

Ecotourism Potential Study Island Mangroves Ponelo North District Gorontalo

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Abstract:- This study aims to determine the biophysical potential of mangrove ecosystems in situ, suitability of eco-tourism and ecotourism carrying capacity of mangrove in Ponelo Island. This study was conducted in May-November 2019 is located on the island of Ponelo. The method used was quadrant transect method, travel suitability analysis, and the carrying capacity of the region. Mangrove biophysical potential is calculated based on the criteria IVI. Eligibility Criteria is observed Travel mangrove thickness, density, types of mangroves, tidal and biota. Carrying capacity of the region judged based on the maximum amount of capacity. The results showed that the distribution of mangrove area Ponelo Island is 129.1743 ha and Importance Value Index (IVI) with the highest tree found in *Rhizophora mucronata* (93.524%) and the lowest type of *Avicennia marina* (0.481%). Travel Suitability Index (IKW) category of the highest degrees of thickness 217, 93 m (station Ponelo village) and the lowest was 156.59 m (Village station Malambe), the density of the mangrove between 13.30 - 15.85 Ind / m by the number of mangrove species found are 16 species, and there are 29 types of biota. Tidal conditions on the island Ponelo is 0-195 m. Suitability ecotourism on the island mangrove Ponelo including category (S2) in accordance with IKW value of 76.32% - 77.63% to (S1) is in accordance with IKW value of 89.47%. The carrying capacity of mangrove ecotourism area is 5711 m² with a capacity of visitors reached 457 people / day. Suitability ecotourism on the island mangrove Ponelo including category (S2) in accordance with IKW value of 76.32% - 77.63% to (S1) is in accordance with IKW value of 89.47%. The carrying capacity of mangrove ecotourism area is 5711 m² with a capacity of visitors reached 457 people / day. Suitability ecotourism on the island mangrove Ponelo including category (S2) in accordance with IKW value of 76.32% - 77.63% to (S1) is in accordance with IKW value of 89.47%. The carrying capacity of mangrove ecotourism area is 5711 m² with a capacity of visitors reached 457 people / day.

This research was AIMD to Determine biophysical potential of the mangrove ecosystem in situ, the suitability of ecotourism, and the carrying capacity of the mangrove in Ponelo Island. This research was conducted in May-November 2019 with was held in Ponelo Island. The method used is the transect method quadran, tourism suitability analysis, and the carrying capacity of the region. The biophysical potential of mangroves is calculated based on IVI criteria. The tourism suitability criteria chosen are mangrove thickness, density, type of mangroves, tides, and biota. The carrying capacity of an area is based on the maximum amount of capacity. The results Showed that the acre of mangrove distribution in Ponelo Island was 129, the highest importance haand 1743 value index (IVI) at the tree levels was found *Rhizophora mucronata* species (93.524%) and cancel *Avicennia marina* species (0.481%). Tourism conformance index (TCI) the highest thicknes category level is 217.93 m (Ponelo Village Station) and the Lowest is 156.59 m (Malambe Village Station), the level of mangrove density is between 13.30 to 15.85 Ind / m with the total of mangrove species found are 16 types, and there are 29 types of biota. Tidal condition on Ponelo Island are 0-195 m. The suitability level of mangrove ecotourism in Ponelo Island is included in the category (S2) According to the TCI value of 76.32% - 77.63% to (S1) very much in accordance with the TCI value of 89.47%. The carrying capacity of visitors reaching 457 people / day. the level of mangrove density is between 13.30 to 15.85 Ind / m with the total of mangrove species found are 16 types, and there are 29 types of biota. Tidal condition on Ponelo Island are 0-195 m. The suitability level of mangrove ecotourism in Ponelo Island is included in the category (S2) According to the TCI value of 76.32% - 77.63% to (S1) very much in accordance with the TCI value of 89.47%. The carrying capacity of visitors reaching 457 people / day. the level of mangrove density is between 13.30 to 15.85 Ind / m with the total of mangrove species found are 16 types, and there are 29 types of biota. Tidal condition on Ponelo Island are 0-195 m. The suitability level of mangrove ecotourism in Ponelo Island is included in the category (S2) According to the TCI value of 76.32% - 77.63% to (S1) very much in accordance with the TCI value of 89.47%. The carrying capacity of visitors reaching 457 people / day.

Keywords:- Mangrove, Mangrove Ecotourism Suitability, Carrying Capacity, The Suitability of Mangrove Ecotourism.

I. INTRODUCTION

Mangrove forest is one of the natural resources of coastal areas with an important role (Suzana., Et al., 2011). The benefits of mangrove forest ecosystems, encourage the exploitation which often ends in severe environmental degradation (Gorontalo Provincial Regulation No. 7, 2016).

According to Data Center Consolidation XV Gorontalo Regional Forest Area, mangrove forest area in 2016 reached 9.294.00 Ha. The coastal area of North Gorontalo District has potential extensive mangrove forest resources. Recorded area of mangrove forests in the coastal area of North Gorontalo District of 2587.50 hectares. Kwandang extensive mangrove forests in an area of 487.16 hectares, an area of mangroves in Pulau Ponelo of 113.35 Ha (Kasim, et al., 2017).

