

UNDERWATER RESTOCKING INNOVATION BY THE MARINE AND FISHERIES OFFICE OF EAST JAVA PROVINCE TO ENHANCE FISHERIES PRODUCTIVITY AND COMMUNITY ECONOMY

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Abstract

The marine biodiversity of Indonesia is exceptionally diverse. It is no surprise that this attracts foreign countries to commit illegal activities, specifically illegal fishing. Illegal fishing is an unlawful practice that threatens the sustainability of Indonesia's marine resources. It causes a decline in fish populations within territorial waters, which in turn impacts the economy of fishing communities. This study aims to evaluate the extent to which the Underwater Restocking innovation contributes to restoring damaged marine ecosystems and increasing fishery yields. The method employed in this research is qualitative, using a case study approach at the Department of Marine Affairs and Fisheries of East Java Province. Data was collected through interviews, documents, and relevant reports. The findings indicate that although the effectiveness of the Underwater Restocking innovation still requires further evaluation, it has shown positive impacts by helping increase fishermen's productivity by approximately 60%. The author believes that this innovation represents a strategic step in restoring marine ecosystems and improving the economy of the community, provided it is implemented consistently.

Keywords: Department of Marine Affairs and Fisheries of East Java Province, Illegal Fishing, Innovation, Underwater Restocking.

A. INTRODUCTION

In their survival, humans and other living things are supported by the main source that comes from public waters. Based on the functions and benefits obtained by many sectors through public waters, appropriate, targeted and wise actions should be taken, so that they can continue to maintain and preserve their balance so that they can be used and utilized continuously. Indonesia is an archipelagic country whose geographical location is determined by astronomical and geological locations (Andea, 2014). Judging from its geographical location, Indonesia is flanked between 2 large oceans in the world, namely the Pacific Ocean and the Indian Ocean, then also located between the Asian Continent and the Australian Continent, and has 2 mountain ranges, namely the Pacific Circum and the Mediterranean Circum (Hermawan & Sutanto, 2022).

Indonesia as a maritime country is a country that has two-thirds of its ocean area which is wider than its land area, which is 6.4 million km² (Lasabuda, 2013). From this statement, Indonesia is also the country with the second largest fish production after China (Aryanti et al., 2023). With an area of 6.4 million km², Indonesia has very high potential for marine biota, including capture fisheries and aquaculture, coral reefs, mangrove forests, marine tourism, and so on (Suryanti et al., 2019)



Figure 1. Indonesia's Marine Biodiversity

Source: (Coordinating Ministry for Maritime Affairs and Investment, 2021)

The wealth of the fisheries sector produced by Indonesia in the second quarter of 2023 reached 2.81% or equivalent to IDR 146.78 trillion of GDP (Aryanti et al., 2023). From the vast sea area owned by Indonesia, the potential for the emergence of various types of marine biota in it is very high. One of them is the potential for capturing fisheries and aquaculture. Based on the Decree of the Minister of Maritime Affairs and Fisheries of the Republic of Indonesia Number 19 of 2022, the estimated potential for fish resources from capture fisheries is around 12.01 million tons with a permitted figure of 8.6 million tons per year. Furthermore, fisheries production in Indonesia is not only in the capture fisheries sector, but also in the aquaculture sector. Aquaculture in Indonesia is recorded as one of the sources of food security (Kartamihardja et al., 2009). This is because capture fisheries in Indonesian seas are experiencing a fully-exploited phase that makes aquaculture a mainstay in food supply, including in the fisheries sector (Notohamijoyo, 2023).

As stated by Rokhim in (Coordinating Ministry for Maritime Affairs and Investment, 2021), the area of marine cultivation (mariculture) which is estimated at 24 million hectares, has a production potential of 46.7 million tons per year, with a realization of 0.7 million tons. According to data attached to the Ministry of Marine Affairs and Fisheries through (Coordinating Ministry for Maritime Affairs and Investment, 2021) in the last ten years, fisheries production from the capture and aquaculture sectors has increased significantly, with an increase of almost two-fold, starting from 11.7 million tons in 2010, and successfully reaching 22.18 million tons in 2022. From this brief data, it can be concluded that Indonesia's vast marine area has great potential for sustainable economic growth.

