FAD Trials in East Africa

FMSP R8331

Annex 8.

Sample FAD publication materials

- MPA Toolkit

- Fisheries Observer Handbook

- Published narrative for FAD video
Written by Hands ON Production (available on Internet)

- 3:44 min video report on FAD Programme
produced for BBC World Earth Reports (available on request)

FAD 'theme sheet' in *Toolkit for Marine Protected Areas*

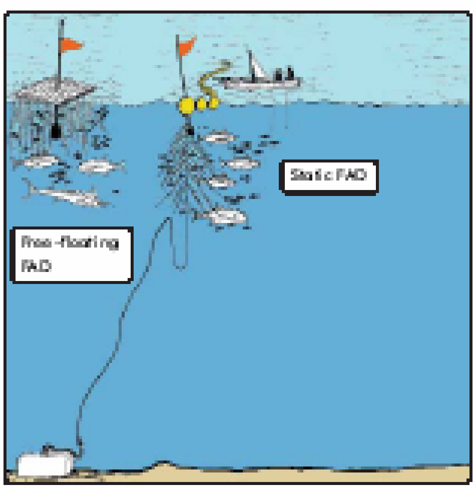
Fish Aggregating Devices (FADs) I4

MPA managers may want to help fishers who use either the MPA itself or the surrounding waters to find alternative fishing technologies that will reduce the impact of existing gears and take pressure of resources within the MPA itself. FAD technology is one method that is proving to be appropriate and is being tested in the WIO.

Tunas and other pelagic species are often attracted to floating objects such as coconuts, logs, seaweed, and plastic bottles. These are often found at current boundaries and up-wellings, which are areas of the ocean that are usually very productive and therefore good places for tuna to search for food. Local fishers generally know about such areas, but current boundaries, and the fish that feed around them, are never stationary. Fishers may have to search a large area to locate them, in order to take advantage of the good fishing.

Fish aggregating devices (FADs) are floating objects that are specifically designed and located to attract tunas, and therefore allow fishers to find them more easily. No one understands exactly why tunas are attracted to FADs, but the ropes, floats and the other materials used presumably mimic the build-up of driftwood and seaweed found naturally in the sea. A FAD comprises a large anchor (up to 1 mt), a heavy-duty mooring chain (usually about 30m in length) and mooring rope, with about 50 purse-seine floats strung at the surface. The ropes and chain are joined using various shackles, rope connectors, splices and thimbles. A flag-pole is attached to facilitate finding the FAD.

FADs may be placed in shallow (30-100m) or deep (300-1,500m) waters. Deep-water FADs attract or aggregate Skipjack (*Katsuwonus pelamis*), Yellowfin (*Thunnus albacares*), and Bigeye tunas (*T. obesus*) and also sharks, Dolphin-fish, Rainbow-runner and other smaller fish. FADs anchored a few kilometres off the coast, and in depths of over 500m are generally more successful in attracting schools of tunas than shallow-water FADs. FADs aggregate the smaller tunas (Skipjack and immature Yellowfin, for example) at the surface and larger tunas (such as mature Yellowfin and Bigeye) at depths of 300-400m.



Types of FAD used in deep water in the Indian Ocean.

A key point to recognise is that FADs do not increase the biomass of fish (i.e. they do not increase size of a fish population). All they do is aggregate them in one place, making them easier to catch. Schools of tuna never actually 'live' under a FAD, but they associate with it for a few days or weeks, often ranging some kilometers away searching for food, before moving on. Fishing captains have reported finding individual schools of tuna that exceeded 1,500 mt in total weight and may hold more than a million individual fish.

The types of gears used around FADs will depend on local fishing vessels, but the following are typical:

- **Drop lining** - using a single hook and bait wrapped in cloth with slip knot and targeting deep-swimming tunas.
- **Vertical long-lining** - Similar to drop-lining but with a number of hooks hung off branch-lines (or snoods) and with single baits on each hook. Good baits include squid and oily fish. Baits do not have to be fresh.
- **Trolling** - A common and cheap gear used by many fishers world-wide. There are an enormous range of lures that be can tried.

