A new approach to management of small-scale fisheries

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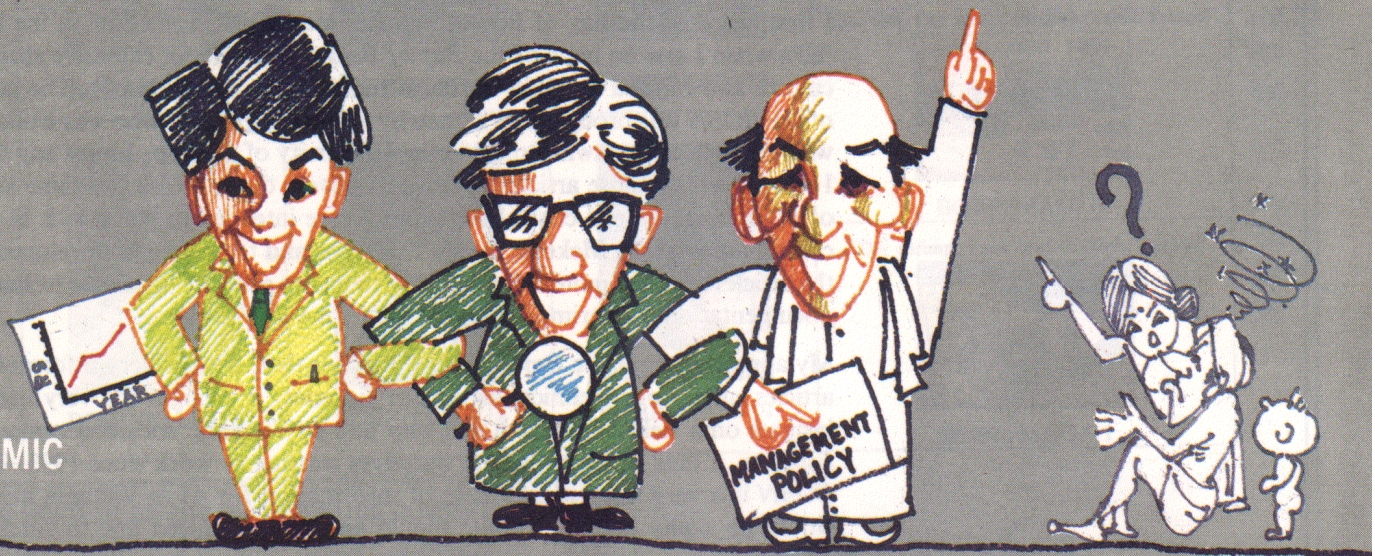
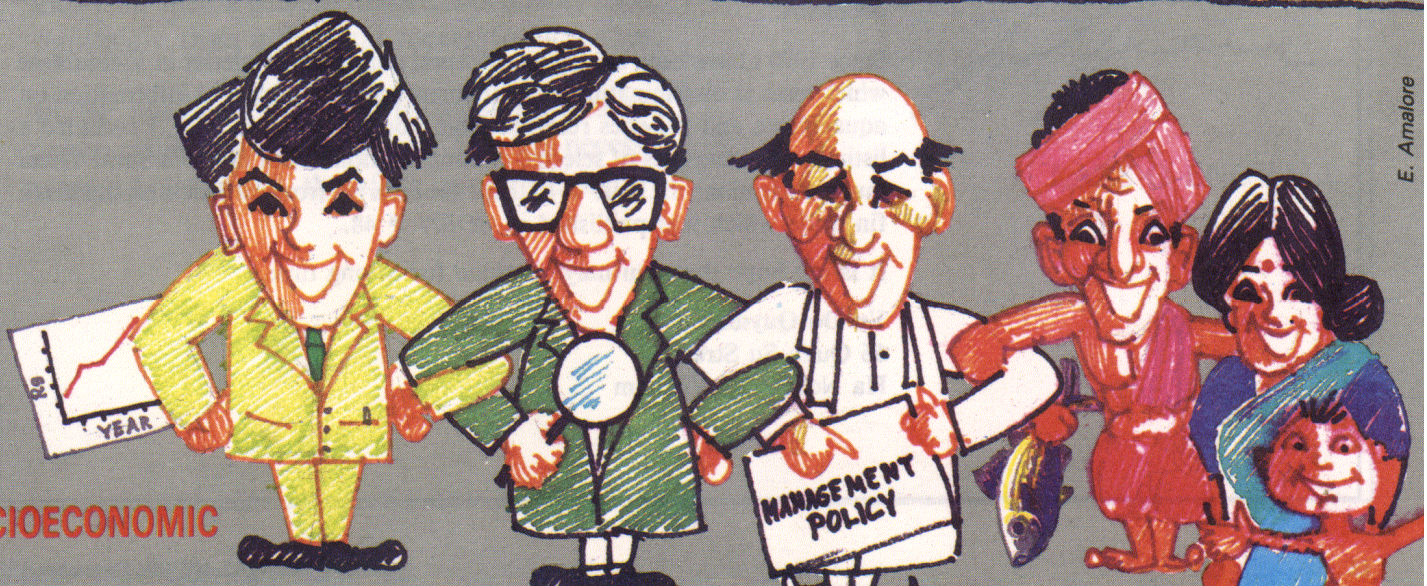
THE BIOLOGICAL WAY



THE BIOECONOMIC WAY



THE BIOSOCIOECONOMIC WAY

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LETTERS TO THE PUBLISHER

South Pacific benefited

Regarding the effect of your programme outside your region, there has definitely been such an effect in the island countries of the South Pacific.

As Project Manager of the FAO/UNDP South Pacific Regional Fisheries Support Programme, I found many of the publications of the Bay of Bengal Programme (BOBP) quite useful. In addition, through your Programme I was able to obtain advice on many subjects. This included: fisheries credit, fisheries development planning, safety at sea, boatbuilding, and flyingfish fishing technology, to name just a few. The 23 countries have most certainly benefited from the BOBP.

I have been discussing this subject with the staff of the South Pacific Commission and they support this view.

Robert Gillett
Fisheries Adviser
Ministry of Agriculture, Naku'alofa
Kingdom of Tongo

New insights

I first heard of the Bay of Bengal Programme (BOBP) sometime in the late ***'80's*** when I saw an issue of the ***Bay of Bengal*** News about extensive shrimp culture and rainfed crops in northern India (or in Bangladesh?). The copy of the ***BOBN*** was brought to Vietnam by a Dutch expatriate who was working with the Artemia-prawn project in the University of Cantho. I must say that I was struck by those articles because they were dealing with the same kind of poor, undeveloped coastal communities we intended to work with in the coastal areas of the Mekong Delta. The prose and the concepts developed in the articles sounded quite different from the more generally available technical documentation on shrimp culture at that time in Vietnam.

My appreciation of the ***Bay of Bengal*** News is that, besides very informative articles on various technical aspects of fisheries, it brought me very useful insights on a field of research still very new to Vietnam: socioeconomics of fisheries, a field in which we are ourselves starting to work since 1993. The ***BOBN*** is a very interesting source of information for us in Vietnam and it would be a pity that the BOBP should end or be reduced due to funding problems.

Since 1990 I have been editing an informal quarterly newsletter in Vietnamese which aims at disseminating to Vietnamese scientists technical information on aquaculture and fisheries received from abroad. In Issue # 9, I included a listing and summaries of selected communications from BOBP's Surat Thani mudcrab seminar. In Issue # 15 there are excerpts from an article on the shark fin trade which was published in ***BOBN # 48.***

It is my hope that you may continue for a long time.

Vu Do Quynh
66Quan Su Street
Ha Noi, S. R. Vietnam

LETTER FROM THE PUBLISHER

As the second phase of the Bay of Bengal Programme (BOBP) comes to an end, and the direction changes into fisheries management in the third phase, it might be appropriate to briefly look back on the past 14 years.

