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IMPACT ANALYSIS OF THE FUJI LESTARI PROGRAM ON FISH RESOURCE RECOVERY AND THE ADVANCEMENT OF SUSTAINABLE DEVELOPMENT GOAL 14 (LIFE BELOW WATER) IN THE JAVA SEA (FISHERIES MANAGEMENT AREA 712), INDONESIA

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ABSTRACT

The Fuji Lestari program, implemented regularly by the Ministry of Marine Affairs and Fisheries (KKP) through the Fishing Technology Center (BBPI), aims to restore fishery resources. The Java Sea (FMA-712), characterized by the highest population of fishers, has been categorized as fully exploited, necessitating the Fuji Lestari program to restore its condition. This study evaluates the program's impacts in Bangsring waters, Banyuwangi Regency (2011); Panjang Island, Jepara Regency (2021); and Karang Jeruk, Tegal Regency (2024). The methodology included field observations, underwater visual census (UVC), and interviews using purposive sampling targeting program beneficiaries. Data analysis assessed ecological and economic impacts. Ecological impacts included changes in coral cover in Bangsring and Panjang Island, as well as increases in fish abundance and diversity in Karang Jeruk. Economic impacts were analyzed by calculating the total economic valuation (TEV) for the three locations. Results show a significant increase in live coral cover of 2.4 hectares in Bangsring waters and 1 hectare in Panjang Island waters. In Karang Jeruk, reef-associated fish species increased from 6 to 12 species, with a diversity index rising from 1.49 to 1.71. The TEV from direct, indirect, existence, and option benefits in Bangsring, Banyuwangi Regency was IDR 11,856,378,385; Panjang Island, Jepara Regency was IDR 5,136,896,500; and Karang Jeruk, Tegal Regency was IDR 9,655,638,600. Variations in impact across regions depended on environmental damage levels and the characteristics of fisher beneficiaries. Furthermore, stakeholder collaboration is crucial in optimizing existing opportunities to ensure the program's future success.

Keywords: Bangsring, fish apartment, fuji lestari, karang jeruk. panjang island

Introduction

The FUJI LESTARI program (Fish-Apartment Untuk Jadikan Laut Sehat, Nelayan Hebat dan Mandiri or Fish-Apartment for Healthy Seascapes, Empowered and Independent Fishermen) is a community empowerment initiative designed to enhance marine resource sustainability through technical assistance, training, and support for Indonesian fishing communities. This program is anchored in the 14th Sustainable Development Goal (SDG 14: Life Below Water), which emphasizes marine conservation and the sustainable use of ocean resources. The program has been recognized by the Government of Indonesia as a national priority due to its potential to mitigate overfishing and support ecosystem restoration [1].

A key innovation of the program is the fish-apartment (FA), an artificial reef structure developed by the Fishing Technology Center (BBPI), Ministry of Maritime Affairs and Fisheries (KKP). These structures consist of vertical and horizontal partitions made from recycled polypropylene (PP), a material chosen for its strength, durability, and elasticity. Unlike traditional artificial reefs, FA modules can be mass-produced, facilitating broader adoption across Indonesia. When well-managed, FA structures function as spawning grounds, feeding areas, and nursery habitats—critical for enhancing fish populations and supporting biodiversity recovery [2].

Since its launch in 2011, the FUJI LESTARI program has deployed 10,950 FA modules across Indonesia, with one of its most intensive implementations occurring in the Java Sea, particularly in Fisheries Management Area (FMA) 712 (WPP 712) [3]. The Java Sea plays a vital role in Indonesia's fisheries sector, supporting highly productive but heavily exploited fish stocks. Official assessments indicate that FMA 712 has been under significant pressure, as evidenced by the utilization rate of large pelagic fish, which increased from 0.63 in 2017 to 1.3 in 2022, and demersal fish, which rose from 0.83 in 2017 to 1.1 in 2022 [4] [5]. This trend underscores the urgent need for sustainable fisheries management to restore declining fish stocks and ensure long-term economic viability for local fishermen.

