



Chapter 19

Fish Aggregating Devices and Resource Conservation

G. Rajeswari

Visakhapatnam Research Centre of Central Institute of Fisheries Technology
Andhra University P.O., Visakhapatnam - 530 003
Email: rajeswari_govathoti_icar@yahoo.com

1.0 Introduction

The fish aggregating devices (FADs) are man-made structures which facilitate attraction and aggregation of fish. FADs are deployed to enhance biological productivity in coastal waters, rehabilitate and conserve the depleting stocks, increase catch rate with a reduction in the cost of production, reduce the scouting time during harvesting operations and to enhance fishery resources and income and the standard of living of the fishermen. The marine fishery resources in the coastal areas have declined considerably over the past few decades. Deployment of bottom set FADs or Artificial Reefs (ARs) is one of the approaches towards enhancement and management of coastal fishery resources. Code of Conduct for Responsible Fisheries has stressed the importance of rehabilitation of coastal resources. Fishes are known to gather near coral reef areas. These serve as natural breeding grounds of fishes and provide habitat for a variety of marine fauna and flora. Destructive fishing practices and pollution are two main factors leading to destruction of coral reefs and other fish habitats. Artificial reefs attract and aggregate marine animals, like coral reefs.

Installation of FADs for fish aggregation have a long tradition in many part of the world. During the past decades, several countries have attempted setting FADs with varying success. Artificial reef when properly designed, located and constructed with an adequate quantity of stable and durable substrate can be as productive as naturally occurring hard-bottom habitats, limited only by the life-span of the materials utilized. These structures could remain productive for several years. ARs increase biomass locally and also prevents trawling. These structures provide shelter to fish and also serve as spawning, nursery and

feeding ground to live in.

2.0 Site selection

Site selection is an important factor for FAD installation. A firm seabed with sandy bottom is preferable for deployment of FADs. The area should be free from strong currents and should have adequate water clarity. The selected area should be away from navigational routes and easily accessible to fishermen.

2.1 Selection of material for FAD

FADs consists of a floating part, anchoring part and mooring part. The material selected for FAD construction should be durable and long lasting. It should be "cheap and easily available and should not have toxic content. Ease of handling and transportation are other requirements.

3.0 FADs in world fisheries

In various countries varieties of artificial reefs are installed to enhance the fish production. In Philippines, the floating and anchored bamboo rafts called payaw are used mainly for attracting tunas and small pelagic fishes (Fig. 1). A payaw consists of one or two layers of bamboo of 10-15 m long and 2-4 m wide. A 25-35 m long hanging line with coconut leaves and cycle tiers tied to it at 2 m intervals as attractant is used mainly for attracting tunas and small pelagic fishes. Empty oil drums filled with rocks are used to anchor the payaw. The number of weights needed to anchor a payaw depends on the depth of the water. The bamboo rafts last for 6 months depending on the weather conditions. Large concentration of tunas aggregate underneath the payaw, after about 3 weeks. The aggregated fish are harvested every 5-6 days. Purse seines, ring nets, hook and lines are used to exploit the FAD fishery. Yellowfin tuna, skipjack, other tunas and small pelagic species are generally caught. About 90% of the tuna production in Philippine are payaw based and non-tuna species consists of 5-40% (Aprieto, 1980). Improved deep sea floating FADs consisting of steel buoy and galvanized drums are anchored between 900-2700 m depth. Small scale fishermen fish in the proximity of FADs by using hand lines and the species harvested include yellowfin, bigeye tuna, skipjack and dolphin fish. Commercial fishing companies operate purse seines to exploit FAD fishery which are generally set early in the morning. The juveniles enter the fishery at 16 cm length. About 90% of the skipjack landed by surrounding seines operated around FADs is between 24-38 cm.

