Jurnal Biodjati, 3 (2) 2018

JURNAL BIODJATI

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STUDY OF MUD CLAM *Polymesoda erosa* (BIVALVIA) CONSERVATION STRATEGY BASED ON LANDSCAPE CHARACTER AND ANTHROPOGENIC ACTIVITY

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Received : 10 September 2018
Accepted :07 Nobember 2018

e-ISSN : 2541-4208
p-ISSN : 2548-1606

DOI :10.15575/biodjati.v3i2.3209

Abstract. *Information on landscape character and anthropogenic activity is necessary to develop conservation strategy, especially for mud clam (Polymesoda erosa) sustainability harvesting. The purpose of this study is to identify the landscape character and anthropogenic activity that influence mud clam conservation strategy in the coast of Tabanio Village, Takisung Sub-District in Tanah Laut Regency. The research discovered seven types of landscape in the coastal area of Tabanio namely human settlements, rice fields, plantations, cemetery abandoned land, offices, and other public infrastructures. Landscape, landscaping, abandoned land and settlements provide the largest contribution (96 %t) in the formation of coastal characters. Related to changes in landscape structure, environmental pollution activity in the form of waste disposal to the landscape is the most frequent activity (91.4 %) related to changes in landscape structure. Destructing collecting, cutting down and destroying plants and animals in and from the region (87.7%) are the most frequent anthropogenic activities related to the conservation of mud clam in the coast of Tabanio Village. The landscape zonation consists of four i.e : recreation zone, mangrove forest zone, economic zone and distribution zone. The position of each zone tends to clump primarily for the economic zone behind the recreation zone. The core zone of the landscape design at Tabanio Coast, Takisung District is concentrated in the recreation zone which functions as a meeting place for various communities (fishermen, traders and visitors) and the government workers (village officials and TNI-Polri). Furthermore, the recreation zone also facilitates activities that support coastal economy and tourism. Community assistance programs are required to build the capacity of fishermen and farmers as an effort to achieve a successful mud clam conservation and management in Tabanio Village, Takisung District*

Keywords : *adaptation, conservation, shellfish, coastal*

Citation
Kadarsah, A., Krisdianto. & Susilawati, I. O. (2018). Study of Mud Clam *Polymesoda Erosa* (Bivalvia) Conservation Strategy Based on Landscape Character and Anthropogenic Activity. *Jurnal Biodjati*, 3(2), 99-109.

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INTRODUCTION

Kerang kapah or mud clam (*Polymesoda erosa*) is one type of shellfish from class Bivalvia (Pelecypoda) based on its characteristics such as feet, gills and two shell pieces (Bachok et al, 2006). This type is often found on the base of substrate (Brotowidjoyo, 1994), especially on the mangrove forests in Indo-Pacific western including Indonesia (Poutiers, 1998). The last decade, at the coast of Tanah Laut Regency, mud clam is an important culinary menu, its give many benefits for the community and fishing households. The economic value of *P. erosa* as a side dish of local specialties and also in ecological value as a feeder filter for food chain (Listyaningsih et al, 2013). But unfortunately until now the utilization of mud clam is still relies on the catchement from nature and has not been supported by cultivation. So if it carried out continuously, it will reduce its population and sustainability harvesting for the people who use it, especially in Tanah Laut Regency.

As a part of Barito River Basin, the Tabanio Coast has a very important role in the conservation of mud clam (*Polymesoda erosa*). About 150 hectares of mangrove forest in this region turned out to be useful as an important habitat for a number of mud clam populations (Direktorat Jenderal Pemberdayaan Masyarakat dan Desa : Desa Tabanio, 2014) as one of the main components in the mangrove soft sedimentary community (Listyaningsih et al, 2013). Economically, the availability of mud clam throughout the year can also increase the income for the people (Hafizianor, 2009). Moreover, it is known that ecological of mud clam is an important food chain feeder filter and an effective cleaner for aquatic environment which is contaminated by heavy metals (Ghufran, 2011).

Current conservation has become an important demand and must be met as a harmonization of the community economic needs and desire to conserve resources for the future (Pranata & Satria, 2015). The conservation efforts and attention of the unique biota are very urgent, as well as mud clam (*Polymesoda erosa*) which continue to be threatened due to mangrove conversion (Listyaningsih et al, 2013), the more urgent the need for conservation strategies.