There are several successful FAD programmes in the WIO, including in Seychelles, Comores, and Mauritius where a programme has been underway since 1985. There are currently 21 FADs around Mauritius in depths of 400-3,000m and at distances of 1.5-12 n.mi from the coast. The average CPUE is 4-5 times higher than the CPUE in the traditional reef-based fishery. Inshore, shallow-water FADs have also been trialed in Tanzania (e.g. Tanga, Latham Island) and in Kenya, although with variable success. The technology of FAD-design continues to improve and in some areas around the world (e.g. Hawaii, Western Pacific) FADs can last for 2-3 years. Most research into FAD design and the behaviour of tuna around FADs has been done by the Institute de Recherche pour le Développement in La Réunion, and in the South-west Pacific Ocean.

Before investing in FADs, their potential success must be evaluated. Key points to consider are:

- FADs ideally need to be sited in water at least 500m deep and a minimum of 3-5km from the coast;
- Tuna should be known to be present in the general area, even if only on a seasonal basis;

Managing Marine Protected Areas: A TOOLKIT for the Western Indian Ocean — Sheet I8.

- Fishers must have appropriate vessels, and ideally some experience of fishing off-shore.
- There need to be marketing opportunities for FAD-caught fish.

If the introduction of FAD technology seems feasible, the following steps will have to be taken:

Site Survey - This must be done in collaboration with local fishers to make sure that they are able to get to the FAD safely. Important to check local charts and find out about currents and seasonal winds in the area. High-powered SONAR equipment (providing a signal of at least 2Kw) is required to measure the depth accurately and to find an area that is relatively flat. SONAR equipment can be bought but there is at least one suitable SONAR device available for hire in the WIO (see www.amanulasail.com). The South Pacific Commission FAD Manual describes how to conduct a site survey (see Sources).

FAD Construction - There are two main designs: the Spar Buoy and the Indian Ocean FAD. The latter is probably the most popular and long-lived, but a detailed comparison of the two types is provided in the SPC FAD Manual. The SONAR survey data allow the correct lengths of ropes (nylon and polypropylene) to be calculated (see SPC Manual). A FAD anchored in 1,000m of water would require 1,250m of rope. Prices vary depending on materials but are typically around US$3,500 per unit excluding import duties. Because the FAD will be deployed in a high-energy environment and subject to stress from currents and waves, the construction procedure needs to be followed very carefully and expert advice should be sought.

FAD Deployment - Although simple in design, FADs are very bulky and deployment in deep-water is potentially dangerous. Expert advice is required, as well as a good-sized vessel. The rope and surface component are usually placed in the ocean first and the anchor last, after all ropes are safely off the boat. The SPC Manual provides details.

KEY POINTS FOR THE MPA

- ❑ **Since there are a number of options for assisting fishers who are affected by the presence of an MPA, a careful evaluation is required before deciding to spend resources on a FADs programme.**
- ❑ **An MPA itself is unlikely to have the resources/capacity/finance to install FADs directly; a better approach is likely to be to work with the Fisheries Department and other organisations.**
- ❑ **If it is decided that FADs represent a good solution to some of the problems facing the MPA, seek expert advice at an early stage.**

Sources of further information

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Institut de Recherche pour le Développement (IRD), La Réunion. **http://www.ird.fr**

Secretariat of the Pacific Community (previously South Pacific Commission) (SPC) - Oceanic Fisheries Programme **ofp@spc.int**