Ponelo island located in North Gorontalo District has mangrove areas that have not been used optimally. Ponelo Island has the potential of marine biological resources as diverse as mangrove ecosystems, considering the number of potential opportunities that may be obtained from the mangrove ecosystem. To prevent depletion of mangroves in Pulau Ponelo hence the need for a way out of the mangrove utilization for the community. Another potential of mangrove forests that have not been developed optimally ie its utilization as a natural tourist attraction or tourism.

Ecotourism Mangrove is one of the efforts of environmental services that can be developed for the management of lesatari and sustainable manner. Ecotourism is travel activities responsible tourism in the area unspoiled purpose other than to enjoy its beauty also involves elements of education, understanding, and support for nature conservation efforts and improve household incomes (Wiharyanto, 2007).

The mangrove ecosystem has the potential to be developed to improve the welfare of society as it has a unique and distinct in itself as form roots distinctive as well as various types of fauna associated with mangrove ecosystems as diverse species of birds, snakes, lizards, shrimp, fish, mollusks, and crabs as well as a place berasosiasinya epiphytic plants such as orchids. Mangrove ecosystem is very good potential to be developed as an alternative ecotourism destination (Agussalim and Hartoni, 2014).

The hope is if the mangrove areas are opened to the location of ecotourism in accordance with the principles of ecotourism is to increase people's income, where almost half of the island of Ponelo who work as motorcycle taxi boat (route conveyance of Port Kwandang - Village Tihengo and Village Otiola, Port Kwandang - Village Ponelo and Village Malambe and Port Kwandang - Saronde Island and Island Bogisa) can take advantage of tourists who will visit the island would Saronde Ponelo to visit the island in advance to enjoy the beauty of the mangrove ecotourism.

This study aims to determine the potential biophysical determine insitu mangrove ecosystem, ecotourism suitability, and the carrying capacity of mangrove ecotourism on the island Ponelo.

II. RESEARCH METHODS

This study was conducted in North Gorontalo District Ponelo Island in May and November 2019. The study is divided in four stations that represent the location of the Village mangrove Ponelo Island Otiola (0o51'34.63 "N 122o53'5.90" E), Village Tihengo (0o52'6.45 " N 122o53'36.15 "E), Village Ponelo (0o53'22.32" N 122o52'52.20 "E), and Village Malambe (0o53'35.76" N 122o52'3.98 "E). Location map is presented in Figure 1.

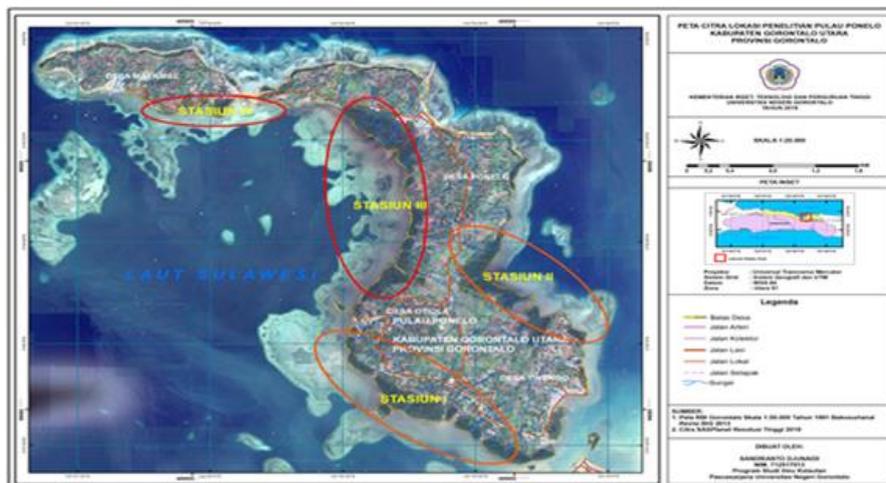


Fig 1:- Map Location Research

Tools and materials used is a GPS (Global Position System), knife or machete, raffia rope, writing tools, cameras, mangrove and fauna identification guide, Palm Pasut.

Making the observation transect method quadrant at each observation station, by specifying the line transect from seaward to landward (perpendicular to the shoreline) (Figure 2).

