JOURNAL OF MARITIME RESEARCH

Vol XXIII. No. I (2026) pp 139–143

ISSN: 1697-4840, www.jmr.unican.es

Modified Structure as An Appropriate Technology in Supporting the Rehabilitation of Coral Reef Ecosystems on Tuan Island, Indonesia

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ARTICLE INFO

Article history:
Received 21 Mar 2025;
in revised from 15 Apr 2025;
accepted 25 May 2025.

Keywords:
Fish House, Modification, Fishing Spot, Catch.

ABSTRACT

A fish house is a place where fish associate, where some fish that live in nature tend to be in one location with territorial behavior. The loss of a number of coral reefs in coastal areas that function as fish houses has resulted in a reduction in the number of marine resources. Fishing locations are also increasingly limited. Through the application of appropriate technology, modified fish houses that also function as coral transplantation media, it is hoped that the number of fish catches and other fishery products such as octopus, cuttlefish, squid and others will continue to increase. The steps taken in this study were to create a design, an initial survey in determining the fishing ground point, then create a structure, the placement process, and monitor the development of the use of the structure made. Monitoring at the final stage was carried out to measure the effectiveness of this appropriate technology.

1. Introduction.

The research conducted must be in accordance with the new paradigm implemented by the government, which is problem solving, comprehensive, meaningful, complete, and sustainable with multiple targets. This research is indeed designed to provide real solutions to problems in society. In this context, the new paradigm has several important principles. Problem solving means that research in the community must be able to provide concrete and direct solutions to the problems faced by the community, not just providing assistance that is temporary or does not lead to long-term solutions (Wekke, 2022; Rizwan *et al*., 2024).

According to Santrock (2018), problem solving is finding the right way to achieve goals with optimal results. Comprehensive is the approach used must cover various aspects of community life, ranging from economic, social, educational, health, to environmental aspects.

The solutions provided must be interconnected and take into account factors that are related to each other. Meaningful, namely the research program carried out must be able to provide a significant and meaningful impact on people's lives, so that people really feel the benefits. Complete means that research on the community does not only touch the surface of the problem, but must solve the root of the problem with a comprehensive approach and touch various dimensions. Sustainable is one of the most important principles, namely that research programs must be able to continue in the long term, provide sustainable benefits, and not depend on temporary assistance that is seasonal or intermittent (Moshood ET., AL. 2022). Multi-Target states that effective community research must be able to target various groups of people in need, including the vulnerable and underserved. This approach must be inclusive and not just focus on one segment.

This principle aims so that the research carried out does not only provide temporary assistance, but also creates sustainable change and empowers communities to be independent in facing

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their challenges. The government encourages researchers, be it educational institutions, social organizations, or other related parties, to integrate this approach into every activity they do. Therefore, this research continues previous research in resolving fisheries problems faced by fishing communities in Lhok Lamteungoh, Peukan Bada District. Efforts to improve the condition of the marine environment as a supporter of fishermen's livelihoods have been carried out in the previous year through the creation of fish house technology as well as underwater technopark locations to support tourism, as well as alternative additional livelihoods in the same location. Efforts that will encourage the creation of natural conditions that are getting better day by day. The continuation of previous research will be continued with the application of appropriate technology to support coral rehabilitation while creating new fishing locations or fishing grounds that will support fishermen's businesses directly and measurably.

The main problems in the coastal fisheries sector include reduced catches of fishermen, irregular unemployment, and the problem of suboptimal fishing fleets (Sall, 2024). Factors such as overfishing, according to Guiry et. al., (2021) Overfishing is the excessive taking of fish stocks, too much to the point where most of the potential food and wealth taken is not fully utilized. Ecosystem damage, climate change, marine pollution, and technological limitations affect fishermen's catches. Declining fish stocks, high operational costs, and lack of income diversification make it difficult for fishermen. The existing fishing fleet is also often not utilized optimally due to high costs and limited results. Meanwhile, traditional fishermen have difficulty finding new fishing locations due to ecosystem damage and limited access to technology (Sarjana et., al. 2024). The solution offered is the application of appropriate technology to increase the productivity and economy of coastal communities.