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CASE STUDY

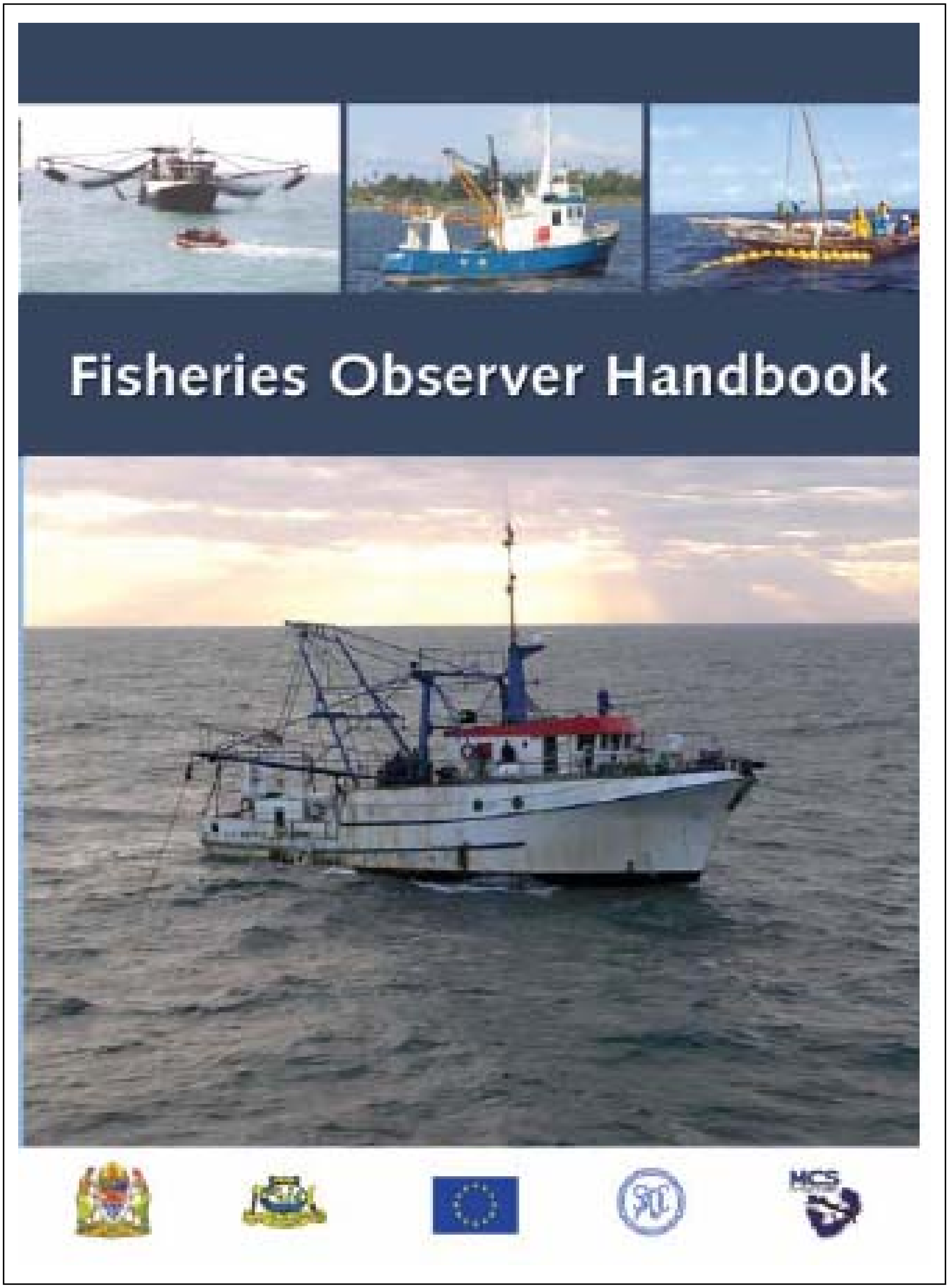
Using FADS to help MPA management in Tanzania

Following an evaluation of the potential of FADs in East Africa, a cooperative programme was initiated in Tanzania in 2003 between the UK Government's Department for International Development (DfID) and two independent conservation initiatives: Mafia Island Marine Park (MIMP) and Conservation Corporation Africa (CCA), which jointly manages a protected area off the north-east coast of Unguja Island, Zanzibar with the Zanzibar Department of Fisheries and Marine Resources (DFMR). The programme is being designed to diversify fishing opportunities for local fishers who have had the size of their fishing grounds reduced by the declaration of closed areas or who use fishing techniques that are believed to damage the benthic environment and take large quantities of juvenile fish.