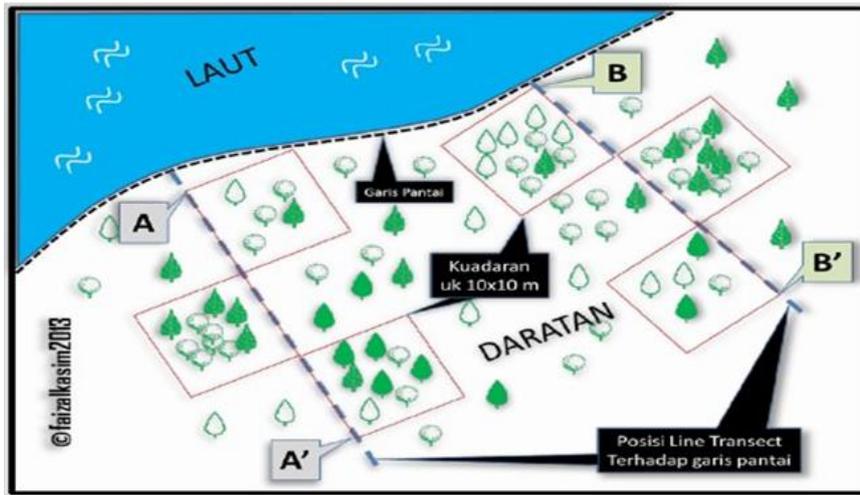


Fig 1:- Transect models Observations Mangrove

Along the transect line, placed sample plots (plot) a square with a size of 10 x 10 m. The object of research is a mangrove plant species, and the species of animals living in the mangrove ecosystem. Observation research object is also accompanied by a collection of point coordinates using GPS. The plot measuring 10 x 10 m for the observation of mangrove trees with diameter > 10 cm measured parallel to the chest of adults (Saparinto, 2007). Mangrove thickness measurement is done manually by means measured by using a roll meter. The thickness was measured at each station mangrove perpendicularly from land to sea boundary limit until the last mangrove vegetation (Sadik, M., et al., 2017).

Mangrove biophysical data analysis Importance Value Index (IVI) is a quantity that indicates the position of a species to another species in a community. IVI is derived from the relative density (KR), Relative Frequency (FR), and relative dominance (DR) of the type - the type that make up the community are observed. INP is determined by the formula (Bengen, 2002) the following:

$$INP = KR + DR + FR$$

To calculate the relative density, relative dominance and relative frequency can use the formula Saparinto (2007) as follows:

a) Relative density

$$Density (K) = \frac{Jumlah\ total\ individu\ suatu\ jenis}{Luas\ plot\ pengamatan}$$

$$Relative\ density\ (KR) = \frac{Kerapatan\ suatu\ jenis}{kerapatan\ seluruh\ jenis} \times 100\ %$$

b) Relative dominance

$$Dominance\ (D) = \frac{Total\ luas\ basal\ suatu\ jenis}{Luas\ plot\ pengamatan}$$

$$Relative\ Dominance\ (DR) = x \frac{Dominasi\ suatu\ jenis}{100\% \times Dominasi\ seluruh\ jenis}$$

c) Relative Frequency

$$Frequency\ of = \frac{Jumlah\ plot\ ditemukan\ suatu\ jenis}{Total\ jumlah\ seluruh\ plot}$$

$$Relative\ frequency\ of = x \frac{Frekuensi\ suatu\ jenis}{100\% \times Total\ frekuensi\ seluruh\ jenis}$$

The result of the index calculation value diversity and importance of each station will be tabulated in the form of graphs and tables. Subsequently analyzed descriptively to see the condition of each station.

Travel category mangrove expensive 5 with 4 classification parameters of assessment (Table 1). The formula used for the suitability of coastal tourism and marine tourism to ecotourism mangrove (Yulianda 2019)

$$IKW = \sum \left(\frac{Ni}{Nmax} \right) \times 100\%.$$

Parameter	Weight	Category S1	Score	Category S2	Score	Category S3	Score	Category N	Score	Reference
Mangrove thickness (m)	5	> 500	4	> 200-500	3	50-200	2	<50	1	Yulianda, 2019
Mangrove density (100 m2)	4	> 15-25	4	> 10-15	3	5-10	2	<5	1	Agussalim and Hartoni, 2014
mangrove species	4	> 5	4	3-5	3	1-2	2	0	1	Agussalim and Hartoni, 2014
Tides (m)	3	0-1	4	> 1-2	3	> 2-5	2	> 5	1	Yulianda, 2019
object biota	3	Fish, shrimp, crabs, mollusks, reptiles, birds	4	Fish, shrimp, crab, mollusk	3	Fish, mollusks	2	One of the aquatic biota	1	Yulianda, 2019

Table 1:- Matrix suitability mangrove area travel category
Source: Agussalim and Hartoni (2014); Yulianda (2019).

Description: The maximum score = 76

S1 = Very appropriate, with a value of 80% -100%

S2 = In accordance with a value of 60% - <80%

S3 = In accordance conditional, with a value of 35% - <60%

N = Not in accordance with the value of <35%

DDK (Capability Region) is the maximum number of visitors who physically can fit in the area provided at any given time without causing interference with the natural and human. DDK calculation using the following formula (Yulianda, 2019):

$$DDK = k \times \frac{Lp}{Lt} \times \frac{Wt}{Wp}$$

Data from the field and then processed in accordance with the suitability matrix area and power category shaman mangrove tour and represented in the form of value. The value obtained by multiplying the weight and score of each parameter of each category and analyzed using travel suitability to determine how much potential Ponele mangroves on the island.

Type of activity	K (Visitor)	Length area (Lt)	Information
Mangrove tour	1	50 m	Track length is calculated, each of the 50 m

Table 2:- Potential visitors (K) and the length of the area of activity (Lt)
Source: Yulianda (2019).

Type of activity	The time required (Wp) (hours / day)	Total Time 1 day (Wt) (hours / day)
Mangrove tour	2	8

Table 3:- The time required for the activities of mangrove tour
Source: Yulianda (2019).

III. RESULTS AND DISCUSSION

A. Potential Biophysical Mangrove

➤ Distribution of Mangrove Island Ponelo.

The presence of mangroves in Pulau Ponelo influenced by the level distribution of mangrove adai at that location. Distribution of mangrove are found in coastal areas Ponelo island can be seen in Figure 3.



