Coral Reef Management Model in West Buleleng Regency, Bali, Indonesia

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Abstract. This research was conducted by the Buleleng Regency, which focused on the coastal area of West Buleleng in Pemuteran Village. This research aims to design a management model of west Buleleng coastal areas, specifically on the potential of coral reef coastal resources. Methods of data collection with surveys, observations, in-depth interviews, and documentation. Data processing and analysis in model design is carried out diagrammatically every input, process, and output of the potential of superior coastal resources owned by the west Buleleng coastal region. The study results showed the potential of the superior coastal resources of the West Buleleng coastal area, namely coral reef management. The model resulting from the potential of the excellent coastal resource is made with a diagrammatic design. The stages of starting the preparation of materials and tools used to make coral reef planting media, the stage of testing the suitability of the requirements and the location of activities, especially the ideal depth of coral reefs, namely with a depth of more than 3- 20 meters and 100 meters from the coastline. The stage of the activation process is to make planting media with bio rock technology, put media and seeds in the sea, and oversee the development of coral reefs; and the results of activities and benefits obtained from coral reef cultivation are the preservation of marine life.

Keywords: Model, GIS; Coastal

1 Introduction

Coastal and marine resources are enormous and promising assets for the future [1], [2]. The utilization of coastal and marine resources in each region has increased. However, its management is still far from optimal and sustainable. One of the coastal potentials that become the main potential that must be mapped is coral reefs. The Coral reef conditions as an indicator of fishery conditions on the coast [3]. Coral reefs have an essential meaning because of their function and role both ecologically, socially, and economically for other biota and the lives of people living in coastal areas [4]. Managing coastal resources in an integrated manner with the initial mapping of coastal potential is one step to utilize the potential as optimal as possible. The provision has been expressly stipulated in the Coastal Resource Management Act [5], utilizing the existing potential directed to the welfare of the coastal community. It should be a substantial capital for equitable development.

There is an inequality of development, especially in the tourism sector, which tends to focus on the South Bali area compared to other areas, such as North Bali (Buleleng Regency), East Bali (Bangli Regency and Karangasem Regency), and West Bali (Jembrana Regency). People

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in South Bali can already feel the benefits of the tourism sector and its participating sector. However, the opposite condition occurs in the people of North Bali, East Bali, and West Bali. The impact of these conditions is the occurrence of economic inequality by the community in each region.

The potential of coastal and marine resources in Buleleng Regency spread in the east Buleleng, Central Buleleng, and West Buleleng regions, has a varied distribution. Previous research results showed that the most complete and dominant coastal and marine resource potential variation is found in the West Buleleng region [6]. Findings on the various potentials of coral reefs, mangroves, sand, and ponds, particularly in the West Buleleng region obtained in the first year of research, were used as primary data and supporting information in the design of coastal marine management models. This year's research focuses more on the West Buleleng region by reviewing the potential that becomes a superior product, namely coral reef cultivation. Creating a model of coral reef management is expected to be a reference source for the management of coastal and marine resources in other regions.

The coastal area management model is considered one of the innovative regional development strategies because it can provide information on the potential of coastal resources of an area [7]–[10]. The implementation of this management model impacts coastal communities so that it is expected that equitable development of the region will be achieved. The region's development will be measured by knowing the empowerment of the community to the management of tourism and creating a superior attraction. Therefore, this study aims to make modeling of coral reef management with diagrammatic model design.

2 Methodology

The design of this study is descriptive [11]. Respondents were determined by purposive techniques, namely tourist-conscious groups, fishing groups, and community leaders who can provide information following the purpose of the study. Data is collected with observation techniques, in-depth interviews, and documentation from each stage. Data analyzed with qualitative analysis techniques, namely all stages of coral reef management made diagrammatic models [12], ranging from preparation, implementation, supervision, external and benefits obtained by coastal communities.

3 Result and Discussion

Coral Reef Management (biorock) in Pemuteran Village consists of several stages. The stages of coral reef management (biorock) are made in the following diagrammatic format (Figure 1.).