The Programme has demonstrated several technologies and methodologies from which small-scale fisherfolk have benefited. But equally impoitant have been the unsuccessful attempts, since they make the picture of what can, and cannot, be done more comprehensive. One general lesson learned has been that sustained support over a long period is required if there is to be success in small-scale fisheries development. The experiences, whether of success or not, have been well documented in some 160 reports and quarterly newsletters which have been circulated widely.

A disappointment though has been the poor follow-up by national agencies on some of the results. This mainly concerns different types of extension activities which require structural changes and/or new coordinating mechanisms in the agencies concerned and changes in attitudes. It was too optimistic to anticipate this to materialize in the time given.

The many activities of the programme and the associated information material have definitely brought about an increased awareness of small-scale fisheries issues and resulted in a better focus on them in all the participating countries. In the long run, such a general impact is probably more significant than individual successful activities.

BOBP has been unique in focusing on a target group rather than on a subject. This has necessitated a holistic and, therefore, multidisciplinary approach which has set trends for similar development efforts not only in the Bay of Bengal but worldwide. Institutions and individuals in nearly one hundred countries have requested and paid for BOBP publications.

There is also no doubt that there has been an impact through direct learning, although impossible to quantify, in the various fisheries offices and on the beaches in the region where thousands and thousands of people have been actively involved in project activities or been exposed to them. The BOBP-organized training activities alone amount to some 300 man-years.

Finally, the Programme has had a stimulating effect on regional cooperation. Officials of all countries have met yearly to monitor and give direction to the Programme. In between those meetings, there have been numerous specialized regional workshops and study tours during which administrators, scientists and technicians have had opportunities to exchange knowledge and experience and to establish contacts.

This issue of the Bay of Bengal News, the 52nd, is the last under my stewardship and I wish to take this opportunity to thank our readers for all the encouraging remarks and suggestions over the years.

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THE BIOSOCIOECONOMIC WAY

A new approach to management of small-scale fisheries in the Bay of Bengal region

by
K Sivasubramaniam
(Sr. Fishery Biologist)

Background

In the early stages of fisheries development, just before and after World War I, each of the major resources was exploited mainly by one type of catching unit (craft and gear), limited in number and in variations of size and characteristics. Hence, what are problems today – competition, interaction and intensity of fishing – were not major issues then. Understanding the dynamics of the populations exploited and simple biological production models to know the sustainable yield levels were found to be sufficient in those years. During this period, the economics of fisheries was treated the same way as any other business investment on land.

Developments after World War II changed things. Larger craft were developed and they began to compete with smaller ones for the same resources. Increased intensity of fishing led to new issues. And new principles of fisheries economics came into application in the Fifties. The 'common property' nature of fishery resources, and economic considerations overriding biological ones, led to resource management being looked at from an economic point of view in the Sixties.

The 1960s and 1970s saw considerable multiplication and diversification of the fisheries. Besides ocean-wide expansion of fisheries in the developed world, the establishment of EEZs and coastal and offshore fisheries in developing countries also became accelerated with motorization of traditional craft and new gear made of synthetic materials. The coastal resources of

Operating an estuarine set bagnet in Bangladesh

many developing countries began to be exploited intensively. These and other economic and sociocultural issues contributed not only to complex management problems, but also to a widening disparity in income and its distribution between, and within, the small-scale fishing communities. The need for resource management, then, became even more acute.

In the 1980s, numerous complex bio-economic models for specific fisheries, embracing not only the different kinds of fisheries but also various categories of craft, gear and resources, came into use. The advent of the microcomputer made it easier for biologists and economists to carry out complex analytical exercises. FAO also contributed to developments in this field by creating packages such as BEAM I-IV (Bio-economic Analytical Methodology). Many of these were introduced in the Bay of Bengal region in the developing countries bordering it.

In the Bay of Bengal region

There are, in the Bay of Bengal, four major categories of marine capture fisheries – large pelagics, small pelagics, shellfish and demersal finfish are the targets. On an average, there are nearly 20 interactive craft-gear combinations in each of these fisheries in the countries around the Bay.

The trend in this region has been a shift, first, from traditional to non-traditional small-scale craft/boats, then to large vessels. But there have been deviations.

The Maldives has made changes to her traditional fishing *dhonis,* but has not introduced nontraditional or new types of craft. The country also has no large fishing vessels as yet. In Shri Lanka, there has been a reversal – large tuna longliners and demersal trawlers have been replaced by smaller catching units. And Indonesia has banned trawlers in the seas around Sumatera.

In view of the fact that the greater number of fishing craft in the Bay of Bengal countries are still traditional, nonmotorized types, the small-scale subsector fisheries is the mainstay of marine fisheries. But there are growing fisheries using nontraditional craft in both the small- and large-scale sectors. As a consequence, coastal fish

Small pelagics (tuna and other species) landed on a Shri Lanka beach on the south west coast

resources are being depleted and socioeconomic and sociopolitical problems have emerged. These have brought about an increasing disparity in incomes, destroyed the homogeneity of the fisherfolk and created heterogeneity within the small-scale fishing communities. When this happens, traditional management systems tend to lose their effectiveness.

Tradition and change

Traditional management systems were built on the foundation of a homogeneous community, such as one using purely traditional craft and gear and everyone operating one with equally low efficiency, resulting in almost equal income to everyone. If one got less than the others, then the community took steps to help the one with less. The abundance of the resource was also not a problem, because all systems were of low efficiency.

In the changing scenario today, when intensive exploitation prevails, disparity in incomes, a lack of homogeneity within communities and rapidly depleting resources do not leave room for humane considerations in the struggle for existence. In these circumstances, it is not only the highly capitalized and efficient large-scale fisheries and the efficient fishing methods used by the nontraditional small-scale fishing craft, but also active traditional fishing methods – such as pushnets, dragnets, bagnets, beach seines, boat seines etc. – operated in shallow coastal waters that have to be regulated to manage the fisheries and the resources sensitive to them. However, fisherfolk, particularly

the small-scale, traditional ones with very poor incomes, seem to have difficulty in abiding by any management measures introduced. Though most countries around the Bay have introduced management measures of one type or another, hardly any of them have achieved effective implementation because of the lack of cooperation from the fisherfolk. This is due to many reasons, such as:

- Their present income from fishing is barely enough for survival.
- There are no opportunities or facilities to get involved in any other fishery, fishery-related or nonfishery activity as an alternative.
- They lack understanding of resources and management.
- They feel they have the right to stay as they are and it is the newcomers, with new methods of fishing, who should be limited or forced to leave.

