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FISH APARTMENT AS AN EFFORT TO INCREASE PRODUCTIVITY AND CONSERVATION OF FISH RESOURCES (LITERATURE REVIEW)

Rumah Ikan (Fish Apartment) Sebagai Upaya Peningkatan Produktivitas dan Konservasi Sumberdaya Ikan (Telaah Pustaka)

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ABSTRACT

The decline in global marine fisheries production has sparked concerns about depletion of fish resources. The innovation developed is the use of fish apartments to increase productivity and conserve fish resources. Fish apartment is useful as fishing media, replacement habitat for damaged coral reefs, nursery ground and feeding ground for fish habitat ecology. Fish apartment can also be an indicator of changes in trophic levels in the food chain in aquatic ecosystems. This research explores the benefits of fish apartment for increasing productivity and conserving fish resources. Descriptive and exploratory research methods were carried out by combining literature and published research results. The benefits of fish apartment as an effort to increase the productivity of fish resources can be seen from the existence of waters that have the potential to become fishing areas which contribute to increasing fish stocks so that catches increase by 80% per year from 2013-2015. The fish apartment can restore damaged aquatic ecosystems because it increases the abundance of 39 types of fish species and improves the fish habitat for the 20 families of coral fish that occupy the fish apartment.

Key words: Conservation, Ecosystem, Fish Apartment, Fish Resources and Productivity

ABSTRAK

Penurunan produksi perikanan laut global memicu kekhawatiran akan deplesi sumber daya ikan. Inovasi yang dikembangkan yaitu dengan penggunaan rumah ikan (fish apartment) untuk meningkatkan produktivitas dan konservasi sumber daya ikan. Rumah ikan bermanfaat sebagai media penangkapan ikan, habitat pengganti terumbu karang yang rusak, nursery ground dan feeding ground bagi ekologi habitat ikan. Rumah ikan juga dapat menjadi indikator perubahan tingkat trofik dalam rantai makanan di ekosistem perairan. Penelitian ini mengeksplorasi manfaat rumah ikan bagi peningkatan produktivitas serta konservasi sumber daya ikan. Metode penelitian deskriptif dan eksploratif dilakukan dengan menggabungkan literatur dan hasil penelitian terpublikasi. Manfaat rumah ikan sebagai upaya peningkatan produktivitas sumber

daya ikan terlihat dengan adanya perairan yang potensial menjadi daerah penangkapan ikan yang berkontribusi pada peningkatan stok ikan sehingga kenaikan hasil tangkapan sebesar 80% per tahun dari tahun 2013-2015. Rumah ikan dapat memulihkan ekosistem perairan yang rusak karena meningkatkan kelimpahan 39 jenis spesies ikan serta meningkatkan habitat ikan sebanyak 20 keluarga jenis ikan karang yang menempati rumah ikan.

Kata kunci : Konservasi, Ekosistem, Produktivitas, Rumah Ikan, Sumber Daya Ikan

INTRODUCTION

Fisheries resources are important state assets which, if managed properly, will provide maximum benefits for society. The current use of marine and fishery products has shown the phenomenon of overfishing (Budhiman, 2011). The decline in fish resources is the impact of the interaction between increasingly intensive fishing activities and the decline in the carrying capacity of waters due to the degradation of fishery habitats such as coral reefs, mangroves, seagrass and similar water bottom forms, so that this will affect the condition of aquatic ecosystems as fish spawning areas, fish growth (nursery ground), and areas for fish to find food (feeding ground) (Gundersen *et al.,* 2013).

In connection with existing problems and efforts to find other alternatives to increase the productivity of capture fisheries resources without causing pressure on these resources, technology applications are being carried out with the aim of maximizing the carrying capacity of aquatic resources (Wafi *et al.,* 2021). Alternative applications of this technology include the creation of artificial reef units (fish apartment) in waters experiencing degradation (Puspasari *et al.,* 2020).

Efforts to increase fish resources through innovative and environmentally friendly methods, one of which is by making a fish apartment, is a building made of polypropylene plastic partitions that have cavities, assembled, arranged and placed on the seabed which functions as a spawning ground, feeding ground and nursery ground. Fish apartment can be an alternative for repairing damaged habitat by increasing water productivity and additional food sources (feeding grounds) by providing a large enough substrate (Sartimbul, 2017). With technological engineering in the fisheries sector, it is felt that it will be possible to restore the level of water carrying capacity (Ariadi *et al.,* 2021).

The aim of this research is to determine the important role of fish apartment in maintaining fish populations, supporting local fisheries, and reducing the impact of environmental degradation on marine resources.