Fig 3:- Distribution Map of Mangrove Island Ponelo

The area of distribution of mangroves in Pulau Ponelo based image analysis results using GIS is 129.1743 ha and is divided in four villages in the Ponelo Island Village Otiola 34 613 ha, 41 326 ha Tihengo Village, Village Ponelo 47 702 ha, and the Village Malambe 5.5328,

➤ Important Value Index Ponelo Mangrove Island

Importance Value Index (IVI) to reflect the existence of roles (dominance) and mangrove vegetation structure in a location (Table 4).

NO	Jenis Mangrove	INP (INDEKS NILAI PENTING)				Rata-Rata
		Desa Otiola	Desa Tihengo	Desa Ponelo	Desa Malambe	
1	<i>Aegiceras floridum</i>	1.195	0	3.421	0	1.154
2	<i>Avicennia alba</i>	13.578	36.58	21.673	0	17.957
3	<i>Avicennia marina</i>	1.926	0	0	0	0.481
4	<i>Avicennia officinalis</i>	4.022	5.27	4.247	0	3.385
5	<i>Bruguiera cylindrica</i>	32.477	8.56	21.274	0	15.577
6	<i>Bruguiera gymnorizha</i>	57.87	50.33	72.302	28.332	52.208
7	<i>Bruguiera parviflora</i>	3.649	0	1.616	0	1.316
8	<i>Ceriops decandra</i>	0	15.61	1.508	0	4.280
9	<i>Ceriops tagal</i>	6.33	7.57	9.063	0	5.740
10	<i>Rhizophora apiculata</i>	9.885	13.54	10.095	0	8.380
11	<i>Rhizophora mucronata</i>	101.777	103.80	90.190	78.328	93.524
12	<i>Rhizophora stylosa</i>	41.276	20.02	44.323	82.710	47.081
13	<i>Sonneratia alba</i>	17.488	22.04	14.650	80.213	33.597
14	<i>Sonneratia caseolaris</i>	4.651	10.60	0	30.417	11.418
15	<i>Sonneratia ovata</i>	3.478	0.00	0	0	0.870
16	<i>Xylocarpus granatum</i>	0	6.09	5.638	0	2.932
JUMLAH		300	300	300	300	300

Table 4:- Important Value Index Ponelo Island

Overall average critical value index with the highest tree found in *Rhizophora mucronata* (93 524%). The type classified as having a role to community mangrove species that grow around it. This value indicates that the type of influence the stability of the ecosystem. Prasetyo (2007) explains that mangrove areas that have significant value high indicates that the mangroves in the area in good condition and not subject to change, otherwise if the condition is reduced or turned into land for humans, it is necessary to rehabilitation for the balance of the ecosystem is maintained.

B. Compliance Ponelo Ecotourism Mangrove Island

➤ Mangrove Island thickness Ponelo

Based on mangrove thickness measured at each station perpendicularly from land to sea boundary limits of the obtained thickness of mangrove. mangrove thickness can be seen in Figure 4.

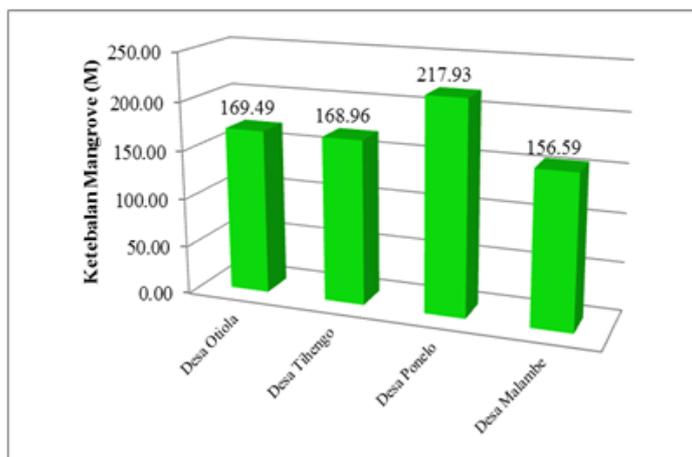


Fig 4:- The thickness Ponelo Mangrove Island. Source: Primary Data (2019)

Mangrove thickness value is highest in the Village Ponelo (217.93 m), and the lowest thickness values in the village Malambe (156.59 m). In the village station Otiola has a thickness of 169.49 m and mangrove station Tihengo village, mangrove thickness of 168.96 m. Based on mangrove thickness parameters for ecotourism by Yulianda 2019, very appropriate category (S1) is > 500 m, corresponding (S2) > 200-500 m, and S3 (corresponding conditional) of 50-200 m. The thickness of the tallest mangroves in the village Ponelo observation stations

categorized accordingly (S2), and three other stations in the category corresponding conditional (S3).

➤ *Mangrove density Ponelo Island*

The density of the number of stands of mangrove species is a species in a unit area (Bengen, 2004). Mangrove density value ind / m and ind / ha on the island Ponelo are presented in Table 5 and Figure 6.