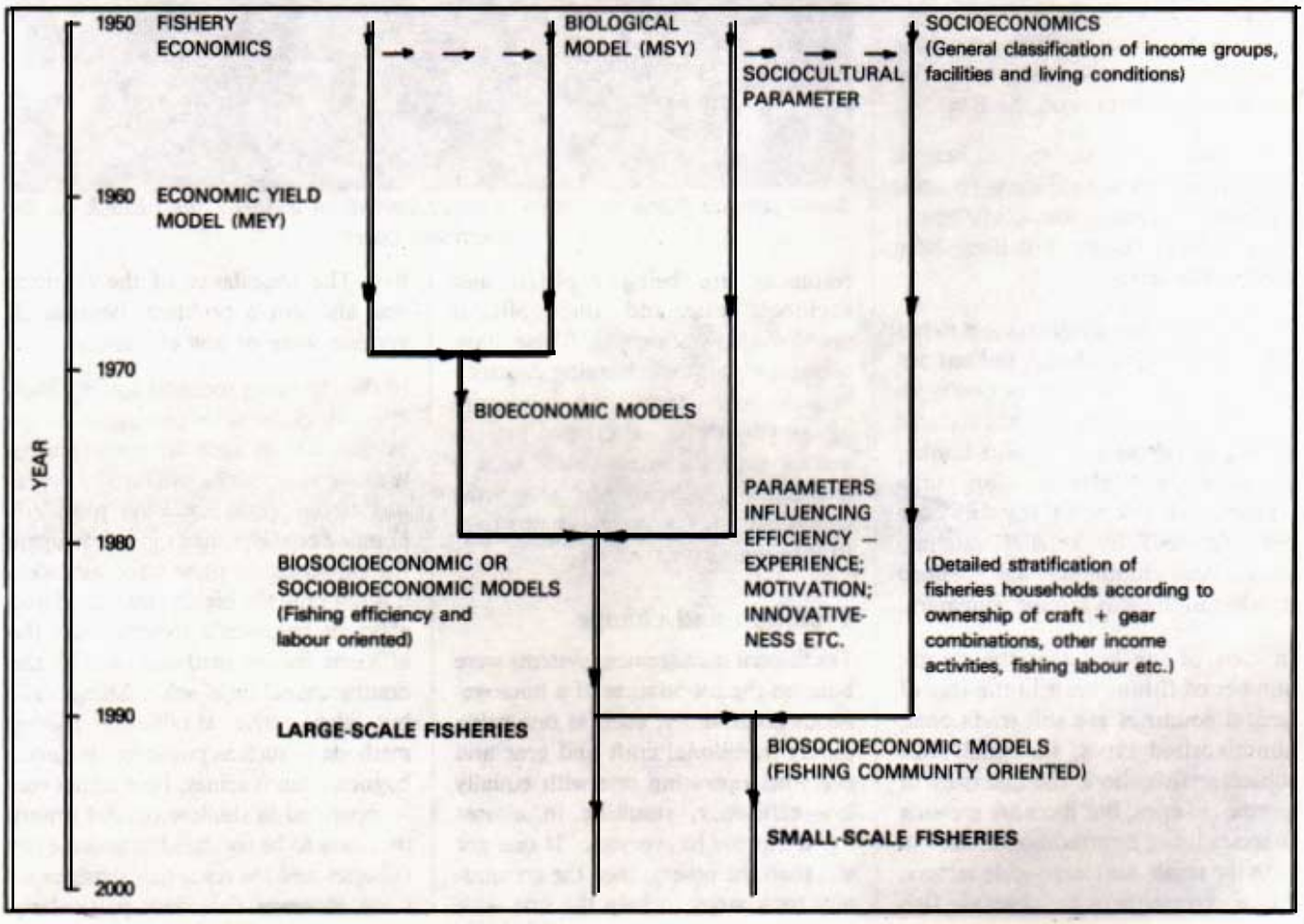
Socioeconomics essential

It is in this context that it is essential to acquire knowledge about the socioeconomic situation of the fisherfolk along with bioeconomic information about the fisheries. And both sets of information have to be looked at in an integrated way for a better understanding of the fisheries and to plan effective action to manage them. In other words, **a biosocioeconomic assessment** has now become necessary (see figure below).

In the late 1980s, 'Biosocioeconomic'/'Sociobioeconomic' simulation models were used in the northern hemisphere — in the temperate water fisheries of developed countries. Including sociological aspects in these cases has been more to assess parameters, such as motivation, innovativeness, age of fisherfolk, experience etc., that could improve the fishing efficiency of the operation (Krauthamer *et al.*, 1987; Charles 1989; Valatin 1990). The effectiveness of these models for actual situations in the developing countries, especially in a tropical environment, is yet to be tested. Certainly, the basic issues of the fisherfolk in the Bay of Bengal region have not been taken into consideration in the existing specific and generalized models. But even if any of the latter were to be used in the Bay of Bengal region, they would be limited by the lack of data and information required as inputs, as well as by their applicability or not to all types of interactive fisheries, to cases of highly migratory species and to such bioeconomic assessments as the impact of artificial reefs or fish aggregating devices.

In order to learn more about bioeconomic and biosocioeconomic analyses and their usefulness in this region, case studies were undertaken in 1991-1993 for six countries under the Bay of Bengal Programme (BOBP) project 'Bioeconomics of Small-scale Fisheries' (RAS/91/006) funded by UNDP.

Evolution of biosocioeconomic models

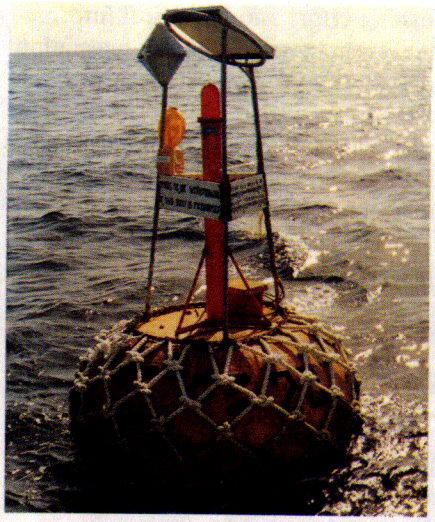


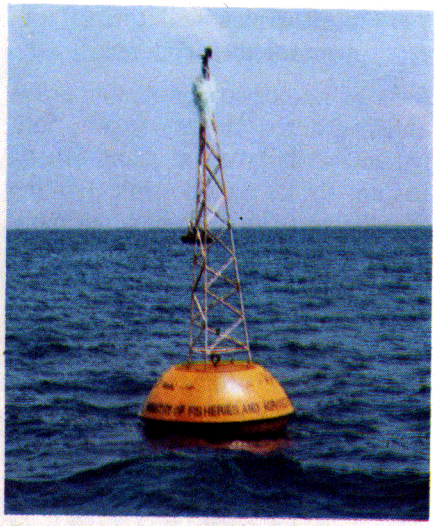
The biosocioeconomic approach

In the case of small-scale fisherfolk engaged in traditional fisheries and earning meagre incomes, implementation of management measures based on biosocioeconomic assessments and involving restriction/reduction of effort, suspension of the use destructive types of gear, enforcement of closed seasons/areas for a fishery or even a change in mesh size, requires information that will not only indicate the impact of such actions on their livelihood, but which will also help to identify the number of households that will be affected. Their income from other sources, other income-generating activities they are engaged in, the potential for expanding these activities or the resources for new activities (fishing/fishery-related/nonfishery) which they could take to, also need to be assessed.

The following types of socioeconomic information were considered necessary by the BOBP project:

- The general living conditions of the fisherfolk in the countries – housing, amenities, food etc. *(To assess their contribution to good health, motivation, efficient fishing with maximum fishing days etc.)*
- The actual number of fisherfolk involved. *(To identify alternative income activities and potential resources that could absorb that number.)*
- Other income-generating activities, the income from them and the possibilities of expanding them. *(To assess and organize appropriate increases in the income of the Jsherfolk.)*
- Other potential resources – fishing/fishery-related/non-fishery. *(To find new activities and to consider rehabilitation programmes.)*
- Educational attainments. *(To identify appropriate income-generating activities in keeping with the level of training that can be absorbed.)*
- Age structure of population. *(To determine number going out and entering productive age groups in the immediate future; in other words, the increase/decrease in the productive population size and the employment opportunities/demand.)*





Two fish aggregating devices (FADs) tried out in the Maldives

- Sex ratio of population. *(To ascertain the ratio of active fshing and nonfishing members and whether there is need for more nonfishing activities, particularly in situations where women are predominant.)*
- Awareness and perceptions of the fishery resources exploited and of fishery management. *(To determine appropriate approach and material/media for communication in order to create awareness among fisherfolk.)*

Introduction of management measures must go hand-in-hand with the demonstration and introduction of alternate fishery, fishery-related and/or nonfishery income-generating activities, and rehabilitation of fisherfolk in them without, as far as possible, dislocation.