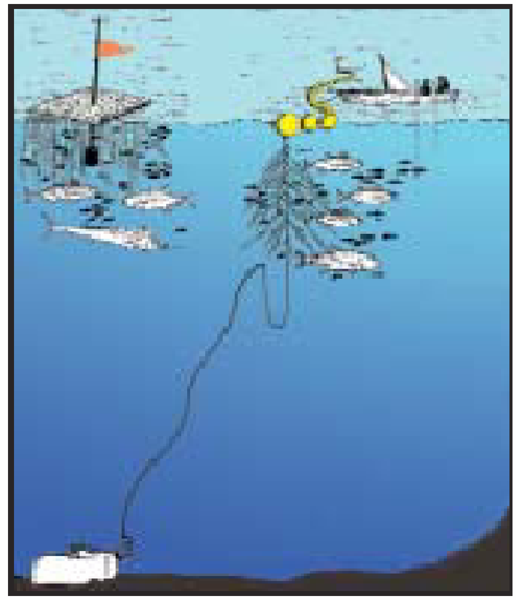
Two FADs are being jointly funded by DfID and MIMP (WWF) and two are funded by CCA. In addition to providing the FADs, the programme is funding a highly experienced Masterfisherman to guide their construction and deployment and, crucially, to provide local fishers with training in the use of longline technology. The project is managed by a Tanzania-based marine resources consultancy company, Samaki Consultants Ltd., in collaboration with the MIMP authorities and DFMR. The project is still at an early stage but will provide extremely valuable experience in how FAD technology can be used to improve MPA management.

Samaki Consultants Ltd. www.samaki.net.

A half-page section in Tanzania's *Fisheries Observer Handbook*



Fish Aggregating Devices (FADs)
FADs are floating objects that are specifically designed and located to attract tunas, and therefore allow fishers to find them more easily - a feature used by purse seiners (see page 16). The exact reasons why tunas are attracted to FADs are not known, but the ropes, floats and the other materials used do mimic the build-up of driftwood and seaweed found naturally in the sea which normally attracts fish. FAD technology is a method that is proving to be appropriate for the WIO, being used in Mauritius, Seychelles and other countries.


Free-floating and fixed, deep-water Indian Ocean FADs.

In March 2005, six FADs were deployed in Tanzania - four off NE Unguja and two outside the Mafia Island Marine Park's east coast. Tanzania's FAD design includes a float section of 22-25 pressure floats (16 lt. vol.), along a 30 m, 16 mm PVC-coated steel wire, with streamers attached (see above). The 12-ply rope (part polypropylene, part nylon) is secured to a one tonne concrete anchor. A 2-3 m marker pole with radar reflector is attached to the float section.

Tagging and research
In Kenya and South Africa, tourist sport fishers have been contributing to fisheries research and conservation by tagging and releasing fish caught on rod and line. The unharmed fish swim away and when eventually caught again can reveal data on growth rates and distance travelled. Several tags from sailfish tagged in Kenya have been removed from fish caught in Zanzibar, with the Institute of Marine Sciences acting as a focus point for fishers to hand in the tags, in exchange for a small reward. During the last season, over 1,000 sailfish, over 200 marlin and 300 other species (including sharks) were tagged in Kenya. Currently there are few sport fishing clubs in Tanzania and no fish tagging.

http://www.handsontv.info/

Series 6: Programme 1 (of 10) - 'Africa Works'

Not Just a FAD – Tanzania

The coastal fisheries of Tanzania are fast becoming an over-exploited resource. Fish stocks among the coastal reefs are being depleted, taking a toll on local livelihoods and protein intake. To address this problem, the UK's Department for International Development (DFID) has helped to encourage offshore tuna fishing. The adoption of fish aggregating devices (FADs) in the area helps to exploit the currently under-utilised stock of tuna fish in the region. Local fisherfolk are now tapping into this resource to enhance their livelihoods.

