How effective are artisanal fish aggregating devices?

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Preparing a FAD flotation system in Fiji. (Image: © Michael Savins)

Introduction

Fish aggregating devices (FADs) have been used in Pacific Island countries for more than four decades to assist small-scale fishers in catching pelagic fish. Presently most of the government fisheries agencies in the region have FAD activities in which funds from local and overseas sources are used to manufacture and deploy FADs. A general conclusion from many years of experience in fisheries development efforts throughout the Pacific Islands is that FADs are one of the few innovations that enable small-scale fishers to more economically take advantage of the region's large tuna resources. Although there is a consensus that FADs are effective, quantitative evidence of this effectiveness has been elusive.

This paper is a short summary of a longer report of a study carried out in late 2020. This work was a component of the Japan-funded FAO-implemented project "Enhancing livelihoods and food security through fisheries with nearshore fish aggregating devices in the Pacific Ocean", commonly referred to as the FishFAD Project.

Studying FAD effectiveness

What is FAD effectiveness? Because FADs are deployed for various reasons, there are several ways in which a FAD programme could be effective or ineffective. In other words, effectiveness depends on the objectives of a FAD programme. Some of the main objectives of FAD programmes in the Pacific Islands region are improving the catch per unit effort (CPUE) of small-scale pelagic fishing, increasing economic returns for fishers, relieving fishing pressure from coastal resources and recovering from natural disasters. Each FAD objective is associated with a different way in which effectiveness can be viewed. In this report, this is referred to as a dimension of effectiveness.

The purpose of the study is to identify and examine the various dimensions of FAD effectiveness, review the literature on FAD effectiveness studies, identify and explore factors influencing FAD effectiveness and make observations and suggestions on studies of FAD effectiveness – with the overall intent of improving FAD programmes.

Previous work relevant to the study of FAD effectiveness

The study obtained 160 research papers from around the world conceivably relevant to the study of FAD effectiveness. Those reports were closely examined to identify those that give the results of specific quantitative studies of FAD effectiveness. This resulted in a list of 17 reports. Each of those reports was examined for the dimension of FAD effectiveness studied. Many of the reports had slightly different names for the various dimensions, but for comparison purposes, the dimensions were placed into six general categories, the shortened names of which are: catch rates (i.e. CPUE), cost–benefit, profitability, coastal fishing pressure, tuna production, and sportfishing development. Those papers are shown in Table 1.

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Table 1. FAD effectiveness studies: the dimension(s) of effectiveness studied and the results.

Author	Year of report	Area	Dimension of effectiveness	Results
Buckley	1986	American Samoa	CPUE	The FAD CPUE was 3.6 times greater than the open-water CPUE, and the bank/seamount CPUE was 1.8 and 6.4 times greater than the FAD and open-water CPUEs, respectively.
Sims	1988	Cook Is.	Cost–benefit	Returns of 312% on FAD expenditure are realised.
Buckley et al.	1989	American Samoa	CPUE	The quantitative information in this study on differential catch rates between open-water areas, FADs, and offshore banks, conclusively shows that FADs are an effective method for enhancing the troll fishery catches of commonly caught pelagic fish in American Samoa.
Cillaurren	1990	Vanuatu	Profitability	The results indicated a troll fishery around the FADs was not viable due mainly to high running costs because of travel to and from the FADs.
Cayré et al.	1991	Comoros	CPUE	FADs significantly (+86%) enhanced the CPUE of both species of tuna for handline gear, but only the CPUE of yellowfin gear for trolling gear (+29%)
MRAG	1994	Fiji	Tuna production, CPUE; coastal fishing pressure	There has been a large increase in tuna landings due to FADs. CPUE on FADs is greater for yellowfin (not skipjack) tuna. FADs appear to have had little impact on effort on coastal fisheries except for spearfishing.
MMR	1999	Cook Is.	Cost–benefit	The cost for a single FAD is approximately NZD 7000 with estimated returns in 1989 of NZD 69,000 from trolling. This is 10 times the cost of deploying a FAD.
Chapman et al.	2005	Niue Cook Is.	Cost–benefit, coastal fishing pressure	In both Niue and Rarotonga, the value of the catch far exceeded the cost of the materials. The success of FADs as a management tool (i.e. changing coastal fishing effort) was harder to determine.
Templeton and Blanc	2008	Nauru	Cost–benefit	The total cost of one nearshore FAD was AUD 2100, which meant the value of catches at the nearshore FADs was equivalent to the cost of 10 of the FADs, so nearshore FADs tested were cost effective.
Sharp	2011a	Niue	CPUE, cost-benefit	Although offshore FADs have the greatest impact on CPUE (kg/hr), it is clear that inshore FADs also improve CPUE (kg/hr). Unlike some other studies, the "benefit" in this study is the net production gain plus the fuel cost saving (i.e. not just the gross value of the catch). The government investment of NZD 39,729 provided an economic return of NZD 95,813 over a two-year period.