No.	type Mengrove	Mangrove Island density type Ponelo			
		Village Otiola	Village Tihengo	Village Ponelo	Malambe village
1	<i>Aegiceras floridium</i>	2	0	4	0
2	<i>Avicennia alba</i>	14	9	13	0
3	<i>Avicennia marina</i>	1	0	0	0
4	<i>Avicennia officinalis</i>	6	1	2	0
5	<i>Bruguiera cylindrica</i>	32	5	42	0
6	<i>Bruguiera gymnorriszha</i>	23	12	66	5
7	<i>Bruguiera parviflora</i>	7	0	1	0
8	<i>Ceriops decandra</i>	0	20	1	0
9	<i>Ceriops tagal</i>	19	3	9	0
10	<i>Rhizophora apiculata</i>	11	5	17	0
11	<i>Rhizophora mucronata</i>	275	133	241	25
12	<i>Rhizophora stylosa</i>	69	12	112	15
13	<i>Sonneratia alba</i>	26	11	11	6
14	<i>Sonneratia caseolaris</i>	5	5	0	4
15	<i>Sonneratia ovata</i>	2	0	0	0
16	<i>Xylocarpus granatum</i>	0	1	4	0
	Average / village	13:30	14:47	15.85	13.75

Table 5:- Density Mangrove Ind / m Island Ponelo

Very appropriate categories found in the village station Ponelo namely 15.85 ind / m. While the categories for which there are at 3 stations namely Desa Tihengo (14:47 Ind / m), Village Malambe (Ind 13.75 / m) and the Village Otiola (1330 Ind / m). It is based on Agussalim and Hartoni

(2014) that the density of the mangrove tree species > 15-25 including highly appropriate category (S1), > 10-15 including seseai category (S2) for the development of ecotourism mangrove.

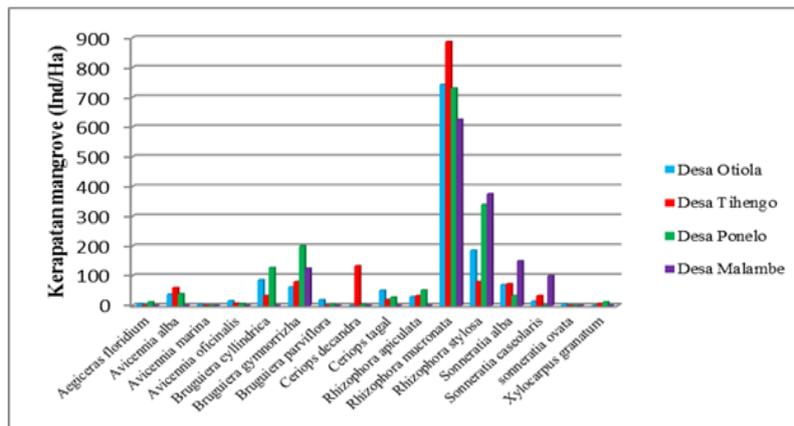


Fig 6:- Graph Density Mangrove Ind / ha Source: Primary Data (2019).

The result of the density value calculation based on a category tree mangrove species at all stations show that *Rhizophora mucronata* has the highest density value when

compared to other types namely 887 Ind / ha and is located in the village of Tihengo.

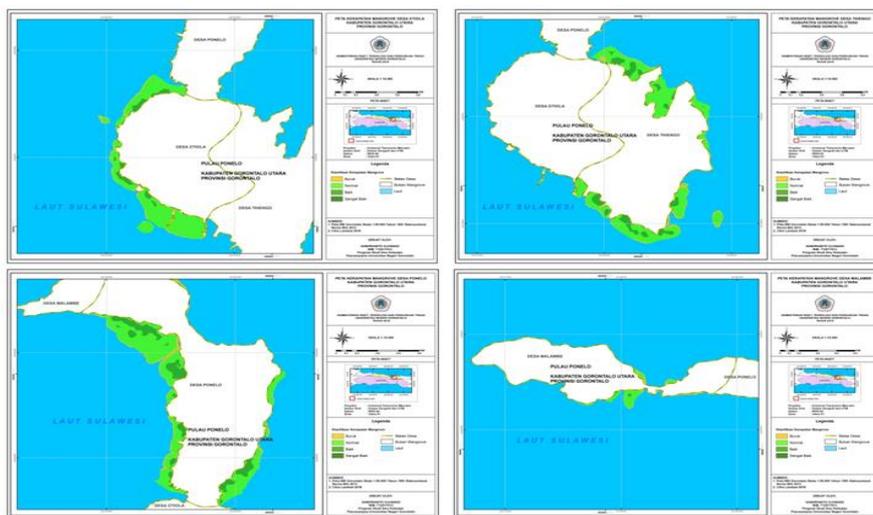


Fig 7:- Map Mangrove Island Density Ponelo

➤ *Island Mangrove type Ponelo*

Based on the results of research conducted on the island Ponelo, found 16 (sixteen) of mangrove species. The

types and the presence of mangroves are found in every station can be seen in Table 6 and Map of Figure 8

No.	Jenis Mangrove	Kehadiran Mangrove di Pulau Ponelo			
		Desa Otiola	Desa Tihengo	Desa Ponelo	Desa Malambe
1	<i>Aegiceras floridum</i>	+	+	+	-
2	<i>Avicennia alba</i>	+	+	+	-
3	<i>Avicennia marina</i>	+	-	-	-
4	<i>Avicennia officinalis</i>	+	+	+	-
5	<i>Bruguiera cylindrica</i>	+	+	+	-
6	<i>Bruguiera gymnorrhiza</i>	+	+	+	+
7	<i>Bruguiera parviflora</i>	+	+	+	-
8	<i>Ceriops decandra</i>	-	+	+	-
9	<i>Ceriops tagal</i>	+	+	+	-
10	<i>Rhizophora apiculata</i>	+	+	+	-
11	<i>Rhizophora mucronata</i>	+	+	+	+
12	<i>Rhizophora stylosa</i>	+	+	+	+
13	<i>Sonneratia alba</i>	+	+	+	+
14	<i>Sonneratia caseolaris</i>	+	-	-	+
15	<i>Sonneratia ovata</i>	+	-	-	-
16	<i>Xylocarpus granatum</i>	-	+	+	-

Table 6:- Presence of Mangrove Island Ponelo
Description: + Found, - Not found. Source: Primary Data (2019).