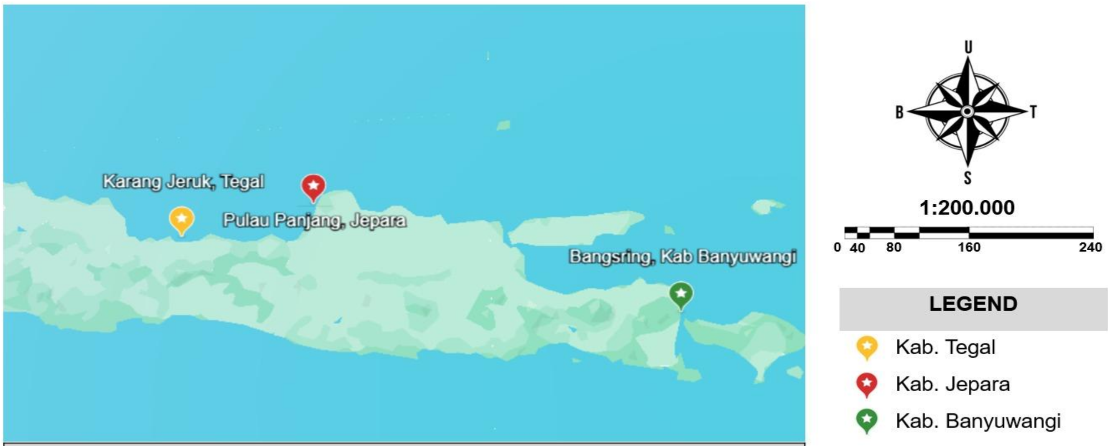
Within FMA 712, three key regions have received FA installations at different points in time, reflecting diverse ecological and socio-economic conditions:

a. Banyuwangi Regency (2011) – Among the earliest adopters, this area has seen significant changes in fish population dynamics and local fishing practices.
b. Jepara Regency (2021) – A relatively recent recipient, offering insights into mid-term ecological and economic impacts.
c. Tegal Regency (2024) – The latest implementation site, providing an opportunity to assess short-term effects and early adoption challenges.

This study aims to determine the impact of the Fuji Lestari program ecologically and economically in various regions and at different implementation times. By analyzing the merits of the program, the study will highlight how FA can serve as a model for balancing fisheries sustainability and economic resilience, aligning with the SDG 14 targets of reducing marine degradation, restoring fish stocks, and promoting responsible fishing practices in FMA 712.

Methodology

This research was conducted from November 2023 to November 2024 in three locations: Bangsring waters, Banyuwangi Regency, with 589 FA modules; Panjang Island waters, Jepara Regency, with 100 FA modules; and Karang Jeruk waters, Tegal Regency, with 40 FA modules (Figure 1).



Location Coordinate		
Tegal Regency	Jepara Regency	Banyuwangi Regency
109°12'39.91"E 06°48'56.55"S	110°37'59.37" E 6°34'51.41" S	114°25'54.10" E 8°03'11.10" S

Figure 1. Research Locations

The methods used include field observations, underwater visual census (UVC), and interviews. Data analysis was conducted descriptively by explaining the ecological and economic impacts. Ecological impacts observed included changes in coral cover in Bangsring and Panjang Island, as well as increases in fish abundance and the Shannon-Wiener diversity index in Karang Jeruk. Economic impact analysis was conducted by calculating the total economic value (TEV) for the three locations. (Figure 2).