RESEARCH METHODS

The method used is an exploratory descriptive method from various previous research literature, both from national journals and international journals such as *Researchgate*, *Directory of Open Access Journals* and *Google Scholar*. This literature review was carried out from March to May 2024. Key words used to search for relevant discussion topics included fish apartment, fish apartments*,* fish resource productivity and fish resource ecosystems, so that the main material for discussion is arranged based on suitability to the theoretical framework.

RESULTS

Fish Apartment

A fish apartment is a hollow building/construction consisting of partitions, *shelters* and weights placed at the bottom of the waters to function as a spawning ground *and* /or a protection, care and rearing area for eggs, larvae and young fish (nursery ground). which aims to restore the availability of fish resources (Bambang *et al.,* 2013).

The fish apartment is a development of the basic FAD installation which has succeeded in increasing the availability of fish stocks. The difference between a FAD and a fish apartment

lies in the operating process. FADs are a tool for collecting fish in the fishing process, while fish apartment are a tool for improving environmental conservation (El-matien, 2016).

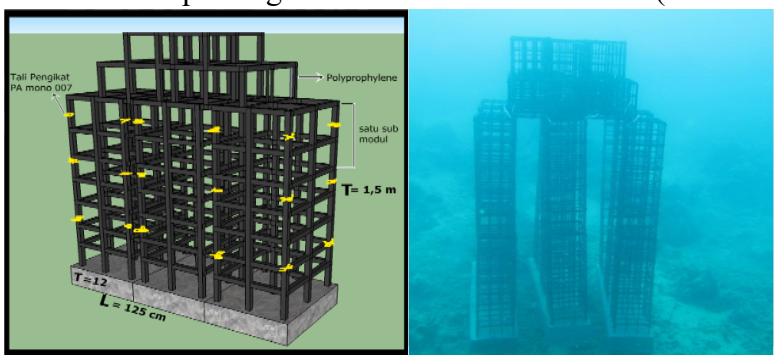

Figure 1. Fish Apartment
Source: Julia (2014)

Fish apartment Construction Design

Based on the results of the literature study that we have carried out, it was found that there are several aspects to the fish apartment construction design, namely the function of the fish apartment, materials and construction, structure of the fish apartment, material innovation, size and influence and maintenance of the fish apartment. These are listed in Table 1 below.

Table 1. Fish apartment Construction Design Aspects

Aspect	Description	Reference
Fish Apartment Design	The design of the fish apartment must imitate the function of natural coral reefs according to the fish's habitat. The size, shape, material and area of the fish apartment must adapt to the habits and behavior of the fish in their activities. This design should also allow for spawning, rearing, foraging, and protection from predators.	Stageary, 2023
Materials and Construction	Initially using an arrangement of used plastic baskets which were easily damaged, then switched to polyprophylene (PP) plastic or concrete. PP plastic is a transparent plastic that is strong, light, resistant to fat, and stable at high temperatures.	Bambang *et al.,* 2013
Fish apartment Structure	1. Partition: The main material for the framework of the fish apartment module 2. Sub Module: A combination of partitions that forms a 4-5 partition level arrangement. 3. Module: A collection of four sub-modules with ballast and antractor. 4. Colony: A collection of 4-6 modules into one unit. 5. Group: A collection of 50-60 colonies in one area.	Budhiman *et al*., 2013

Aspect	Description	Reference
	6. Shelter: Ribbon/plastic/rope/net for attachment and protection of eggs, larvae and juvenile fish. 7. Ballast: Cast concrete as ballast or stabilizer.	
Design Benefits	The fish apartment is designed with many gaps or partitions to protect the eggs, larvae and young fish as well as a place for various types of fish to gather	Budhiman *et al*., 2013
Material Innovation	Concrete is combined with pearl shell waste which contains Calcium Carbonate (CaCO3) to attract fish	Stageary, 2023
Size and Influence	Artificial reefs such as fish apartment measuring 1 m - 10 m or more, weighing 1 ton or more, affect the abundance of fish species. Larger structures allow for horizontal distribution of fish and provide variation in the presence of different species	El Matien, 2016; Stageary, 2023.
Fish Apartment Care	Treatment is carried out by removing stuck rubbish or plastic and restoring the position of fish apartment that have fallen due to strong currents	El Matien, 2016

The design of a fish apartment that resembles a natural coral reef is very important to support fish activities such as spawning, rearing, foraging and protection from predators. Materials such as Polyprophylene (pp) plastic and concrete with pearl shell waste increase the attractiveness of fish apartment. The modular structure of fish apartment (partitions, sub-modules, modules, colonies, groups, and shelters) provides a good habitat for various fish species. Caring for your fish apartment is important to maintain its effectiveness as a habitat. A large and heavy fish apartment can increase the abundance and diversity of fish species.