In addition to marine biota sources in the form of capture fisheries and aquaculture production, Indonesian marine waters also have marine biological resources in the form of very large expanses of coral reefs. Based on (Coordinating Ministry for Maritime Affairs and Investment, 2021) the area of coral reefs owned by Indonesia reaches 25,000 km² or 10% of the total coral reefs in the world which have an area of 284,300 km² making Indonesia the country with the largest biodiversity in the world or what is called marine mega-biodiversity. The area of coral reefs owned by Indonesia makes Indonesia the heart of the Coral Triangle Area which stretches in the waters of Indonesia, Malaysia, Papua New Guinea, the Philippines, the Solomon Islands, and Timor Leste. Another biological resource that is an attraction for Indonesia is mangroves. The potential of mangroves owned by Indonesia is the largest in the world, namely 3.36 million hectares or more than 24% (KLHK, 2023).

The wealth of biological resources is one of the main focuses in the survival of the Indonesian people. One of them is biological resources in the waters. The vast waters make Indonesia the country with the second largest fisheries sector after China (Ramli & Lumumba, 2021). With the various biodiversity in these waters, it is not surprising that it has

attracted the attention of many foreign countries to carry out illegal acts through IUU (illegal, unreported, unregulated fishing) activities or illegal fishing practices in Indonesian waters (Harun, 2020). Based on data obtained from IOJI (Indonesia Ocean Justice Initiative), here is a list of ships suspected of carrying out illegal fishing in 2022:

Table 1. List of Illegal Vessels from Vietnam and China

No	Vessels Name	Period Detected	Country
1.	N/A	01-10-2022 s.d 15-10-2022	Vietnam
2.	TAU 79 A27	10-11-2022 s.d 30-11-2022	Vietnam
3.	CHIBAO A27	08-12-2022 s.d 24-12-2022	Vietnam
4.	CHINA COAST GUARD 5402	November – Desember 2022	China
5.	CHINA COAST GUARD 5403	September 2022	China
6.	CHINA COAST GUARD 2204	April – Mei 2022	China

Source: Indonesia Ocean Justice Initiative, 2022

It is known that foreign ships operating in Indonesian waters are ships flying the Vietnamese and Vietnamese flags. The ships operate in the North Natuna Sea area.

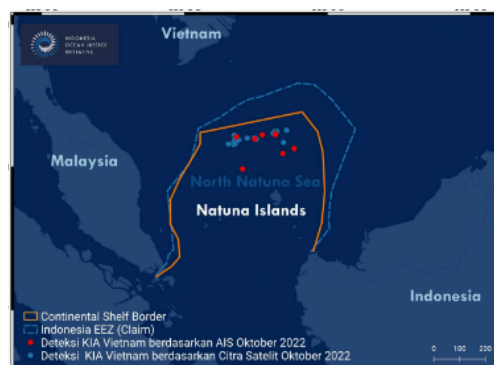


Figure 2. Vietnam KIA in Natuna Sea in November 2022

Source: Indonesia Ocean Justice Initiative, 2022

In addition, there is also data on Indonesian fishing vessels operating in the Papua New Guinea EEZ.