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Table 1. (continued)

Author	Year of report	Area	Dimension of effectiveness	Results
Beverly et al.	2012	Mauritius	Sportfishing development, cost–benefit	The number of sport fishery boats increased from 40 to 75, though only 45 of those were considered to be fishing regularly.
Guyader	2013	Guadeloupe	Profitability	Profitability was greater for FAD vessels than coastal vessels.
Sharp	2014	Yap	CPUE, coastal fishing pressure, cost-benefit	FADs improve fisher efficiency, in terms of increasing CPUE; FADs may divert fishing activity away from the coast; the financial cost incurred from procuring and installing FADs is significantly outweighed by the additional catch values generated.
Albert et al.	2014	Solomon Is.	Cost-benefit (CPUE and tuna production in different papers from same study)	A cost–benefit analysis indicated that the financial cost of the FADs (including materials, deployment costs and fisher training) can be recovered within 2–5 years, as long as the FADs are well utilised. This study was also covered by two other papers: Masu and Albert (2014) and Albert et al. (2013), with the latter having (a) a CPUE analysis indicating that catch rates at the FADs areas were not significantly higher than at the non-FAD fishing areas, and (b) a tuna production analysis showing FADs increasing the supply of fish to four communities.
Albert et al.	2018	Vanuatu	CPUE	Contrary to expectations, catch rates for all fishing methods were not consistently higher at the FADs than at non-FAD fishing areas.
James	2018	Fiji	CPUE	The data suggest that FADs are twice as efficient as reef and lagoon fishing. FADs tended to provide a good return per dollar spent in fishing activity when compared to open ocean, but not compared to spearfishing.
Tilley	2019	Timor-Leste	CPUE, cost–benefit	There was a significant positive effect of FADs on productivity, with a mean CPUE value of 2.17 kg/(fisher-hour) for FAD-associated fishing compared with 1.21 kg/(fisher-hour) for reef fishing and 0.8 kg/(fisher-hour) for other habitats. Time to 100% return on investment was from 18 days in Vemasse to 3343 days in Biacou.

Several features emerge from Table 1. The most common dimensions of FAD effectiveness examined in those studies were CPUE (10 studies), cost–benefit (9), coastal fishing pressure (3), profitability (2), tuna production (2) and sportfishing development (1). Although a large number of objectives for FAD programmes have been cited, many objectives do not appear to have been studied for effectiveness (e.g. reducing sea safety incidents, producing food for post-cyclone recovery efforts). A careful reading of the reports listed in Table 1 suggests that studying FAD effectiveness is often associated with a number of difficulties, including the reliance on non-verified fisher-supplied data, distinguishing a FAD fish from a non-FAD fish, and the use of inappropriate methodology.

Summary of the results

Analysis of the studies in Table 1 reveals several features detailed below.