Fish apartment Placement Location

Based on the literature that we have reviewed, in the location of fish apartment there are several things that must be considered, including placement criteria, environmental parameters, physical conditions and their effects, placement location criteria and location recommendations. The following are listed in Table 2 below.

Table 2. Location aspects of fish apartment placement

Aspect	Description	Reference
Placement Criteria	- Aquatic habitats that are experiencing degradation - Areas that are heavily fished - Avoid areas with high sedimentation - Sloping water bottom.	Bambang *et al*., 2013
Environmental Parameters	- Maximum water depth of 30 m	

Aspect	Description	Reference
	- Dissolved oxygen content > 3 mg/l - Salinity levels 25 – 35 ppm - Temperature 25ºC – 32ºC - Minimum brightness 5 m - pH value 7 – 8.5 - Water flow speed 0.6 – 0.7 m/s - Sand substrate - Area of sloping waters > 200 m² - Safe from interference with fishing activities	
Physical condition	- Speed - Brightness of waters - Wave height - Condition of the bottom of the waters	
Influence of Physical Conditions	Physical conditions influence the existence and benefits of fish apartment, as well as the stability of the structure.	Stageary, 2023
Placement Location Criteria	- Aquatic habitats that are experiencing degradation - Catch/over catch areas - Avoid areas of sediment deposits - Far from the river mouth - Water depth 10-30 meters - Sloping water bottom - Outside the conservation area	Bambang *et al.,* 2013
Location Recommendations	Based on the cumulative weight value, the recommended location for the fish apartment is - Palang Waters, Tuban Regency - Modung Waters, Bangkalan Regency - Jumiang 3, Pamekasan Regency - South of Batu Elong, Gresik Regency - Bandaran Waters, Probolinggo Regency - Karang Katon Waters, Probolinggo City	

Aspect	Description	Reference
	- White Sand Beach, Situbondo Regency	

The location chosen must pay attention to degraded habitat, water depth, oxygen content, salinity, temperature, brightness, pH, current speed, substrate, and safety from disturbance. Assessment of fish apartment locations in various districts produces recommendations for optimal locations for the sustainability of aquatic ecosystems.

Fish Apartment Regulations and Management

Fish apartment are an important strategy in the rehabilitation of aquatic habitats to improve the condition of fish resources, which is regulated by various related policies and regulations. The following are the regulations and management of fish apartment which refer to efforts to restore fish resources and their habitats and contribute to the productivity of fish resources, based on related policies and regulations:

Table 3. Fish apartment Regulations and Management

Regulations / Regulations	Explanation	Reference
Decree of the Minister of Marine Affairs and Fisheries No. 42 of 2021	Determining fish apartment package assistance as one of the aquatic habitat rehabilitation strategies to support the protection, spawning and rearing of fish.	Decree of the Minister of Marine Affairs and Fisheries
Minister of Marine Affairs and Fisheries Regulation No. 26 of 2021	Regulates the principles of implementing sustainable use of fish resources and maintaining the condition of fish populations and the environment.	Regulation of the Minister of Marine Affairs and Fisheries
KP Ministerial Regulation No. 18 of 2021	Determine the arrangement for the placement of fishing equipment and fishing aids in fisheries management areas, including prohibitions on fishing in certain zones.	Regulation of the Minister of Marine Affairs and Fisheries
Decree of the Minister of Marine Affairs and Fisheries No. 42 of 2021	Prohibits fishing in fish apartment areas to protect the area as a spawning and rearing place for fish, with provisions for reporting and utilization after a certain time.	Decree of the Minister of Marine Affairs and Fisheries
Law no. 32 of 2004	Give authority to the central government in managing coastal and marine resources, including regulating exploitation, conservation and law enforcement.	Constitution

Fish apartment are an important initiative in efforts to restore aquatic habitats and increase the productivity of fish resources. Through various regulations and procedures that have been established, the distribution of fish apartment packages is one of the strategies implemented to support this goal.

Benefits of Fish Apartment for Fish Resource Productivity

Fish apartment are used to provide space for fish to carry out activities, such as eating, sheltering and spawning. The existence of fish apartment at the bottom of the waters can attract coral fish because coral fish are fish that live in coral reef areas from juvenile to adult, closely connected to coral reefs because of the availability of food and shelter. Apart from that, reef fish still benefit from the ecological functions provided by the presence of fish apartment, such as protection against currents or predators, reproductive structures and possible mating sites.

Stageary & Marabessy (2022) state that fish apartment not only act as additional habitat for various fish species, but also contribute to increasing fish catches. There are several literature studies regarding the use of fish apartment for fish resources which are shown in Table 4.