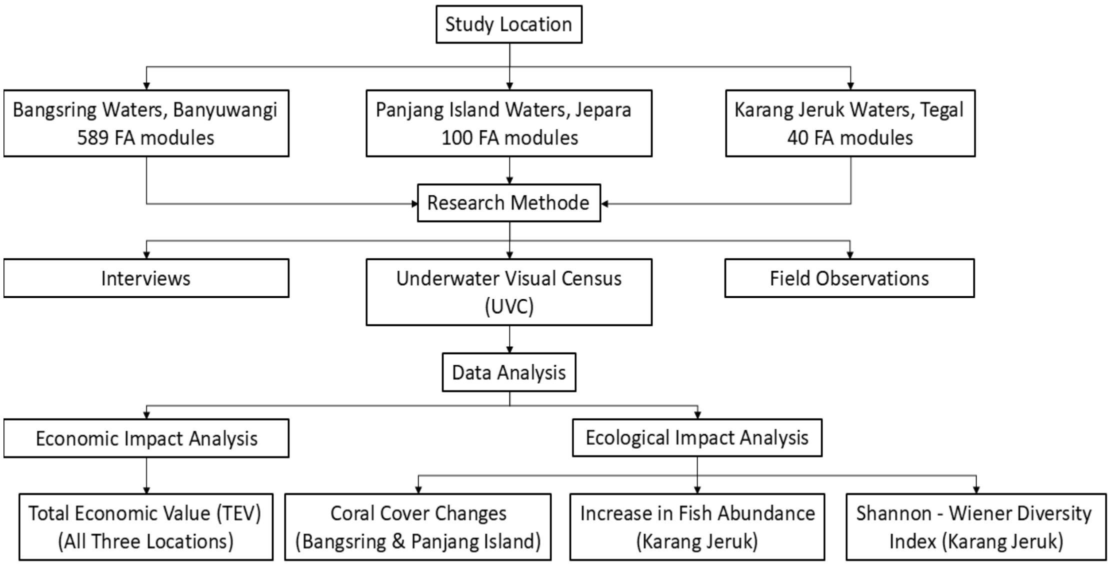


Figure 2. Flowchart Diagram Research

a. Coral Cover and Fish Diversity

Coral fish data were collected using the Underwater Visual Census method by [6] with modifications to the Stationary Visual Census (SVC) method by [7] and [8], as illustrated in Figure 3.

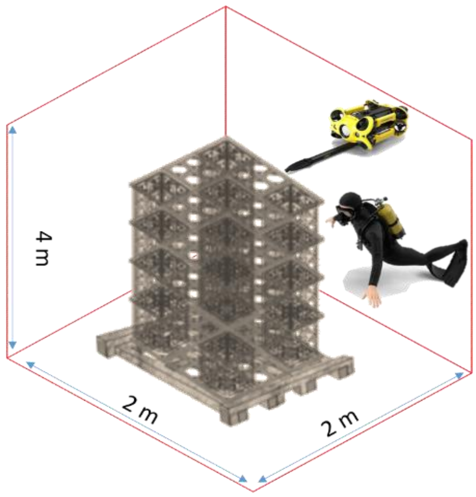


Figure 3. Illustration of Underwater Visual Census

The Shannon-Wiener diversity index (H') was used to calculate coral reef fish diversity.

$$H' = -\sum_{i=1}^{n} Pi . \ln Pi$$

Where:
H' = Diversity Index
Pi = ni/N
ni = Number of individuals of the first species
N = Total number of individuals

According to [9], diversity is categorized as:

Low diversity: H' < 2,30
Moderate diversity: 2,30 < H'< 3,50
High diversity: H' > 3,50

b. Total Economic Value

The number of beneficiary fishermen respondents was determined using the Slovin method. According to [10], the Slovin method is formulated as follows:

$$n = \frac{N}{N . e^2 + 1}$$

Where:
n = Number of respondents
N = Population size
e = Margin of error

Based on the Slovin calculation, the number of respondents in each location was 200 in Banyuwangi Regency, 100 in Jepara Regency, and 100 in Tegal Regency. These respondents represented artisanal fishermen using environmentally friendly fishing gear who benefited from the Fuji Lestari program.

The total economic valuation (TEV) of coral reefs in the FA deployment areas was calculated using the following formula by [11]:

$$TEV = UV + NUV$$
$$UV = DUV + IUV + OV$$
$$NUV = EV$$

Where:
TEV = Total Economic Value
UV = Use value
DUV = Direct use value

IUV = Indirect use value
OV = Option value
NUV = Non-use value
EV = Existence value

Result and Discussion

a. Increase in Live Coral Cover

The study results show an increase in live coral cover following the implementation of the Fuji Lestari program. Observations in Panjang Island and Bangsring waters, as reported [12] and [13] (Table 1), demonstrate the program's success several years after FA deployment. This increase is marked by a reduction in dead coral and sandy areas, as well as the growth of soft and hard corals on FA partitions. Although the FAs in Panjang Island waters have not yet formed a complex coral reef community, the presence of biofouling on some modules indicates the beginning of interactions between passive and active biota communities. In contrast, findings in Banyuwangi, where the program was implemented earlier (2011), show a more complex coral reef structure and ecosystem stability due to FA introduction.