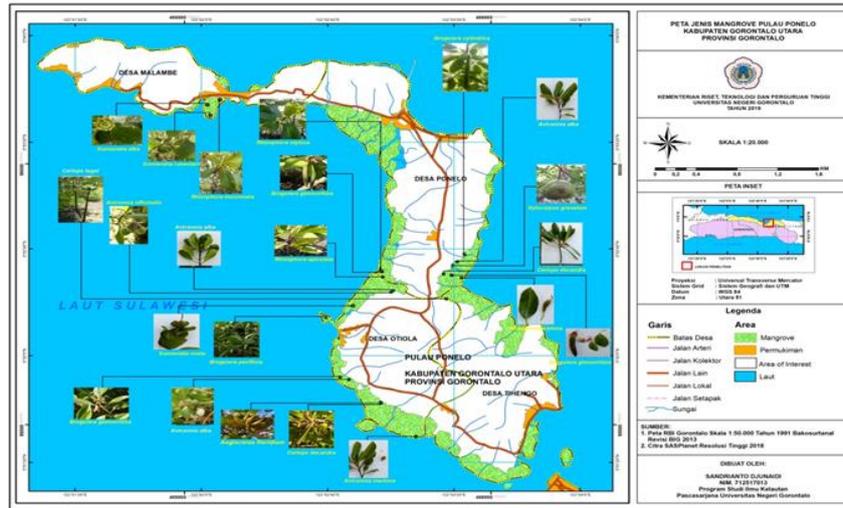


Fig 8:- Map of Mangrove Island type Ponelo

Number of mangrove species found on the island of Ponelo experience ketambahan and deployment type (Figure 4). It is based on research conducted in 2017 by Kasim, et. Al, there are 13 species of true mangroves spread over 4 stations (Ponelo, Malambe, Tihengo and Otiola) observations on Ponelo Island.

➤ *Tidal Ponelo Island*

Ocean tides result from the gravitational pull of the earth. Island tidal graph Ponelo at each station are presented in Figure 8.

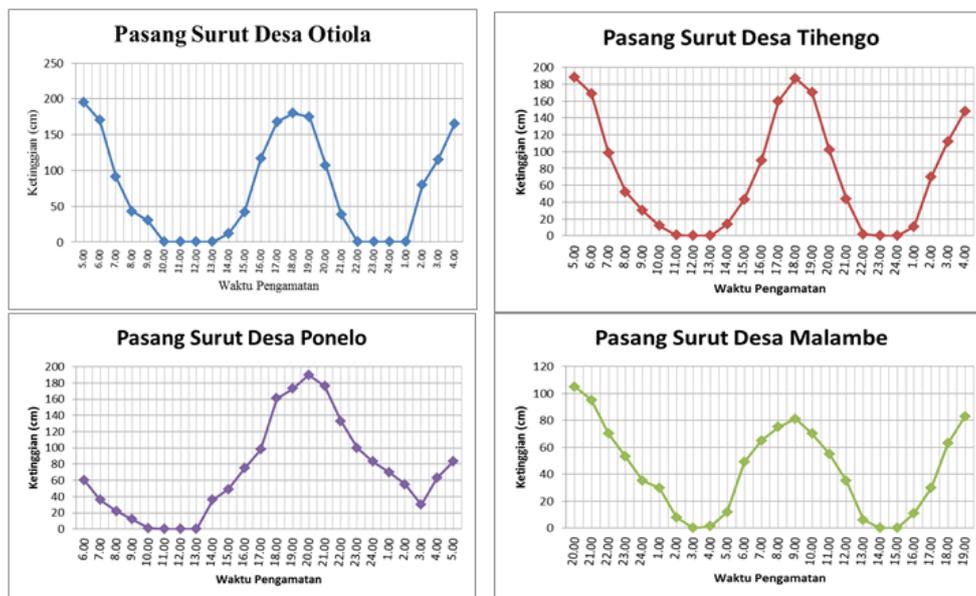


Fig 9:- Graph Tidal in 4 stations. Source: Primary Data (2019)

The measurement results tidal field observations indicate tidal highest in station village Otiola occurred at 05.00 pm at 195, Village Tihengo high tides by 188 cm at 05.00 pm, and at the station Village Ponelo and Village Malambe tidal highest at 20:00 pm at 190 cm and 105 cm. The tidal conditions are often influenced by the position of the moon and a varied topography factor.