The enactment of the Regional Autonomy Law in 1999 aims to increasing the biota and landscape, but on the other hand, these conditions encourage human activities in changing the structure of mangrove ecosystem landscape for settlement purposes, dry land farming (farms), cattle farming and pond fisheries (Hafizianor, 2009). If it is continuously left unattended and uncorrected it will be a potentially frustrating conservation effort (Chapin III et al, 2002), because of its impacts to the environment and surrounding of communities (Listyaningsih et al, 2013). The actual action should to be done immediately, including managing conservation of mud clam based on landscape characteristics and anthropogenic activities. This plan is very much needed because the landscape structure reflects how far the carrying capacity, not only to the mud clam but also to the extraordinary amount of biomass - millions of species - from the existing biodiversity (Vold & Buffett, 2008).

Based on the description, so the purpose of this study is to identify the landscape characteristics and anthropogenic activities that influence the conservation strategy of mud clam at the coast of Tabanio Village, Takisung District, Tanah Laut Regency. This information is important for conservation efforts because it is the main capital base to increase coastal resistance to various threat

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that disrupt the stability of the economic system and the ecology of mangrove ecosystem (Kuspriyangga, 2011).

MATERIALS AND METHODS

This research took place in the Tabanio Village, Takisung District, Tanah Laut Regency, South Kalimantan Province. Tabanio village is located at latitude 114° 44'25,9 "East Longitude 3° 26'52,0" South Latitude (See Figure 1). The duration of the research was about three months, starting from August to October 2017. A number of tools used in this study are GPS, notebooks, voice recording devices, and digital cameras. While the materials used are mud clams, landscape data, anthropogenic activities related to the conservation of mud clam, environmental carrying capacity analysis and conservation strategies of the mud clams in Tabanio Village.

Data collection was carried out through surveys of landscape conditions, observing anthropogenic activities, conservation status of mud clam and landscape-based scaffold conservation strategies. Information of landscape is including the types of landscaping and percentage of usage. The settlements are recognized by the form of simple boxes that are close to each other in a relatively small size with the color that looks white, light brown to dark brown. Settlements are generally located on the side of the road extending along the road pattern. Meanwhile, the vegetation is usually colored by light green to dark color (Malik, 2011).

The information of anthropogenic activities was carried out based on the gender and livelihood level related to the changes in landscape structure and conservation of mud clam. Data collection of anthropogenic activity was carried out by reviewing information from the book "Profil Desa Tabanio Kecamatan Takisung Kabupaten Tanah Laut Provinsi Kalimantan Selatan" (Direktorat Jenderal Pemberdayaan Masyarakat dan Desa : Desa Tabanio. (2014) and also a significant number of papers in respect to a variety of issues, including lanscape and anthropogenic activities. An extended internet survey has been carried out in order to collect more information for case studies (Coccossis et al, 2012).

The important points on conservation status are calculating of the economic value and carrying capacity of the environment (Moran & Pearce, 1994). Carrying capacity is defined as the capacity or capability of the land in the form of environment to support the lives of humans and other living things (Brandon & Patrizia, 2005). This value is obtained by using the parameters :

(1) the total area that can be used for agricultural divided by plantation activities,
(2) the frequency of harvest per hectare per year, the number of households,
(3) the percentage of population living, and
(4) the size of the average agricultural land owned by farmers.

Meanwhile, adaptation strategies include landscape design at Tabanio Coast, action plans adaptation and the concept of co-management (Dewi, 2010).

