INTERNATIONAL WATERS EXPERIENCE NOTES

Toward Fisheries Refugia in Indonesia Coastal Water

Abstract:. Fisheries refugia in Indonesia is considered a novel approach to Indonesian fisheries management by offering a balance between ecological and economic interests. This approach may become a rapid solution in response to the currently degrading habitat and declining fisheries resources. The identified 409,432 Ha shrimp refugia area in West Kalimantan Province and the 1,529,097.93 Ha of potential fisheries refugia area for squid in Bangka Belitung Province became a breakthrough to be recommended as fisheries refugia area. Furthermore, by offering the open-close system, rather than the permanent “no-take” zone, the fisheries refugia concept has a huge opportunity to be well-accepted by the local fishermen community and to be replicated for the other important fisheries commodities. Finally, the fisheries refugia-based management may serve as a management pilot project for the important fisheries commodities, especially in IMFA 711.

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PROJECT DESCRIPTION

The Fisheries refugia known as a novel approach in fisheries management which in principle is form of integration fish stocks and its habitat management. The concept of fisheries refugia was introduced by UNEP/GEF as stated in the GEF/UNEP Regional Guidelines on the Use of Fisheries *Refugia* for Capture Fisheries Management in Southeast Asia. The guidelines that published as part of the ASEAN-SEAFDEC Regional Guidelines for Responsible Fisheries in Southeast Asia in 2006, has provided countries bordering the South China Sea and Gulf of Thailand a milestone and a clear policy support for the development of sustainable fisheries in Southeast Asia.

The initiative to establish a fisheries refugia system in the South China Sea developed by SEAFDEC/UNEP/GEF through a regional project: "Establishment and Operation of a Regional System of Fisheries Refugia in the South China Sea and Gulf of Thailand"in collaboration with six countries bordering the South China Sea; Cambodia, Indonesia, Malaysia, Philippine, Thailand and Vietnam. The specific project objective is 'to operate and expand the network of fisheries refugia in the South China Sea and Gulf of Thailand for the improved management of fisheries and critical marine habitats linkages in order to achieve the medium and longer-term goals of the fisheries component of the Strategic Action Programme for the South China Sea'.

The project have four components, are (1) Identification and management of fisheries and critical habitat linkages at priority fisheries refugia in the South China Sea and Gulf of Thailand; (2) Improving the management of critical habitats for fish stocks of transboundary significance via national and regional actions to strengthen the enabling environment and knowledge base for fisheries refugia management in the South China Sea and Gulf of Thailand; (3) Information Management and Dissemination in support of national and regional-level implementation of the fisheries refugia concept in the South China Sea and Gulf of Thailand; (4) National and regional cooperation and coordination for integrated fish stock and critical habitat management in the South China Sea and Gulf of Thailand.

Indonesia has decided two potential priority areas for establishing fisheries refugia system are Bangka-Belitung Waters and West Kalimantan Waters which is part of Fisheries Management Area (FMA) 711 of Republic Indonesia. In term of fisheries management, Indonesia consists of eleven Fisheries Management Area, and FMA 711 encompasses the Karimata Strait, Natuna Sea, and the South China Sea, is a strategic fishing ground in Indonesia.

THE EXPERIENCE

Issue

The fisheries sector plays important role in providing food for the nation, serve as a source of employment, income, and foreign exchange. Small-scale fisheries play dominant role in contributing fish for the domestic market and local consumption. On the other hand, landings for export are mostly derived from semi-industrial fisheries. Most inshore fish resources have been more intensively exploited than those offshore. Accordingly, fisheries in coastal and marine areas require good management that aims to rebuild resources and maintain the integrity of marine and coastal ecosystems.