Changes in live and dead coral cover in Panjang Island demonstrate the dynamics of restoration following the Fuji Lestari program. In 2010, live coral cover was recorded at 3.23 hectares, decreasing to 2.42 hectares in 2019, but increasing again to 3.51 hectares in 2023. This decline is likely related to local ecosystem pressures before the Fuji Lestari program, such as massive and unsustainable destructive fishing. The increase in live coral after 2019 indicates the success of FA deployment, which provided new substrates for coral colonization. From 2010 to 2019, live coral cover decreased by 0.81 hectares, while dead coral increased by 0.80 hectares. However, this trend reversed from 2019 to 2023, with live coral increasing by 1.09 hectares and dead coral increasing by only 0.09 hectares. The smaller increase in dead coral compared to live coral growth indicates the success of the restoration program, where additional substrates through FAs supported new coral colonization. This is consistent with findings that artificial reefs can provide additional substrates that support coral growth and mitigate ecological pressures [14].

Meanwhile, in Bangsring, the longer-running Fuji Lestari program has resulted in more stable coral ecosystem development. The restoration program, which began in 2011, has shown more significant results compared to Panjang Island. In 2011, live coral cover was recorded at 3.7 hectares, increasing significantly to 6.1 hectares by 2020. Live coral increased by 2.12 hectares from 2017 to 2020, far exceeding the growth in Panjang Island. In contrast, dead coral in Bangsring increased by 0.54 hectares during the same period, though at a relatively controlled rate compared to live coral growth. [15]. state that artificial reefs can strengthen physical structures and increase ecosystem heterogeneity. Additionally, Bangsring's initially better condition compared to Panjang Island may have facilitated biota adaptation to FA modules.

Table 1. Changes in Live Coral Cover in Bangsring and Panjang Island

Year	Coral Cover (Ha)		Changes (Ha)	
	Live	Dead	Live	Dead
	PANJANG ISLAND - JEPARA			
2010	3,23	3,01	-	-
2019	2,42	3,81	0,81	0,80
2023	3,51	3,90	1,09	0,9
	BANGSRING - BANYUWANGI			
2011	3,7	0,79	-	-
2017	3,98	0,7	0,28	0,09
2020	6,1	1,24	2,12	0,54

Source: Jepara Regency [12] and Banyuwangi Regency [13]

Although the coral reef structure associated with Panjang Island is not yet complex, the presence of biofouling and initial colonization indicates interactions between biota communities. Support this finding [16], stating that artificial reefs serve as transitional habitats that can improve local ecosystem dynamics. Bangsring, with its more complex ecosystem, exemplifies how artificial reefs can help achieve ecosystem stability through long-term planning and continuous monitoring. [17] state that artificial structures can provide substrates that support coral ecosystem restoration by increasing substrate diversity. For long-term restoration success, it is essential to set specific goals when designing artificial reefs, such as targeting biodiversity enhancement and ecosystem stability. These findings align with [18], which shows that restoration success depends on design, substrate materials, and project locations that support coral colonization and long-term ecosystem stability.

b. Fish Species Composition

Based on initial observations in Karang Jeruk waters, Tegal Regency, in August, six species from six families of associated fish were found, while in November, 12 species from 12 genera and nine families of associated fish were observed around the FAs. The fish species composition is presented in Table 2.

Reef-associated fish can be categorized based on their feeding habits into herbivores, carnivores, and corallivores. Herbivorous fish, such as those from the *Pomacentridae* family, feed on algae and help maintain coral ecosystem balance by preventing algal dominance. Carnivorous fish, such as those from the *Lutjanidae* family, prey on small fish or invertebrates and play a role in maintaining the food chain structure in coral reef ecosystems. Meanwhile, corallivorous fish, such as those from the *Chaetodontidae* family, feed on coral polyps, and their presence is often used as an indicator of coral reef health due to their dependence on healthy coral conditions [19].