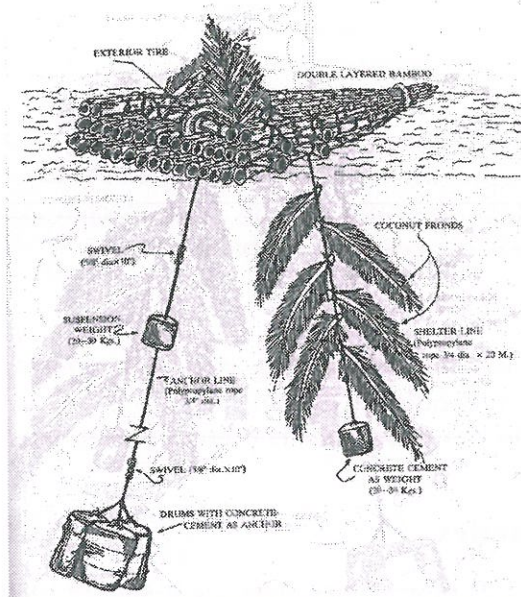


Fig. 1. Floating FADs of Philippines

In French Polynesia several anchored buoys made of wood, polyester and iron were deployed mainly for skipjack fishery (Fig. 2). The main species caught near FAD include yellowfin and albacore tuna at 100 m depth and skipjack, yellowfin and dolphin fish during the surface fishing. It was reported that the CPUE has been 50 fish per day around FADs while it was 41 fish per day in non-FAD areas.

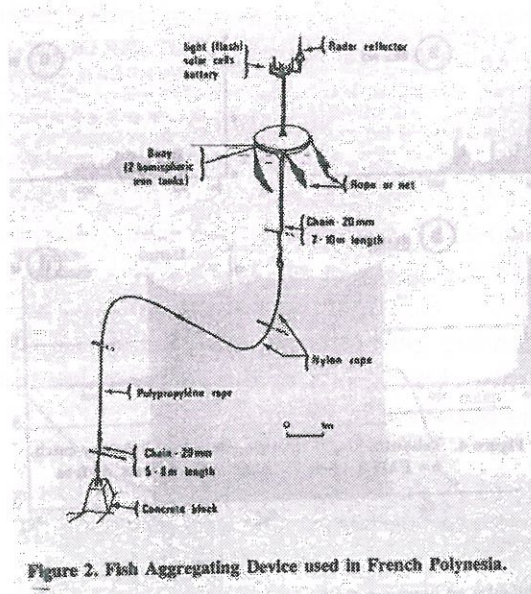


Figure 2. Fish Aggregating Device used in French Polynesia.

In Indonesia, about 170 FADs known as rumpon are employed for catching skipjack and other tuna. These anchored FADs are placed at a depth of 20-25 m and consists of floating part made with bamboo. Coconut leaves and thatch-grass are used as attractants. Tricycles and buses tied into units are employed as artificial reefs (Fig.5.). Skipjack, yellowfin tuna and Auxis thazard were attracted around rumpon FADs.

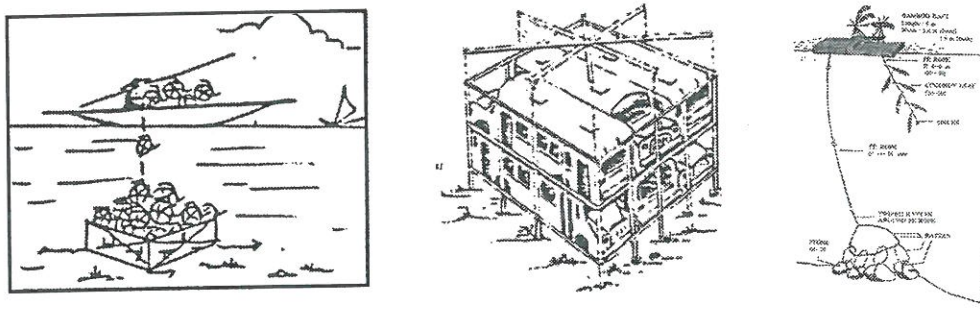


Fig. 5. FADs of Indonesia

In Japan, the biggest traditional floating reef fishery is called shira tsuke. It is a bamboo raft and a surrounding net without purse line. These bamboo rafts are assembled in lines set perpendicular to the coast over a length of several kilometers (Fig. 6.). One line may have 30-60 rafts, spaced between 1000 to 1500 m. This method is used from June to September while the operations of trawlers are suspended. The aggregated fishes are exploited by baited troll lines and surrounding seines. The dolphin fish and amberjack are generally attracted to the raft.