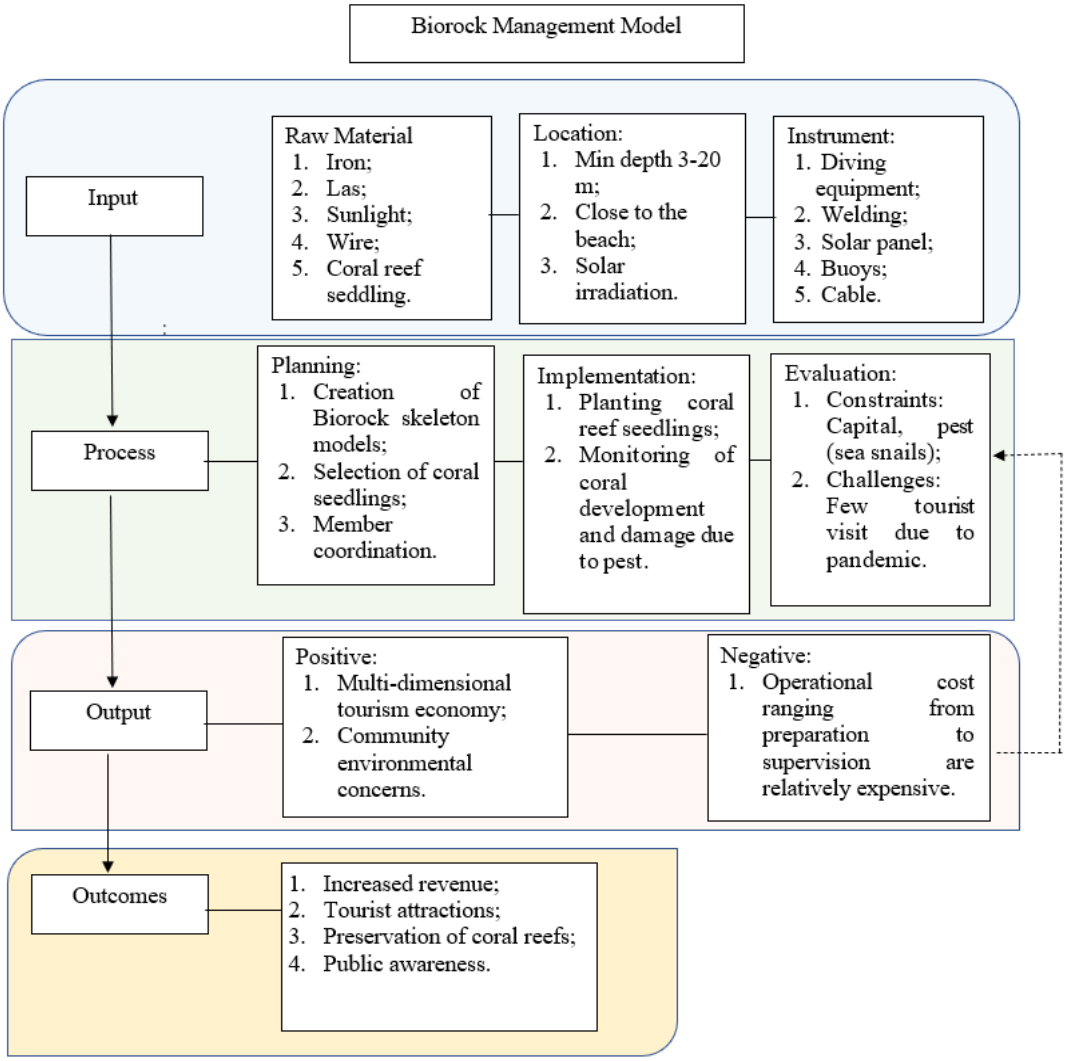


Fig. 1. Coral Reef Management Model (Biorock)

1. Preparation

At this stage, organizations, infrastructure and facilities (materials and tools), and environmental conditions related to weather and climate conditions. The organization formed for the cultivation of coral reefs in Pemuteran Village is called Karang Lestari. The organization is a coral reef restoration center that adopts bio rock technology. Under the coordination of the village government and the Buleleng Regency government, it has made rules on the protection of bio rock in writing or writing (customary village awig-awig). Infrastructure is built in the form of operational offices and facilities where solar panels are located in the middle of the sea to conduct electricity to the bio rock. Some buildings are used to indicate the existence of bio rock in the coastal area so that people who do not know the location of the bio rock can be more careful in doing activities around the beach to avoid damage. The means of transportation used

by the Karang Lestari Foundation is a rental car. Capital to make planting media in addition to coming from self-help and government donations, capital also comes from tourists who want to make bio rock it will be built in the manufacturing process until the planting process in the middle of the sea.

The materials and tools used in the manufacture of bio rock are iron. in addition, the land used in the manufacturing process is utilizing existing land on the coastal periphery. This is done so that transporting bio rock under the sea can be quickly done. In addition, accessibility between the distance from the bio rock manufacturing site to the location of the bio rock is easily reached. In the process of coral reef growth using bio rock technology, weather and climate are very influential. Where in the process of coral reef development, if the sun's irradiation is suitable and the sea is clear, the growth of coral reefs will be better (Figure 2).

(a)

(b)

Fig. 2. Biorock (a) Biorock Manufacturing Raw Materials and (b) Biorock Manufacturing Land

The workforce in the manufacture of bio rock comes from volunteers and members of the Karang Lestari Foundation, which amounted to 4 people. In the manufacture of bio rock, the average capital spent is 25 million / 1 piece of bio rock. The capital used in this manufacturing process uses Karang Lestari foundation cash previously received from sponsors and grants (Figure 3).

