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Availability of ecological resources in power plant Tanjung Tiram Village, South Konawe, Indonesia

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ABSTRACT

Coastal area is one of the potential marine resources in Indonesia. With a coastline length of 81,000 km (Rusu, 2019; Tomascik, 1997), it holds the potential for rich biological natural resources in fisheries, mangrove sand coral reefs, biological and non-biological minerals, and stourism. Thus, various coastline types in Indonesia are very suitable for coastal fisheries, aquaculture, hospitality industry, tourism, and so forth. The objectives of this research, are to investigate the existing ecological resources and the effect of Tanjung Tiram Steam Power Plant development. The method was carried out by determining the species composition and the percentage of seagrass cover, and measurements are made by making a 10 m × 10 m observation plot. Seagrass ecosystem was specifically measured by using quadratic transect method. The results showed that the two station so observed in the coral reef ecosystem were categorized very well (75-100%), while the mangrove ecosystem was in moderate ecological pressure with diversity indices of 0.92 and 2.60. In seagrass ecosystem, however, the seagrass covers at Stations 1 and 2 varies from 2% to 40%.

Key words: *Ecological, Coastal, Resource, Tanjung Tiram*

Introduction

Coastal area is one of potential resources in Indonesia with a coastline length of 81,000 km (Rusu, 2019; Tomascik, 1997). With a long coastline throughout the peninsula, it is potential for producing rich biological natural resources in fisheries, mangroves, and coral reefs, biological and non-biological minerals, as well as tourism. The characteristics of coastlines in Indonesia vary greatly (Tomascik, 1997), ranging from white sandy beaches, gentle slopes, muddy, shady, undulating, all of which are very suitable for various purposes, such as coastal fisher- ies, aquaculture, hospitality industry, tourism, etc.

The coastal area of Tanjung Tiram Village, North Moramo Regency, Konawe Selatan District is the location of the Steam Power Plant (ESPP) Kendari-3 development. It was previously designated as a reserve area for Southeast Sulawesi Regional Water Conservation Area (RWCA) akin to Governor Decree No. 324 of 2014, then had further revision based on the Governor's Letter No. 98 of 2016. This determines that the coastal waters of Laonti and Moramo Districts located in Staring Bay in Konawe Selatan Regency are potentially productive for coastal and marine resources that support the development of conservation-based tourism. Under those considerations, it is necessary to build a protected area for the Southeast Sulawesi Regional Water Conservation Area together with Aquatic Tourism Park (Brandon, 1996). It is known that the reserve (RWCA) aims to protect and preserve the coastal ecosystems and marine habitats as well as optimally and sustainably manage the potential use of coastal resources and small islands and im- prove the quality and quantity of biodiversity and non-biodiversity contained in Coastal Waters in Southeast Sulawesi Province.

In addition, we need to identify types of resources which still exist in Tanjung Tiram waters so that the ideal coastal management can be realized by com- bining the interests of industrial development with no major adverse effects on the ecosystem (Bin *et al.*, 2009; Christie, 2005; Taljaard *et al.*, 2012).

Materials and Methods

This research was conducted in the waters of Tanjung Tiram Village, Moramo Utara District, Konawe Selatan Regency (Fig. 1). Ecological and biophysical measurements were carried out in the mangrove, seagrass, and coral reef ecosystems. The measured variable was the area of coral reef cover using Line Intercept Transect (LIT) measurements at two measurement station points (Jokiel *et al.*, 2015; Wilson *et al.*, 2007).

Fig. 1. Location Map of Tanjung Tiram Village Research Sample (Point one; S; 04 ° 03443, E; 122 ° 67378; Point Two; S; 04 ° 04986; E; 122 ° 64991) (Primary Measurement, 2017).

Data Collection

Biophysical data on coral reefs was collected by scuba diving (Fig. 2A). Analysis and identification of basic biota habitat were based on life forms identification codes referring to English *et al.*, (1997) and Veron (2000). For seagrass ecosystem, measurements of seagrass community structures were carried out through quadratic transect method that runs perpendicular to the coastline (Fig. 2B). It was to determine species composition and percentage of seagrass cover (English *et al.*, 1997; (Eklöf *et al.*, 2005; Glancy *et al.*, 2003; Nagelkerken *et al.*, 2000).