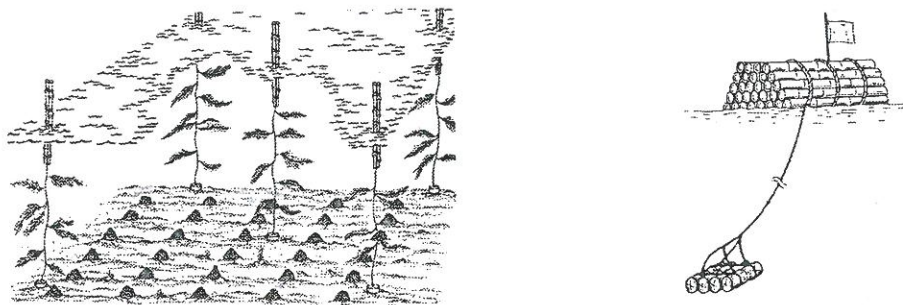


Fig. 6. FADs used in Japan

In Malaysia, a total of 65 ARs had been built and deployed using over 5,90,000 scrap tyres. The size of ARs ranges from minimum of 300 tyres to a maximum of over 50,000 tyres per reef. A pyramidal structure was constructed by arranging 20 concrete units on a wooden platform and secured by steel cables (Fig. 7.). A total of 20 pyramids were placed on the seabed with the use of a crane. More than 70 derelict boats were also installed in coastal waters ranging from 200-500 m from the shoreline. The reef sites harbour a high density of marine life with the development of a complex marine eco-

system similar to coral reefs. Encrustations on the surface of the artificial substrate have been prolific with marine organisms such as algae, sponges, tunicates, anemones, soft corals, hard corals, sea fans, feather stars and bivalve molluscs. The major fishes aggregating around ARs are snappers, groupers, sweet lips, parrot fishes, rabbit fishes, damselfishes, squids and cuttlefishes.

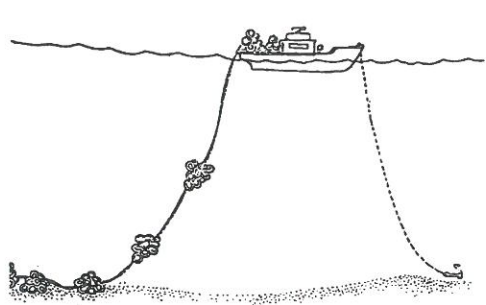
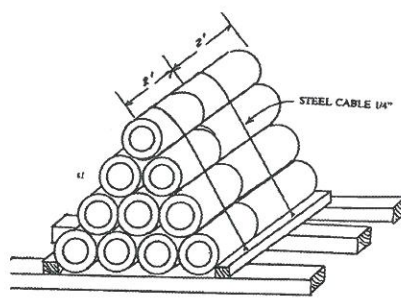


Figure 6: Emplacement of tyre of pyramids at reef site



20 PIECES CYLINDRICAL CEMENT PIPES/PYRAMID

Fig. 7. FADs used in Malaysia

Reef balls are designed reef modules made of concrete which are hollow, and typically have several convex-concave holes of varying sizes to approximate natural coral reef conditions (Fig. 8). Reef balls for open ocean deployment may vary in diameter from 0.3 m to 2.5 m and in weight from 15 kg to 3500 kg (Anon, 2009). They are cast around a polyform bladder which is left in the unit to provide flotation while towing to the site of deployment. Once at the site, the bladder is deflated and removed. Reef balls are now being used world wide to build environmentally friendly artificial reefs. The concrete used to make reef balls has a pH similar to natural seawater. Reef balls of size 1.8 x 2 m were designed and made with use of special admixtures and micro silica. Fishes, barnacles, sea urchins, nudibranches, lobsters also can be found around reef balls. The structural complexity in reef ball FADs enhances fish recruitment, aggregation and diversity.

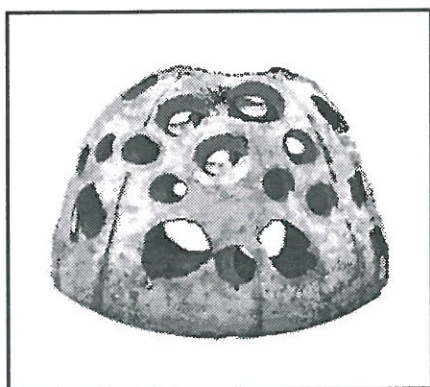


Fig. 8. A reef ball module

3.1 FADs in Indian fisheries

In India, several groups of fishermen particularly from villages of Kerala state, have erected reefs in the coastal waters to rejuvenate the depleting fish stocks. Reefs erected in this manner were termed Peoples Artificial Reefs (PARs). Large rocks, packed in monofilament net bags, cement well-rings, granite stones, and old tyres were installed in coastal waters at 25-50 m depth. Hook and lines are the main gear to fish over the PARs. The reef becomes productive after three months.

