Nearshore fish aggregating devices (FADs):
A technology to boost fisheries production and combat malnutrition in Timor-Leste

WorldFish

Benefits of artisanal nearshore FADs in Timor-Leste

- **Food production and nutrition security**: FADs provide an opportunity to increase the sustainable production of nutrient-rich food in Timor-Leste to combat chronic malnutrition.
- **Coastal resource management**: FADS transfer fishing effort from the reef to the pelagic zone.
- **Climate change adaptation**: FADS act as a food security buffer against socioeconomic and climate shocks, and they increase the resilience of coral reef ecosystems.
- **Improved well-being**: Safety at sea is improved through defined fishing zones around FADs, and income is increased from more consistent catches.

Approach and context

Investment in production and management of fisheries in Timor-Leste can boost coastal livelihoods, nutrition and food security. Fisheries currently contribute little to the Timor-Leste national economy but are a low-hanging fruit for growth of food production. Fish and other aquatic foods are healthy, nutritious sources of protein and micronutrients to combat chronic and widespread malnutrition and poor diets in Timor-Leste. However, since independence, there has been very little investment in fisheries or in technologies that can improve fishstocks and support sustainable fisheries practices.

The Timor-Leste fishing fleet is exclusively small-scale, with fishing taking place in nearshore reef habitats with simple gear. Fishing is undertaken by women and men on foot (gleaning) and in unpowered canoes or small motorboats, targeting reef and nearshore pelagic fish primarily with gill nets, hand lines, spear guns and long lines. Open-ocean fishing in small or unpowered boats carries more risk and requires more expensive and sophisticated gear, so fishers tend to remain in nearshore reef or shelf habitats. But coral reefs in Timor-Leste are thin and fringing, clinging to steep island slopes, so they are vulnerable to the compounding impacts of climate change on coral reef structural integrity and the biodiversity and biomass they support.

Nearshore fish aggregating devices (FADs) were proposed and tested having shown potential to enable fishers to access an abundant and sustainable source of nutritious fish using their existing boats and fishing methods. FADs attract pelagic and semi-pelagic fish, representing a newly accessible stock of highly mobile, rapidly reproducing fish. With a relatively small investment, a national program of nearshore FADs could improve fisheries performance and productivity, and positively impact the well-being of the Timorese people.

What are FADs?

A FAD (known as *rumpon* in Tetum) is a floating object in the ocean that attracts fish. These occur naturally (e.g. floating logs), but can also be constructed from local or imported materials. FADs are most commonly used to attract high-value tuna and billfish, but are also used in coastal areas to attract small pelagic fish such as scads and mackerels. Pelagic fish gather around FADs in schools (either for refuge or to hunt smaller fish), which makes it easier for fishers to find and catch them. In nearshore, small-scale fisheries, FADs are used to bring oceanic fish nearer to shore within reach of fishers in small motor boats or paddle canoes.

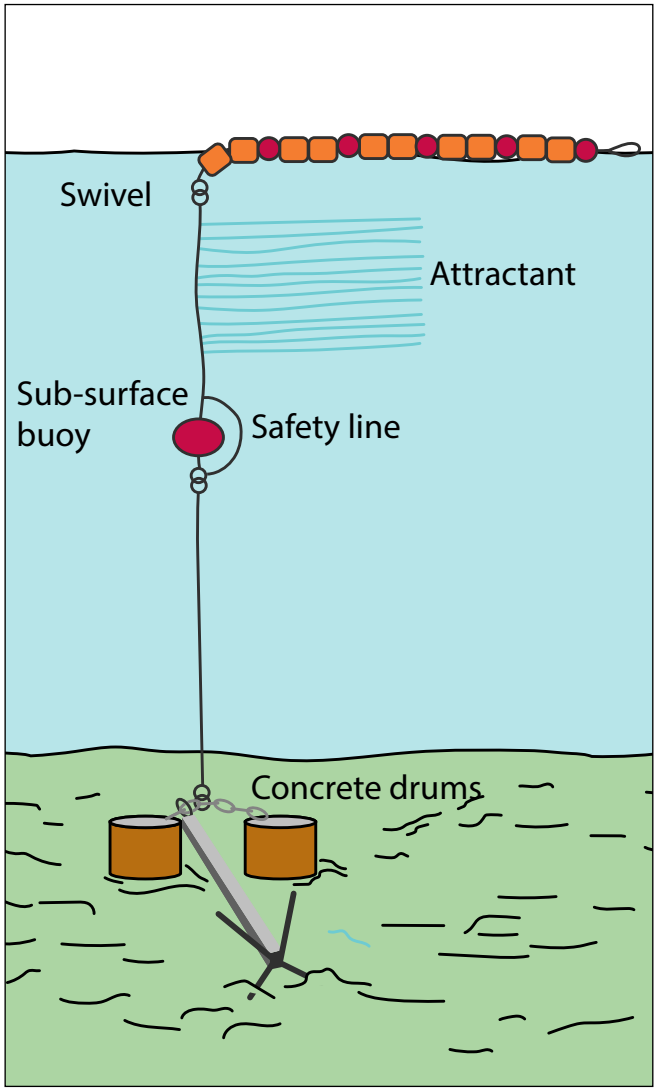
How much do FADs cost and how long do they last?