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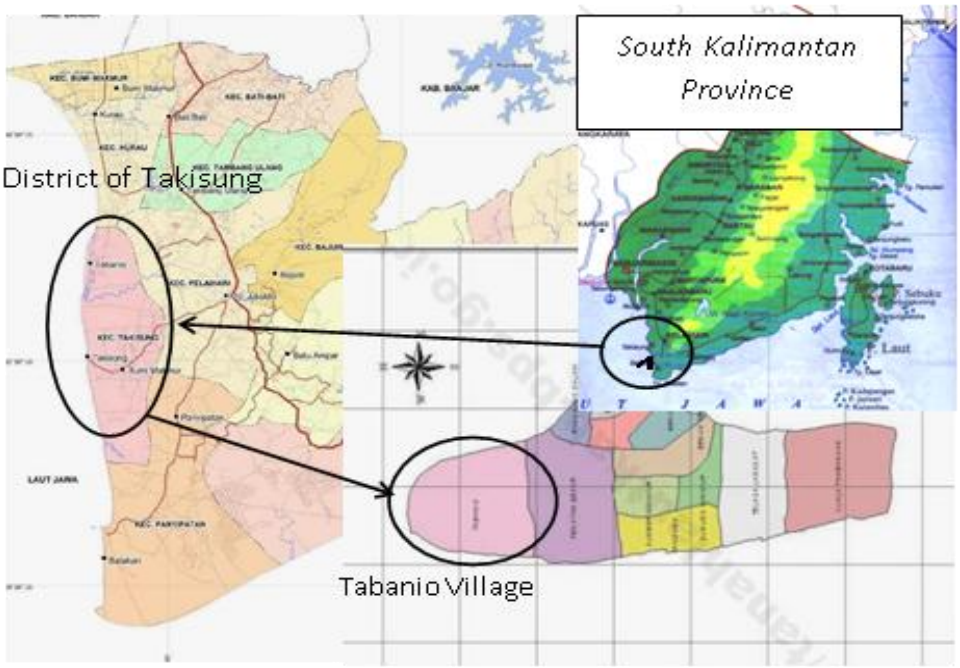

Figure 1. The study location is in Tabanio Village, Takisung District, Tanah Laut Regency, South Kalimantan Province

RESULTS AND DISCUSSION

Landscape Character of Tabanio Village

In the modern agricultural landscape, there will be conditions of spatial structure, habitat diversity and habitat composition that vary greatly from one landscape to another (Yaherwandi et al, 2008). From this study, about seven main types of ecosystem landscape use are found, including settlements, rice fields, plantations, graves, sleeping lands, offices, and other public infrastructure. The total area of Tabanio Village is 2,355 Ha (Direktorat Jenderal Pemberdayaan Masyarakat dan Desa : Desa Tabanio, 2014). The type of land use is divided into two parts namely dry land and wetland. Dry land consists of fields, settlements and yards while wetlands consist of rain-fed rice fields, semi-technical irrigated fields, swamps and peat lands. The average ratio percentage of dry land area to wetland is about 30.4%: 69.6%.

Figure 2 below shows that the settlement landscape dominates all dry land (93.9%) in Tabanio Village, the rest is field for about 3.19% and the yard about 3.72%. Although the percentage of both is small, the yard is known to have various important functions for family life, which can be used to meet family needs and increase household income if it is properly designed and planned (Ashari et al, 2012). On the other hand, Kadarsah & Susilawati (2018) observations show that the average area of the yard owned by residents in the coastal area of Tanah Laut Regency is around 28.5 - 181.67 m2. The settlements are recognized by the form of simple boxes that are close to each other in a relatively small size with the color that looks white, light brown to dark brown. Settlements are generally located on the side of the road extending along the road pattern. Meanwhile, the vegetation is usually colored by light green to dark color (Malik, 2011).

