Strategy management area coral viewed from threat level in tanah Bumbu regency South Kalimantan

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Abstract. The major threats of coral reefs are anthropogenic and non-anthropogenic factors. The research aims to determine the threat level and formulate a strategy to manage coral reefs. The methods used are lozenge, the analysis of threat status, the analysis of hierarchy processes and the interpretation of strategic management. Threat assessment was based on an expert view obtained through a questionnaire. The results of the research indicate that the low threat level of coral reefs is 225.84 ha (66.3%) and the moderate threat level is 114.58 ha (33.7%). The result of modeling for the next 20 years indicates that the low threat is 84.03 ha (24.69%), the moderate threat is 238.49 ha (70.06%) and the high threat 17.88 ha (5.25%). The management strategies used are watershed conservation, harbor management, the prevention of destructive fishing practices, integrated and sustainable marine tourism management, revitalization of coastal settlements and the control of population growth, and adaptive management for coral reefs related to global warming.

1. Introduction
Tanah Bumbu 2017-2037 stipulates that coral reefs, including 12,664.43 ha of water conservation areas, are facing threats of anthropogenic damage such as mining / extracting corals, environmentally friendly fishing, pollution, tourism development, regional development and non-anthropogenic sedimentation in the form of warming global, natural disasters (hurricanes, earthquakes, floods, tsunamis), natural phenomena of el-Nino and la-Nina, and coral predators AcanthasterPlancii [1].

States that illegal fishing causes nearly 100 ha of coral reefs in Kab. Kota Baru and Tanah Bumbu are destroyed and damaged [2]. Coral mining/theft activities (for building purposes) and port development contribute to the damage to coral reefs [3]. [4], the destruction of coral reefs in South Kalimantan caused by the theft of corals by unscrupulous people who were used to make houses and land functions become special ports such as coal ports. In PulauPanjang, Tanah Bumbu Regency, the coral reefs were very bad due to ship anchors and construction of a booming mining port in 2000 and automatically invited large loaded barges [5].

The problems mentioned above will be increasingly complex as the population continues to experience an increase especially in coastal areas and will require settlements, infrastructure and spatial use which will certainly have an impact on the existence of coral reef ecosystems. The provincial government of South Kalimantan through the 2017 Coastal and Small Islands Zoning Plan in 2017 states that the issue of problems namely the lack of settlement area arrangement, the condition of infrastructure and means of drainage, solid waste and sanitation are not optimal, the number of residential areas that utilize river areas with no heed river border. This has the potential to cause pollution due to household waste, as the population continues to increase, the volume of waste is...
increasing. The negative impacts of waste such as covering up the photosynthesis process of coral reefs and become food for fish and coral reefs [6].

Issues of climate change, such as massive coral bleaching, caused by an increase in average sea surface temperature, have now affected almost every large coral reef ecosystem on earth. Coral bleaching is a stress response that culminates in the loss of symbiotic dinoflagellates from coral tissue [7,8]. Global warming in the form of rising sea temperatures is one of the main factors causing coral bleaching in Indonesian waters in 2010 [8,9]. Increasing sea surface temperature with a long duration of about 2 months, has an impact on some vulnerable coral genera can not survive [8,10]. For example in Gilimatra dead coral occurs due to bleaching by only 1% [8,11]. Based on preliminary observations in 1999 the area of Tanah Bumbu 714.87 ha has decreased to 340.42 ha based on data from the South Kalimantan [12]. This has an impact on the decline in marine fisheries production in Tanah Bumbu. Tanah Bumbu marine fisheries production in 2007 was 37,124.4 tons and dropped to 20,110.71 tons in 2010 [5]. Thus a study aimed at assessing the level of threats and strategies for management of coral reefs in Tanah Bumbu Regency.

2. Research Methods

2.1. Time and Location
Research This research was conducted in July 2018 - April 2019 with research locations in coastal areas and small islands in Tanah Bumbu Regency.

2.2. Types and Sources
Data Primary data using a questionnaire, then distributed to experts or respondents related to the research topic (expert judgment) of 5 experts. Secondary data includes Regency Statistics data related to population, tourists, ports, Regency RTRW documents, Provincial RZWP3K Documents, Landsat 8 satellite images of resolution 15 m in 2016, and the RupaBumi Indonesia map.