Based on their role in the ecosystem, reef-associated fish can also be categorized into major fish, target fish, and indicator fish. Major fish play a significant role in the structure of coral fish communities, such as herbivorous fish from the *Scaridae* and *Acanthuridae* families. Target fish are species with high economic value and are frequently caught by fishermen, such as snappers (*Lutjanidae*) and groupers (*Serranidae*). Indicator fish are species whose presence reflects the health of the coral reef ecosystem, such as fish from the *Chaetodontidae* family, whose abundance correlates with the presence of live coral [20].

At the family level, the composition of all observed fish comes from different families. The August composition consisted of one major fish species with herbivorous feeding habits and five target fish species with carnivorous feeding habits. The November composition consisted of three major fish species with herbivorous feeding habits, seven target fish species with carnivorous feeding habits, and two indicator fish species with corallivorous feeding habits.

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Table 2. Coral Fish Composition in Karang Jeruk Waters - Tegal

NO	Family	Species	Type	Group
		Periode Agustus		
1	*Pomacentridae*	*Pomacentrus coelestis*	**Herbivore**	Major Fish
2	*Lutjanidae*	*Lutjanus lutjanus*		Target Fish
3	*Terapontidae*	*Terapon jarbua*		Target Fish
4	*Lethrinidae*	*Gymnocranius grandoculis*	**Carnivore**	Target Fish
5	*Carangidae*	*Alectis indica*		Target Fish
6	*Scatophagidae*	*Scatophagus argus*		Target Fish
		Periode November		
1	*Pomacentridae*	*Abudefduf vaigiensis*		Major Fish
		Pomacentrus coelestis	**Herbivore**	Major Fish
2	*Blenniidae*	*Cheilodipterus isostigma*		Major Fish
3	*Siganidae*	*Siganus javus*		Target Fish
4	*Lutjanidae*	*Lutjanus lutjanus*		Target Fish
5	*Nemiptridae*	*Scolopsis temporalis*	**Carnivore**	Target Fish
6	*Carangidae*	*Gnathanodon speciosus*		Target Fish
		Selaroides leptolepis		Target Fish

7	*Scatophagidae*	*Scatophagus argus*		Target Fish
8	*Ephippidae*	*Platax teira*		Target Fish
9	*Chaetodontidae*	*Chelmon rostratus*	**Corallivore**	Indicator Fish
		Chaetodon octofasciatus		Indicator Fish

The presence of species from the Pomacentridae family, albeit low, provides an initial indication of live coral growth around the FAs. The presence of species such as *Scatophagus argus* and *Gymnocranius grandoculis* also enriches the community, although their numbers are lower. Research by [21] shows that artificial structures with high complexity can serve as alternative habitats that support target species. With a total of six species found, these results demonstrate the potential of FAs to increase fish diversity

Indicator species such as *Chelmon rostratus* and *Chaetodon octofasciatus* indicate improving habitat quality. The presence of target species such as *Lutjanus lutjanus* further strengthens the potential of FAs to support local fishery sustainability. This aligns with previous studies, which show that the longer artificial reefs are deployed, the more algae attach to the attractors, ropes, and covers, indicating that artificial reefs provide food for coral fish [22]. Research by [23] adds that artificial reefs not only attract target fish but also support a broader diversity of fish species, from herbivores to carnivores. The data obtained show predation and competition among fish species, an important ecological process in maintaining a healthy fish community structure in artificial reef areas.

c. Coral Fish Diversity Index

Observations in August and November showed significant increases in dominance (C), evenness (E), and diversity (H') for fish associated with the FAs. The observation results are shown in Figure 4.