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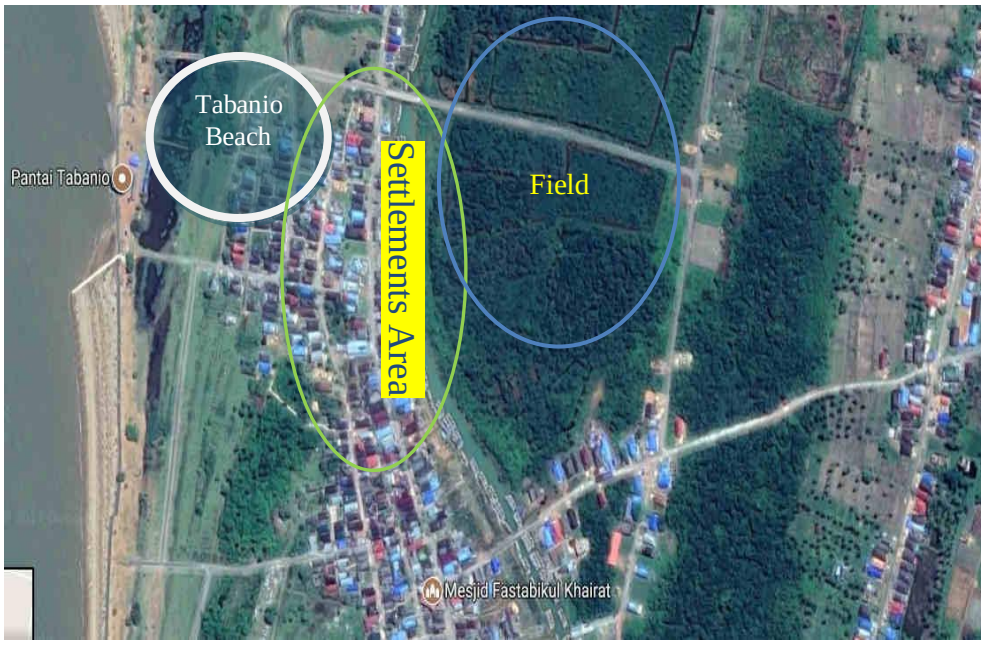

Figure 2. Appearance of the landscape structure of the coastal ecosystem in Tabanio Village, Takisung District (http://maps.google.com).

Anthropogenic Activity Related to The Landscape Structure

In general, the anthropogenic activities will change the structure and function of ecosystems (Chapin III et al, 2002). Anthropogenic activities and their impacts related to changes in landscape structure are divided into three important themes, such as : habitat destruction, exotic species competition, and excessive exploitation of biological resources. The theme of habitat destruction is related to activities to change structures and functions such as: changing waterways and making ponds, conversion of agricultural land into residential areas, logging of mangrove trees, physical changes in spatial planning and zoning and pollution. The theme of exotic species competition includes: the inclusion of exotic species in various ways, the deliberate removal of high-value native species and the spread of exotic species left without control. And the theme of excessive exploitation of biological resources includes: excessive commercial capture and use of fishing or hunting equipment that are not in accordance with the rules (Sunaryo et al, 2012).

Population census data for 2014 in Tabanio Village (Direktorat Jenderal Pemberdayaan Masyarakat dan Desa : Desa Tabanio, 2014) show that the population under 10 years old is around 18.09% while the population under 20 years old is around 35.1% and around 52.48% are under 30 years old. From a demographic perspective, Investments (2017) said that its have a great potential in terms of productivity and creativity. In Figure 3 below, it can be seen that the most activities of productivity and creativity was carried out by residents in Tabanio Villag. They are environmental pollution by doing waste disposal to the landscape (91.4%), and forestry activities, especially in logging of mangrove trees (71.7%).

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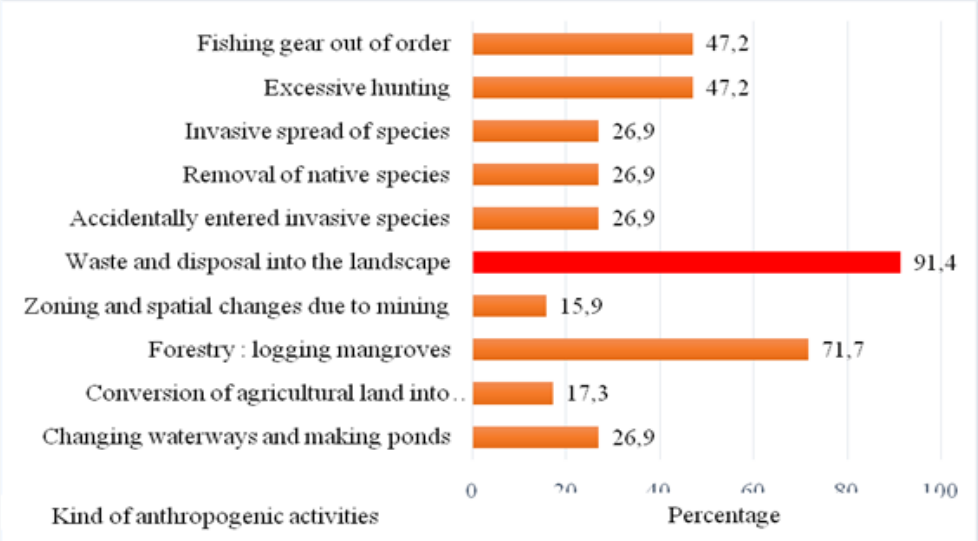