According Yulianda (2019), the category of ups and downs to the suitability of ecotourism in mangrove very appropriate (S1) is 0-1 m and the corresponding category

(S2) > 1-2 m, corresponding conditional category (S3) > 2-5 m, as well as the category is not appropriate (N) with a value of tidal > 5 m. so the value of ups and downs in four observation stations on the island Ponelo enter the appropriate category (S2) with values > 1-2 m.

➤ *Island Mangrove Ecosystem Fauna Ponelo*

Fauna found at the time of observation of mangrove ecosystems in four stations Ponelo Island among other species of birds, reptiles, mammals, fishes, mollusks and crustaceans (Table 7).

Jenis dan Nama Fauna	Pulau Ponelo			
	Desa Otiola	Desa Tihengo	Desa Ponelo	Desa Malambe
Ikan				
a. Gelodok (<i>Periothalamus</i> sp.)	+	+	+	+
Reptil				
a. Biawak (<i>Varanus salvatoe</i>)	+	+	+	+
Burung				
a. Kelelawar (<i>Pteropus vampyrus</i>)	-	-	+	-
b. Gagak (<i>Corvus enca</i>)	+	+	-	+
c. Kuntul (<i>Egretta garzetta</i>)	+	+	+	+
d. Walet (<i>Collocalia vestita</i>)	+	+	+	-
e. Kacer (<i>Copsychus saularis</i>)	-	-	-	+
f. Trinil Pantai (<i>Tringa hypoleucos</i>)	+	-	-	+
g. Cinenen Kelabu (<i>Orthotomus rufice</i>)	-	-	-	+
Mollusca				
a. <i>Littoraria scabra</i>	+	+	+	+
b. <i>Physella gyrina</i>	+	-	+	+
c. <i>Telescopium telescopium</i>	+	+	+	-
d. <i>Crassostrea</i> sp.	+	-	+	-
e. <i>Saccostrea cucullata</i>	+	+	+	+
f. <i>Gafrarium tumidum</i>	+	-	+	+
g. <i>Macra maculata</i>	+	+	-	+
h. <i>Littoraria intermedia</i>	+	-	+	+
i. <i>Gyrineum natator</i>	+	-	-	-
j. <i>Nerita balteata</i>	+	+	+	+
k. <i>Geloina erosa</i>	-	+	+	+
l. <i>Indothais lacera</i>	-	+	-	-
Krustasea				
a. <i>Uca crassipes</i>	+	+	-	+
b. <i>Episesarma versicolor</i>	+	+	-	+
c. <i>Xanthidae</i> sp.	+	+	-	-
d. <i>Cardisoma carnifex</i>	+	-	-	-
e. <i>Scylla serrata</i>	+	-	+	-
f. <i>Portunus pelagicus</i>	+	-	-	+
g. Udang (<i>Alpheus</i> sp)	+	+	+	+
h. <i>Thalassina anomala</i>	+	-	-	-

Table 7:- Type fauna found on Location Research
Description: + = Found, - = Not found; Source: Primary Data (2019)

C. Compliance Ecotourism Mangrove Ponelo Island
According Yulianda (2019), the suitability of coastal tourism travel category mangrove consider the parameters of

thickness, density, types of mangroves, tidal and biota object. Overall suitability index Ponelo Island mangrove tour can be seen in Table 8 below.

locations	total Score	IKW (%)	Category
Village Otiola	59	77.63	S2
Village Tihengo	59	77.63	S2
Village Ponelo	68	89.47	S1
Malambe village	58	76.32	S2

Table 8:- mangrove ecotourism suitability index Ponelo Island
Source: Primary Data (2019)

The results based on ecological aspects and assessment score given showed that the mangrove forest on the island of North Gorontalo District Ponelo included in the category of Most Suitable (S1) and Match (S2) for the development of

ecotourism mangrove. Mangrove ecotourism potential suitability maps using geographic information system analysis is presented in Figure 10.

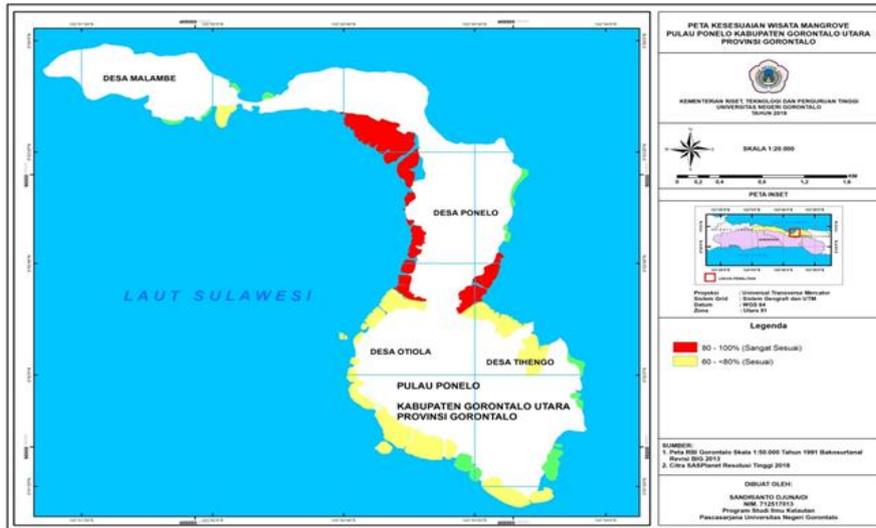


Fig 10:- mangrove ecotourism suitability maps Ponelo Island

Figure 10 shows that the ecotourism potential of mangroves on the island of North Gorontalo District Ponelo. The observations in the field and processing image analysis known total area of mangrove ecosystems that can be used as ecotourism on the island Ponelo is 129.1743 ha categorized as very appropriate 47 702 ha in the village Ponelo and categories for which an area is in three observation stations in the village of Otiola 34 613 ha, Tihengo village of 41 326 ha, and the village Malambe 5.5328 ha. Overall, Ponelo Island can be used as a travel

region for ecotourism development to improve the welfare of society mangroves on the island of Ponelo.