Table 4. Use of fish apartment for fish resource productivity

Fish Apartment Placement Location	Use of Fish Apartment	Results
Bangsring Waters, Banyuwangi (Kamaali *et al* ., 2016).	- Can increase the number of catches - Fish catch production in 2013-2015 increased, with a value of 4,130 fish in 2013, 8,949 fish in 2014, and 12,844 fish in 2015 - The average percentage increase in catch in 2013-2015 was 80% per year.	The types of ornamental fish caught by fishermen that most often use fish apartment include: - Angel fish (*Pomacanthidae*), - Betok (*Pomacentridae*) - Butterflies (*Chaetodontidae*), - Chameleons (*Gobiidae*), - Rivets (*Labridae*), - Grouper (*Serranidae*).
The waters of Ohoieuw Island, Southeast Maluku (Tahapary and Marabessy 2023).	- Fish apartment are an indicator for assessing changes in trophic levels in the food chain in aquatic ecosystems (Tahapary and Marabessy 2023). - The fish apartment structure that has been in the water continuously shows its existence in collecting fish (Tahapary and Marabessy 2023).	- Fish apartment provide significant shade for reef fish (Tahapary and Marabessy 2023). - There are 20 families of coral fish that dominate the fish apartment, and the largest numbers are found in the major fish (Tahapary and Marabessy 2023).

Fish Apartment Placement Location	Use of Fish Apartment	Results
Kalih Island Waters, Serang Regency (Nanto *et al* ., 2023)	- The installation of fish apartment is aimed at improving the ecological function of natural habitats which are used by various types of fish as *nursery grounds* and *feeding grounds*	- The waters has great potential to become a Fishing Area for pelagic fish that will occupy fish apartment.
Warhu Island, Southeast Maluku (Renhoran *et al.* , 2023)	- Fish apartment as a solution to replace damaged coral reefs. - *reef ball* -shaped fish apartment functions to prevent erosion on the beach, because its round shape can minimize waves and currents that reach the beach.	- The results of monitoring fish apartment showed that fish from the Acanthuridae family, the Acanthurus genus, such as surgeonfish or also known as botana fish, had occupied biorocks and fish apartment. - There are fish from the Siganidae family, the genus Siganus, which is often called rabbitfish, which has been found occupying the fish apartment.

The use of fish apartment as an innovative solution has been proven to have a significant impact on the welfare of fish resources in various locations, such as Bangsring Waters, Kalih Island and Warhu Island. With strategic placement, fish apartment increase fish catches, improve aquatic ecosystems, and provide shade for reef fish, becoming an important instrument in restoring habitat and balancing marine ecosystems.

Benefits of Fish Apartment for Conservation of Fish Resources

The following are some of the benefits of fish apartment for the conservation of fish resources and their implementation locations, which are reviewed based on research and successful development in various regions. The following are listed in Table 5 below.

Table 5. Benefits of Fish Apartment for Conservation of Fish Resources

Benefit	Reference
Prevent illegal fishing by trawling	Hartati (2007)
Increasing the attractiveness of fishing and diving tourism	Wasilun (1997)
Protecting erosion of the Sicilian Coast	Soedharma et al. (1995)
Increase tourist visits, especially foreigners	Risamasu et al. (1998)

Benefit	Reference
Fish apartment increase fisheries production by increasing the number of fish species caught, including target and indicator fish	Soedharma *et al.*, 1995; Risamasu *et al.,* 1998.
Other organisms such as brown algae, hydrozoa, sponges, ascidians, anemones, and barnacles are also found.	Risamasu *et al*., 1998
The abundance of coral fish in fish apartment made of wooden, bamboo and concrete modules showed a significant increase, with the highest variety of fish species in bamboo modules.	Risamasu, 2000
Fish apartment in Bangsring waters have been proven to restore damaged aquatic ecosystems by increasing the abundance of 39 types of fish species, fish habitats and fish stocks, as well as a significant increase in fishing.	Munasik, 2020

Fish apartment have a significant positive impact on the conservation of fish resources by creating new habitats, increasing fish populations, protecting beaches, and creating new fishing areas as well as protection and conservation marine tourism areas. In various studies, fish apartment have been proven to increase fisheries production and restore damaged aquatic ecosystems, showing their important role in global fish resource conservation efforts.

DISCUSSION

Fish Apartment Construction Design

The design of the fish apartment must have a function like a natural coral reef according to the fish's habitat so that the size, shape, material and area of the fish apartment must adapt to the habits and behavior of the fish in their activities (Tahapary, 2023). The design of the fish apartment must also be a place for spawning, care/rearing, foraging, and shelter from predators.