Simultaneous execution of the socioeconomic survey and the bioeconomic survey is advisable. Alternatively, the data for the two components should be valid for a period of time. The integration of these two components provides additional benefits in the following manner:

- Further strengthening of the information improves the interpretation of disparity in incomes, heterogeneity within the community and of the feelings and attitudes of the subgroups within the community engaged in different fisheries.
- Contributes to a more reliable monthly/seasonal estimate of the income from the fisheries investigated and, consequently, provides reliable estimates of income, to owner and crew member households, by using average catch rates, species composition, prices of species, value of craft and gear and operational costs.
- Dialogue prior to, and during, the survey between those conducting the field investigation and the fisherfolk is useful in awareness-building among fisherfolk and also helps to get their cooperation and support during data-collection and the conduct of experimental fishing.
- Since bioeconomic data-collection covers every month of the year, information on seasonal changes in the fishing condition and suspension of fishing during the lean season help to determine the periodicity for systematic interviews on changes in fishery-related activities such as fish processing, fish marketing, fish transport, supplying ice, fish storage, middlemen etc., and from nonfishing activities such as agriculture, livestock-rearing, business not involving fish, handicrafts, tailoring, pottery, mat-weaving, coir rope-making, nonfishery labour etc. Thus, estimates of income from fishery-related and nonfishery activities can also be improved.
- Information on. income from fishing, fishery-related and nonfishery activities permits correlating them with the assets of the households to determine the primary income activity of every household, the relative importance of other income sources, investments and assets according to earning level and to understand the desires and perceptions

of fishermen and their future plans for their children.

Some of the socioeconomic information obtained during the project was non-parametric and, hence, quantification has not always been possible. Linking bioeconomic and socioeconomic parameters is often difficult. However, a meaningful linkage can be established by extending the bioeconomic survey stratifications of the fishing areas along the coastline, according to differences in catch rates and species composition, the fishing seasons and fishing craft and gear combinations, into the stratifications for the socioeconomic survey of the households in the adjacent villages, in which the owners and operators of the craft and gear live. The household is used as the basic unit for the socioeconomic survey and analysis.

In carrying out the bioeconomic analysis of a fishery or fisheries exploiting a particular resource or group of resources, such as penaeid shrimp, all the interactive fisheries catching the species or species groups should be analyzed collectively. But in almost all the countries in the region, the necessary specieswise and craft-gear combinationwise estimates of production, fishing effort and biological information are not available. Hence, integration of all interactive fisheries into the analysis would demand enormous input of skilled manpower, time and funds. Further, replicability of such case studies as a routine becomes doubtful. The only hope lies in the expectation that national institutions will improve their fisheries statistics and information systems sufficiently for such purposes in the near future.

Case studies

The case studies proposed by the respective countries and implemented in this project, were as follows:

BANGLADESH

Biosocioeconomic assessment of the impact of estuarine set bagnet fisheries on the other marine fisheries of Bangladesh.

INDONESIA

Biosocioeconomic assessment of the shrimp fisheries in the Langkat District (Sumatera).

MALAYSIA

Biosocioeconomic assessment of the shrimp fisheries in Kuala Sepetang (Perak).

MALDIVES

Biosocioeconomic assessment of the impact of fish aggregating devices on the tuna fishery.

SHRI LANKA

Biosocioeconomic study of the fisheries for small pelagics along the southwest coast of Shri Lanka.

THAILAND

Biosocioeconomic assessment of the impact of artificial reefs on the small-scale fisheries in Ranong Province.

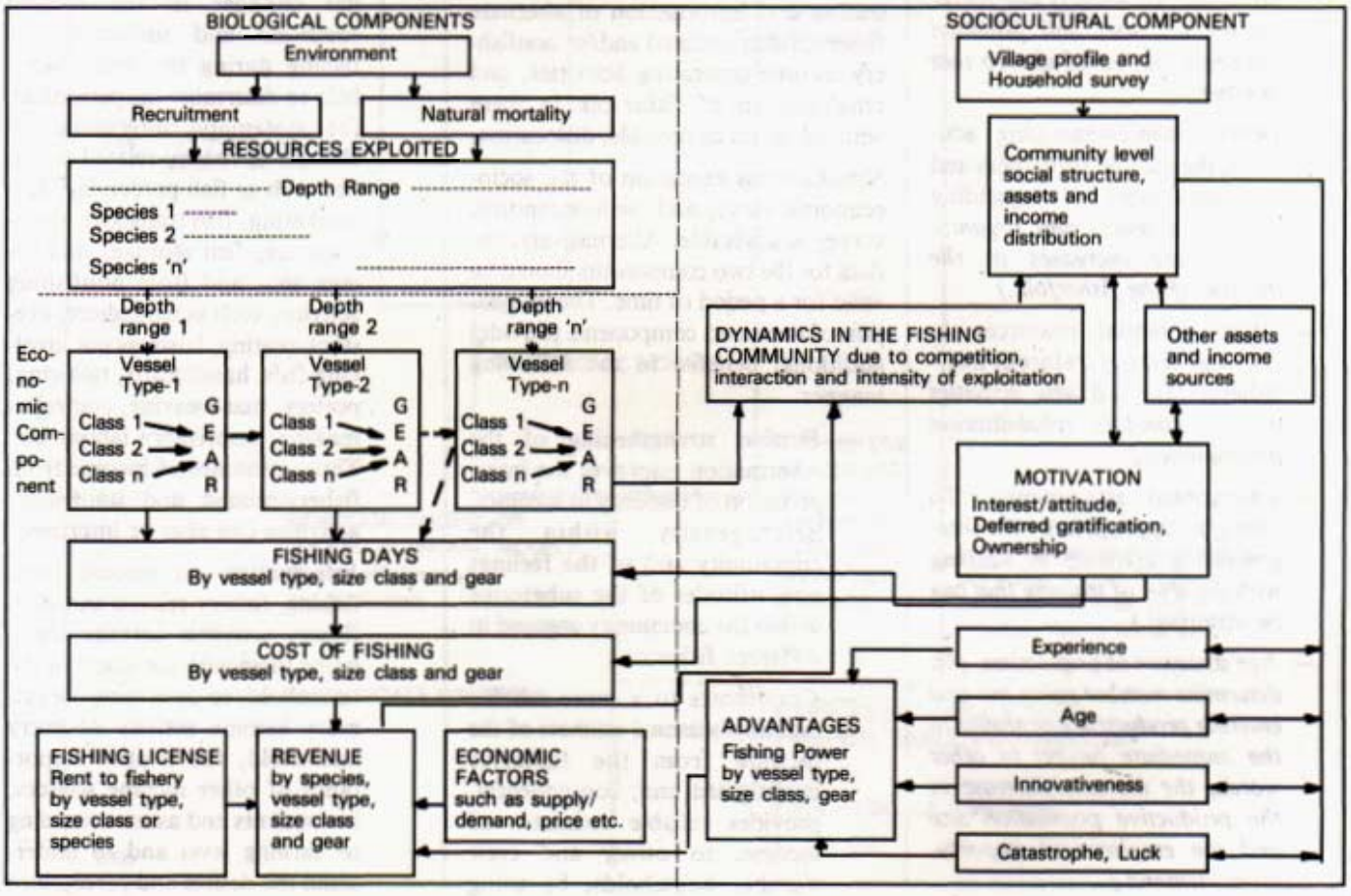
(Also see pages 11 - 15)