Habitat in the coastal areas plays an essential role in the stock sustainability of marine fish, crustacean, mollusc or other species. In completing their life cycle, most of marine fish, shrimp, squid are linked to critical habitats such as mangroves, coral reefs, seagrass beds, and estuaries. However, critical habitats have been threatened for decades due to human activities, including intensive exploitation in coastal areas. Therefore, there is crucial to integrate fish stock and habitat management in fisheries management to conserve fisheries resources and their habitat, improve the welfare of the fishers and achieve ecological and economic balance in sustainable fisheries development.

The fisheries refugia project implemented in Indonesia was conducted to develop recommendations in two administration areas, Bangka Belitung Province, and West Kalimantan Province, focused on two

fisheries commodities, Squid and Penaeid shrimp. There were important issues to put as the main concern in this project implementation, fishing on the spawning stock and juvenile/pre recruits and habitat degradation.

Fishing on the spawning stock of squid in Bangka Water and shrimp in West Kalimantan may threaten the stock and trigger to growth overfishing of squid and shrimp stock. The broody squid are caught by the fishers mostly in October-November that is indicate as the spawning season of the squid. On the other hand, the same issue also faced by the shrimp resource in West Kalimantan, particularly in the project site, coastal around Padang Tikar, Teluk Batang, and Delta Pawan. The mature female of shrimp also being caught by the fishing gears during the spawning season, which identified around November to December.

Similar to the spawning stock, juvenile/pre recruit also threaten by the fisheries activities, particularly the small-scale fisheries in the coastal areas. Non-selective fishing gears used in both locations threaten juvenile stock of squid and shrimp, which may cause the growth-overfishing targeted fisheries commodities in their early-life phase or the growth phase Both recruitment and growth-overfishing activity produce a significant impact on the lower recruitment that existed in the fisheries area.

In addition, the critical habitat of squid and shrimp was indicated being degraded as impact of anthropogenic activities in coastal and mainland area. Degradation of critical habitat of squid and shrimp in the coastal area were caused by high sedimentation flux carried from the upper stream. This condition triggers coastal siltation and forces fishermen to fish more distance fishing ground. This condition triggers coastal siltation and forces fishermen to fish more distance fishing ground. Tin Bangka Belitung, the sediment source came from sea tin mining activities. The high sedimentation rate shown from the high Total Suspended Solid (TSS) value, was potentially covering essential habitats such as coral reefs and sea grass that important as squid egg-laying ground.

The issues provided a huge challenge in understanding the overlapping economic activity involved. Squid and shrimp fishing on both and the tin mining activity in the coastal area of Bangka Belitung were economic activities that have been operating for a long time. Creating ecological-economical balance management by considering the ecosystem-based for fisheries management was essential to overcome this challenge and resolve all the existing issues. The Fisheries Refugia concept implementation offers a comprehensive solution to achieve ecological and economic balance.

Fisheries refugia concept in Indonesian fisheries resource management

The Indonesian government, through the Ministry of Marine Affairs and Fisheries, has the vision to secure 10% of the seawater area in Indonesia dedicated as a biodiversity and sustainable fisheries area. Currently, there were 377 marine conservation areas established in Indonesia to use as a role model in habitat management. West Kalimantan and Bangka Belitung, as the fisheries refugia project area, are in the Indonesian Fisheries Management Area (IMFA 711). The Indonesian government has implemented a regulation regarding the number of catches allowed. According to MMAF decree No. 19/2022, the fisheries commodities allowed to catch in this area were 911.534 tons in total from nine important commodities such as big pelagic fishes, small pelagic fishes, demersal fishes, coral reef fishes, lobsters, crabs, penaeid shrimps, and squids. Implemented fisheries management in IMFA 711, through this note, was represented by two locations, Bangka Belitung and Wes Kalimantan.

The existing marine conservation area established by MMAF in Bangka Belitung was Momparang islands (124.320,70 ha) and Belitung waters (391.820,23 ha). Today, the marine tourism area of Tuing (7.372,50 ha) was still in the process of being designated. Tuing waters' designation as a protected area was due to its ecological functionality as the squid egg-laying area. The fishermen's community also found evidence of matured squid in Tuing waters which could be caught in a certain season. The operational lift net in Tuing waters also caught squid juveniles. This evidence supported that the Tuing waters play an important ecological role as spawning, egg-laying, and nursery area.