The basic materials and construction of fish apartment have changed over time, in the beginning they only used plastic baskets which were used as shelter for small fish (El-Matien, 2016) but plastic baskets are very easily damaged so now there are some using polyprophylene (PP) plastic or concrete. PP type plastic is a transparent plastic that is not clear or cloudy, is light and strong with low vapor permeability, has good resistance to fat, is stable at high temperatures (Bambang *et al.,* 2013).

According to Budhiman *et al.,* (2013), the shape and construction of fish apartment made from plastic consists of several parts including:

a. Partition : The main material that makes up the frame of the fish apartment module.
b. Sub Module : A combination of partitions that are assembled to form a 4-5 partition level arrangement.
c. Module : A collection of four sub-modules assembled and equipped with weights and antractors.
d. Colony : A collection of several modules consisting of 4-6 modules which are arranged into a unit using poles and guide ropes.
e. Group : A collection of colonies consists of 50 - 60 colonies placed in a predetermined area.
f. *Shelters* : Fish apartment components made from ribbon/plastic/pieces of rope/pieces of net function as a medium for attaching and sheltering eggs, larvae and juvenile fish.

g. Ballast: Fish apartment components made of cast concrete function as ballast or stabilizers so that the frame can stand upright.

Figure 2. Parts of a Fish apartment
Source: Hasan (2023)

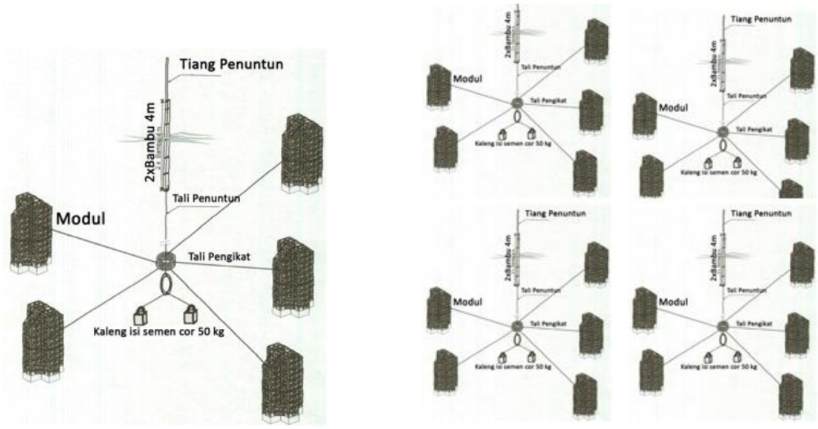

Figure 3. Colony (left) and Group (right) Fish apartment
Source: El-Matien (2016)

Budiman *et al.,* (2013) stated that fish apartment are designed to have many gaps or partitions which are useful for protecting eggs, larvae and young fish as well as gathering places for various types of fish.

Stageary (2023) conducted research on making fish apartment from concrete combined with pearl shell waste where the pearl shell layer contains Calcium Carbonate (CaCO3) like that contained in coral reefs so it is hoped that it can attract fish to gather and use the fish apartment as a place to live. .

Figure 4. Fish apartment made of Concrete and Shells
Source: Stageary (2023)

In general, artificial reefs such as fish apartment measuring 1 m - 10 m or wider and higher and weighing between 1 ton or 70 tons or more will have an influence on the abundance of fish species (El Matien, 2016). Size influences the attractiveness of the species especially the height of the reef which acts as a visual stimulus. Larger structures allow fish to spread significantly horizontally with depth so that fish apartment placed on the ocean floor can provide variations in the presence of different species in the fish apartment (Tahapary, 2023).

Fish apartment maintenance is carried out to maintain fish habitat until damaged coral reefs return. Maintenance is carried out by taking out rubbish or plastic stuck in the fish apartment and returning the fish apartment to its position which has fallen due to strong currents (El Matien, 2016).

Fish apartment Placement Location

The placement of fish apartment must be able to restore the natural structure and function of coral reefs (El-Matien, 2016). Fish apartment are made for fish that can become new homes for a long time. So that fish in a water area can increase productivity which can form fishing areas. The placement of fish apartment must pay attention to several things such as water habitats that are experiencing degradation, considering installation in densely caught areas, avoiding areas that easily experience sedimentation and sloping water bottoms (Bambang *et al.,* 2013).

Ways to determine the location and selection of a fish apartment include looking at the maximum water depth of 30 m, dissolved oxygen content of more than 3 mg/l, salinity level between 25 – 35 ppm, temperature between 25ºC – 32ºC, minimum brightness of 5m, pH value between 7 – 8.5, water current speed 0.6 – 0.7 m/s, substrate type is sand, area of sloping bottom waters is more than 200 m^2 and safe from interference from fishing activities.