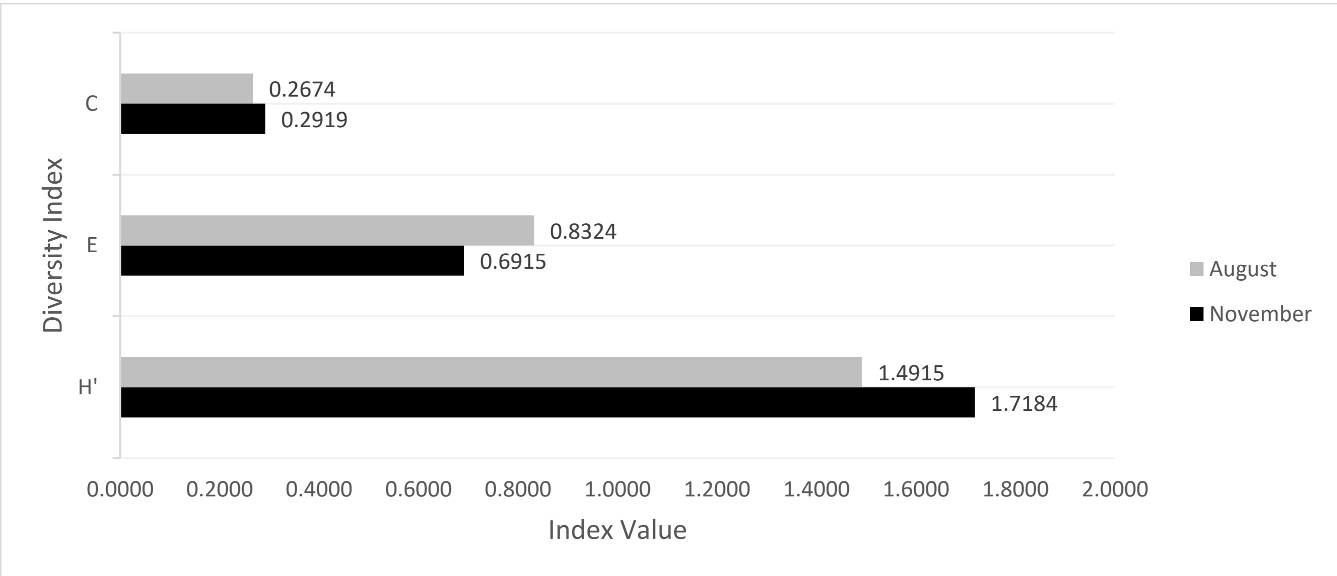

Figure 4. Diagram of Coral Fish Diversity Index in Karang Jeruk Waters, Tegal Regency

The dominance index (C) for this fish community was 0.2674, indicating that dominance by a single species is not overly strong. This is important because low dominance suggests that community diversity remains well-maintained. Although *Pomacentrus coelestis* show ed higher abundance, the low dominance index indicates that no single species significantly dominates the entire ecosystem. This suggests that the artificial reefs can provide a relatively balanced environment for various fish species. In contrast, the dominance index (C) in November was 0.2919, slightly higher than in August (0.2674). This increase in dominance reflects the role of dominant species, such as *Siganus javus*, which dominated the community. However, the relatively low dominance value indicates that the FAs can still maintain species diversity effectively. Data indicates that the FAs are beginning to function as effective alternative habitats for supporting both target and non-target species. Further increases in diversity are expected as the habitat develops. [24] highlight that the success of artificial habitats often requires time to reach optimal carrying capacity. [25] state that mature habitats can support greater biomass and ecosystem functions, as reflected in this study. Well-managed FAs demonstrate significant potential to support local fishery sustainability.

The evenness index (E) in August was 0.8324, indicating that although some species dominated, the distribution of individuals among species was relatively even. This suggests that while certain species were more abundant, the artificial reefs were able to maintain a balance among species overall. *Pomacentrus coelestis*, as the species with the highest individual abundance (41.51%), contributed significantly to the existing diversity. This evenness index value indicates that other species, such as *Terapon jarbua* (22.64%) and *Lutjanus lutjanus* (15.09%), played significant roles in maintaining community structure. In contrast, the evenness index (E) in November was 0.6915, lower than in August. This indicates that the distribution of individuals among species became less even, with greater dominance by *Siganus javus*. This decline in evenness is typical during the ecosystem adaptation phase, where dominant species tend to take advantage of new habitats. However, species such as *Scolopsis temporalis* and *Selaroide s leptolepis* still played important roles in maintai ning ecosystem balance. This is supported by [26], who state that well-designed artificial habitats can reduce pressure from dominant species and support the growth of fish communities.The presence of species with moderate contributions to community structure shows that the FAs can still support a fairly diverse species distribution despite the dominance of certain species.