What is a FAD?

Oceanic fish such as tuna are often found gathered around floating logs and other drifting objects, sometimes in very large numbers. Having observed this behaviour, fisherfolk learned that they could often increase their catches by fishing near floating objects. Some industrial fishing techniques rely on this tendency for tuna to gather near natural floating objects to improve their catch; many tonnes of tuna have sometimes been taken around even small bodies of floating debris. The floating debris is often found at current boundaries and up-wellings (which occur when strong, usually seasonal, winds push water away from the coast, bringing cold, nutrient-rich deep waters up to the surface), although these are rarely stationary. At such boundaries the ocean is very productive and known by tuna to be a good source of food. Local fisherfolk often know about them, although they may have to search large areas to locate them.

In the early 1900s fisherfolk in Indonesia and the Philippines began building floating rafts of bamboo and other materials to attract schools of fish. They moored these rafts to the sea floor with natural-fibre ropes secured to baskets of stones that served as anchors. These structures were the first fish aggregating devices, or FADs. The use of FADs by both small-scale fisherfolk and industrial fishing fleets is now very widespread. In the Philippines over 3000 FADs are in use, and most yellowfin tuna production comes from them.

FADs in Tanzania

Ensuring the sustainability of subsistence fisheries and maintaining an adequate supply of affordable dietary protein are primary objectives for the coastal population on Tanzania. Most of the fish that is sold in Tanzanian markets is currently caught among the reefs of shallow coastal waters and inlets. This inshore fishing is rapidly reaching its sustainable limit. In many coastal areas, growing populations and the need to increase fish production have led to overfishing of inshore and reef resources.

At the same time, tuna resources generally remain under-exploited and provide an opportunity to increase fish production. FADs can play an important part in significantly increasing the sustainable fish catch. If fisherfolk who normally fish inshore are able to catch more fish and earn better incomes by changing to FAD-based tuna fishing, the fishing pressure on inshore resources will be reduced.

FADs also decrease the potential danger to marine life that is posed by net fishing. As Ali Makame, a fisherman from Nungwi village, explains:

> "Turtles are sometimes caught in our net, this is unfortunate. Dolphins are also caught in deeper water, this is also unfortunate, but if caught we use the dolphin flesh for bait to catch sharks. It is not good though."

In most coastal areas of Tanzania, there are few opportunities for income generation apart from agriculture and fisheries. In areas where there is a lack of arable land and the population is increasing, fisheries may present the only opportunity for development. FADs can be effective tools for enhancing fisheries because they can improve catch rates, thereby improving the supply of much-needed protein, and increasing the incomes of artisanal fisherfolk. FADs can make it possible for fisherfolk to produce good catches more consistently, which is an important factor in developing markets.

Increased fish catches can lead to the development of small-scale secondary enterprises which produce value-added products such as smoked or dried tuna for local consumption or export. Such activities create employment opportunities for people, particularly women, who are not directly involved in catching fish. This may be an option for communities that can produce an oversupply of fresh fish but are unable to access non-local fish markets.

Why FADs Attract Fish

Although fisherfolk have been using FADs for nearly a century, and much is now known about the behaviour and biology of tuna and other pelagic (open water) fish, the reasons why FADs attract fish still remain largely unexplained. Research into this question, mostly through observing fish behaviour in association with FADs, has suggested several possibilities, of which the most accepted are the 'shelter and protection' and the 'orientation' theories:

- *Shelter and protection:* This theory suggests that both the FAD raft and the mooring line offer protection to fish from predators. Schools of fish may remain close to or 'hide' behind the underwater parts of FAD rafts.
- *Orientation:* This theory argues that fish use the FAD as a physical reference point in an ocean generally devoid of such signals.