In Andhra Pradesh, Visakhapatnam Research Centre of CIFT initiated a programme to install Fish Aggregating Devices in the coastal waters. Discarded scrap tyres have been found suitable for FAD construction. Pyramidal structures made of scrap tyres weighed with concrete rings were installed at 15-20 m depth covering about 10 m area at Jodugullapalem village near Visakhapatnam (Fig. 9.). Hooks and lines and gillnets were employed to exploit FAD fishery. The major species of fishes caught in the area near FAD site comprised of mackerel, seerfishes, carangids, sciaenids, *Upeneus* spp., engraulids and tunas. The quantum of fish increased by 20% more than the pre-FAD period. Large scale installation of FADs covering about 3-4 km area is expected to enhance the socio-economic condition of fishermen of surrounding villages. The deployment of benthic FADs protect the fishing ground from mechanized trawling, keeping the area accessible to artisanal fishermen operating gill nets and lines.



Fig. 9. Benthic FAD module, being deployed off Jodugullapalem, Visakhapatnam

Andhra Pradesh State Fisheries Department had installed FADs at Kakinada, Visakhapatnam, Vijayanagaram and Nellore. Hut type structures made of PVC pipes with attached attractants, anchored at 20 m depth had shown good fish aggregation (Fig. 10.).

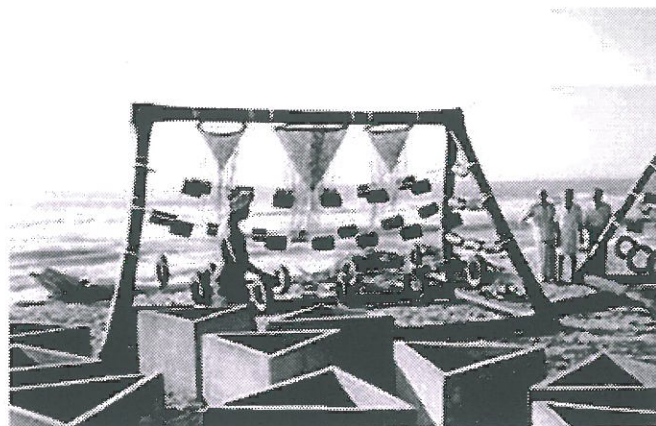


Fig. 10. Hut type AR modules deployed off Andhra Pradesh

Two types of bottom set FADs, one of pyramidal shape and another of semi-prismatic shape constructed using tyres were tested for their aggregating efficiency in an artificial freshwater reservoir stocked with freshwater carps such as catla (*Catla catla*), rohu (*Labeo rohita*), mrigal (*Cirrhinus mrigala*) and silver carp (*Hypophthalmichthys molitrix*) (Madhavan and Neethiselvan, 2002). The FADs were placed 60 m apart from each other and 500 m away from the shore. Ten cement blocks of 50 kg each were used as anchors to hold the Fish Aggregating Device. The gill net catch around FADs and in non-FAD sites showed significant difference. Pyramidal FAD of 1.6 m height with tyres arranged in vertical orientation attracted more of surface feeders such as catla and silver carp compared to semi-prismatic FAD of 1.3 m height with tyres arranged in horizontal pattern. The gill net catch around pyramidal FAD was significantly higher than that of semi-prismatic FAD.

4.0 Regulation of FAD deployment

Benthic FADs should be constructed and installed in such a way as to enhance fishery resources, minimize conflicts among competing users, minimize environmental risks and without causing obstruction to navigation. A system of licensing which give the approved location, design and specifications of the FADs, could be introduced, to manage the deployment of FADs in coastal waters. An ecological impact analysis is advisable before deployment of ARs in large scale and ownership issues have to be resolved, on a participatory basis.

5.0 Conclusion

FADs are important in the present context, where over-exploitation and low income of the traditional fishermen are evident. The benefits accrued through the operation of FAD encompass, several aspects of fisheries, viz., biological, environmental, economic and social. Though economic benefits of FADs have been well recognized, the diffu-

sion of technology to the fishermen has been inadequate. Low-cost FADs could be popularized by government agencies, NGOs and fishermen's cooperatives as an effective tool to enhance the productivity of inshore waters and, thus, increase the standard of living of the traditional fishermen. As most inshore fishery resources are heavily exploited, FADs, if appropriately and judiciously used could help in prevention of shallow water trawling and enhance the fishery resources. As fishermen need only spend less time for scouting fish, there is substantial improvement in fuel economy.

6.0 Further reading

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