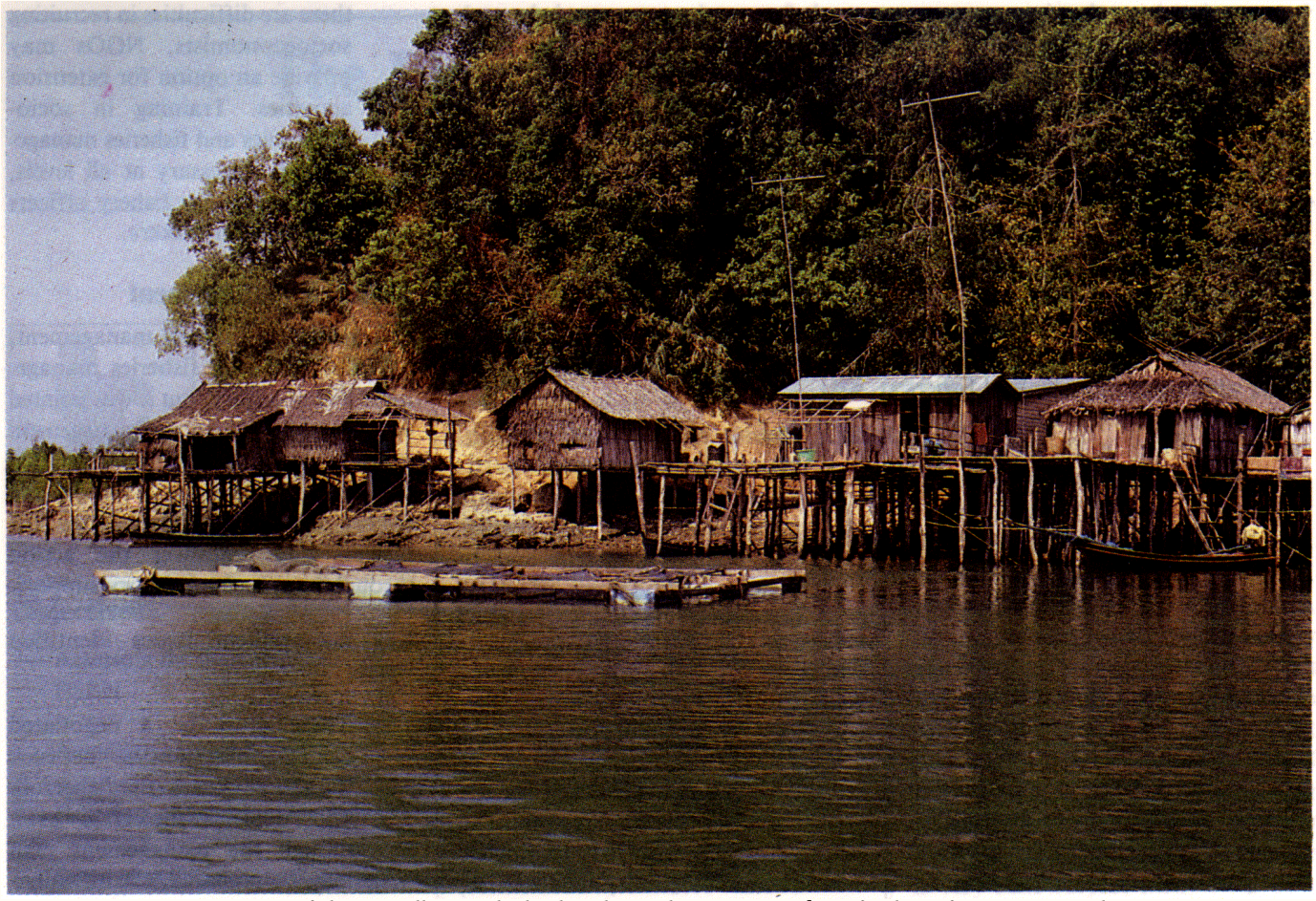
Project's progress

In May 1990, a regional meeting was held in Penang (Malaysia) to discuss the project objectives, the inputs/ outputs and the case studies proposed by the participating countries, and to outline the concept and prepare the project proposal for each case study. In October 1990, a regional workshop was held in Penang to go into the details of the bioeconomic and biosocioeconomic approaches, demonstrate the BEAM IV (see figure below)

Key components of the biosocioeconomic model developed from the model by Krauthamer *et al.* (1987)

Particularly relevant to small-scale community-based fisheries in developing countries, where traditions, family ties, group decision-making are crucial factors and overall benefit to the community which is the target.





Ranong fishing village, Thailand, where the impact of artificial reefs was assessed

and prepare the general workplan for each case study, including identifying equipment and making necessary budget allocations. Subsequently, each country was requested to nominate national participants to undertake the case studies. All survey plans were designed and sampling procedures, schedules and forms/questionnaires drafted.

There was considerable delay in the nomination of national participants and there was also difficulty in getting them released to work on a full-time basis. In most countries, at least a couple of participants had to be hired from outside to undertake the case study. This project on 'Bioeconomics of the Small-scale Fisheries', thus, commenced only in May 1991. However, preliminary testing of the biosocioeconomics in the Bay of Bengal region, awareness building among fishermen and some of the preparatory work for the case studies had already been conducted between March 1988 and April 1991, under the Small-scale Fisherfolk Communities Project (GCP/RAS/118/MUL), the mother project of the BOBP. Testing of the biosocioeconomic approach and awareness-building among the fisherfolk had been attempted during the investigations for the subproject on *kattumaram* fisheries in Kothapatnam, Andhra Pradesh (India) and through periodic dialogues with fisherfolk and the display of the results/findings in the form of illustrations on the 'field-day at Kothapatnam' *(Bay of Bengal* News, No. 33, March 1989). In fact, knowledge and experience gained here became the content of the first comic book-type of publication on fishing methods *(Our Fish, Our Wealth,* BOBP/MAG/10), for fisherfolk in the southern part of Andhra Pradesh (in Telugu) and northern part of Tamil Nadu (in Tamil).

Once the project got underway there was, in effect, only about one year of actual fieldwork that could be carried out in each case. The rest of the time was spent in preparation and in analyzing and reporting. Discontinuity in the participation by nationals resulted in incompleteness in data collection, and the assignment of inappropriate and temporarily hired personnel resulted in some degree of loss in the quality of data collected as well as in difficulties with analysis and reporting.

The draft reports were presented at a Regional Workshop held in Phuket (Thailand) October 7-13, 1993, by the national staff making the case study in each country. An officer involved in Fisheries Management in each country also participated. The member countries felt that, in almost all the countries, the methodologies applied for the case studies were suitable and had enabled them to successfully achieve the objectives. The shortcomings, responsible for incomplete results in a few cases, were attributed to reasons other than the methodologies. Member countries expressed their commitment in various degrees to continuing the use of the methodologies in other fisheries of the same kind or in the same types of fisheries in different areas, perhaps with some variation and improvement in the arrangements for data collection. In the case of the artificial reef study alone, it was difficult to assess the suitability of the methodology used, but this was due to poor data availability of the predeployment situation.

It was pointed out that in some cases the socioeconomic information had not been sufficiently linked to the bioeconomic information in the analysis. There is a need to look at fisheries management from the perspective of managing people rather than managing fish. New methods and, hence, new information would be required for this perspective. Two frameworks were proposed for consideration: one looked at co-management, which not only involved fisherfolk participation, but actually empowered them in the process, the other adopted the integrated coastal fisheries resource management approach, which simultaneously looked at various sectors which interact and influence each other in the geographical context of the coast.

It was also noted that methods and techniques are available for incorporating qualitative parameters in models, but these methods are often complex and difficult to apply. Biosocioeconomic methods need also to be more participatory, including all stakeholders, from the ministerial level to fisherfolk. There is also an increasing need for considering the developments in other sectors interacting with fisheries.