In either case it is apparent that the fish are able to find their way to and from the FAD when they wish. Although fish may spend days or weeks associated with a FAD in this way, other urges eventually cause them to move on and be replaced by new arrivals.

However, it is important to note that FADs do not increase the size of a fish population in a given area of ocean. The FADs gather fish from a large area to a smaller one, making them easier to find and catch. This allows fisherfolk to concentrate their fishing effort in an area where the fish are themselves concentrated. As a result, overall catches and catch rates around FADs tend to be higher than in open-water fishing. FADs aggregate different fish at different depths. Small tuna are usually found near the surface. Larger yellowfin, bigeye and albacore tuna generally gather near FADs at depths of between 50m and 300m.

Funding the Project
In 2003, a co-operative programme was initiated in Tanzania between the UK's Department for International Development (DFID) and two independent conservation initiatives: Mafia Island Marine Park (MIMP) and Conservation Corporation Africa (CCA). The programme was designed to diversify fishing opportunities for local fisherfolk. DFID and MIMP jointly funded the construction of two FADs by the local company Samaki Consultants; a further two were funded by CCA. In addition, the programme has enlisted the help of a 'master fisherman' to guide their construction and deployment, and to provide local fisherfolk with crucial training in the use of longline fishing technology.

Site Selection

First, a decision is required on the general location of a FAD programme. This decision is based on factors such as development priorities, funding, access to markets, number of fisherfolk in the area, and the potential economic benefits of the programme. Following such a decision, further technical and local considerations are taken into account for a more specific site selection process. These considerations include:

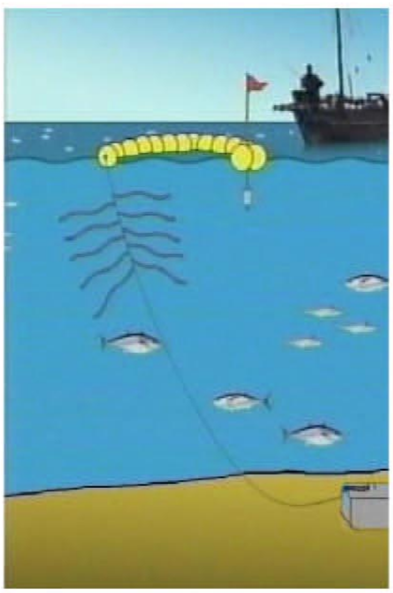
- *Historical presence of tuna*
  Whenever possible, FADs should be placed in areas where tuna and other pelagic species are known to occur. Local fisherfolk are likely to know when and where fish occur in abundance, and should be consulted. Most fisherfolk will be able to report areas where tuna schools are frequently sighted.
- *Topography of the seabed*
  The best FAD mooring sites are broad flat areas with little or no slope. Broad areas are important because the anchor's actual path of descent during deployment is somewhat unpredictable. As a result the anchor may end up hundreds of metres away from the intended landing spot. Narrow flat areas, sharp slopes, and steep drop-offs all increase the potential for the anchor to end up in the wrong depth. This could lead to mooring damage or stress and premature failures.
- *Depth*
  There are two important considerations: FADs that are moored at depths of less than 500m generally do not aggregate tuna effectively; while mooring costs increase with depth because of the greater length of mooring rope needed. FADs moored at 1000–2000m generally work well, and mooring costs are lower than for those deployed in deeper waters.
- *Prevailing weather and sea conditions*
  Care should be taken to avoid sites where bad weather and rough sea conditions prevail, as this will limit the amount of time fisherfolk can work around the FADs. Sites where strong currents exist should also be

avoided. Strong currents increase the strain on the mooring, causing mooring components to wear more quickly.