The physical condition of the location where the fish apartment is placed is very important because it will affect the existence and benefits of the fish apartment to the surrounding environment. Physical conditions relating to environmental parameters are current speed, water brightness, wave height and bottom condition of the water. The physical condition of the waters is a determinant of the success of fish apartment development because apart from bringing nutrients to the fish apartment area, it can also have a negative impact on the construction and stability of the fish apartment structure (Tahapary, 2023). Bambang *et al.,* (2013) stated, that the location for placing fish apartment must have several criteria, namely aquatic habitat that is experiencing degradation, consideration of installation in fishing/overfishing areas, avoiding areas of sediment deposits, location far from river mouths, water depth between 10- 30 meters, sloping water bottom and outside the conservation area.

Handayani (2023) assessed, the location of fish apartment in Tuban Regency, Bangkalan Regency, Pamekasan Regency, Gresik Regency, Probolinggo Regency, Probolinggo City, Situbondo Regency based on cumulative values through weighting on the suitability matrix of fish apartment placement locations. The assessment point for candidate locations for fish apartment in Tuban Regency is located in the waters of Palang District; Bangkalan Regency in Karang Bayi Waters 1, Karang Bayi 2 and Modung Waters; Pamekasan Regency at Jumiang 1, Jumiang 2 and Jumiang 3 locations; Gresik Regency located south of Batu Elong and north of Noko Selayar Island; Probolinggo Regency in Bandaran Waters; Probolinggo City in Karang Katon Waters and Situbondo Regency on Pasir Putih Beach.

Based on the cumulative weight values, several recommendations for the location of houses were obtained, namely in Palang Waters in Tuban Regency, Modung Waters in Bangkalan Regency, Jumiang 3 in Pamekasan Regency, South Point Batu Elong in Gresik Regency, Bandaran Waters in Probolinggo Regency, Karang Katon Waters in Probolinggo City and White Sand Beach in Situbondo Regency.

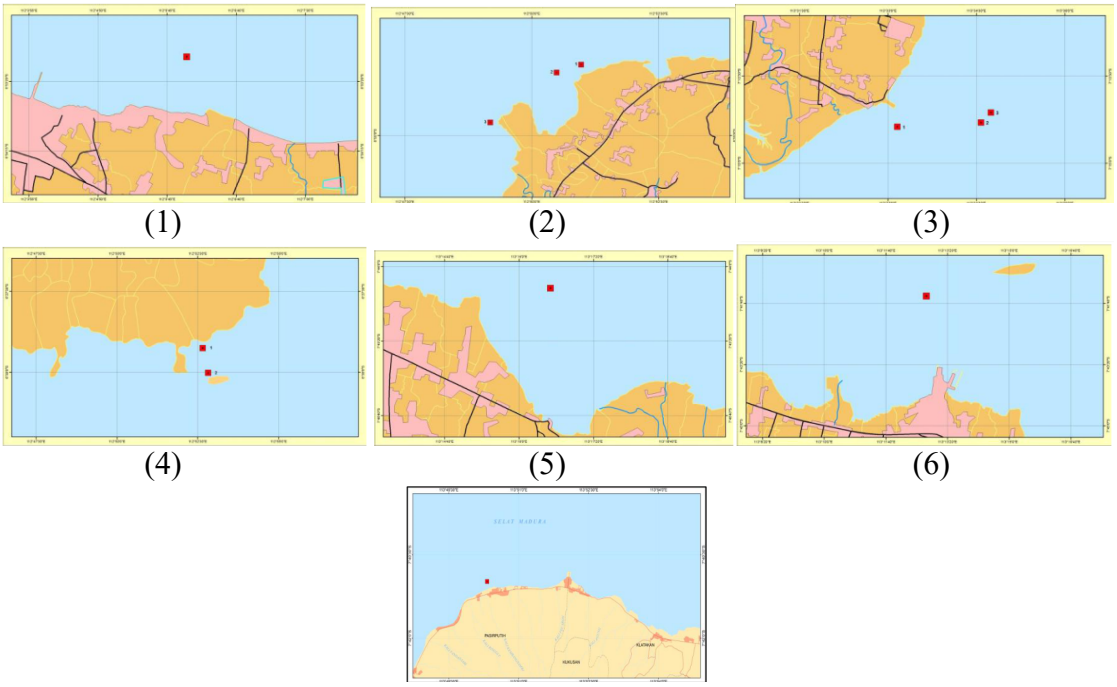

Figure 5. Recommended locations for placing fish apartment
(1) Tuban Regency, (2) Bangkalan Regency, (3) Pamekasan Regency,
(4) Gresik Regency, (5) Probolinggo Regency, (6) Probolinggo City and
(7) Situbondo Regency.
Source: Handayani (2023)