Results and Discussion

Based on the measurement results at Station 1 and 2, the lowest or densest level of mangrove density was identified at Station 2 with an average density of 1 m^2 or 1000 trees/Ha. Dense mangrove vegetation was closely related to the existence of a relatively protected estuary and a periodic supply of fresh water with a muddy base type of water that strongly supports the mangrove growth (Almahasheere, 2016; Alongi, 2018; Ellison and

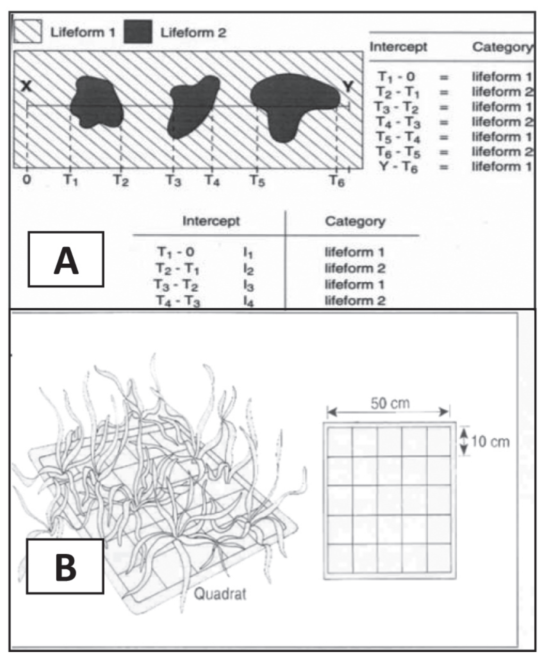

Fig. 2A. Measurement of the Coral Reef Ecosystem; B. Measurement of Seagrass Ecosystems

Farnsworth, 1996; Reef *et al.,* 2016).

By using the H value indicators, the value of the mangrove ecosystem around Tanjung Tiram village was considered under moderate ecological pressure with a diversity index of 0.92 and 2.6 (Primary Data, 2017).

Seagrass cover varied from 2% to 40% for Station 1, while for Station 2 ranged from 2% to 74%. Some seagrass covers were categorized damaged and in good condition (for criteria see Minister of Environment Decree No. 200 of 2004 concerning Standard Damage Criteria and Guidelines for Determination of Seagrass Status).

The results in (Table 1). reveals a very important ecological function, which does not only provide goods and services but also as a sediment trap to prevent coastal erosion and abrasion (Akbar *et al.,* 2017; Malik *et al.,* 2017). The nutrient cycle provides nitrogen and phosphorus sources for all tropical levels in the mangrove forest ecosystem and surrounding ecosystems (seagrasses and corals), as well as improve water quality (Gilby *et al.,* 2016; Lamb *et al.,* 2017). Through the carbon cycle, mangrove ecosystems regulates the accumulation of carbon dioxide in the atmosphere, both as a source and storage (Andreetta *et al.,* 2016; Ouyang *et al.,* 2017). Results in Tables 2, 3, and 4 indicate that seagrass ecosystems are the main producers in the seawater food chain with primary productivity ranging from 900 to 4650 GC/m^2/year. Growth, morphology, abundance and primary productivity of seagrasses in water are generally determined by the availability of phosphate, nitrate and ammonium nutrients (Han *et al.,* 2016; Oehler *et al.,* 2018). Since 1980 until now, it is estimated that seagrasses in the world have experienced a degradation of 54% (Alongi *et al.,* 2016; Arias-Ortiz *et al.,* 2018). The function of the seagrass ecosystem complements the mangrove and coral reef ecosystems. Seagrasses are also the basis for ecosystems and as a major producer, where habitat is often a place that supports the live of young fish and crustaceans (Lusher *et al.,* 2017), Seagrasses protect these organisms from predators (Fraser *et al.,* 2017; Maxwell *et al.,* 2017). The amount of phosphate absorption concentration

Table 1. Relative Frequency of Mangrove at Stations 1, 2 and 3

Species	ST 1	ST 2	ST 3
Rhizopora	71.01	73.08	54
Sonneratia	28.99	25	36
Cylocarpus		1.92	10

Table 2. Relative Frequency of Seagrass at Stations 1 and 2

Species	Station 1	Station 2
Thalassiahemprichi	40	74
Enhalusacoroides	38	26
Cymodecearotundata	8	52
Halodulepinifolia	8	
Holoduleuniversis	2	
Cymodeceaserulata	2	

Table 3. Frequency of Seagrass Types

Species	Station 1	Station 2
Thalassiahemprichi	0.4	0.74
Enhalusacoroides	0.38	0.26
Cymodecearotundata	0.08	0.02
Halodulepinifolia	0.08	
Holoduleuniversis	0.02	
Cymodeceaserulata		0.52

