# PRACTICAL AND LEGAL ASPECTS SETTLEMENT AND EXPLOITATION OF FISH AGGREGATING DEVICES (FADs)

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## SUMMARY

The various fields where the effects of exploitation of Fish Aggregating Devices (FADs) can be assessed is illustrated by the results of experiences of anchored FADs recently conducted in 4 island countries of the Western Indian Ocean (i.e. Comoros, Madagascar, Mauritius and La Reunion). It appears that only a wide programme including studies in the different biological, economic and social fields can lead to appreciation of the real benefits which can be obtained through the mooring and exploitation of FADs. The too frequent straight comparisons of the results obtained in one field only (e.g. fishing efficiency) from area to area is misleading in evaluating the impact of the exploitation of FADs.

The authors propose a scheme of steps and questions which should be considered before starting a FAD programme or during its execution. The FAD entity appears as a rich and wide field of integrated research.

## 1. INTRODUCTION

For many years it has been observed that large pelagic fish such as tunas, are attracted and concentrated by floating logs, whatever the size of the logs (Gooding and Magnusson, 1967; Hunter and Mitchell, 1968). This behaviour is well-known by fishermen all over the world both industrial and artisanal fisheries of tropical tunas. Natural floating logs are actively searched for and exploited by purse seiners in the open ocean (Hallier, 1986); some purse seining fleets even construct and exploit these drifting logs (Watanabe *et. al.*, 1988). Artisanal fisheries for tunas exploit anchored floating objects, named Fish Aggregating Devices (FADs), settled off many coastal or insular countries of the Pacific and Indian Oceans (Murdy, 1980; Matsumoto *et. al.*, 1981; De San, 1982; Preston, 1982; Veolini et Robert, 1982; Marsac et Stequert, 1987; Roullot et Venkatasami, 1987).

In the Indian Ocean, several projects for anchored FADs are being undertaken since 1980, and more recently (1988) in Madagascar and Comoros Islands through the Regional Tuna Project of the Indian Ocean Commission (Fig. 1).

From the different reports and analysis of these anchored FAD experiments conducted in the different countries and under different circumstance, it appears that despite the use of apparently homogeneous techniques, the results and effects are quite numerous, varied and sometimes contradictory.

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A careful review of these reports clearly indicates that in most cases neither the possible diverse consequences of FAD settlement were clearly investigated before the beginning of the operation nor the real consequences monitored during and after the operation. This lack of exhaustive overview can be easily explained by the numerous biological, fishing, social, economic and legal aspects involved in FAD introduction, and by the number of specialised experts needed to assess these different study areas.

As a consequence of the varied and very often patchy results obtained from previous reports and analyses, FAD introduction continues to be initiated year after year in different countries without a clear and documented objective of the operation.

From recent examples taken from the Western Indian Ocean, we will illustrate the diversity of the objectives and possible consequences of the introduction of FADs. We will then show the importance of an exhaustive and comprehensive analysis of the local situation with its different biological (resource), economic and social components prior to any decision to initiate a FAD programme. A checklist with different steps to follow in order to initiate and assess a FAD Project will be proposed.

## 2. OBJECTIVES OF FAD SETTLEMENT

Before discussing any aspect of FAD introduction, it is of major importance to keep in mind the positive results or benefits that can be expected from the activity.

In a simplified manner we can say that FADs can be considered to be efficient if one or both of the following results are obtained whatever the detailed mechanisms involved:

- increased catch of species that can be aggregated by FADs (e.g. tunas);
- decreased cost of exploitation of these species.

These two parameters demonstrating FAD efficiency should be considered together or separately as being the basic aim of any FAD introduction programme. From the following short descriptions of FAD experimentation conducted in Mauritius, Comoros Islands, Madagascar and Reunion Island, we will try to point out which effects were targetted and what secondary consequences can follow these effects.

## 3. EXAMPLES OF FAD EXPERIMENTATION RESULTS

### 3.1 Mauritius

In Mauritius a FAD Project was initiated in 1985 and financed by UNDP from 1985 to 1989 (Roullot and Venkatasami, 1987); FADs settled during this Project are still kept in use by Governmental Services. The reported exploitation of the fish aggregated by FADs (Roullot *et. al.*, 1988) and the position of Mauritius with regard to the tropical tuna resources (yellowfin and skipjack tunas mainly) indicate relatively low catch rates year round except during the winter months when activities have to be practically stopped. The catches are however, higher than from the traditional fishery. On the other hand, the Project permitted to fit a fairly well resistant (lifespan exceeds 2 years) model of FAD. In such a context, FADs appear to be an additional means to relocate the artisanal fishing effort and thus in some ways to lower the heavy fishing pressure applied to the lagoon resources. In this country where situation of full employment exists, catches around FADs should remain relatively interesting to encourage fishermen to stay in the industry. The even growing shortage of fresh fish supply on the local market has to be emphasized. FAD exploitation is also of some help to the important sport fishing activities and in tourism development.