In August 2024, observations showed a diversity index (H') of 1.4915, which is relatively low but reflects the initial formation of a coral fish community. The composition was dominated by *Pomacentrus coelestis* (41.51%), which stands out as an opportunistic species with high adaptability to artificial habitats. The presence of species such as *Terapon jarbua* (22.64%) and *Lutjanus stellatus* (15.09%) indicates that the FAs have begun to provide habitats for target fish groups. Although the diversity value is moderate, the dominance index (C) of 0.2674 suggests the presence of dominant species. This aligns with findings by [27], who state that new habitats tend to be dominated by adaptive species during the early stages.

In November 2024, observations showed a diversity index (H') of 1.7184, higher than in August. This value reflects a more stable and diverse coral fish community, indicating improved ecological function of the FAs. The fish community during this period was still dominated by *Siganus javus* (50.20%), which became a key species in the community structure due to its ability to utilize artificial habitats as a source of food and protection. The presence of species such as *Lutjanus lutjanus* (13.98%) and *Scolopsis temporalis* (10.10%) shows that the FAs are beginning to support target fish species with significant economic and ecological value. This aligns with findings by Bohnsack (1986), who state that artificial habitats can attract species with specific ecosystem preferences, particularly economically valuable fish species.

Ecologically, the presence of species such as *Gymnocranius grandoculis* and *Scatophagus argus* contributes to the balance of the fish community. The presence of species such as *Platax teira* (3.47%) and *Scatophagus argus* (1.02%) also indicates that the FAs can attract species with specific habitat preferences. The complex structure of artificial habitats allows these species to find optimal shelter, supporting overall community stability.

d. Total Economic Value

Total Economic Value (TEV) was used to measure the economic benefits of the artificial reef program by considering various types of values associated with the ecosystem. TEV includes direct use value (DUV), derived from the direct use of resources, such as fisheries, tourism, and marine recreation. This use contributes economically to coastal communities through increased income from the fisheries and marine tourism sectors [28].

Additionally, there is indirect use value (IUV), which includes the ecological role of artificial reefs in maintaining marine ecosystem balance, such as coastal protection from abrasion and providing habitats for various marine species. The presence of artificial reef structures can enhance marine biodiversity, contributing to the stability of the food chain and fishery productivity in the surrounding areas [29].

Direct use value was calculated based on income from the fisheries and tourism sectors affected by the Fuji Lestari program. Indirect use value was estimated based on coastal protection and carbon sequestration benefits experienced by program beneficiaries. Existence value was calculated based on the willingness to pay (WTP) of beneficiaries to sustain the program, and option value was derived from the conversion of biodiversity value based on the land area used in the Fuji Lestari program across the three regions. Based on quantitative analysis, the economic value of the fish apartment areas in each region is presented in Table 3. This comprehensive approach captures both the tangible and intangible benefits of the program, providing a holistic assessment of its economic impact. Furthermore, these findings offer a robust basis for policy recommendations and strategic planning to enhance sustainable marine resource management in the region.

Table 3. Total Economic Value (TEV)

Region	Types of Fish Apartment Values				Total (IDR)
	Direct Use Value (IDR)	**Indirect Use Value (IDR)**	**Existence Value (IDR)**	**Option Value (IDR)**	
Banyuwangi Regency	11,348,700,000	450,540,825	41,800,000	15,337,560	11,856,378,385
Tegal Regency	9,614,000,000	30,597,000	10,000,000	1,041,600	9,655,638,600
Jepara Regency	4,908,000,000	76,492,500	20,000,000	2,604,000	5,007,096,500
Total Economic Value of Fish Apartment (IDR)					26,519,113,485

Based on Table 3, the total economic valuation (TEV) of the fish apartments in Banyuwangi Regency, Jepara Regency, and Tegal Regency amounts to IDR 26,519,113,485. The highest TEV was recorded in Banyuwangi Regency at IDR 11,856,378,385, followed by Tegal Regency at IDR 9,655,638,600, and Jepara Regency at IDR 5,007,096,500. These results show that direct use value contributes the most to the TEV compared to other value types.

Banyuwangi Regency has the highest TEV due to the 13-year duration of the program, as explained earlier (Table 1). The high value of capture fisheries is due to the fact that all fishermen in Bangsring are ornamental fish exporters, and their high awareness of environmentally friendly fishing practices has resulted in sustainable economic impacts. The tourism sector also plays a significant role, as the area was not a tourist destination before 2011. The highest contributions came from capture fisheries and tourism. The fisheries sector contributed IDR 6,552,150,000, while the tourism sector contributed IDR 4,796,550,000. However, thanks to the efforts of the beneficiary groups, the annual tourism revenue now reaches IDR 12.6 billion, generating multiplier effects for the local economy in Banyuwangi [30].