The main limitations noted were:

- The risk error, in estimating parameters. (This is ***because the analysis is based on one-year survey data where confidence is not always demonstrated.)***
- The quality of the results. ***(This depends on the human and financial means available for the exercise and, therefore, those responsible for the study need to document the limitations of the advice provided to the decision-makers.)***
- The quality of manpower – and the lack of it.
- The quality of statistical information.
- The quality of communication in a multidisciplinary team whose members often find it difficult to communicate with others.

But though conscious of these limitations, all participants felt the need for, and recommended, such studies in their respective countries.

Constraints and suggestions

Regarding the institutional constraints in executing biosocioeconomic assessments the following suggestions were made in the context of the project experience:

- **Fisheries statistics**

  There is need to include at least some of the basic data/information required for biosocioeconomic assessment, particularly the socioeconomic information, into the regular data-collection system and to review methodology of data-collection. There is also a need for a fisheries census at regular intervals.

- **Multidisciplinary studies**

  This is a new approach for the countries of this region. The expertise required (biologist, social scientist, economist, fishing technologist) needs to operate in an integrated and coordinated manner. A project working group with a permanent membership and an executing agency to organize funding arrangements and regularly monitor the progress of project implementation needs to be formed.

- **Fishery research priorities**

  There is need for the establishment of clear priorities according to the needs of the industry and the manpower, funds and facilities available. Results should be submitted to the Government and widely publicized, especially to the fisherfolk.

- **Manpower requirements**

  Availability of trained manpower in the agencies is a problem. Recruitment of trained personnel is, thus, limited. Training of new recruits often delays the project implementation. And it is often difficult to retain trained manpower. Biologists need to be trained in the field of socioeconomics because there are difficulties in recruiting socioeconomists. NGOs may provide an option for extension activities. Training in socioeconomics and fisheries management is necessary at all levels, including senior fishery officers and decision-makers.

Fisheries management

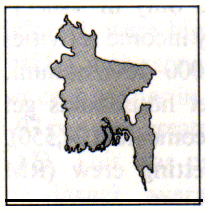
In considering fisheries management, it was agreed that fisheries management was necessary, but it was pointed out that while, ultimately, management is done by fisherfolk and is only possible with their participation, the fishery agency should manage the process and empower the action through legal and regulatory support.

Key management issues identified were:

- There must be a negotiated settlement/agreement between the stake-holders (the fisherfolk and decision-makers), even though the management plan may be prepared scientifically.
- Negotiation is impossible, unless all parties agree on the same common objectives and unless they are aware of the issues. This increases 'the necessity for awareness-building at all levels.
- Negotiated management has to be empowered and legitimized by authority and enforced by it.
- Management plans are time-bound and have to be regularly reviewed and modified.
- Management can, and should, begin with the information on hand and should not be held up until everything is known.
- Fishery agencies will need new skills and their mandate must be clearly defined for each to function as a management agency with the powers necessary.

A consideration in each country of these suggestions, issues and constraints in the light of the local experience would enable it to adopt a biosocioeconomic approach and get the fullest benefit out of it for the effective management of its fisheries.

The Biosocioeconomic project case studies



1 Biosocioeconomic assessment of the impact of the estuarine set bagnet (ESBN) fishery on other marine fisheries in Bangladesh

Objectives

- Assessing the destructiveness of the ESBN.
- Assessing the kind and degree of damage to the resources, and other fisheries, caused by this fishery.
- Suggesting management actions to be taken.
- Providing in-service training on methodologies to national staff.

Results

The ESBN interacts in the following sequence with the pushnet/dragnet/ fixed bagnet for shrimp fry collection as well as with the beach seine, marine set bagnet, trammelnet, trawlnet and bottom longline fisheries. The ESBN fishery has the second largest number of gear units and the highest production. The trawl fishery, on the other hand, has the least number of units but ranks second in production. Shrimp fry collection gear has the largest number of units, but has less production by weight. Present levels of effort exceed maximum sustainable yield and maximum economic yield levels in most of these fisheries – particularly so for the ESBN, beach seine and marine set bagnet. If the ESBN fishery is banned, there would be as much as a 250 per cent gain in yield and value by the other interactive fisheries.

There is no evidence of possible gain to the 55,000 ESBN fishermen, and about 100,000 fisherfolk dependent on the ESBN fishery for their livelihood, from technologically improving the ESBN or from improvements to the marketing of their catch.

Fishing is the primary source of income for the ESBN fisherfolk, 34 per cent solely dependent on the ESBN, while 62 per cent combine ESBN with other fishery-related or nonfishery income activities. There are 82 per cent ESBN-owning households, 25 per cent of whom own other fishing gear also. Only 11 per cent are fishing labour households. The ESBN operation is primarily a family-oriented enterprise, but because of negligible use of hired labour and motorized craft and because of poor catches seasonally, more than 40 per cent of the ESBN fisherfolk are below the poverty line. There is income disparity due to uneven distribution of resources in the different estuarine areas. Low fish density areas do not give enough surplus income during the low season, unless each household has more than two units of the gear. The harshness of nature is a major factor in the poor incomes to be got from the ESBN fishery.

Female illiteracy (8 1 per cent) is greater than male (57 per cent) among the illiterate (69 per cent) ESBN fisherfolk. This contributes to the limited scope for income-generation through nonfishery activities. Only 21 per cent keep above the poverty line – through supplementary income from other fisheries (8 per cent) and fishery-related and nonfishery activities (13 per cent). Alternatives to the ESBN fishery are likely to be only in the fisheries sector. In the high catch rate and high income areas, ESBN owners invest their surplus income in more ESBN whereas in moderate income areas their surplus income is invested in other fisheries. But in low income areas there is very little surplus income for only investment.

Any regulation of the ESBN effort during the peak season (July-September) in an area with high catch rate could have a favourable impact on the resources of many of the valuable species, without lowering the income of the fisherfolk in such an area to the levels of those in other areas. This would also enable the transfer of some of the fisherfolk to other fisheries, like trammelnetting, bottom longlining or even to marine SBN. Reduction of the ESBN effort or introduction of a closed season will not increase income to ESBN fisherfolk. It could, however, enhance recruitment, catch rate and income from other interactive fisheries outside the ESBN area, into which some of the ESBN fisherfolk could enter.

An analysis of age structure indicates that there will be a very significant increase in ESBN fisherfolk of the productive age group by the year 2000 and, consequently, additional employment opportunities would become necessary. Many recommendations for management of other interactive fisheries also have been made.

2 Biosocioeconomic assessment of the shrimp fisheries in Gala Sepetang, Perak State, Peninsular Malaysia

Objectives

- Analyzing the relative performance of various interactive gear in the shrimp fisheries and assessing the biosocioeconomics of these fisheries.
- Finding management approaches in order to optimize exploitation of shrimp resources and maximize economic benefits.
- Improving the capability of the national staff.

Results

Fisherfolk engaged in the interactive fisheries targeting shrimp, live in reasonably well-separated geographical areas – the pushnet fishery has 200 households in Kampung Menteri, the bagnet 50 households in Kuala Sanga and the shrimp trawl and trammelnet 200 households in Kuala Sepetang. The depth range covered by all four gear is not too wide, as distribution of the major species, such as Banana Shrimp *(P. merguensis),* extends only upto 30 m depth. There is, therefore, considerable overlapping of the fishing grounds, except for the pushnet. Metapenaeus species form the bulk of the catch with all gear.

In a catch of 426 t of four selected species of shrimp, the contribution by trawlers was 71 per cent, pushnet 18 per cent, trammelnet 10 per cent and bagnet 1 per cent. But the highest yield per recruit was for trammelnet. Differences in yield levels of different gear increases, when values are considered, because of the sharp increase in price of larger size shrimp. All fisheries are profitable throughout the year, even though there is very little, or no, revenue from the finfish by-catch. Highest net annual earning was RM 19,750* for trawlers and lowest RM 5445 for bagnet. Pushnet yielded the highest annual rate of return on investment and IRR due to the low investment cost.