### 3.2 Reunion Island

As in Mauritius, the local abundance of tuna resources is rather low but the social context is quite different with an important unemployment problem. Thus FADs appear to be a means to create some new activities attractive for people without work. Moreover, the demand for fresh fish is very high and not fully satisfied by the local artisanal fisheries. By now several requests for anchoring "private" FADs have been addressed to the local marine authorities by fishermen; these were rejected because of the fear of having an uncontrolled multiplication of the number of FADs and also because of the possible appropriation of areas of the maritime zone which is illegal under French Law.

In view of this social and legal context, and considering the numerous demands for FADs and also the cost of constructing and anchoring FADs, new FADs will most probably continue to be placed by the local administration. Simultaneously investigations for developing new fishing techniques, such as gillnets, to exploit the fish aggregated around FADs are undertaken and financed by the local administration.

### 3.3 Madagascar

Because of a vast and rich continental shelf, non-motorized craft mostly operate in the artisanal fishery. These crafts are consequently not adapted for the exploitation of tunas. In such conditions the FAD operations undertaken by the Regional Tuna Project were aimed at exploring the feasibility of exploiting tunas aggregated around FADs by pole and line or purse seines from small vessels. It now appears that the concentrations observed are not important enough and are too scanty to support an industrial operation. Moreover, the resources of the continental shelf are far from being fully exploited, given the actual fishing pattern (Ralison, 1988); it thus appears untimely to introduce specific and costly modifications (e.g. motorized craft) in the artisanal fishery, in order to exploit the very occasional aggregations of tunas around FADs. Moreover, tuna is not much appreciated by the local population.

The implementation of FADs in Madagascar thus appears to have only scientific interest at this stage.

### 3.4 Comoros Island

Tunas have been actively exploited for many years by an artisanal fishery using trolling lines from motorized craft or baited handlines from non-motorized canoes (Cayre *et. al.*, this Symposium). Due to the important and growing need of the population for fish products, the scarce resources of benthic species, and the absence of continental shelf and lagoon, FADs appear to be a means to enhance the landings of tunas by the artisanal fishery.

Catch and effort statistics carefully monitored until December 1989, revealed that FADs anchored by the Regional Tuna Project (Indian Ocean Commission) and by a national EEC-funded project, enhanced very significantly the tuna catches of the non-motorized canoes (Cayre *et. al.*, this Symposium). The enhancement of the activities of the non-motorized canoe fleet has a great social impact as the fleet is quite large (3,750 units) compared to the motorized fleet (370 units). In this context, FADs appear to be of great value.

Some conflicting interests however, recently cropped up between the two fleets (the use of conflicting gears, i.e. trolling and handlining) and between different communities of fishermen (i.e. neighbouring villages or islands). Moreover, although it has not been measured, it appears that the increasing supply of tunas on the local market has caused prices to decline. Such recent events raised the necessity of precisely assessing the social and economic effects of FAD introduction (during FAD programme), and to think of legislation which could prevent the conflicts and restabilize the local market situation. In the future, if FADs moored at greater distances from the coast are found efficient in aggregating significant quantities of fish, industrial fishing units could be introduced. In the near future however, the artisanal fishery and the local market supply will remain the main target.

### 3.5 Review of the results

From the previous examples of FAD introduction projects some effects and consequences can be analyzed.

In areas where the overall abundance of tunas is relatively low, i.e. Mauritius and Reunion Island. FAD settlement operations increased the production of fish to some extent. In Mauritius, FADs will have a marginal effect in both social and economic fields. In Réunion Island FAD will probably have a marginal effect on the local economy but can be considered, thanks to the prevailing social context. In Mauritius the programme seem to have some positive role in various fields, though not fully assessed, (relocation of fishing effort, supply of fresh fish, help for the game fishery, job opportunities to fishermen..).

In Madagascar, the overall abundance of tunas is important, but the tunas and FAD mooring zones are too far away from the coast to be accessible to the existing artisanal fishery without drastic and costly modifications to the fishing craft. Moreover, the tuna species have too low a market value, and a relatively weak local interest in comparison to the other exploited species of fish. Thus even if they had been efficient in concentrating tunas, FADs have little priority over the existing artisanal fishing pattern and over the present consumption trends.