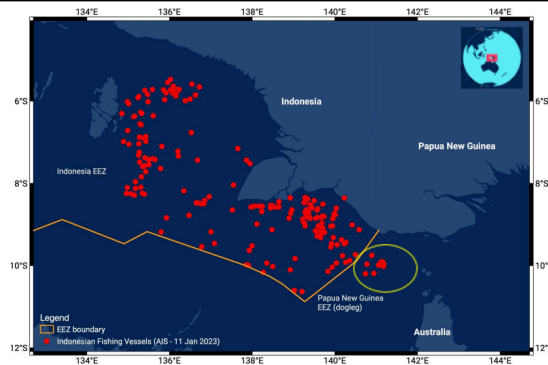


Figure 2. Detection of Indonesian Fishing Vessels in Papua New Guinea EEZ in December 2022

Source: Indonesia Ocean Justice Initiative, 2022

On August 25, 2022, based on the alleged shooting incident of an Indonesian fisherman, the Ministry of Foreign Affairs sent a diplomatic note to the Papua New Guinea government. The incident occurred because the Indonesian fisherman, Sugeng, was considered to have violated the fishing area border using the KMN Calvin-02 vessel (Dianti, 2022). Based on data from (INDONESIA OCEAN JUSTICE INITIATIVE, 2022), there are several lists of Indonesian fishing vessels operating in the Papua New Guinea EEZ, as follows:

Table 2. List of Illegal KII

No	Nama Kapal	GT
1	LATIMOJONG 5	29
2	SEMANGGA 5	30
3	DEVI CLORA	110
4	SURYA NELAYAN	75
	18	
5	ORTEGA 18	N/A
6	BANDAR	135
	BAHARI 889	

Source: Indonesia Ocean Justice Initiative, 2022

Furthermore, in 2024, the Directorate General of Marine Resources and Fisheries Supervision said that as many as 212 fishing vessels, consisting of seven Malaysian vessels, 17 Philippine vessels, three Vietnamese vessels, one Russian vessel and two Sierra Leonean vessels had been successfully captured (detikSumut, 2024). Not only that, the Director General of Marine Resources and Fisheries Supervision, Pung Nugroho Saksono also said that the total losses from illegal fishing reached IDR 3.4 trillion. From a number of phenomena that have been explained above, if these unlawful acts are allowed to continue, they will potentially cause damage to the aquatic ecosystem along with all its damage in other sectors, especially the economic sector. Therefore, the Indonesian government needs to create a regulation that regulates these illegal acts. As stated in Law of the Republic of Indonesia Number 5 of 1990 concerning the Conservation of Biological Natural Resources and Ecosystems, it is a shared responsibility as Indonesian citizens to participate in the protection and management of the marine environment in Indonesia. This aims to maintain the sustainability and balance of the ecosystem of natural resources and better support the process of improving people's living standards and the quality of human life.

Furthermore, in Government Regulation of the Republic of Indonesia Number 13 of 2022 concerning the Implementation of Security, Safety, and Law Enforcement in Indonesian Waters and Indonesian Jurisdiction Areas, it is stated that every incident suspected of being a violation of laws and regulations and/or a criminal act must collect data and information, in the form of incident reports, pictures of the pursuit and action situation/oleat maps, statements regarding the position of the ship, minutes of arrest, warrants and minutes of inspection of ships, people and cargo, warrants and minutes of bringing ships and people, documentation, and minutes of handover of ships, ship equipment, people, and documents. The collection of various documents is intended to be submitted to the agency that has the authority for this matter to carry out investigations based on the law. Along with the passage of time and the rapid development of technology that is increasingly blending with the scope of government, the regional government as the implementing institution of the policy is required to be able and competent in providing the latest innovations for the welfare of the community and the surrounding environment, including the welfare of the community who work as fishermen and the life of the waters as a place of livelihood. In line with the discussion on innovation, Law Number 23 of 2014 concerning Regional Government has included innovation in it which states that innovation is one of the main tools in accelerating the increase in regional competitiveness and is aimed at achieving increased economic growth and welfare of the community in Indonesia. With innovation that focuses on the welfare of marine areas in Indonesia, it is hoped that this can overcome the main problems that occur in Indonesian waters, namely IUU (Illegal, Unreported, Unregulated) Fishing (Yuliantiningsih, 2019). As in the results of research on innovative solutions for illegal fishing which innovated by creating drone technology to monitor illegal fishing activities in Indonesia, so that the security of the maritime area has increased and positively reduced the number of foreign ships sailing in Indonesian waters (Nurdiantoro et al., 2024). The difference in research conducted by the researcher here is that the researcher conducted research on an innovation aimed at reducing illegal fishing practices by installing fish house modules on the potential seabed and spreading fish seeds in them, so that the recovery of the fish ecosystem in waters that had been damaged due to illegal fishing can be improved. Meanwhile, research by (Nurdiantoro et al., 2024) focuses on the innovation of creating drone technology which is carried out by flying artificial intelligence in the form of drones in Indonesian waters to monitor the movement of foreign ships entering Indonesian waters to carry out illegal fishing practices.