None of the fishermen in this fishery are below the poverty line – owners receive more than 1000 RM/month, while crew members receive around 800 RM/month. Fishing is the primary income of 71 per cent of the households and is responsible for about 47 per cent of the employment. Craft-owning households with more than one vessel (28 per cent) generally do not go fishing, but engage in fish trade and marketing. Most owners obtain their crew from family members or relatives, but for pushnetting the owners are fish dealers (or towkays) from an area different from the crew's

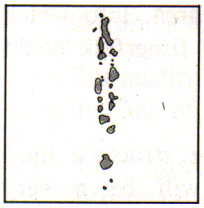
Fishery-related activities are engaged in by 29 per cent of the households and they contribute about 10 per cent of the total income and 8 per cent of the employment in the villages. About *70* per cent of the vessel owners who are nonoperators are involved in this. About 60 per cent of the households are engaged in nonfishery activities (factories, processing plant, labour, etc.), but they are not involved in agriculture.

The average total income of a fishing household is 30,000 RM/annum. Those households involved only in fishery-related or nonfishery income activities earn less than 12,000 RM/annum. Trawlers/trammel-net households get the highest average income (RM 24,550), followed by pushnetting crew (RM 23,693) and bagnet operators (RM 19,700). There are very little investment opportunities in this area.

There would be positive effects on the MSY and revenue of shrimp trawlers by eliminating the pushnet and bagnet fisheries. But if those affected fail to get alternative employment, about 21 per cent of the households would fall below the poverty line (mainly crew) even with their fishery related/ nonfishery activities and 7 per cent would find themselves with no income at all.

The shrimp resources appeared to be capable of sustaining the present level of exploitation and, perhaps, some increase also. The trammelnet fishery is very encouraging, judging from its economic performance; it is also the least destructive. Restrictions on other gear will encourage the expansion of this fishery. There are limitations to the improvement in the performance of pushnetters in deeper waters, even if regulations, such as on mesh size and fishing area, are introduced.

* US $ 1 = RM 2.5 appx.



3 Biosocioeconomic assessment of the impact of fish aggregating devices on the tuna fishery in the Maldives

Objectives

- Quantifying the benefits from the use of FADs.
- Assessing the impact of these benefits on the socioeconomic conditions of the fisherfolk.

Results

Bait fish aggregate overnight, but tuna generally aggregate after about three weeks. Fish which aggregate close to a FAD in the Maldives are juvenile Blue Trevally, Rainbow Runners, Dolphinfish and Triggerfish, while Skipjack and Yellowfin Tuna aggregate 50-500 m away from the FAD. Fish from adjacent areas are drawn to the FAD, affecting the non-FAD areas. The distance from which tuna can be effectively attracted to a FAD could not be estimated during the study.

The pole-and-line fishery with live bait being the predominant fishery in the Maldives, nearly 60 per cent of the catch recorded during the study was Skipjack, 30-35 per cent Yellowfin and 5-10 per cent small Tuna, Spanish Mackerel etc. The Yellowfin catch was higher near the FAD than away from it. Though few in number, the percentage of larger Skipjack also tended to be higher near the FAD, while smaller Skipjack were higher away from the FAD. Catch rate at the FAD was 5-50 per cent greater in number of fish and 5-97 per cent greater in weight near the FAD. This was probably because of the larger average size of tuna aggregating at the FAD.

The wide range in values of the catch are due to differences in distance from the island to the FAD and the sequence of arrival at the FAD. The cost of fabricating and deploying a FAD was US $5000. The cost of fuel consumed when fishing at a FAD was l/3 less than the normal fishing trip, due to reduction in the search time for Tuna.

The net earnings of a craft varied from 13 to 227 per cent (Rf 2200~9000*), depending on the location of the island in relation to the FAD – the greater increases being for islands closer to the FAD. One island showed gains very much greater than the others because its catch was usually sold at Male market, where the prices are many times higher than anywhere else in the country.

The cost of a FAD can be recovered by providing only five per cent of the gain in annual net income by each of the 8-10 craft that can efficiently fish around a FAD.

The socioeconomic study revealed that there would be about 14 per cent increase in the number of males on the islands, in the productive age classes, over the next ten years. But the preponderance of females calls for initiating income-generating activities for the large number of women in each household. Ensuring 100 per cent literacy should facilitate development of such opportunities.

Fish processing, to make smoked and salt dried tuna, is the only fishery-related activity, and incomes from it are Rf 400-800 a month. Nonfishery activities are in the tourist sector, agriculture, sewing, masonry etc., and incomes are Rf 100-3000 a month.

The survey was too soon after the initial deployment of the FADs to assess the impact. But interviews indicated that the gains were being used to improve conditions and facilities in the homes of the fisherfolk.

All craft-owners are willing to contribute to the cost of the FADs, but Government policy is to provide 50 per cent of the cost in order to enable greater access to FADs by every Maldivian fishermen. There are no conflicts among fishermen operating around FADs.

* US $ 1 = Rf 10 appx.

4 Biosocioeconomic study of the fisheries for small pelagics along the southwest coast of Shri Lanka

Objectives

- Assessment of the exploitation of the small pelagics by various fisheries and the effects such exploitation has on the income distribution of alternative management regimes.
- In-service training of national staff in the relevant aspects.
- Improving awareness among the fisherfolk of resources and management.

Results

Nearly 1000 craft are involved in the fisheries for small pelagics – using beach seine, gillnets, ringnets and purse seine. Beach seine primarily catch Anchovy (49 per cent), purse seine, mature Trenched Sardine (48 per cent); small mesh gillnet with motorized canoes and FRP craft with outboard engines, mature Trenched Sardine (15 per cent), small tuna gillnet, immature Frigate Tuna (42 per cent); and ringnet operated from motorized canoes also Frigate Tuna (86 per cent). The average catch rates for beach seines, purse seines, small mesh gillnet, small tuna gillnet and ringnet were 99.7 kg, 102 kg, 15 kg and 30 kg per operation, respectively.

There is very little interaction between gear. Beach seine catch of Trenched Sardines is very seasonal and is mainly of juveniles. Suspension of this fishery during the season (Nov/Feb/March) will improve recruitment to other fisheries. As the beach seine harvests more of the species not taken by other fisheries, it may be operated during other months targeting these species, provided that only a small percentage are immature.

Increasing fishing effort of the small mesh gillnet fishery will increase yield and economic value by 25 per cent and 50 per cent respectively. A 15 per cent reduction of mesh size will also improve the yield and value of the underexploited Trenched Sardine.

The small tuna gillnet and ringnet fisheries catch Tuna species and have no influence on the beach seine, gillnet or purse seines. However, their mesh sizes may be increased by 20 per cent and 30 per cent respectively to improve yield and economic value. Purse seine effort may be trebled to reach maximum sustainable yield and maximum economic value. However, the increase achieved will be small compared to the large increase in effort, which may also damage other species of immature sizes. Purse seine should target only Trenched Sardine.

Reduction in the purse seine effort would reduce the production of Trenched Sardine and Squid, which none of the other gear exploit effectively. If Trenched Sardine are exploited by gillnet also, then only motorized craft can cover the whole area of distribution. This would mean fewer fishermen being employed, as an 18ft FRP boat uses only two crew/craft. Both gillnet owners, would receive less income than if they had operated purse seiners.