How conclusive have the past FAD effectiveness studies been?	The analysis shows: • The cost–benefit and CPUE studies appear to be reasonably conclusive; there have been a large number of such studies and almost all show that FADs have a favourable cost–benefit ratio and that FADs result in relatively high catch rates. • The issue of whether FADs relieve coastal fishing pressure is relatively difficult to study and the results from past studies have not come up with strong evidence that FADs can perform this function, and therefore the results of those studies should be considered inconclusive. • The other types of FAD effectiveness studies examined (profitability, tuna production increases, sportfishing development) cannot be considered conclusive due to the small number of these studies.
FAD monitoring	In this report "monitoring" is considered to be the periodic observing and recording of data relevant to FADs. It can include information about the condition of FADs, fish catches, fishing areas, fishing operations, fish sales and fish consumption.
Current FAD monitoring in the region	The results of two regional surveys that included FAD monitoring indicate that most countries in the region are having difficulty with monitoring. Many of the problems associated with FAD monitoring can be placed in three categories: lack of monitoring, difficulties with the monitoring methodology, and not using the data collected.
Conditions required for FAD monitoring	Certain conditions are necessary for a national FAD programme to be able to carry out effective FAD monitoring. These include that adequate money is available for the monitoring, the FAD monitoring budget is not subject to cuts, there is enthusiasm for FAD monitoring (among both Fisheries Department staff and fishers), the staff of national FAD programmes have the capacity to monitor/report, and the results are used. There appears to be the assumption in several of the reports and comments on FAD monitoring that these conditions occur – but the reality is that these prerequisites simply do not exist in most Pacific Island countries and territories.
Mitigation of FAD monitoring difficulties	If monitoring and reporting are not happening due to shortages of resources and capacity, one approach would be to aim, at least initially, for something cheap/simple. Very basic monitoring that produces useful information for various purposes is probably better than a very sophisticated system that is dysfunctional. Another approach is to establish a hierarchy of priorities for the various types of monitoring. FAD monitoring can range in complexity from recording the presence/absence of a deployed FAD to the collecting of information to determine whether a FAD is relieving coastal fishing pressure. A country could identify several possible types of monitoring of varying complexity and cost – with the appropriate level being chosen depending on the current national FAD objectives and resources available.
Specific factors influencing FAD effectiveness	FADs relieving coastal fishing pressure appears to be the most complex in terms of interplay of factors that affect success, contributing to the fact that no study has established how effective FADs are at reducing coastal fishing pressure. FAD fishing skills are important for almost all the dimensions of FAD effectiveness.
Relationship between FAD programme institutionalisation and FAD effectiveness	It is now generally accepted that national FAD activities are most effective where there is a national FAD programme as part of the government fisheries agency – rather than a project that comes/goes with the availability of funding, pressure from fishers, or the availability of external FAD services. An ongoing FAD programme within a fisheries agency allows for greater continuity of FAD work, in-house training, successful technology transfer to staff, and a mechanism for interaction with stakeholders. By being an established unit inside a fisheries department (rather than a project with no permanent staff), there is likely to be greater stability of funding. Without institutionalisation, the process of learning from past FAD-related mistakes is more difficult.
Stakeholder input	Several studies indicate that formal input of FAD users is important for FAD effectiveness, with the general situation being summed up thus: Involving local fishers in the site selection process is important. This local knowledge can also increase the effectiveness of the FAD by locating it at a known productive fishing ground. Through the community engagement process, mechanisms are also required to enable conflict and dispute resolution.

The impact of FAD effectiveness studies	Have FAD effectiveness studies (1) helped the flow of FAD funding, or (2) determined if FAD objectives have been met? • From the limited information available, it appears that there are several examples of #1 being successful. • The ability of FAD effectiveness studies to determine whether FAD objectives are being met (#2 above) depends on the conclusiveness of the studies. The analysis shows that effectiveness studies have been successful in determining the meeting of objectives related to cost–benefits and CPUE, but not for the other objectives. • Another finding is that effectiveness studies oriented to defined objectives (e.g. cost–benefits, CPUE) appear to have been most relevant at the early part of the FAD era (1980–2000).
The future of FAD effectiveness studies	The need for FAD effectiveness studies probably varies considerably between Pacific Island countries and territories. In places where there are only rudimentary FAD activities, such studies are probably much more useful than in countries where there is a well-functioning national FAD programme. Another concept related to the need for future FAD effectiveness studies concerns competing priorities. In the use of scarce funding for FADs and related work, what has the highest priority? Obviously, this would differ between countries, but for many countries the establishment and development of national FAD programmes is arguably the most important, or at least more important than additional effectiveness studies.
Improving future FAD effectiveness studies	It is important to have considerable economic expertise in designing such studies and in the subsequent analysis. Several other suggestions for improvement of future studies are given in the full report of the study.
Additional significant messages from this study	• FAD fishing skills are important for almost all the dimensions of FAD effectiveness. • Fisher inputs into FAD programmes are also important for many dimensions of FAD effectiveness. Fisher associations seem to be good at initiating and maintaining this input. • At least some monitoring of FADs needs to be carried out, with the simplest being a system for determining the presence/absence of a deployed FAD. Any less than this could be considered negligent.