The East Java Provincial Marine and Fisheries Service is one of the initiators of an innovation called the UWR or Under Water Restocking innovation. This innovation is a breakthrough in new innovation launched by the East Java Provincial Marine and Fisheries Service in 2016. One of the objectives of the East Java Provincial Marine and Fisheries Service in creating this innovation is because several marine areas in Indonesia are experiencing symptoms of overfishing as a result of illegal fishing carried out by foreign vessels, as well as KII (Indonesian Fishing Vessels). From this impact, the East Java Provincial Marine and Fisheries Service designed this innovation as an effort to improve and restore fish resources, so that fisheries productivity can increase and the results of this production can also participate in improving the community's economy. Therefore, the purpose of this study was to review more deeply the UnderWater Restocking Innovation created by the East Java Provincial Marine and Fisheries Service.

B. LITERATURE REVIEW

Marine Ecosystem Restoration

Research on marine ecosystem restoration through underwater restocking techniques shows that this method is effective in increasing fish populations and improving the ecological conditions of the waters. By restocking certain fish species into their natural habitat, this technique helps overcome population decline due to overexploitation (Indrawan et al., 2007). As a result, the ecosystem condition becomes more balanced, with increasing biodiversity. This method also strengthens the environmental carrying capacity for the sustainability of marine resources, thus supporting the ecological stability of the waters in the future. In addition to ecological benefits, underwater restocking techniques have positive social and economic impacts. With increasing fish populations, local fishermen can experience an increase in catches, which leads to increased income (Hamdi, 2023). This condition not only improves the welfare of coastal communities but also encourages more sustainable management of fishery resources. In the long term, this method can reduce dependence on overexploitation, creating a balance between the sustainability of marine ecosystems and the economic needs of the community (Adolph, 2016).

Socio-Economic Impact

The study shows that the underwater ecological restocking program not only focuses on ecological aspects, but also brings significant social and economic benefits. This program is designed to restore fish populations in their natural habitat through restocking, thereby improving the balance of the marine ecosystem. With the return of a more stable fish population, ecosystem productivity increases, creating a more supportive environment for other marine species. The article in *JIPPNAS* also highlights the involvement of coastal communities in this restocking process, where fishermen are actively involved in managing marine resources. This participation not only provides a better understanding of the importance of conservation, but also increases the community's sense of responsibility for the sustainability of the ecosystem (JIPPNAS, 2024). The impact of this program on the welfare of coastal communities is very visible through the increase in fish catches. Fishermen reported higher incomes along with the increasing number of fish that can be caught sustainably. This economic increase not only impacts individuals, but also brings positive changes to coastal communities as a whole. This program is also proof that a community-based approach can create a synergistic relationship between ecosystem conservation efforts and local economic development. With the success of this program, underwater restocking shows great potential to be implemented in other areas experiencing similar problems, as well as being a real solution to achieving ecological and economic sustainability.

Fish Resource Management Strategy

Research on fish resource management strategies in East Java shows that a collaborative approach between the government, fishermen, and NGOs plays a key role in implementing the underwater restocking program. This approach involves a clear division of roles, where the government is responsible for providing regulations and funding, while fishermen play an active role in implementing the program in the field. A report from the East Java Provincial Marine and Fisheries Office highlighted the importance of NGO support in providing training and education to coastal communities on environmentally friendly restocking techniques. This collaboration not only ensures the smooth running of the program but also increases community awareness of the importance of sustainable fish resource management.