D. Carrying 3.4 Ponelo Island Region

Ecological potential visitors are nature's ability to accommodate visitors by type of tourist activity in certain areas (Yulianda, 2019). Regional carrying capacity calculation results in the form of the number of people who will carry out activities on the island mangrove ecotourism Ponelo per tourist activities are shown in Tables 9 and presented on a map Figure 11.

Station	Extent of Land utilized (m)	Capability Areas (person / day)
Village Otiola	2082	167
Village Tihengo	1218	97
Village Ponelo	1855	148
Malambe village	556	44
amount	5711	457

Table 9:- mangrove ecotourism carrying capacity Ponelo Island
Source: Primary Data (2019)

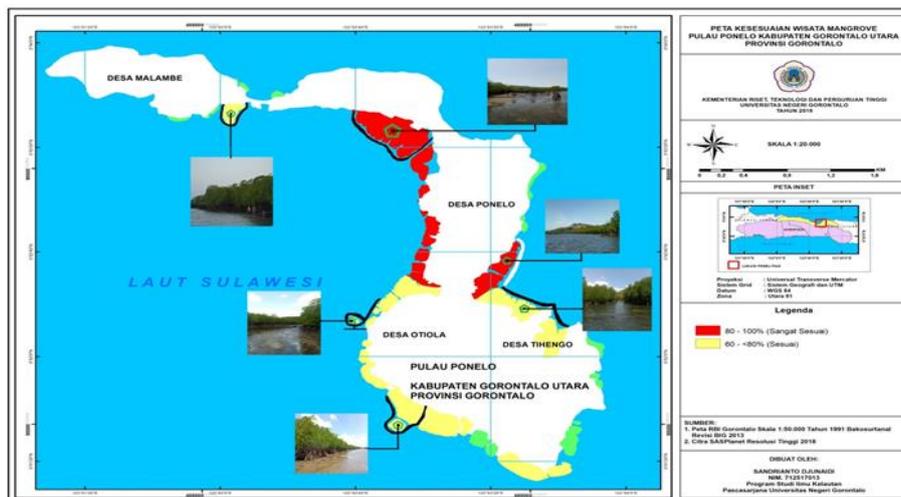


Fig 11:- Map of the carrying capacity of the region on the island of Ponelo

Mangrove ecotourism development carried out at locations categorized as very suitable and appropriate. Based on the results of the calculation of the carrying capacity of the area which refers to Yulianda (2019), the capacity of the visitors to conduct tours per day in the village Otiola with spacious areas used approximately 2,082 m² is 167 people / day, the Village Tihengo with extensive mangrove which utilized 1,218 m² is 97 person / day, Ponelo village with 1,855 m² area of mangrove utilization is 148 people / day, and the village Malambe with extensive

mangrove utilized is 44 people / day with a long time in one day open area of about 8 hours.

The condition of facilities and infrastructure on the island Ponelo needs to be improved to better attract tourists when visiting the island Ponelo (Figure 12). The condition of facilities and supporting infrastructure in the island Ponelo such as docks and boat mooring, lodging, parks, Pertamina, smart electricity, public lavatories, stalls wifi, and others.



Fig 22:- Infrastructure of support on the island Ponelo

The development of ecotourism object must always be guided by the principles of ecotourism and sustainable tourism in order to achieve the purpose of tourism development that is sustainable ecotourism (ecotourism sustainable). Spatial planning, improvement of infrastructure, human resources and legislation that will set out in the development of the ecotourism area of mangroves should optimize the current natural resource with regard to the preservation and sustainability of the region. Tourism development on the island Ponelo need support and the cooperation of various parties, especially institutional as stakeholders Policy.

IV. CONCLUSION

Based on the results and the discussion above it can be concluded that

- 1) The potential of mangrove ecosystems in the island Ponelo ie from 129 174 ha of mangrove area, and important value index is the highest mangrove mucronata Rhizophora (93 524%).
- 2) Category suitability of mangrove ecotourism on the island Ponelo by category value of 712.97 m² overall thickness of the mangrove, mangrove density value of 1433.8 ind / ha, presence of mangrove are found are 16 types, the value of tidal 0-195 m, and there are several types of mangrove fauna such as fish , birds, molluscs, and crustaceans so overall Ponelo Island belonging to categories according to the very appropriate.
- 3) Carrying capacity of ecotourism area of mangroves in Pulau Ponelo with an area that will be used for ecotourism activities mangrove is 5711 m² with a capacity of visitors reached 457 people / day, divided in several locations such as village Otiola, Village Tihengo, Village Ponelo and Village Malambe supported some means and the existing infrastructure.

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