Table 4. Frequency of Occurrence of Seagrass Types

Species	Station 1	Station 2
Thalassiahemprichi	20	37
Enhalusacoroides	19	13
Cymodecearotundata	4	26
Halodulepinifolia	4	
Holoduleuniversis	1	
Cymodeceaserulata		1

Table 5. Percentage of Corals Closing at Station 1 and 2

Species	Station 1	Station 2
Coral Mushroom (CMR)	4.24	1.54
Fleshy Seaweed (FS)	7.1	2.46
Acropora Branching (ACB)	55.16	37.36
Soft Coral (SC)	0.7	1.34
Dead Coral With Algae (DCA)	22.08	16.74
Dead Coral (DC)	1.7	6.66
Rubble (RB)	0.42	0.56
Coral Foliose (CF)	6.58	1.48
Other (OT)	0.64	0.28
Coral Submassive (CS)	1.38	10.76
Acropora Encrusting (ACE)		1.02
Coral Massive (CM)		2.46
Rock (RK)		1.88
Acropora Tabulate (ACT)		2.72
Coral Encrusting (CE)		2.36
Coral Branching (CB)		0.74
Silt (SL)		8.36
Acroporan Digitate (ACD)		0.38
Sands (S)		0.9

by seagrasses depends on the type of seagrass and the length and width of the leaf (Ow *et al.,* 2016). In addition, the adequacy of micronutrients such as iron, manganese, and copper in the ecosystem can determine the growth factor of seagrass plants.

In the context of ecosystem services, seagrasses can be interpreted as benefits for people who live around them, and that the economy of rural communities in coastal areas has a great dependence on marine resources as a source of food and income (Manning *et al.,* 2018). Therefore, an investigation of ecosystem functions and services is needed in order to identify the management framework (BenDor *et al.,* 2017) including management of seagrass ecosystems. Seagrass ecosystem management also certainly cannot be separated from coastal and marine management planning theory. (BenDor *et al.,* 2017; Schick *et al.,* 2017) which confirms that coastal management planning approaches tend to be part of a combination of a number of planning theories to provide the best planning solutions, namely rational, incremental, adaptive, and consensual planning. Sustainable development is the end of management goals that have accommodated ecological, social, and economic aspects that are in an interrelated and integrated state (Scott and Rajabifard, 2017).

On (Table 5), the two coral reef ecosystem stations are in well category, therefore it needs to be preserved. This is in line with Nybakken (Li *et al.,* 2017) who suggests that high productivity occurs because of the presence of microalgae or Zooxanthella which are symbiotic with coral polyps and other coral animals. This production sustains a very diverse and specialized life for coral reefs. Meanwhile according to (Cheal *et al.,* 2017; Darling *et al.,* 2017), Tanjung Tiram waters have a percentage of coral cover of 61.15% with temperature of 28 °C, 34 ppt salinity, current speed of 0.07-0.20, pH 7 and 100% brightness.

Water temperature largely plays an important role in coral growth and development (Cacciapaglia and van Woesik, 2016; Hughes *et al.,* 2017; Humanes *et al.,* 2017). Coral reefs do not develop at an annual minimum temperature below 18°C, and the most optimal occurs at an average annual temperature below 25 °C – 29 °C, with minimum and maximum tempera- tures range between 16 °C – 17 °C and around 36 °C. Thus, coral reefs are largely foundin tropical waters. However, the tolerance of coral constituents to temperature changes varies from one species to another (Louis *et al.,* 2017).

Overall, the existence of the steam power plant in the coastal area of Tanjung Tiram Village reveals the ecological resources of water with biophysical parameters, i.e. temperatures around 30 °C, salinity around 26 – 30°/00, water depth ranging from 3 – 7m, dissolved oxygen ranging between 6.2 up to 7.2 ppm, waves ranging from 10-13 cm, open protection, with a substrate of sand and gritty sand, current speed ranging from 4.6 – 5 cm/second, brightness 80-100%, phosphate ranging between 0.0170 – 0.0190 mg/L, and nitrates ranging from 0.007 to 0.0082 mg/L. Such parameters show normal conditions that can support the life of aquatic organisms, especially capture fisheries, marine, and brackish aquaculture.

Conclusion

Biophysical measurements onmangrove ecosystems, seagrass ecosystems, and coral reef ecosystems are classified in good condition. Therefore, management should go through approaches that maintain ecological values so the preservation of the Tanjung Tiram aquatic ecosystem can be well-achieved.

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