2.3. Data Analysis
Determination of the distribution of coral reefs through the interpretation approach of Landsat 8 Satellite Imagery which was analyzed by the Lyzenga algorithm. [13,14], to strengthen the spectral response of coral reefs in this study, several transformation methods for coral reefs were chosen, namely the transformation method is used to strengthen the spectral response of coral reefs and distinguish them from other substrate waters. Correction column (water-column correction) and lozenge transformation can reduce the influence of the depth effect. Movement and turbidity of the water, to increase the acquisition of information on the characteristics of shallow water bases. The lozenge transformation is carried out by eliminating the effect of the water column. Furthermore, the channel used is a visible channel with a wavelength range: 0.42-0.50 μm for the blue channel, 0.52-0.60 μm for the green channel, 0.61-0.69 μm for the red channel [15]. Furthermore, the threat status assessment using a threat matrix consisting of the distance of the existence of settlements from [16] supported by [17] which states that the existence of human activity in coastal areas causes vulnerable coral reefs affected from human activities that can damage, the intensity of the use of tools fish bombing from [18], suspended solids content from [19], the impact of the number of diving tourists from [20] and the distance of settlement from [16].

From the results of the matrix, the coral reef threat level will be assessed which is the accumulation of sources of threats using a process hierarchy analysis approach. The analytical hierarchy process is a decision support method developed by [21]. This decision support model will break down complex multi-factor or multi-criteria problems into a hierarchy. Hierarchy is defined as a representation of a complex problem in a multilevel structure where the first level is the goal, followed by the level of factors, criteria, sub-criteria, and so on to the last level of alternatives [22,23].

Modeling in determining the management strategy of modeling steps using the method systemdynamics is [23,24] Identifying problem behavior and determining the simulation model.
Determine the priority of the management strategy by ranking the results of expert judgment and the consistency ratio test. The value of the consistency ratio (CR) which indicates whether the questionnaire filled out by respondents is consistent or not. If the CR value > 0.1, then filling out the questionnaire is not consistent so that it needs to be adjusted or revised opinions [25].

3. Result

3.1. Resident Threat

The population of Tanah Bumbu continues to show an increasing trend. In 2007 there were 230,018 people and in 2017 the population was 343,193 people. In 10 years there has been an increase of 113,175 people or around 67.02%. The population that continues to experience an increase in terms of the number will need to add to the basic needs of housing. One possible impact is damage to surrounding ecosystems such as coral reef ecosystems. The results of the interpretation of land changes from 1997 to 2017, settlements in 1997 were 3,415.8 ha and in 2017 became 8,279.43 ha or an increase of 41.26%.

The increasing number of settlements in the coastal area of Tanah Bumbu has a threat impact on the existence of coral reefs that are close to these settlements. Figure 1 shows the results of the spatial analysis of coral reef threats based on the distance of settlement development which is low 225.84 ha, medium 103.52 ha, and high 11.06 ha.

Figure 1. Distribution of settlement threats

3.2. Pollution Threats From the Watershed

For conditions in the Tanah Bumbu watershed that land cover for forest groups is only 23.89% of the total land cover area. This condition is not good for land cover. While those classified as non-forest reached 76.11% consisting of mixed gardens, plantations, settlements, mining, agriculture, swamps, rice fields, shrubs, ponds and water bodies. This is the factor causing sedimentation in the coastal and marine areas of Tanah Bumbu. The condition of land cover as mentioned above tends to be the closure of open land which is a supplier of land material which is carried by the flow of water through the rain to the river and finally to the sea waters.

Figure 2 shows the distribution value of suspended solids in Tanah Bumbu waters is 0.83 - 774.8 mg / l. The threat is low due to sedimentation of 0.17 ha, moderate 212.11 ha and high 128.14 ha.
3.3. Threat of Ports
The results of the identification carried out reveal that there are at least around 20 ports on the Tanah Bumbu coastline. These ports consist of Very port, Pelni port, Fishing port, speed boat and special port (oil, cement, and coal). Figure 3 shows the results of the spatial analysis of the existence of ports that pose a low threat of 225.84 ha, moderate 103.52 ha, and high 3.25 ha.

3.4. The threat of Marine Tourism Activities
The number of Tanah Bumbu tourists in 2016 was 29,566 tourists and increased in 2017 to 37,336 people. This indicates that the coastal tourist attraction is one of the attractive destinations for tourists. However, based on information obtained that marine tourism activities related to underwater tourism activities (diving) are only about 1% of total tourists. The still low number of visitors to the underwater is due to the low interest of tourists and also infrastructure such as the availability of tools and human resources for diving is still limited. From these data, it can be seen that for marine tourism activities which only reach 373 visitors/year, the threat to coral reefs is still relatively low.
3.5. The Threat of Illegal Catching (Fish Bombs)
Field information that fishing activities with fishing bombs are not indicated to occur again. Referring to this information, the threat of catching fish bombs on coral reefs is classified as low with the intensity of the use of fishing gear with bombs not indicated.