Figure 3. Percentage of anthropogenic activities is related to changes in landscape structure in Tabanio Village, Takisung District

The anthropogenic disturbance that is often found in mangrove ecosystems on the coast of Tabanio Village is the felling of trees (71.7%), which is not only has an impact on the loss of vegetation in the mangrove ecosystem but also the other big impact that is the conversion of land into fish / shrimp ponds. The subsequent negative impact is the loss of various services provided by mangrove ecosystem such as : direct fishing grounds, sources of firewood and charcoal, sources of building timber, sources of food, animal feeding, medicinal ingredients, industrial raw materials, and tourism and education interests (Setyawan & Winarno, 2006).

Anthropogenic Activities Related to Conservation

Republic of Indonesia Government Regulation Number 68 of 1998 is an important basis for determining the types of disturbances and the impacts that arise on biodiversity conservation in Tabanio Village, Takisung District based on the order of the scale of disturbance. The intended disturbances include: 1) Wild hunting of animals, 2) Entering exotic species of plants and animals into the area, 3). Changing landscapes that interfere with plant and animal life, 4). Making holes that disturb plants and animals in the area, and 5). Damaging, taking, cutting, and destroying plants and animals in and from the region. Figure 4 below shows that damaging, taking, cutting, and destroying plants and animals in and from the region is the highest activity in Tabanio Village (87.7%). The second highest activity is hunting for animals (81%), and the lowest activity of making holes that disturbed plants and animals in the area (37%)

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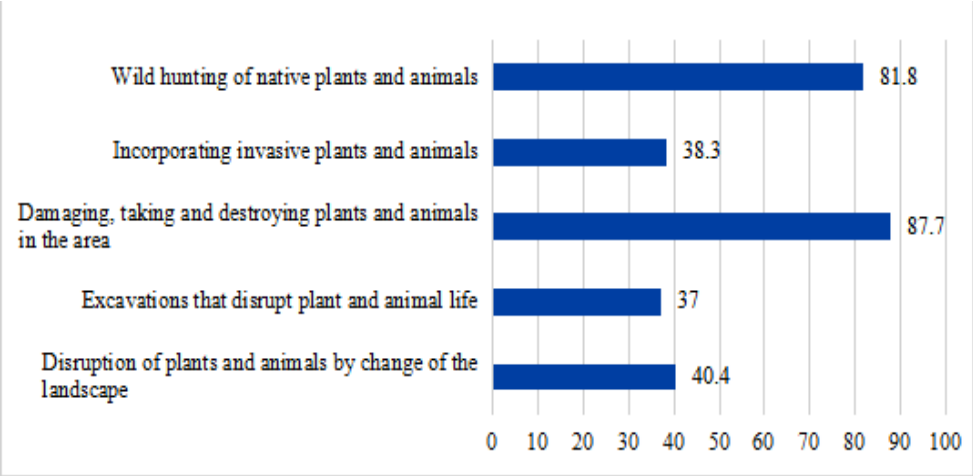

Figure 4. Percentage of anthropogenic activities related to biodiversity conservation in Tabanio Village, Takisung District.

In general, damage to mangrove forest ecosystems caused by human activities in the abuse of natural resources in coastal areas does not pay attention to sustainability, such as: logging for the needs of excessive fuel wood, ponds, settlements, industry and mining (Badan Riset Kelautan dan Perikanan Departemen Kelautan dan Perikanan, 2004). The dominance of the livelihood of the population as fishermen (47.2%) and farmers (24.5%) from the results of this study allegedly gave a strong influence on the anthropogenic activities that occurred in Tabanio Village. Mangrove forest conversion carried out by coastal communities or anyone who is used for various activities in principle will damage the environment. In addition, it is not uncommon that human activities to utilize mangrove land are motivated by thought patterns based on mere economic needs. In our country, a number of coastal community activities that convert mangrove forests are used, among others, for residential, agricultural or plantation land, shrimp or fish farms, salt making, mining and other activities (Pramudji, 2000).