2. Objective.

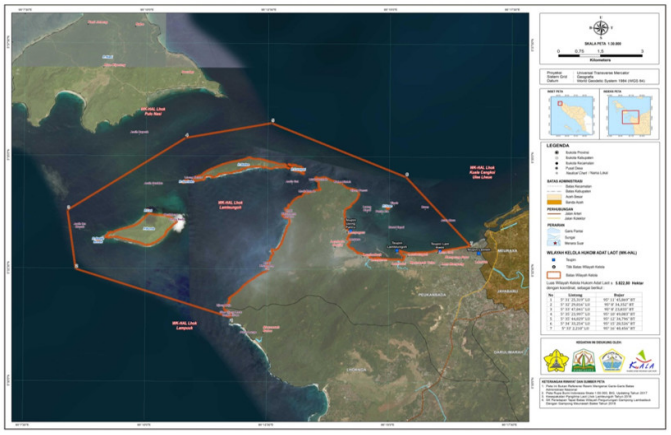
1. How to overcome the decrease in fishermen's catch?
2. How to make an appropriate technology product that is easy to make, cheap, easy to install and can be used as an instrument for providing fishing grounds for traditional fishing communities?

3. Theoretical Framework.

This research was conducted in Lhok Lamteungoh Village, Peukan Bada District, Aceh Besar. This research continues the previous research in resolving fisheries problems faced by the fishing community in that place. The time spent in this research was 8 months, starting from January - August 2024.

The customary law management area of Lhok Lamteungoh village has a unique marine nature consisting of shallow sea areas with coral reef ecosystems in several places, one of which is on Tuan Island, and several other points in the south-west. The existence of coral reefs that are rich in coral animals, reef fish and other living things that support other ecosystems around them (Hasim, 2021). Coral reef areas are resources that must be preserved and provide income for the surrounding community (Turisno et., al. 2023).

Figure 1: Lhok Lamteungoh Location Map.



Source: Authors.

Figure 2: Location of Tuan Island.

Source: Tripadvisor.

This activity focuses on the application of products that can be used to empower and improve the community's economy. The technology that will be created is a simple modified fish house as well as a coral transplant medium.

A multifunctional technology model so that multi-target targets can be achieved with a model like this. This appropriate technology was created with the consideration of making it at a cheaper price than similar structures, easy to make and easy to install at the desired location.

A fish house is a place where fish associate, where some fish live in nature tend to be in a location with their territorial behavior (Tahapary et., al. 2023). Artificial coral reefs in various models have been tested and can withstand a number of waves and have varying capabilities, but in general they are strong enough to be created in wavy areas (Fauzi et al, 2017). Artificial reefs have long been used as an effort to rehabilitate the environment to improve the quality of fisheries and fisheries management, research, or recreation (Fabi et al, 2015).The loss of a number of coral reefs in coastal areas that function as fish

Figure 3: Coral reef ecosystem.

Source: Tripadvisor.

homes has caused marine resources to decrease in number every day (Rahmadyani et. al. 2022). Fishing locations are also getting narrower every day. Through the application of appropriate technology, it is hoped that the number of fish catches and other fishery products such as octopus, cuttlefish, squid and others will continue to increase.

This activity focuses on the application of products that can be used to empower and improve the community's economy. The technology to be created is a simple modified fish house as well as a coral transplant medium. A multifunctional technology model so that multi-target targets can be achieved with a model like this. This appropriate technology was created with the consideration of making it at a cheaper price than similar structures, easy to make and easy to install at the desired location.

4. Materials and Methods.

The activity implementation method will explain the stages or steps in implementing the solutions offered to overcome problems that include the following: Survey Location

4.1. Survey Location.

The first a survey is carried out on the location of the fish house placement which will be used as the location for implementing appropriate technology. An ecological approach is important to consider regarding water depth, the presence of benthic biota and fish, and the presence of coral reefs at the placement location, as well as a technical approach that supports the ease and benefits of implementing appropriate technology that will be applied.

4.2. Research Design.

Strengthening the design and making of modified structures that will be used as fish houses which are the main components in creating a fishing ground location. Strengthening the production aspect in this case is the application of appropriate technology products that will be a supporting instrument for the success of fishermen's fish catches. The creation of modified structures is made with the principle that they are easy to make, inexpensive, and easy to install.