The Directorate General of Capture Fisheries, Ministry of Maritime Affairs and Fisheries carries out efforts to restore resources and habitats through the distribution of fish apartment packages. Fish apartment package assistance is one of the efforts in aquatic habitat rehabilitation activities through the creation of structures or buildings that are deliberately placed at the bottom of the waters with the aim of imitating the natural function of aquatic habitats, namely as a fish shelter, feeding ground and fish spawning ground. (spawning ground) and fish nursery ground, to support improving the habitat conditions of fish resources at the location of the fish apartment (Decree of the Minister of Maritime Affairs and Fisheries No. 42 of 2021).

According to Minister of Maritime Affairs and Fisheries Regulation No. 26 of 2021 concerning Prevention of Pollution, Prevention of Damage, Rehabilitation and Improvement of Fish Resources and the Environment that the Implementation of Improvement of Fish Resources and the Environment is carried out with the principle of sustainability by implementing the use of Fish Resources in accordance with the carrying capacity of the environment and trying to maintain the condition of the Source population Fish power and the environment. And the implementation of improving fish resources and the environment as intended in Article 69 is carried out through fish resource enrichment; Protection of fish resources so that they develop naturally; Maintenance of Fish Resources; and other environmentally friendly activities.

The placement of fishing tools and gear in the fisheries administration areas of the Republic of Indonesia and the high seas as well as the arrangement of fishing andons are regulated in KP Ministerial Regulation No. 18 of 2021. Confirms that fishing activities are prohibited in areas as spawning grounds and nursery areas, shipping lanes, core zones marine conservation areas, marine biota migration routes (turtle migration routes and cetacean migration routes) and other fishing areas determined by the Minister.

Fishing in the fish apartment placement area is prohibited because it is included in the area as a spawning area and nursery area, as regulated in Ministerial Decree No. KP. 42 of 2021 that fishermen must make written reports regarding fish apartment management activities to the Provincial Service and Regency/City Service every 6 (six) months from the sinking of the fish apartment, and the utilization of fish resources can be carried out in waters with a radius of 300 (three hundred) - 400 (four hundred) meters from the fish apartment using fishing equipment in the form of a fishing rod after 6 (six) months of placing the fish apartment in that area.

Based on Law no. 32 of 2004, the Central Government has provided clearer and more concrete autonomy, including the authority to manage coastal and marine resources. This authority includes exploration, exploitation, conservation and management of marine resources up to 12 nautical miles; regulation of administrative interests; spatial arrangement; law enforcement of regulations issued by the Regional Government or those delegated authority by the Central Government; as well as assistance in upholding state security and sovereignty, especially at sea.

Benefits of Fish apartment for Fish Resource Productivity

Fish apartment are used to provide space for fish to carry out activities, such as eating, sheltering and spawning. The existence of fish apartment at the bottom of the waters can attract coral fish because coral fish are fish that live in coral reef areas from juvenile to adult, closely connected to coral reefs because of the availability of food and shelter. Apart from that, reef fish still benefit from the ecological functions provided by the presence of fish apartment, such as protection against currents or predators, reproductive structures and possible mating sites.

Stageary & Marabessy (2022) state, that fish apartment not only act as additional habitat for various fish species, but also contribute to increasing fish catches. There are several literature studies regarding the use of fish apartment for fish resources which are shown in Table 1.

Table 1. Use of fish apartment for fish resource productivity

Fish apartment Placement Location	Use of Fish apartment	Results
Bangsring Waters, Banyuwangi (Kamaali *et al*., 2016).	- Can increase the number of catches - Fish catch production in 2013-2015 increased, with a value of 4,130 fish in 2013, 8,949 fish in 2014, and 12,844 fish in 2015 - The average percentage increase in catch in 2013-2015 was 80% per year.	The types of ornamental fish caught by fishermen that most often use fish apartment include: - Angel fish (*Pomacanthidae*), - Betok (*Pomacentridae*) - Butterflies (*Chaetodontidae*), - Chameleons (*Gobiidae*), - Rivets (*Labridae*), - Grouper (*Serranidae*).
The waters of Ohoieuw Island, Southeast Maluku (Tahapary &	- Fish apartment are an indicator for assessing changes in trophic levels in the food chain in aquatic	- Fish apartment provide significant shade for reef fish (Tahapary & Marabessy 2023).