In the Comoros Island the natural abundance of tunas is improtant, but there is a growing need for marine products as a source of protein food for the population. Due to the low abundance of other fish resources (exploited or not) the exploitation of tunas is very attractive for the local artisanal fishery and exploitation has been greatly increased by the use of FADs. After one year of exploitation of anchored FADs several social and economic effects are cropping up or could crop up:

- conflicts between fishermen groups because of the use of incompatible fishing gears and regular attempts by certain communities to appropriate FADs and their exploitation;
- increased production of tunas seems to saturate the local market and could drastically lower the selling price of these FAD exploited species. As a consequence it could be expected that fishermen using less costly (and efficient) fishing methods (non-motorized canoes) would progressively reduce their effort to catch these fish; as the other exploitable resources are less abundant, some people could leave the fishery;
- exploitation units would have to increase their total production to remain competitive in the local market. If such increase is obtained through a growing import of sophisticated fishing requisites (motors, fuel...) the outlay of foreign currency by the country will also increase; and only export of the harvested species could balance this outlay.

Access to international markets and the necessity to have a significant production that can be exported should lead to consideration about the feasibility of FAD exploitation by industrial fishing units, and of ways to prevent conflicts between artisanal and industrial fisheries (e.g. restriction of industrial vessel activities to be far off FADs only).

## 4. PROPOSED STEPS FOR SETTING UP A RATIONAL FAD PROGRAMME

From the previous discussions it can be seen that there are several and different fields or topics to be surveyed and explored before or during any FAD programme. A list of the various steps to be followed when elaborating a FAD programme can thus be proposed. A chronological order has been adopted in the presentation of the questions and fields which should be investigated.

A. Gross evaluation of the overall abundance of the different species which could aggregate around FADs.

B. Do oceanographic conditions (i.e. current, wind, bottom of the sea...) permit anchoring of FADs?

C. Gross evaluation of the local need (nature and importance) for animal products (whatever they are, e.g. fish, chicken,..).

If the results or answers to steps "A", "B" and "C" are negative, a FAD programme should not be considered.

D. Estimate the relative importance of the exploitation of the different marine species actually harvested.

- which species are exploited?
- how are they exploited (methods, strategies, exploiting persons)?
- intensity of the exploitation of each species or group of species (fishing statistics should be examined at least on a seasonal basis).
- organization of the market (market prices should be examined on the same time scale as used for the fishing statistics).

If the exploitation of species (e.g. tunas) which could aggregate around FADs is relatively low, then proceed to step "E".

If the exploitation of species which could aggregate around FADs is of major importance then proceed to step "F".

E. Determine the reasons why tuna (or any other candidate species for aggregation around FADs) exploitation is of minor importance compared to the exploited species.

- Low local market value

Tunas or related species, are not appreciated by the population which prefers other species for food. In this case, before taklng any decision to initiate a FAD programme, the two following points should be examined:

- is there any way to change the food habits (e.g. new processing method)?
- is there any possibility to export the product?
- High local market value but:

The catchability is low given the existing fishing methods; fishing techniques or gears are not efficient to harvest a scattered resource and/or a high exploitation cost limits the fishing effort.

At this step 3 different options (with different needed means) can be adopted:

- FAD anchoring alone
- FAD anchoring and gear trials to improve the fishing efficiency

- programme to improve fishing efficiency without settlement of FADs (craft, fishing gears, fishing strategy..)

F. The actual exploitation of tunas (or related species) is of major importance.

- Can the local market absorb an increased production?
- Can an export market absorb a potential surplus production?
- Gross evaluation of the potential effect of decreasing exploitation costs?

If a FAD programme is decided after step "F", the reasons which triggered the decision and the benefits expected from a FAD programme would normally have been identified.

G. Census of the places and conditions for FADs settlements

Fishermen must be associated with this step in order to take into account the distance at which the actual fishing craft can operate; moreover the traditional customs and legislation regarding the exploitation of the marine area must be observed.

- which existing fisheries and communities could exploit FADs?
- determine a mooring policy in line with the local traditions and legislation.

H. During the FAD programme

A continuous and careful assessment should be carried out on:

- fisheries (catch, effort, CPUE,...) in order to estimate the impact of the FAD on the activity and the impact of the exploitation on the resources.
- the economic sectors involved in the fisheries which do not exploit the FADs.
- the social impact of the exploitation of FADs.

An efficient sampling strategy should have previously been planned for these 3 parts of the survey. As any decision to modify any practical aspect of the programme would have to be taken during the survey, the information collected has to be processed within a short time

## 5. CONCLUSION

The use of Fish Aggregating Devices and its consequences or effects is a wide and mostly unexplored subject. The research effort should integrate the different fields involved in FAD mooring and exploitation: biological (behaviour of the aggregated species. mechanisms of aggregation and attraction..), exploitation (dynamics and regulation of fisheries), social and economic impacts. Such research would improve the general knowledge in different fields. The knowledge gained can rationalize investment and fishery enhancement planning and management.