4.3. Material Placement Process.

The placement of fish house structures that can function as a medium for coral transplantation together with the fishing community so that there is harmony to achieve the desired research objectives. The presence of the community directly can provide input and become a shared learning experience. Directly, the community will be involved in the management aspect which will be implemented through the management of the fishing ground.

4.4. Documentation.

Along with this process, documentation of activities is also carried out and monitoring is continued from time to time. The importance of monitoring to see the ecological changes that occur in the fish houses that are made and their great benefits for creating new fishing grounds in increasing income for traditional fishermen or small fishing communities.

4.5. Reporting Activities.

The next activity is the Reporting of activities to inform the entire process that has been carried out, and it is hoped that the report can be a source of information and learning material for the future. During the research process.

5. Results and Discussion.

5.1. The description of the applied science and technology.

The modified structure that is made will become a fish house. This structure is known as an artificial structure that is made in such a way that it can become a new habitat for fish and other biota.

Figure 4: The structure is made and placed under water.

Source: Authors.

5.2. Description of Activity Implementation.

The results of the implementation of community service activities that have been carried out by the Community Service Team. The application of science and technology can be seen systematically supported by supporting images/photos.

The stages of implementing community service activities are as follows:

1. Preparation of materials.
2. Create design drawings.
3. Making concrete molds that will be appropriate technology in this research activity.
4. Making molds and drying processes that last 1 to 2 months.
5. The process of mobilization to the port to then be loaded onto a transport ship.
6. The process of placing concrete molds at the research location.

After the activity, monitoring and evaluation of the results of the activity will continue to be carried out.

Figure 5: The structure is made and placed under water.

Source: Authors.

5.3. Impact of Activities.

The placement of this artificial structure which is an appropriate technology will directly become a habitat for a number of biota such as fish and other biota that have productive value. The fishing community will utilize this technology and make this placement location a fishing ground or location for catching fish.

The catch from this area will be a source of income for fishermen from fishing activities. This area will be a location for direct beheading or a habitat that will support other habitats around it. A mini fish habitat of at least 100-200 square meters has been formed with the placement of structures in groups and spread across the Tuan Island area.

The formation of a new fish habitat refers to the process or condition in which an environment or area that was previously not a place to live or a habitat for fish has now become a suitable place for fish to live, breed, and find food. This can happen naturally or as a result of human intervention.

Some things that can happen in the process of forming new fish habitats include:

1. Formation of Coral Reefs or Marine Vegetation: If there is the formation of coral reefs, seagrass beds, or other underwater vegetation, this can create an ideal environment for fish to live in. This vegetation provides shelter and a source of food for fish.
2. The presence of Artificial Structures in the form of sunken fish houses. Humans can also create new habitats for fish by installing artificial structures, such as artificial coral, artificial reefs, or reef balls (concrete balls used to grow coral reefs) which function as shelter and breeding grounds for fish.
3. Changes in the Natural Environment are indicated by the start of succession. It can also occur due to natural changes that cause an area to become more suitable as a fish habitat, such as changes in river flow or control of sedimentation on the coast which creates better conditions for fish.
4. Ecosystem Restoration is the ultimate goal of all these processes. In some cases, new fish habitats can form after ecosystem restoration efforts, such as cleaning polluted areas or replanting lost vegetation.

The formation of new fish habitats means the creation of an environment that supports fish life for the Peukan Bada fishing community, especially in the Lhok Lamt eungoh Laot customary law area, through engineering this research activity, it can provide shelter, food, and breeding for fish species. The researcher hopes that it can be a solution to the difficulty of getting fish and can maintain the marine ecosystem.

5.4. Obstacles faced.

The obstacle faced during this research process is the condition of the underwater environment that is not clear, which makes it a little difficult in the process of documenting activities. The considerable cost of carrying out the engineering process is more of a costly operational effort.

Conclusions.

The coastal fisheries sector faces problems such as reduced catches, the causes include overfishing, ecosystem damage, cli-

mate change, and high operational costs. Traditional fishermen have difficulty finding new fishing locations due to environmental damage and technological limitations.

The proposed solution is the application of appropriate technology (TTG) to increase the productivity and welfare of coastal fishermen. This activity has been carried out well, namely the placement of 82 units of modified structure Appropriate Technology products, which will function in supporting rehabilitation. The plan to add units in optimizing results is included in the follow-up plan.

Acknowledgements.

To all parties who have provided assistance and facilities in this research.

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