West Kalimantan Province belonging huge potency for marine resource sustainability along Karimata Strait. In this area, the established marine protection area was covering 2,06 million ha of sea area and 3,2 million ha of estuarine area consisting of several ecosystems, i.e., mangrove, coral reefs, and seagrass. Currently, the conservation efforts in this area focused on turtle protection, especially in Sebubus paloh village by protecting the coastline and 63 Km water area from the coast. The local

government, to protect the turtle, has conducted monitoring and supported the diversification of the local fishermen's livelihood by introducing commercial commodities farming. These efforts were made through coordination between the NGOs and private sectors.

A social system empowered by local wisdom has the potency to support fisheries management. In Bangka Belitung Province, The traditional Melayu tribes in Tuing called Lom Tribe/ Mapur Tribe belong in correlation with the local folklore "Akek Antak". This folklore inspired and entrusted the tribe's culture to protect the seas and the geo-site metamorph of Tuing coast for hundreds of years. This local wisdom provided a positive impact in preserving fisheries' sustainability by implementing the "use-enough" acts on the use of natural resources. Practically, this local wisdom implied the fishermen's activities in these areas through the use of artisanal fishing vessels and fishing gear. The vessels were unequipped with the motor and used squid selective gears (74,85% selectivity). This local wisdom has been developed the fisheries resource sustainability.

RESULTS AND LEARNING

Fisheries refugia for Penaeid Shrimp in Wes Kalimantan

Shrimp production fluctuated between 2010 to 2020 and showed an increasing trend (MMAF, 2021). Shrimp fisheries in West Kalimantan in 2020 contributed 20% to the total shrimp production in IMFA 711. In West Kalimantan, two shrimp species known for their economic importance, *Penaeus merguiensis* and *Penaeus indicus.*

Nursery areas for the penaeid shrimp population existed on estuarine waters and adjacent mangrove stands, 92% of shrimp caught in this area were in the larval and juvenile phases. Investigation regarding water and mangrove ecosystem quality resulted that this area being suitable for the nursery area. Thus, this area was recommended to be a fisheries refugia area for the protection of shrimp larvae and juveniles.

The penaeid shrimp nursery habitat in West Kalimantan was characterized by typical 4-40% mangrove coverage, consisting of 15-39 species of mangrove vegetation. The average salinity of habitat recorded from the studies were range from 27-34.1 ppt, pH were 32 – 8.32, and water turbidity level were range from 0.7 – 28.7 NTU. The shrimp juvenile were found in high abundance in several locations, i.e., Padang Tikar (Kubu Raya District), Teluk Batang (Kayong Utara District), and Delta Pawan (Ketapang District), on 5-10 m water depth and 4 miles to the sea.

The expansion of the mangrove forest area on the Kayong Utara coast has increased from 41,500 Ha in 2015 to 45,087 Ha in 2019. This ecosystem rehabilitation supported this area as nursery habitat for penaeid shrimp. Nevertheless, numerous anthropogenic activities existed was still can be considered a threat to the shrimp juveniles' survival rate. This might cause by non-selective fishing gear, mangrove deforestation, and water transportation.

The spawning area plays important role in the shrimp life cycle for the protection of matured female shrimp. An individual female banana shrimp could produce 125.000 – 972.000 eggs in a single spawning event. In Kubu Raya and Kayong Utara coastal water, between 20-30 m in depth, was expected as the existing spawning ground for penaeid shrimp. The evidence was supported by 60% of banana shrimp and 22% of white shrimp caught in these areas were in riped gonadal condition. The spawning season was identified between November to December. The higher survival rate of the shrimp in the early-life phase would increase the success rate of shrimp recruitment.