Though exciting and promising, FAD technology can be expensive for developing countries compared to the expenses usually involved in artisanal fisheries and its result is hypothetical. FAD mooring should be first considered as a complement to fisheries (artisanal and industrial) to diversify activities (new targetted species, new fishing techniques, new markets..) before its own viability is demonstrated. The benefits of FADs (or absence of benefits) can only be evaluated after at least a couple of years of exploitation and close monitoring. It seems quite reasonable therefore that the cost of the FADs should not be borne by the fishermen at least during the experimental period. Nevertheless,

during this period it is absolutely necessary to involve the fishermen closely in the operations (preservation of FADs, transmission of fishing statistics..) so that they feel responsible for the FADs. After this sensitizing and training period fishermen could progressively take charge of the FADs depending on the results obtained and given the legal, social and economic context prevailing referred to above in this paper. The proposed steps for starting up a FAD programme should not be considered definitive but as a tentative list of questions and subjects which may be addressed for a rational approach.

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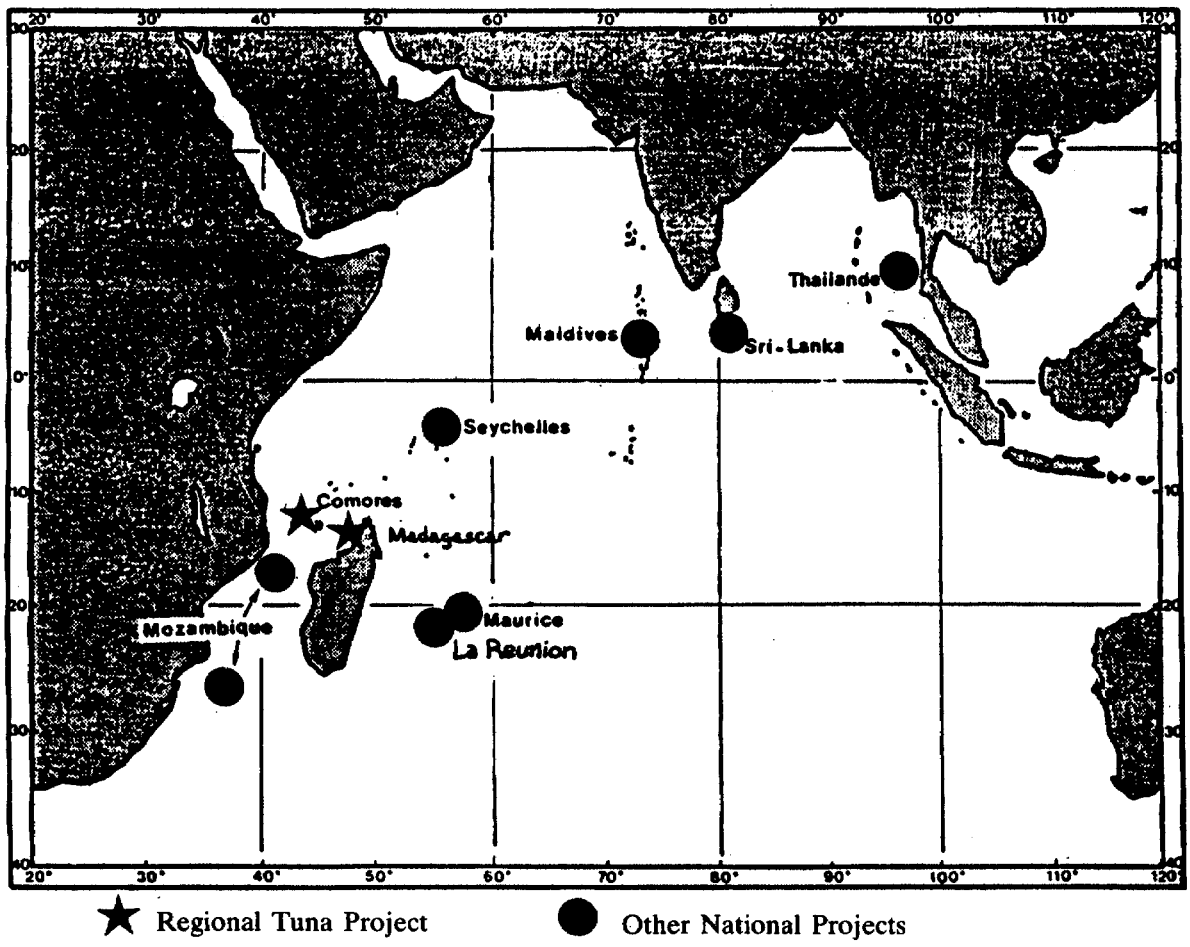


**Figure 1. Location of the anchored Fish Aggreating Devices experiments in the Indian Ocean. (modified from Marsac et Stequert, 1987)**