Fish apartment Placement Location	Use of Fish apartment	Results
Marabessy 2023).	ecosystems (Tahapary & Marabessy 2023). - The fish apartment structure that has been in the water continuously shows its existence in collecting fish (Tahapary & Marabessy 2023).	- There are 20 families of coral fish that dominate the fish apartment, and the largest numbers are found in the major fish (Tahapary & Marabessy 2023).
Kalih Island Waters, Serang Regency (Nanto *et al*., 2023)	- The installation of fish apartment is aimed at improving the ecological function of natural habitats which are used by various types of fish as nursery grounds and feeding grounds	- The waters has great potential to become a Fishing Area for pelagic fish that will occupy fish apartment.
Warhu Island, Southeast Maluku (Renhoran *et al.*, 2023)	- Fish apartment as a solution to replace damaged coral reefs. - reef ball -shaped fish apartment functions to prevent erosion on the beach, because its round shape can minimize waves and currents that reach the beach.	- The results of monitoring fish apartment showed that fish from the Acanthuridae family, the Acanthurus genus, such as surgeonfish or also known as botana fish, had occupied biorocks and fish apartment. - There are fish from the Siganidae family, the genus Siganus, which is often called rabbitfish, which has been found occupying the fish apartment.

The use of fish apartment as an innovative solution has been proven to have a significant impact on the welfare of fish resources in various locations, such as Bangsring Waters, Kalih Island and Warhu Island. With strategic placement, fish apartment increase fish catches, improve aquatic ecosystems, and provide shade for reef fish, becoming an important instrument in restoring habitat and balancing marine ecosystems.

Benefits of Fish apartment for Conservation of Fish Resources

Artificial reefs (fish apartment) developed in Thailand prevent illegal fishing by *trawling* . The Gulf of Mexico as a fishing and diving tourist location is more attractive after

there is a fish apartment. Italian development could protect Sicily's coast from erosion. Meanwhile in Indonesia, the development of fish apartment carried out by the Fisheries Research and Development Center in Bali can increase tourist visits, especially foreign tourists (Hartati, 2007).

According to Wasilun (1997), there are two important impacts of fish apartment, namely ecological and socio-economic impacts. The ecological impact is creating new habitats, increasing fish populations and protecting beaches. Meanwhile, the socio-economic impact is creating new fishing areas, increasing fisheries production, creating protection and conservation marine tourism areas.

Many studies have been carried out to see how far the existence of these fish apartment can increase fisheries production in a place. According to the results of research conducted by Soedharma *et al.* (1995), the total types of fish caught in bamboo fish apartment and the combination of tires and bamboo consisted of 37 species from 4976 individuals, namely 13 types of target fish, 4 types of indicator fish and 20 species main family. Apart from that, periphyton groups and other types of biota were also found.

According to Risamasu *et al*. (1998), The types of coral fish caught in fish apartment and concrete modules were 23 species belonging to 13 families. Each consists of 16 main families, 5 species of target fish and 2 species of indicator fish, with a total catch of 1252 individuals. Apart from that, other organisms were also found such as brown algae, *hydrozoa* , *sponges* , *ascidians* , anemones and barnacles.

According to research results by Risamasu (2000), an abundance of coral fish was found in fish apartment made of wooden, bamboo and concrete modules. From these data it can be seen that at a depth of 5 m for the wood module the family of coral fish that has the highest abundance value is *Caesionidae* at 4.35%, then *Acanthuridae* 8.152% and *Pomacentridae* 2.445% and followed by the next family. In the bamboo module, the coral fish family that has the highest abundance value is *Pseudochromidae* at 38.89%, then *Acanthuridae* at 22.555% and *Pomacentridae* at 11.111% and followed by the next family. In the concrete module, the coral fish family that has the highest abundance value is *Caesionidae* at 71.71Z%, then *Pomacentridae* 11.185%, *Acanthuridae* 7.296%, *Balistidae* 4.276%.

From several studies that have been carried out previously, the presence of fish apartment has a significant effect on increasing the abundance of various fish in a body of water. In fact, according to research results from Munasik (2020), fish apartment in Bangsring waters have been proven to restore damaged aquatic ecosystems by increasing the abundance of 39 types of fish species, improving fish habitat, and increasing fish stocks, which has led to a significant increase in fishing.

CONCLUSION

This research shows that fish apartment play an important role in restoring the availability of fish resources and supporting the sustainability of fish populations. Fish apartment provide habitat that supports various fish activities, such as food availability, spawning, and protection from predators and extreme environmental conditions. Additionally, fish apartment increase habitat diversity, attracting various species of fish and other aquatic organisms, thereby improving the overall aquatic ecosystem. Fish apartment also facilitate research and monitoring of fish populations, providing important data for the conservation and future management of fish resources. Therefore, fish apartment are an important tool in maintaining fish populations, supporting local fisheries, and reducing the impact of marine environmental degradation.

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