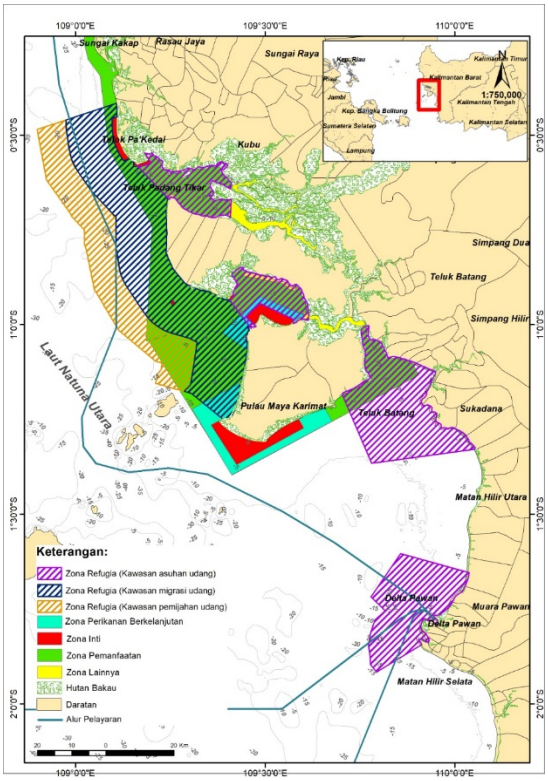

Figure 1. Recommended shrimp fisheries refugia area in West Kalimantan

According to the study result, the delineation of shrimp fisheries refugia candidates in West Kalimantan has overlapped with the established conservation area by MMAF decree No 89/ 2020 (figure 1). The designation of the conservation area has considered the results of several studies which identified the area as an essential habitat for Penaeid shrimp. The proposed refugia area for shrimp fisheries refugia areas in West Kalimantan waters also consider several aspects, namely the biological aspects of shrimp, habitat suitability, socio-economic aspects, and well-established fisheries management.

The fisheries refugia area in West Kalimantan Province was recommended to cover 4,094.32 Km2 (409,432 Ha) by including several coastal areas on site such as Padang Tikar (Kubu Raya District), Dusun Besar, and Teluk Batang (Kayong Utara District), as well as Delta Pawan (Ketapang District). Therefore, several recommendations were proposed for shrimp fisheries refugia management:

- Propose 4.094,32 km2 (409,432 Ha) as penaeid shrimp fisheries refugia area around Kubu Raya District, Kayong Utara District, and Ketapang District (Gambar 5).
- Propose shrimp fishing control through,

    1. Reduction of 20% of existing operational shrimp fishing gears (bottom trawl and trammel net)
    2. Rearrangement passive shrimp fishing gears
    3. Implementation of the closed fishing season in November and December.

- Propose shrimp habitat management through rehabilitation of mangrove forests, increment of public awareness regarding eco-friendly fishing gears, protection of shrimp habitat, and rearrangement of the water transportation route in fisheries refugia area.
- Propose the improvements of social, economic, and management aspects through,

1. Improvements in system and quality for penaeid shrimps' fisheries data collection
2. Intensification of socialization and supervision post-to-regulation implementation
3. The active role of community business group improvements
4. Establishment of community monitoring groups
5. Strengthening local wisdom that essential to preserve

6. Arrangement of the vessels fuel distribution process to be organized and scheduled

- Regulating marine spatial utilization permits include:

  1. Re-arrangement of permits for fishermen with passive fishing gears (including the local community), based on Government Regulation No 21/2021 regarding the Implementation of marine spatial planning.
  2. Propose marine spatial planning activities approval in accordance with the Minister of Marine Affairs and Fisheries Decree Number 28/2021

- Propose monitoring activity for assigned fisheries refugia areas which may be conducted every 3 (three) years accompanied by an evaluation every 6 (six) years since the settlement of the regulation.