The main recommendations from the study

Countries that do not have a national FAD programme institutionalised into the government fisheries agency should consider making steps in that direction. This suggestion is especially relevant for the countries and territories of the region that have sporadic FAD activities dependent on the availability of external funding and FAD expertise.

Prior to committing to new FAD effectiveness studies:

- countries should realistically appraise whether there are more beneficial alternative uses of FAD-related funding;
- in countries where national FAD activities are constrained by lack of knowledge of FAD effectiveness, the results of previous FAD effectiveness studies (including those in neighbouring countries) should be publicised;
- certain conditions are required for effective monitoring in support of FAD effectiveness studies (e.g. adequate budget that is not subject to reduction, and capacity/enthusiasm to monitor and report); deficiencies in those requirements should be addressed before committing to a FAD effectiveness study.

In the design of new FAD effectiveness studies:

- there should be considerable economic expertise input into the study formulation process (and in the subsequent analysis);
- countries should consider the advantages of a "learn-to-walk-before-running" approach; first attempting simple studies (e.g. daily cost of a FAD or CPUE) before embarking on types of effectiveness studies that are more complex or have rarely been conclusive in the past;
- to the extent possible, study methodology should be formulated to account for "messy data" that has plagued many past studies, and consideration should be given to the use of new technologies to mitigate these difficulties;
- the study design should take into account the large difference in studying FAD effectiveness at villages and close to urban areas;
- provisions should be made (budget, work activities) for publicising and using the results of the FAD effectiveness study.

For the study of the effectiveness of FADs for relieving fishing pressure from coastal fishery resources, countries should consider the cost, complexity, and inconclusiveness of past studies – and examine the option that SPC or an external research organisation lead the work, rather than the study being an activity undertaken exclusively by a national FAD programme.

Organisations and donors that are involved with FADs should consider:

- promoting approaches to encourage institutionalisation of FAD activities in national FAD programmes;
- sponsorship of studies to determine effectiveness of FADs studies for relieving coastal fishing pressure;
- including a component of FAD fishing skills into all packages of assistance involving FADs.

Concluding thoughts

FADs have been demonstrated to be one of the few mechanisms by which small-scale fishers in the Pacific Islands are able to economically access the large tuna resources of the region. If we assume that FADs are indispensable for coastal fisheries development in the region, steps should be taken to improve the functioning of FADs in the various countries. Following from this, the need for FAD effectiveness studies must be compared to the need for other work that would improve the benefits from FADs. Although there is no doubt that effectiveness studies have been beneficial in the past, the situation is evolving. Many FAD specialists in the region feel that in some countries other work, especially institutionalisation of FAD activities into a national FAD programme, should have higher priority than effectiveness studies. This contention is consistent with the impressions received in this study.

Another perspective is that the various countries have different FAD-related needs. Some are striving to prove the value of FADs to the government, public, and donors; for others, where their value is well recognised, FAD effectiveness studies are probably less needed. However, the region as a whole could benefit from more knowledge on whether FADs can relieve pressure on coastal fishery resources.

Despite being generally accepted that national FAD activities are most effective where there is a national FAD programme as part of the government fisheries agency, such programmes are not common in the region. SPC has undertaken work in this area (e.g. the checklist for sustainable national artisanal FAD programmes; SPC 2017), but other approaches should be considered, such as a requirement for countries to demonstrate progress in this area to be eligible for a visit from a FAD technician.

A detailed 79-page report of this study is available from the author on request at rgillett1@yahoo.com

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Setting a FAD, and getting ready to drop the anchor in Kiribati
(Image: © Michael Savins)