Economic Value of Mud clam and Environmental Carrying Capacity

The calculation of the economic potential of the mud clam in Tabanio Village shows that the average number of mud clam produced by hunting during the last three months (August - October in 2017) is 13 - 22 kg per month (Figure 5). Based on personal interviews, this acquisition value is generally influenced by the tide or ebb condition of sea level.

Viewed from the livelihood, the total number of people who are actively involved in hunting the mud clams on Tabanio's coast are 135 families. The acquisition of mud clam from hunting results is in the range of 3,120 - 3,480 kg per month or the average value of 3,300 kg per month. If it is calculated in one year, the acquisition range is 37,440 - 41,760 kg per year or an average of around 39,600 kg per year. The selling price per unit kilograms of raw mud clam to the consumer level is Rp. 5,000.00. The range of gross income from hunting of mud clam every year before deducting by the purchasing of plastic bags and transportation is Rp. 187,200,000.00 - 202,200.00.00 with an average of Rp. 198,000,000.00.

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The result of the calculation of the carrying capacity of the coastal environment in Tabanio Village is 0.146. Thus, based on the amount of coastal land and mangrove forests that exist, then in the region it is impossible to hunt for expansive and explorative mud clam. Further efforts are programs to increase productivity, intensification and extensification through technological improvement (Purnama, 2015).

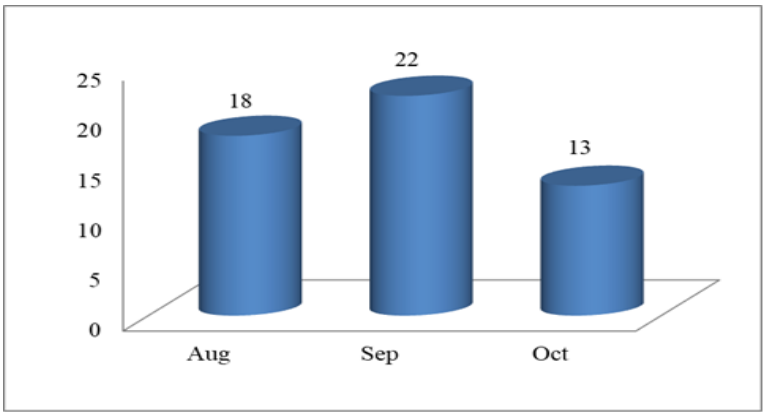

Figure 5. Average collection value of mud clams in Tabanio Village (during August - October 2017).

Mud Clam Conservation Adaptation Strategy

Regarding landscape structures and anthropogenic activities, the concept of managing biological resources basically must be based on the principles of sustainability, the balance between economic and ecological factors, and local wisdom (Yuniati, 2011). In the case of mud clam management, the above principles can be adopted through five main activities, namely: 1). Feed management, 2). Mud clam management, 3). Management of disease pests, 4). Environmental management, and 5). Sustainable harvest, as shown in Table 2.

Landscape analysis shows that zoning on the coast of Tabanio Village consists of four segments, namely: (1) recreation zone, (2) mangrove forest zone, (3) economic zone and (4) distribution zone. The position of each zone tends to cluster especially for economic zone behind the recreation zone (Figure 6). Core zoning of landscape design in Tabanio Coast , Takisung District is based on recreation zone (zone 1). This zone is a meeting place for various communities and the government to carry out activities that support the economy and coastal tourism such as meetings, cultural ceremonies, exhibitions, picnics and sports.

Furthermore, to implement the mud clam conservation, adaptation action plan can be done by imitating the concept of Co-management proposed by Dewi (2010) as follows: (1) directing changes in mesh size of the cod end from 2 cm to 5 cm and with the addition of BED. (2) diversification of fishing gear that has high selectivity and does not deplete resources, (3) arrangement of catching season for Mud clam, and (4) community assistance program to improve skills.