Fisheries refugia for Squid in Bangka Belitung

The critical phase in the squid life cycle was the matured adult which was ready to spawn and the early life phase of the squid. In these phases, squid will develop an association with a certain habitat to succeed in the recruitment or reproduction processes. These habitats were essential as spawning, egg-laying, and nursery habitat. Disruption in the critical phase habitat may disrupt resource sustainability.

Based on scientific consideration, an area of 1,529.097,93 ha, consisting of 1,212,572.60 ha of spawning area and 316,525.33 of egg-laying area, was recommended as potential Fisheries Refugia areas for squid. The proposed spawning area consisted of four sub-area, i.e., Tuing water, Dua island, Karang Sembilan, and Karang Timah. The proposed egg-laying area covered coastal water on the northern side of Bangka Island, coastal water of Bangka, coastal water of Pangkal Pinang, and coastal water of Bangka Tengah, Kelapa Island, Dua Timur Island, Dua Barat Island, northern water of Dua Island, Karang Jagur, Karang Mejan, Karang Sembilan, and Semujur Island water and Gusung Asem (Figure 2). Furthermore, from those potential squid fisheries refugia areas, a single cluster of priority areas was proposed as squid refugia covering 157.668,35 ha consisting of 148.087,08 ha of spawning area and 9.581,27 ha of nursery area (Figure 6).

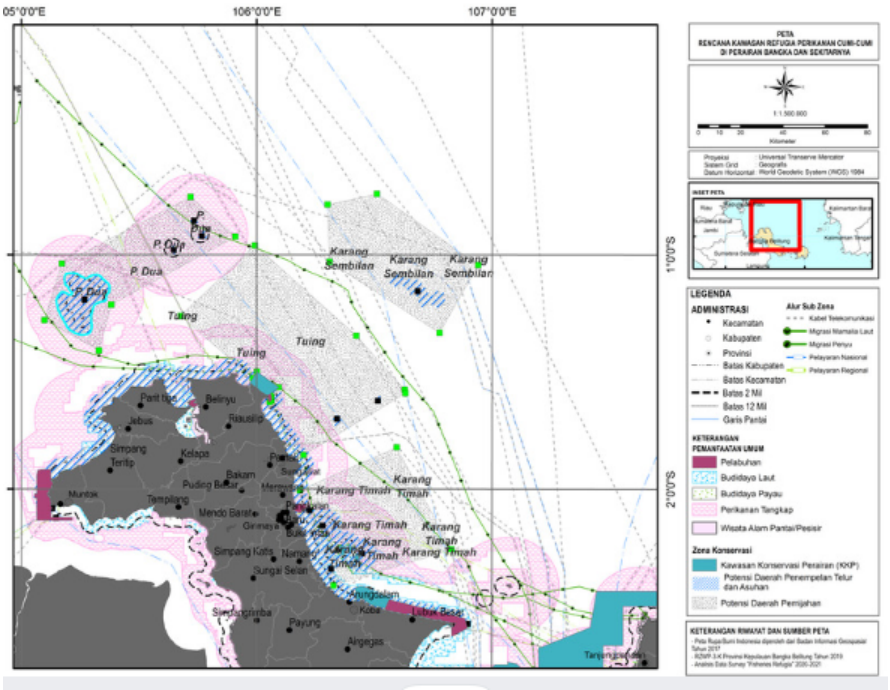

Figure 2. Potential area recommended for squid fisheries refugia in Bangka Belitung Province.