The results of this underwater stocking program show positive impacts, both ecologically and economically. Data from the report recorded an increase in fish populations in the areas targeted for stocking, which then had an impact on increasing the catch of local fishermen. This success is proof that organized cooperation between various parties can create effective solutions to the problems of overfishing and marine ecosystem degradation. In addition, this

program also provides long-term benefits in the form of improving the welfare of coastal communities while ensuring the sustainability of fishery resources in the East Java region. This kind of collaboration is expected to be a management model that can be replicated in other areas with similar challenges (Saleh, 2019).

C. RESEARCH METHODOLOGY

The research conducted by the author at this time is qualitative research. The research strategy carried out by the author is a case study research strategy, namely observing carefully an event, process, and activity of a group of individuals collected through information and collection procedures with a predetermined time span. The collection of various information needed in this study comes from interviews, documents, and relevant previous research, as well as various reports with similar topics. Interviews were conducted with trusted sources and informants, who were face to face from the beginning to the end of the implementation of this innovation. The sources and informants are Ardiani Mariasari, S.Ti., M.Si as Katimja PSDI.

The focus of this research is located in East Java Province with the locus of the East Java Provincial Marine and Fisheries Service. The importance of maintaining the balance of the marine ecosystem and the economic welfare of the community is the main reason for researchers to conduct in-depth research on the UnderWater Restocking Innovation initiated by the East Java Provincial Marine and Fisheries Service.

The theory used by researchers in compiling this research is Everett M. Rogers' innovation theory. Rogers provides his explanation regarding the meaning of innovation, namely an idea, practice, or object that is considered new by individuals or other entities involved in the adoption process (Rogers, 1995). In a theory of innovation put forward by Rogers, there are also characteristics in it, namely:

- a) *(Relative Advantage)*
- b) *(Compatibility)*
- c) *(Complexity)*
- d) *(Triability)*
- e) *(Observability)*

D. RESULT AND DISCUSSIONS

Illegal Fishing Practices and Their Impact on Fishery Production

East Java Province is the largest province on Java Island. As of 2023, East Java Province has a total area of 48,036.84 km² (Central Statistics Agency, 2024). Although East Java Province does not have close borders with provinces that have large water areas, according to (Maritime and Fisheries Service, 2018), East Java Province has a total water area of 54,718 km². With this large water area, East Java Province certainly has a number of rich biological resources originating from the ocean. According to (Central Statistics Agency of East Java Province, 2023) in 2022, Quarter I to Quarter III, fishing results in East Java Province experienced a significant increase, namely by 359.96 tons to 699.57 tons of fish per day. Then, in Quarter IV, the fish catch that was landed decreased to 539.21 tons per day. Despite a decline in the last quarter, fish catches in 2022 in East Java Province continued to increase compared to 2021. The soaring practice of illegal fishing is now a major problem that threatens the sustainability of marine resources and damages the ecosystem. If illegal and unreported fishing activities continue and become more widespread, it will have an impact on decreasing fisheries catches, as well as hindering conservation efforts and management of natural resources in the waters. In East Java itself, six vessels have been arrested for illegal fishing (Utomo, 2021). These vessels were considered illegal fishing because they had been

fishing using trawl fishing gear. Trawl fishing gear is used by dragging the trawl net using a ship, then filtering fish and other catches into a smaller net (Safitri & Yustitiantingtyas, 2022). It is stated in the Regulation of the Minister of Maritime Affairs and Fisheries (PERMEN KP) Number 2 of 2015 that trawl fishing gear can cause a decline in fishery resources and threaten the sustainability of the environment in fishery areas.