3.6. Level of Threats to Coral Reefs Soil

Table 1. Matrix weights threat level of coral reef soil spices

| Source of Threat                              | Weights |
|----------------------------------------------|---------|
| Distance of Occurrence of Total Suspended Solid (TSS) | 0.298   |
| Distance of Existence of Ports               | 0.285   |
| Amount of Tourist Underwater                 | 0.144   |
| Intensity of Fish Bombs Occurrence           | 0.181   |

Table 2. Threat level of coral reefs in seasonal spices in 2017

| Threat Levels of Coral Reef Area (Ha) | Percentage (%) |
|--------------------------------------|-----------------|
| Low                                  | 225.84          | 66.34          |
| Medium                               | 114.58          | 33.66          |

Table 1 shows the results of the assessment of the threat level of coral reefs with a hierarchical analysis process with the result that the distance of settlement existence is 0.092, the content is total suspended solid 0.298, the port presence distance is 0.285, the number of underwater tourists is 0.144, and the intensity of bomb events fish of 0.181. From these results, it is known that the highest weighting is the threat of total suspended solid content and the lowest is the threat of settlement existence. The weight value is obtained with an average consistency test result of 0.1 which means this value indicates a fairly rational level of consistency in the pairwise comparisons made and can be used as weights in determining the threat level of Tanah Bumbu coral reefs. Table 2 shows the results based on the threat weights there are 2 (two) classes of existing coral reef threat levels, namely low threat level 225, 84 ha (66.36%) and moderate threat level 114.58 ha (36.66%).

4. Discussion
This study shows the threat level of coral reef threat in 2017 with a low threat of 25.84 ha and moderates 114.58 ha. This is used as an initial assumption in the formulation of management strategies in overcoming the problem of Tanah Bumbu coral reefs carried out with a dynamic spatial model approach with an emphasis on the extent of coral reefs affected by the low, medium and high threat. It is hoped that this management model can overcome the various coral reef threat problems that exist for the next 20 years (2017 to 2037).

The assumption is that the growth of settlements for 20 years is 142.39% or linearly there is an increase in residential areas of 7.12% per year. The data above is assumed to be linear with the population growth of the coastal districts of Tanah Bumbu Regency which is known that the population growth in the coastal area of Tanah Bumbu over the next 20 years will increase from 268,756 people in 2017 to 426,841 people with an average growth rate of 2.63%. So that the modeling of the development of the Tanah Bumbu coastal settlement area is known that an increase in settlement area occurred from 8,279.43 ha in 2017 to 20,069.34 ha in 2037. Fish bombing activities are known to be not indicated to occur. But in the simulation still, include this variable by referring to the threat matrix with a moderate category if it occurs once a year and a high category if it occurs once a week. Pollution from the watershed in the form of sedimentation that occurred in Tanah Bumbu sea waters was simulated in 2017 the results are known for the threat class low area of coral reef 0.17 ha, moderate 212.11 ha and high 128.14 ha with a range of sedimentation content of Tanah Bumbu waters.
0. 83 - 77.95 mg / l. This is certainly in line with the upper watershed area where it is known that 23.89% of DAS land cover is forest and 76.11% is non-forest. As a comparison, in 1997 the sedimentation range of Tanah Bumbu sea waters ranged from 11.94 - 32.61 mg / l with watershed land conditions 36.18% in the form of forests and 63.82% in non-forests.

Based on the assumptions above, it can be seen that for threats originating from watershed pollution in the form of sedimentation in sea waters will have a high threat impact that tends to increase from 128.14 ha in 2017 to 209.75 ha in 2037 and for the low threat category there was a decrease in area from 212.11 ha in 2017 to 130.50 ha in 2037. While for the low category there was no change. For the threat of marine tourism activities, especially diving activities, it is known that tourists, especially for diving, amounted to 296 people in 2016 and increased to 373 people in 2017. From this, it is known that each year there is an increase in the number of visitors by 78 people. This value is a reference in simulating the impact of the number of diving tourists on Tanah Bumbu coral reefs in the next 20 years. The increase in the number of tourist visitors, especially diving in 2037 to 1,927 people, which means an increase of 1,554 tourists in 20 years. This will certainly have a threatening impact on the existence of coral reefs. However, based on the threat matrix, the number is still relatively low where the limit of visitors for the low category is between 1,250-2,685 visitors/year.