The cost of equipment and building and deploying a FAD of this type was estimated to be USD 1250 for the sake of calculating return on investment (ROI). However, the cost of FADs depends on the materials used and the level of sophistication needed. FADs can be lost without warning and usually with no known cause. FADs can be built very cheaply from locally available materials, but this may shorten the FAD lifespan if the ropes break easily. The cost effectiveness will be determined by the ROI and the likely duration of the FAD according to social and environmental conditions. For example, if the FAD will be actively managed and maintained by a small group to reduce biofouling, and if social conflicts are unlikely, then the lifespan of the FAD may be considerably increased. Or, if the FAD is to be deployed in deep water subject to strong currents and swell, then investment into good quality ropes and buoys will likely extend the FAD lifespan.

The results of our trials showed that the average lifespan of a FAD in Timor-Leste waters is 11 months, but when monitored and maintained, this can be in excess of 2 years. FADs deployed on the south coast last longer due to gentler coastal gradients.

Key results

- FADs improved catch rates and income of fishers at three out of four sites.
- FADs lasted an average of 11 months.
- Revenue from FADs provided an ROI as fast as 3 weeks in some locations.
- FAD catch rates and the rate of ROI were highest where fishers organized into groups, were increasingly specialized and shared catch.



How do FADs work in Timor-Leste?

Research on FADs has been underway in Timor-Leste since 2013. Recently, eight FADs were deployed at four sites (Vemasse, Baucau; Adarai, Viqueque; Beacou, Bobonaro; Adara, Atauro Island).[1] Catch data from the PeskAAS national catch monitoring system[2] was used to compare catch rates before and after FAD deployments, and between FAD fishing and other types of fishing.

Analysis showed that FAD fishers caught more and faster. There were significant improvements in catch rates, catch assemblage and the rate of ROI (Table 1). FADs increased fish catch and paid for themselves in about 5 months or less at three out of four sites (Beacou showed no detectable difference in catch rate).

Despite the relatively short lifespan of FADs deployed in Timor-Leste to date, the fast rate of return seen at most sites indicates that FADs are effective in providing livelihood benefits in certain locations. Across all sites and fishing types, 63 species were identified, but FAD catches significantly reduced overall

Site	FAD catch rate improvement	Days to return on investment	% of total trips to FAD
Adara, Dili	155%	155	82%
Adarai, Viqueque	29%	82	27%
Biacou, Bobonaro	1%	3355	21%
Vemasse, Baucau	465%	18	52%

Table 1. Site-specific impacts of FAD deployments in Timor-Leste.

assemblage diversity, with three species representing 96% of the catch—*Sardinella* spp. (Sardina), *Decapterus macarellus* (kombong) and *Rastrelliger brachysoma* (bainar mutin).

Catching fish faster and more reliably at a FAD means greater food security and less wastage of fuel and energy by spending less time hunting for fish. Also, more consistent catches allow fishers to access new market opportunities by regulating supply. Finally, allowing fishers to remain closer to shore and reporting catch when they return contributes to improved safety at sea.