Efforts of the East Java Provincial Marine and Fisheries Service to Create Underwater Restocking Innovation

The East Java Provincial Marine and Fisheries Service responded to the impact of illegal fishing and overfishing on fishery catches in the waters of East Java which have decreased. Due to this phenomenon, the East Java Provincial Marine and Fisheries Service created an innovation aimed at restoring the marine ecosystem because the fishery population has decreased due to climate degradation and so on. Underwater Restocking which is an Artificial Habitat, namely an artificial living area installed at the bottom of the waters and has a function for fish to live and take shelter from ocean waves and predators that are considered threatening.

In an interview with Mrs. Adriani as Head of PSDI, she stated that through the development of the Underwater Restocking innovation, the East Java Provincial Marine and Fisheries Service aims to grow and increase the productivity of fishermen through Underwater Restocking by making fish houses. The fish houses that have been made will be used as a gathering place for fish whose populations have decreased due to symptoms of overfishing and illegal fishing in certain waters.

The creation of artificial habitats is made in the form of buildings whose composition comes from solid objects which are then placed in the waters. The artificial habitat will be a place for adult fish to set foot, as well as a place of protection and development for eggs and young fish. The main focus of this innovation is to spread fish seeds in the fish house module, so that fishery resources in the waters recover and increase. The installation of fish house modules for the sustainability of the Underwater Restocking project is also determined by the accuracy of the positioning. Water depth surveys, zoning maps, and inlet and outlet flows, as well as the local community's social aspects are aspects needed in determining the installation position. Surveys of water depth and conditions are carried out with the aim that the fish house module can stand firmly. In line with a brief explanation of the meaning and concept of the Underwater Restocking Innovation created by the East Java Provincial Marine and Fisheries Service, researchers want to know how far the innovation has run by using 5 innovation indicators proposed by Rogers (1995), including: Relative Advantage; Compatibility; Complexity; Trialability; Observability.

Relative Advantage

In this indicator, researchers will assess the extent to which the innovation created by the East Java Provincial Marine and Fisheries Service is superior in providing benefits to aspects of life. The assessment of this indicator is taken from the extent to which this innovation is effective in providing significant increases in fisheries yields and economic contributions. Referring to interviews conducted by researchers, this Underwater Restocking innovation was formed due to the phenomenon of damage in water areas caused by symptoms of overfishing, illegal fishing, and changing climate degradation which causes a decrease in capture fisheries yields. Thus, the creation of this Underwater Restocking is an effort to restore fishermen's productivity. This is because the fish houses that are made can be an attraction and a safe shelter for fish seeds that are spread or in the waters, so that the habitat in the waters that was originally reduced increases and fishermen can catch fish again. The advantages of this innovation for people who work as fishermen are that they initially needed a lot of effort, energy, and fuel to catch fish and reach the required fishing ground, it becomes

easier to get fish catches with a distance that is not too far from the shore, which is less than 2 miles. So, even though there is climate change, fishermen can still do their jobs because the population in the fish house has recovered.

However, in interviews, this Underwater Restocking innovation was considered to have not significantly provided effectiveness for fisheries results. This is because the innovation focuses on restoring the marine ecosystem that had decreased. The presence of fish seeds that are spread in fish houses on the bottom of the waters also cannot be ascertained what percentage of seeds survive from predators in the waters. The climate that has an impact on the survival of marine biota is also one of the reasons why this innovation cannot be said to be completely significant.

Although the Underwater Restocking innovation cannot be said to be significantly effective, the fish houses that have been submerged, around 60% of people who work as fishermen feel the benefits of the Underwater Restocking innovation.

Relative Advantage

In the researcher's interview with the informant regarding the suitability of the fishing community with the Underwater Restocking method for their needs as fishermen in the long term, it is that they really feel the benefits of this innovation. Not only from Underwater Restocking, but the government's efforts to rehabilitate marine ecosystems, such as the formation of artificial coral reefs, are also considered to have a very positive impact on the local community who work as fishermen.