Tegal Regency has the second-highest economic valuation potential, as the FA deployment area is a fishing ground that had previously suffered damage. Based on interviews, most fishermen have shifted their fishing practices from within the Karang Jeruk marine conservation area, even encroaching on the core zone, to areas around the FAs located outside the conservation area. The high value is due to the average annual income of beneficiary fishermen in this location reaching IDR 9,130,000,000. This aligns with data from [31], which states that the *payang jabur* fishing industry in Tegal Regency is a major economic driver for coastal communities and supplies raw materials for the processed anchovy industry in Pemalang and Kendal. The anchovy production in Karang Jeruk waters includes *nasi* anchovy and *jawa* anch ovy.

The results in Jepara Regency show the lowest value compared to the other two locations, despite having more FA modules deployed than Tegal Regency. This is because the FAs in Jepara function as artificial barriers against environmentally harmful fishing practices and as release areas for crab larvae. As a result, fishing activities are restricted to prevent damage to the area. Nevertheless, the capture fisheries sector still contributes IDR 3,610,000,000 annually, and tourism revenue from sport fishing amounts to IDR 1,298,000,000 per year.

e. Sustainable Development Goals (SDGs) - 14

The 14th sustainable development goal is to conserve and sustainably utilize marine and ocean resources for sustainable development. To achieve the national marine ecosystem targets by 2030, 10 targets have been set, measured through 15 indicators. These targets include sustainable marine spatial planning and management, Maximum Sustainable Yield (MSY), combating Illegal, Unreported, and Unregulated (IUU) fishing, expanding marine protected areas, and supporting small-scale fishermen. Efforts to achieve these targets are outlined in policies, programs, and activities.

The Fuji Lestari program positively correlates with SDG-14. The program supports 4 out of 10 targets, namely targets 2, 4, 5, 7, and 9. The program's implementation in Bangsring (Banyuwangi Regency), Panjang Island (Jepara Regency), and Karang Jeruk (Tegal Regency) has demonstrated positive impacts, as evidenced by the following: First, an increase in coral cover. Second, the number of fish species caught and associated with the reefs increased from 6 to 12 species in 2015 (**Target 14.2**), indicating success. The transition from destructive fishing practices to environmentally friendly methods (**Target 14.4**). The economic valuation of the program shows that local economies have also benefited (**Target 14.7**). Additionally, there are impacts outside SDG-14, such as a reduction in coastal erosion from 2 meters per year due to the wave-breaking benefits of FAs, stabilizing the coastline by 2050 (**Targets 13.1 and 13.b**). Finally, fish catch production has increased annually (**Targets 1.1 and 1.5**). Based on sampling in the three locations, the program has increased fishermen's income within one to two years (**Targets 1.1 and 1.5**).

Target 14.2 (Ecosystem Restoration): The increase in coral cover (Bangsring: 6.1 hectares) aligns with this indicator. However, it should be noted that this area is still less than 10% of the total WPP-712 area. To achieve the global target (restoring 20% of degraded marine ecosystems by 2030), replicating the program in other regions is key [32].

Target 14.4 (Sustainable Fishing): Although fish catches have increased, WPP-712 remains fully exploited. This indicates that FAs have not fully addressed overfishing pressures. Integration with effort reduction policies is necessary [33].

Target 14.7 (Economic Benefits for SIDS/LDCs): Although TEV has increased, benefit distribution in Jepara is uneven due to access restrictions. Fishermen's participation in program planning (*bottom-up approach*) can improve inclusivity [34].

Conclusion

The Fuji Lestari program has successfully increased live coral cover and fish diversity in the three study locations. Additionally, the program has generated significant economic impacts, particularly through the capture fisheries and tourism sectors. This study demonstrates that FAs can be an effective solution for restoring degraded marine ecosystems while improving fishermen's welfare. The program's success also contributes to achieving Sustainable Development Goal (SDG) 14, particularly in marine ecosystem restoration and coastal community empowerment.

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