ecological potential of bird watching for 1 person requires an area of 67 m^2. The area provided for bird watching is 150 m^2. Therefore, the carrying capacity for bird watching activities is 9 people/day. The total value obtained from the calculation of carrying capacity in the Dualaus Village ecotourism area is 459 people/day. Based on information obtained from interviews with area managers (Belu Regency Tourism Agency), the average person visiting the ecotourism area is 260 people/day. This means that the capacity of tourist capacity is in the good category.

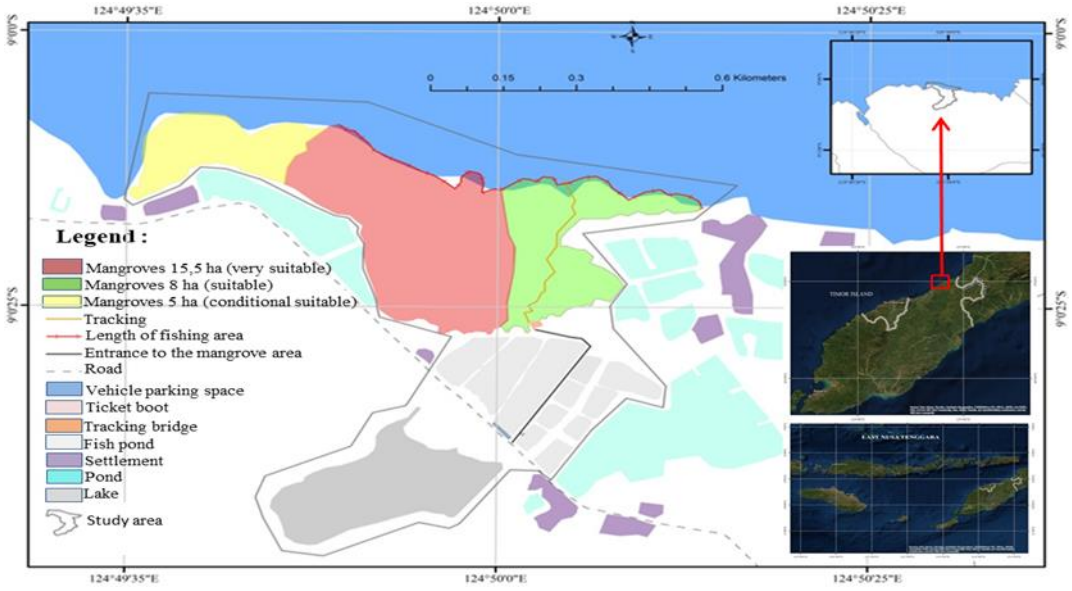


Figure 6. Spatial distribution of suitability level of mangrove ecotourism potential of Dualaus Village

Table 6. Carrying capacity of mangrove ecotourism area in Dualaus Village.

Activities	K	Lp	Lt	Wt	Wp	Carrying Capacity (People/day)
Tracking	1	560 m	50 m	8	2	45
Fishing	1	995 m	10 m	6	3	199
Picnic	1	630 m	16 m^2	8	2	158
Bird watching	1	150 m^2	67 m^2	8	2	9
Total						459

CONCLUSION

The measurement results using GIS show that the total area of the Dualaus Village mangrove ecotourism area is 28.5 ha. Based on spatial analysis, the Dualaus Village mangrove area suitable for mangrove ecotourism development is 23.5 hectares, consisting of ESI 82.33% covering 15.5 ha and ESI 69.67% covering 8 ha. Meanwhile, the location of the 5 ha area is in the conditionally suitable category with an ESI of 44.67%, so it requires intensive management. Some suitability parameters that need intensive attention include mangrove density, especially in the 5 ha area adjacent to residential areas. In addition, the number of mangrove species as many as 6 species fall into the conditionally suitable category. Therefore, the community needs to be educated to participate in preserving the diversity of existing species through counseling and mangrove cultivation. It happens because to support the attractiveness of ecotourism, mangrove ecosystem conditions are needed which are rich in animal diversity and biota in it. Based on the value obtained from the calculation, the carrying capacity of the Dualaus Village mangrove ecotourism area is 459 people/day. Meanwhile, the results of interviews with ecotourism area operators are 260 people/day. This condition informs that the number of tourists in the Dualaus Village ecotourism area does not exceed the maximum threshold. With this concept, it will be able to reduce the occurrence of damage to natural resources and the environment.

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