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Table 2. Criteria for mud clam conservation related with landscape structures and anthropogenic activities in Tabanio Village

No	Criteria of Activities	Example of Activities
1	Feed management	Providing of natural food for mud clam
2	Mud clam Management	Sorting out adult-sized shells for consumption Returning small-sized mud clam catches
3	Management of disease and pests	Allowing natural enemies to survive
4	Environmental management	Reducing pollution to mud clam habitats,and maintaining mangrove ecosystem
5	Management of sustainable crops	Creating seasonal arrangements and time for catching mud clam

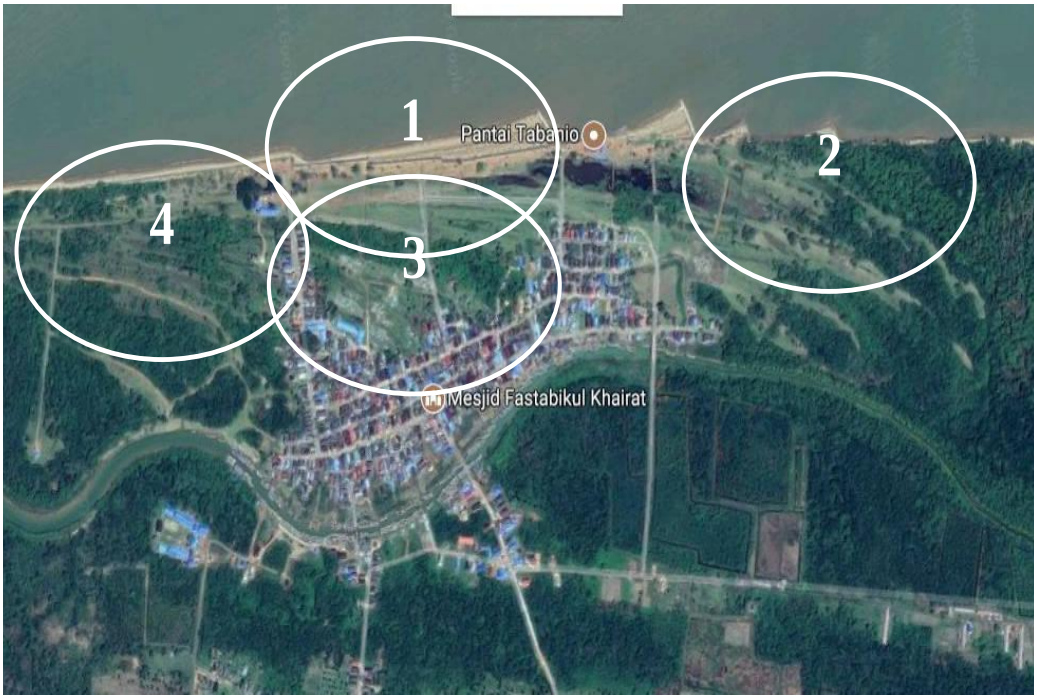

Figure 6. The coastal zones design of Tabanio Village in an effort to adapt mud clam conservation strategies : (1) recreation zone, (2) mangrove forest zone, (3) economic zone and (4) distribution zone.

The conclusion that can be drawn from this study is that there are about seven main types of ecosystem landscape in Tabanio Village, for example: settlements, rice fields, plantations, graves, sleeping land, offices, and other public infrastructures. Settlement landscapes dominate all dry land (93.9%), fields 3.19% and yards 3.72%. The two highest anthropogenic activities that are often carried out by residents are (1) damaging, taking, cutting, and destroying plants and animals in and out of the area (87.7%) and (2) illegal hunting of animals (81%). The lowest activity is making holes that disturb plants and animals in the area (37%). Supporting coastal environment index in Tabanio Village is 0.146 which indicates that the area does not allow expansive and exploratory hunting of mud

clam. The core zoning of landscape design in Tabanio Coast, Takisung District is taken based on recreation zone so that community assistance programs are needed to improve the skills of fishermen and farmers in an effort to improve the success of conservation and management of mud clam

ACKNOWLEDGMENTS

Thanks are conveyed to Kementrian Riset Teknologi dan Pendidikan Tinggi (Republic of Indonesia) through the PDUPT research path in 2018.

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