Complexity

The complexity indicator here is the level of difficulty at which an innovation is considered difficult to understand and apply. In the interview about complexity here, the researcher wants to know about the ease felt by fishermen to apply this method. In addition, the researcher also wants to know the challenges and obstacles experienced, as well as the resolution of problems for the obstacles felt.

Based on the interview, fishermen think that this innovation is very easy to understand its application. This is evidenced by the activities of fishermen who are directly involved in the installation of fish house modules and participate in maintaining and maintaining the sustainability of the installed fish houses. The fishermen consider that this innovation is easy to understand and apply because policy makers also hold socialization and training for local communities in certain waters regarding this Underwater Restocking innovation.

Talking about the complexity of an innovation that is said to be new, of course it is not far from the obstacles and barriers during the implementation process. In this case, the obstacles and barriers experienced are determining the water area that is good for placing fish houses and spreading seeds. This is because not all water areas can be used as a place to install fish houses and spread seeds. Climate, land contour conditions, water currents, and the presence of sea waves in the water area are things that need to be considered. If these two things are not considered properly, then the installation of fish houses cannot be carried out optimally because it has the potential to damage the fish houses. Meanwhile, the way to overcome these obstacles is by surveying the location of the fish house placement to find out the conditions in certain water areas.

Triability

The Underwater Restocking innovation created by the Marine and Fisheries Service has become an innovation that is considered to help fishing communities earn income in a more efficient way. In addition, this innovation has also been proven to restore marine ecosystems that were damaged by the phenomena of illegal fishing and overfishing. The possibility of trying this innovation can be seen from the trial activities of the project. Underwater Restocking collaborates with Brawijaya University to control the sustainability of the project.

The trial mechanism carried out before implementing this innovation is to create a fish house partition scheme and conduct a survey of the characteristics of territorial fish in certain waters. After these steps are completed, the next thing to do is sink the fish house module which is then evaluated every month. When the evaluation results from the trial show a positive impact, the project can be launched.

Observability

From the interview results, the fishermen who were involved in installing the fish houses considered that this project was very helpful for their economy. The fishermen were also happy with the impact obtained from the innovation project. In addition, recommendations also came from the Monitoring and Evaluation activities carried out every year. Because every year the obstacles faced by the implementers are climate, land contours, and water conditions in certain areas, the recommendation given is that the placement of fish houses should be carried out in a more protected place, namely not directly in the open sea, but can be placed in the area around the back of the island or bay. Based on this brief explanation, the conclusion obtained is that this Underwater Restocking innovation is one of the breakthrough innovations that is quite concerned about the success of its implementation. And on the basis of activities such as the annual Monitoring and Evaluation, it also proves that the implementers really hope that this innovation project can successfully provide benefits for aspects of life in the future.

E. CONCLUSION

The Underwater Restocking innovation, first created by the East Java Provincial Marine and Fisheries Service, is a breakthrough innovation that is used as a strategic effort with the aim of restoring aquatic ecosystems affected by illegal fishing and overfishing practices. This innovation project uses artificial fish houses (artificial habitats) as a place to spread fish seeds which will later be used as a place of protection and breeding for marine biota, especially fish, so that the fish population can recover and support the economic sustainability of fishing communities.

Through 5 (five) innovation indicators according to Everett Rogers, this innovation shows relative superiority in increasing fisheries productivity, compatibility with the needs of fishing communities. Although in terms of complexity, this innovation has faced obstacles caused by natural responses from nature, such as climate and water conditions in certain areas, this innovation has a low level of complexity because the implementers of this innovation conduct socialization and training, and conduct surveys on the condition of the water area. The implementers of this project also implemented trials with evaluation results that tended to be positive, although they still faced challenges and natural obstacles such as water and climate conditions.

This project has proven to provide economic benefits for fishing communities, although the effectiveness obtained from this innovation still requires time and further evaluation. With annual monitoring and evaluation activities, this innovation is expected to continue to provide a positive impact on the sustainability of marine ecosystems and community welfare.

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