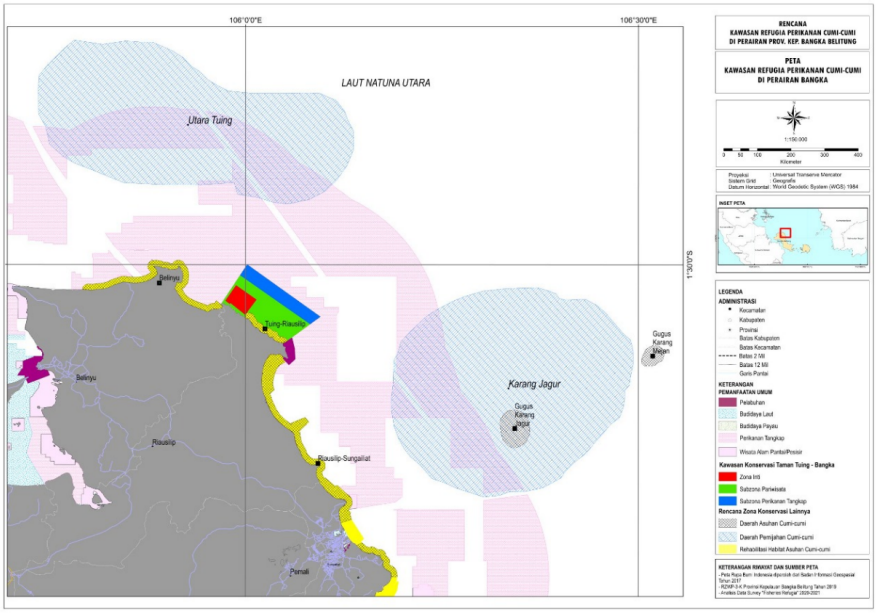

Figure 3. Priority area recommended for squid fisheries refugia in Bangka Belitung Province.

Therefore, several recommendations were proposed for squid fisheries refugia management:

- Proposing potential squid refugia area for 1,529,097.93 ha covering Tuing waters, Dua Island, Karang Sembilan, Karang Timah, 4 miles of coastline on the western and northern side of Bangka Barat, bangka coast, pangkal pinang coas, Bangka Tengah Coast, Kelapa Island, Karang Jagur, Karang Mejan, and Semujur Island, and Gusung Asem waters (Figure 5).
- Implement fisheries refugia to increase the squid management effectivity through:

    1. Broody squid fishing management through an open-closed fishing mechanism from April to June and October to November to be implemented in the designated spawning area.
    2. Regulate squid juvenile fishing by limiting operational lift net and squid juvenile fishing areas as well as prohibit the lift net operation in the designated nursery area.

- Conduct coastal habitat rehabilitation through physical (hard structure) and biological (mangrove planting) engineering to trap the sediment.
- Provide alternative fishery-based livelihood for fishermen during the closed fishing season implementation.
- Encourage the establishment of policy regulations on the use of squid resources at the local level based on independent local wisdom.

REPLICATION

Fisheries management based on a critical phase of the life cycle (Fisheries refugia) was a breakthrough in marine resource management potentially to be implemented and produce a balance between economic and ecological interests. The economic stability of the related community, in Fisheries refugia, becomes the core consideration to ensure the ecology functionality and resource sustainability. Management approaches based on the fisheries refugia concept implementable in Indonesia was an open-close system on the spawning season, regulating allowed fishing gears, fishing gear and fishing ground management, and preservation of critical habitat.

SIGNIFICANCE

The fisheries refugia activities in Indonesian fisheries management contributed to understanding the importance of habitat-fish interaction during the critical phase. The information regarding critical habitat (spawning ground and nursery ground) became essential information in constructing a management plan in Indonesia. Nevertheless, the implementation was haven't been holistically described.

The fisheries refugia project served as one of the management pilot projects aimed to manage the resource and its habitat comprehensively to ensure resource sustainability, managed spatial area, and the active involvement of relevant stakeholders. Through this project, several recommendations and a guideline were proposed to the authorized institutions to achieve the expected outcomes and could be used as a reference in strengthening fisheries management on IFMA 711 and the local governments.

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KEYWORDS

What 2-5 keywords could be used to help others search and find this experience note? Please provide at least one of each of the following:

- Fisheries Refugia
- Indonesia
- Shrimp
- squid