- *Spacing*
  In general FADs aggregate most effectively when moored 4–5 nautical miles (nm) from seaward reefs or the 75m (40 fathom) contour, and when spaced 10–12nm apart. That distance and spacing minimises interference from either reefs or other FADs.
- *Accessibility and safety*
  FAD sites should be safely accessible for the local fleet. Appropriate site location and distance from shore are affected by the seaworthiness and safe operating range of local fishing vessels.

Constructing a FAD

There are two main designs for FADs: the steel spar buoy, which was designed by the South Pacific Commission at the request of the US coastguard; and the Indian Ocean FAD, which originated in the French territories of the Indian Ocean. The former employs advanced technology and construction techniques and is often unsuited to subsistence fisherfolk. The Indian Ocean FAD, therefore, is more common and long-lived among subsistence fishing cultures. The following focuses on the Indian Ocean FAD design.



The raft section is made of two rows of 30 floats, each 200mm in diameter. These are strung on a 35m nylon rope of 18mm diameter. Rubber discs are placed between the floats to reduce abrasion. One end of the float is attached through a swivel to a mast, which may carry a flag and radar reflector. The mast is held upright by 24 similar floats, strung on a rope and tightly attached to the mast. A chain at the lower end of the mast acts as a counterweight. Old nets are hung along the chain as appendages. The total volume of the floats used is 376 litres. Floats are strung in two rows to avoid the loss of the FAD in the event that one row breaks. This section of the device is subject to most wave action and currents, which cause abrasion, wear and tear.

The other end of the float is attached to between 100 and 200m of polyamide (nylon) rope, which has a negative buoyancy and prevents the mooring line from floating to the surface when the current slackens. The mooring line attached to this rope is made of buoyant polypropylene and is 18mm in diameter. The other end is attached to a 20m long, 16mm diameter, chain which is linked to the anchor.

The scope ratio of the mooring is the relation of the sea depth to the length of the mooring line. This should be between 1: 1.1 and 1:1.2. A higher ratio might cause excess rope to float towards the surface and get entangled in boat propellers when current slackens; it might also induce fisherfolk to loot the visible rope, causing the loss of the FAD. A moderate scope ratio diminishes the watch circle of the raft, making it easier for fisherfolk to locate.

Effects on Fishing

The deployment of a FAD can have an effect on a variety of aspects of the local fishing industry. To understand these effects, it is important to have a good understanding of the nature and status of the existing fishing area. This means gathering information such as local fishing statistics, import–export data, trade statistics, rural agricultural surveys, dietary surveys etc. Some important changes are likely to occur regarding the following aspects.

Fishing methods

In Tanzania, local fisherfolk have been trained in new methods of fishing, to prevent the excess damage that comes with gill net fishing. The fish caught by hook and line are fresher and more valuable.

> "After placing the FADs we go to seminars to be trained in the best fishing methods. Using a hook and line, there will be fewer problems, and we can fish in the daytime and rest during the night."
> (Ali Makame, Nungwi Village fisherman)

> "Using something like the Samoan reel, to haul up a fish to the boat, allows them to land a fresh fish, which can then be bled and treated, and placed on ice ideally, and taken ashore and sold for a better price than they are getting with the fish that are caught in the gill net."
> (Matt Richmond, Samaki Consultants)

Catch rates

According to the Food and Agriculture Organisation (FAO), the catch per man day from a FAD fishery in much greater than that from traditional fisheries: a two to three man FAD boat is likely to catch 50–60kg per day, while traditional methods will catch only about 6kg.

Lifestyles

The increased catch rates are likely to result in an increased income for fisherfolk, so long as competition between boats does not exceed the increase in available fish. Nungwi Village has already felt this impact:

> "When we go to fish at the FAD sites we will catch many tuna. Tuna are very popular with the tourists, so during the tourist season, when we are able to catch lots of tuna, our lives are greatly improved."
> (Ali Makame, Nungwi Village fisherman)

Further Information

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