(a)

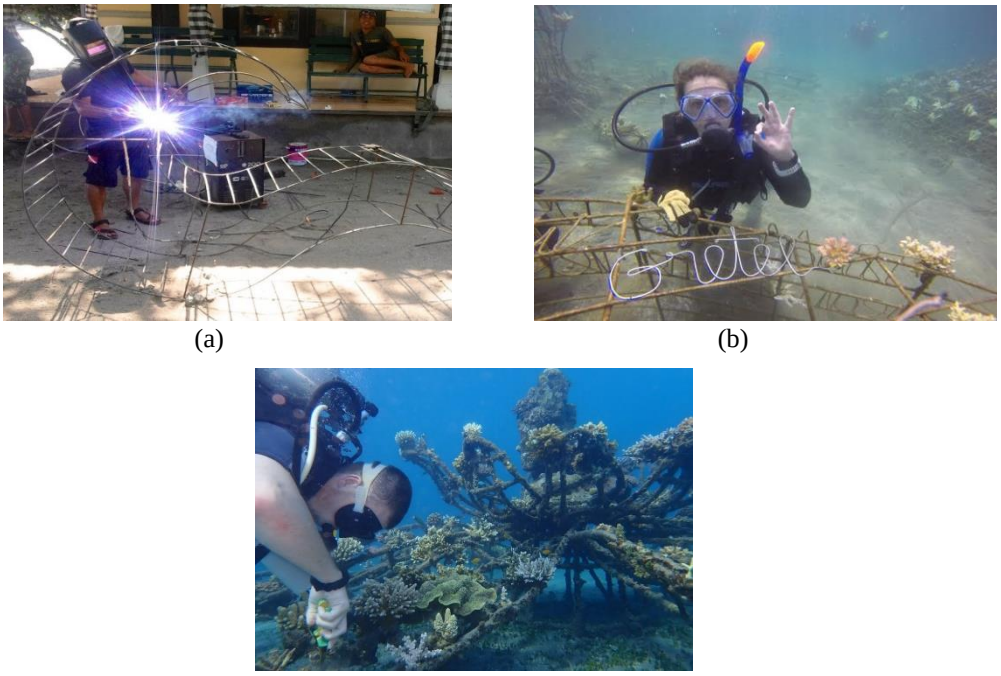
(b)

Fig. 3. Biorock (a) Solar Panel House and (b) Karang Lestari foundation office

2. Process

The preparation of planting media is carried out on the beach in the form of iron skeletons with various forms, then the planting of coral seedlings is carried out in seawater, which will later be associated with the flow of electric power. The planting media in the form of iron frames

placed in the middle of the sea will then be channeled from solar panels and PLN electricity. This technology is called bio rock by coral reef managers in Pemuteran Village. After placing bio rock in the sea, checks will be carried out related to pests that eat coral reef seeds such as rubella or Coralliophila Singkatanata, and sea snails. If there are pests, a thorough cleanup will be carried out so that coral reefs can develop properly. There is no particular drug used to dispel coral reef pests, only in cleaning. Coral reef seeds obtained from existing corals or corals that have not developed then coral will be planted again into a new bio rock to develop better (Figure 4).



(a) (b)

(c)

Fig. 4. Biorock (a) Biorock manufacturing process, (b) Coral reef planting process, and (c) The process of cleaning coral reef-eating pests

3. Benefit

The positive thing that results from the existence of bio rock is that it can improve the sustainability of corals in the sea area of Pemuteran Village. In addition, the people of Pemuteran Village have a serious concern for environmental sustainability and coral reef development. The existence of this bio rock increases the attraction for tourists to come to see the biorock in Pemuteran Village. This bio rock can increase socio-economic height in the Pemuteran Village area because the bio rock can attract tourists to visit. The advantage obtained by the local community is to open a diving equipment rental service, providing benefits for hoteliers in the Pemuteran Village area. Benefit the fishermen because the fish will breed with the presence of many coral reefs on the beach. The resulting physical/environmental benefits are increasing existing reef resources, reducing coastal abrasion because bio rocks will be sea breakwaters, and provide many benefits for coastal areas (Figure 5).

Fig. 5. The beauty of coral reefs resulting from bio rock

4. Evaluation

The obstacles experienced in the development of bio rock are weather and climate because if the weather/climate does not support then the process of coral reef development will be slow and not maximal, the cost required for the manufacture of bio rock is relatively expensive, so it has difficulty to develop bio rock periodically. Surveillance or monitoring requires expensive operational costs, such as a lack of diving equipment. The implementation of the arrangement of the frame and the placement of bio rock in the sea will then be channeled electricity using solar panels and PLN electricity. Yayasan Karang Lestari hopes that the pandemic can end soon so that many tourists who come and visit again to see the biorock in the village, the government to pay more attention to the development of bio rock that has a good impact on the environment and tourism, especially in the North Bali area.

5 Conclusion

The study results showed the potential of the superior coastal resources of the West Buleleng coastal area precisely in Pemuteran Village, namely the model of coral reef management. The model resulting from the potential of the excellent coastal resource is made with a diagrammatic design. The stages of preparation are the organization of the governing body, land, and materials and tools used, namely materials to make coral reef planting media in the form of iron skeletons, operational tools such as diving equipment. The implementation stage is to make planting media with bio rock technology, test the suitability of the requirements and location of activities with an ideal depth of coral reefs, namely with a depth of more than 3- 20 meters and 100 meters from the coastline, but media and seeds in the sea, and monitor the development of coral reefs. The result of activities and benefits obtained from coral reef cultivation is the sustainability of marine life and economic benefits from local communities due to the growing number of tourists.

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