The existence of a port around the coast of Tanah Bumbu poses a threat of coral reefs with a low class of around 225.84 ha, 103.52 ha medium and 11.06 ha high in 2017. Simulation of the threat of the presence of the port is done with the assumption that if the port development is carried out at locations which are close to the coral reef area. This will give an idea of the extent of coral reef areas exposed to the threat of low, medium and high. The results obtained with the above assumptions will increase the number of threatened coral reefs from 11.06 ha to 17.96 ha, the category being affected by a decrease in the area from 103.52 ha to 97.11 ha. As for the low category, there was no change in the extent of the affected.

As a result of a combination of assumptions namely a combination of the threat of settlement in 2022, fish bombs are indicated once a month, sedimentation in 2022, marine tourism activities in 2022 and the presence of ports along the coast will result in extensive coral reefs with levels low threat criteria 128.43 ha (37.73%), moderate 200.53 ha (58.91%), and high 11.45 ha (3.36%).

- The combination of residential threats in 2022, fish bombs indicated once a week / more, sedimentation in 2022, marine tourism activities in 2022 and the presence of ports along the coast will result in a low threat level of 126.72 ha, medium 196, 11 ha, and height 17.59 ha.
- The combination of settlement threats in 2027, fish bombs are indicated once a month, sedimentation in 2027, marine tourism activities in 2027 and the presence of ports along the coast will result in a low threat level of 113.23 ha, moderate 212.12 ha, and height of 15.06 ha.
- The combination of residential threats in 2027, fish bombs indicated once a week / more, sedimentation in 2027, marine tourism activities in 2027 and the presence of ports along the coast will result in a low threat level of 110.97 ha, medium 211, 79 ha, and height 17.65 ha.
- The combination of settlement threats in 2032, fish bombs are indicated once a month, sedimentation in 2032, marine tourism activities in 2032 and the presence of ports along the coast will result in a low threat level of 99.75 ha, medium 223.42 ha, and 17.25 ha high.
- The combination of residential threats in 2032, fish bombs indicated once a week / more, sedimentation in 2032, marine tourism activities in 2032 and the presence of ports along the coast will result in a low threat level of 97.22 ha, moderate 225, 35 ha, and 17.84 ha high.
- The combination of settlement threats in 2037, fish bombs are indicated once a month, sedimentation in 2037, marine tourism activities in 2037 and the presence of ports along the coast will result in a low threat level of 87.03 ha, moderate 235.75 ha, and height of 17.63 ha.
- The combination of residential threats in 2037, fish bombs indicated once a week / more, sedimentation in 2037, marine tourism activities in 2037 and the presence of ports along the coast will result in a low threat level of 84.03 ha, moderate 238, 49 ha, and height 17.88 ha.

Based on the above threat level items, a strategy and program for the implementation of coral reef ecosystem management in Tanah Bumbu are prepared, described below.
1. (Strategy 1) Land Protection / Conservation (DAS)
2. (Strategy 2) Port Management
3. (Strategy 3) Prevention and control of illegal fishing activities
4. (Strategy 4) Management of marine tourism in an integrated and sustainable manner
5. (Strategy 5) Management of coastal settlements and control of population growth.
6. (Strategy 6) Management of coral reefs due to global warming by implementing marine protected area systems, fishing management according to size, coastline protection and encouraging tourists to contribute funds for recovery and management efforts.

5. Conclusions and Recommendations
Based on the results of research conducted it is known that the threat level of coral reefs in Tanah Bumbu Regency currently covers 225.84 hectares or around 66.3% with a low threat level category and 114.58 hectares or 33.7% category of the moderate threat level. Simulation results in the next 20 years the threat of coral reefs will increase ie low to 84.03 ha (24.69%), moderate 238.49 ha (70.06%) and high 17.88 ha (5.25%). The biggest threat factor is pollution from the watershed in the form of sedimentation. Strategies that can be carried out protection / conservation of terrestrial land (DAS), port management, prevention and control of illegal fishing activities, management of marine tourism in an integrated and sustainable manner, structuring coastal settlement areas and controlling population growth, and management of coral reefs due to global warming with implementation of a marine protected area system, fishing management according to size, coastline protection and encouraging tourists to contribute funds for recovery and management efforts. Further research needs to be done about the sedimentation conditions of Tanah Bumbu waters by comparing the time between the sedimentation conditions of the rainy season and during the dry season.

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