National investment in a FAD program could realistically increase overall fish production in the country, thereby improving the availability of micronutrient-rich fish to combat malnutrition. A deployment program should be coupled with capacity building around fisher group formation and defining access rights to ensure equitable community benefits. Further research is needed to understand how FADs may work and contribute to fisheries co-management models such as *tara bandu* by providing alternative fishing grounds to locally managed marine areas closed to fishing.[3]

Conclusions and recommendations

Combine FAD deployment with group formation: FADs can cause increased social tension in communities if they are perceived as owned by individuals or groups that exclude other fishers. However, catch rates were highest in Vemasse where fishers were specialized, invested in FAD fishing, and formed catch sharing groups with access rights to specific FADs. Clearly defined boundaries are important in managing common resources,[4] and this private governance scenario is one that tends to bring better returns even if these are not necessarily legally recognized boundaries.[5] (See Pittman et al. (2020) for more on governance challenges to FADs.[6])

Privately owned and managed FADs are likely to last far longer because they will be checked regularly and maintained.[7] If no one owns the FAD, many will fish on it but few or none will maintain it. If a government program provides the FAD, fishers may assume it will be replaced if lost, further reducing their incentive to maintain it. Training in group formation (*hari grupu*) should be incorporated into a national FAD program so that training and assistance in registering a group are available to all fishers, but FADs will only be distributed to established groups.

Develop FAD credit and insurance schemes: FAD groups should be required to submit catch data to enumerators where appropriate, and should be responsible for repaying the initial costs of the FAD according to a mutually agreed upon schedule. If a FAD is lost and evidence of a maintenance schedule is documented over time, then a form of insurance for FAD groups could be incorporated to cover the costs of replacing the FAD in these instances.

Considerations of FAD cost, design and deployment: In experimental trials, nearshore FAD construction materials were more expensive than would be used in a larger scale deployment program. Assuming that low and high cost FADs have the same ability to aggregate fish, the ROI would be achieved even faster by reducing the initial investment cost. However, quality should not be automatically compromised to reduce costs, because well-made FADs may last much longer and support livelihoods over a longer period of time while also reducing marine debris.[7] However, if FADs are deployed by individual fishing groups in coastal communities (as opposed to a government program), they may lack the resources to purchase higher quality ropes and buoys. In Vemasse and Adarai, fishing on the FADs was only conducted seasonally when conditions were favorable, indicating a year-round FAD may be subject to wear and tear. It could also accumulate biofouling over a significant amount of time while it is not being fished, or may even not be accessed at all, as is the case in Adarai. In this instance, FADs with a detachable top section that could be removed from the subsurface buoy and replaced as needed might be the most appropriate.

Policy support for safety at sea: FADs enable fishers to access fishstocks that are often farther from the coast than traditional fishing areas, presenting different environmental and navigational conditions than they are used to, so safety at sea becomes an important consideration for fishers. Fishers often do not have safety equipment on board, because it is expensive and considered unnecessary.[8] Given that there is currently no specific regulation on safety at sea for small-scale fishers in Timor-Leste, developing a legal framework alongside a FAD program will be important.

FAD placement and traditional knowledge
The amount of fish that gather around the FAD will depend on the ecology of the area. FADs can only be deployed in areas of sufficient depth but with limited slope and current so that the anchor can bind to the seafloor and currents do not wash the FAD into deep water or snap the mooring line. A combination of technology and traditional fisher knowledge is required to choose a suitable location. Local experienced fishers should be consulted for broad areas of interest, then the sea floor must be surveyed for a sufficiently flat area using a high powered depth sounder and transducer. Detailed information on the design and deployment of Indo-Pacific FADs can be found in Sokimi et al. (2020).[9]

Notes

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Contact and further resources

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Overview report on fisheries in Timor-Leste:
https://digitalarchive.worldfishcenter.org/handle/20.500.12348/3737

Citation

This publication should be cited as: Tilley A. 2020. Nearshore fish aggregating devices (FADs): A technology to boost fisheries production and combat malnutrition in Timor-Leste. Penang, Malaysia: WorldFish. Policy Brief: 2020-44.

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