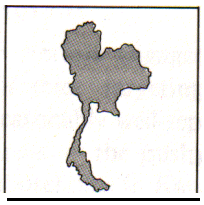
The ministry of Fisheries and Aquatic Resources banned the operation of the purse seine because of conflicts among those fishing for small pelagics. But the results indicative that the conflicts among fishermen are not a resource problem; it is mainly a social problem. There are around 75 villages, with about 28,000 households, in the area studied. About 80 per cent of these households are involved in fishing, 34 per cent of them owning motorized and or nonmotorized craft, while 48 per cent of them do not own craft and gear and work as crew or skipper.

Fishing activities earned SLRs 900-36,000* per unit a month, while crew income was about Rs 450-4200 a month for the different gear. None of the households are below the poverty line.

Fishery-related activities provide monthly incomes varying between Rs 3000 and 10,000. A wide range of nonfishing activities exists, providing incomes varying between Rs 12,000 and Rs 95,OOO/annum. Purse seine owners are engaged in higher income activities, except for a few beach seine owners who had invested in a cinnamon plantation which gives over Rs 100,000/annum.

There were a number of meetings with fisherfolk before and during the study to improve awareness and get better cooperation in conducting the survey. The results of the study are to be announced at a follow-up meeting organized with the help of the Ministry of Fisheries and Aquatic Resources.

* US $ 1 = SLRs 48 appx.



5 Biosocioeconomic assessment of the impact of artificial reefs (ARs) on the small-scale fisheries in Ranong Province, Thailand

Objectives

- Assessing aggregation and enhancement of resources.
- Assessing contribution towards management of fisheries and resources in coastal waters.
- Restriction of operation by very efficient methods, such as banning trawling in coastal waters,
- Reduction of conflicts among fishermen.
- Increasing opportunities for small-scale fisherfolk to improve their income from fishing.

Results

This case study was undertaken about three years after deployment of three ARs. The predeployment surveys were insufficient for reliable quantification of the changes. However, the age of the ARs indicated that the colonization would have stabilized. Of about 100 species of fish inside, outside and around the modules, 77 per cent were common to the natural reefs in the sea around; the rest, found only at the ARs, included Spotted Sicklefish, Longface Emperor, Johnius Snapper, Whiting, certain Trevally, Kingfish and Anchovy. They included a higher proportion of commercially valuable target species'.

Of the three ARs deployed off Ranong in 1989, only the southernmost one showed increased productivity, while the other two were relatively less productive because of their proximity to mangrove and estuarine outflows with heavy suspended matter, heavy sedimentation, high turbidity etc., all factors unfavourable for the colonization of ARs.

These conditions made it difficult to study the ARs visually underwater. But what underwater observations were possible indicated that the deployment system needed improvement to avoid haphazard positioning of the modules on the bottom and to achieve formation of the structure according to the designed layout. No serious influence or alteration of the environmental conditions' because of the ARs was evident. Organisms which almost entirely covered the concrete surfaces of the modules were seafans, sponges, worms, oysters, barnacles etc. Crawling among them were starfish, worms, crabs, seaslugs, snails etc. A later development was the proliferation of edible oysters. Biomass of organisms on the AR varied from 2500 to 14,800 g/m2 depending on the position on the module and the season.

Of about 20 types of fishing gear used by fishermen in the adjacent villages, trammelnet, squid trap, whiting gillnet, crab gillnet, grouper trap and scoopnet were the most popular at the ARs. There has been significant increase of these fishing gear after the establishment of the ARs, but such gear as mullet gillnet, kingmackerel gillnet, pomfret gillnet, otter trawls etc. have decreased. In all, gear units have increased from 568 to 1264. The potential for bottom-vertical longline, bottom longline and fish trap was evident.

Trawler operations have been reduced substantially in the area. Catch rates of squid traps appear to have increased by 265 per cent after the ARs were introduced. Similar improvements were indicated-for whiting gillnets, but trammelnets showed only a slight improvement. Trawl surveys at the location of the ARs by a Government research vessel, from 1988 to 1993, also

indicated an increase in the catch of squid, shrimp and demersal and pelagic fishes. Production almost doubled, but whether it was due purely to aggregation of the scattered resources or due to reduction in the exploitation by trawlers, contributing to increased availability to small-scale fisheries, is not clear. Total investment on the ARs in Ranong was Bht 15,700,000*. The southernmost one alone cost Bht 3,337,878 and the gross fisheries income generated in the two villages near it was Bht 11,901,249 in 1992. The other two ARs were not as rewarding.

The increase in the number of fishing households in the areas near the ARs has been higher than the increase of fishing households in Ranong Province as a whole. The number of trawlers in these fishing villages has decreased, while the number of small boats operating whiting gillnet, trammelnet and squid traps have increased after the installation of ARs.

Males of the productive age group 15-65 years form 43 per cent of the population here. All fishing households have fishing as the primary source of income – 61 per cent from only fishing, 15 per cent from fishing and fishery-related activities, 19 per cent from fishing and nonfishery activities and 5 per cent with fishing, fishery-related and nonfishery activities.

There has been a 26 per cent increase in fishing income in the villages adjacent to the AR (Bht 36,580 to Bht 46,083 per year) from the time of the 1986 BOBP survey. Most fishermen consider ARs suitable for small-scale fisheries and agree that they help to extend the fishing season.

* US $ 1 = Bhat 25 appx.

6 Biosocioeconomics of the shrimp fisheries in the Langhat District, North Sumatera Province, Sumatera, Indonesia

Objectives

- Assessment of the bioeconomics of the exploited shrimp stocks.
- Assessing the socioeconomic conditions of the fisherfolk engaged in shrimp fisheries.
- Determining any management measures to be taken.
- Training national staff in the application of appropriate methodologies .

Results

After trawling was banned in 1980, trammelnetting, shrimp gillnetting and set bagnet operations have been the main shrimp fishing methods. All are small-scale. During surveys in the period April 1992 - March 1933, only the Banana Shrimp *(P. merguiensis),* Tiger Shrimp *(P. monodon)* and White Shrimp *(P. indicus)* were studied.

In 1992/93, an estimated 34,745 t of shrimp were caught. This included a trammelnet catch of 1197 t *(P. merguiensis* 64.4 per cent), shrimp gillnet catch of *747* t *(P. merguiensis* 45.8 per cent) and set bagnet catch of 1547 t *(P. merguiensis* 16.8 per cent, other shrimp 59.6 per cent).

The fishing grounds for all three gear overlap very much. The size of shrimp species caught by these gear also overlap. This leads to competitive fishing among all three small-scale fisheries, causing conflicts and management problems.

Analysis shows that trammelnetting **alone** is capable of providing about 100 per cent increase in maximum sustainable yield and economic benefit from the catches of the three penaeid shrimp species. The fisherfolk in all three fisheries will be able to participate in the trammelnet fishery. The Banana Shrimp, having greater abundance than the other two penaeids, and the Tiger Shrimp resource being greater in depths beyond the presently exploited range, indicate that increased effort through a trammelnet fishery will be possible. White Shrimp, however, appear vulnerable to overexploitation, being less abundant.

Cost and earnings analyses show all three gear to be profitable, in most areas, but earnings in many of the fishing households are not large enough for a satisfactory standard of living.

Though only 3.4 per cent of the fishing households were earning less than Rp l ,000,000 per annum* (recognised as the poverty line), an income of Rp 3,000,000 appears to be sufficient for a fishing household to maintain a marginally satisfactory standard of living.

By increasing the size of the trammelnet unit, fishing depth range and soaking time of the gear and also by varying the mesh sizes of the panels used, according to the peak seasons for the species, the efficiency of the gear may be improved.

NOTE : This case study was affected by insufficient participation by skilled field staff during data collections, and, hence, the results are only of a preliminary nature.

* US $ 1 = Rp. 2000 appx.

Protecting the riches of the reefs

by A M Haghmd Heelas
(Socioeconomist)

The Maldives is known for its natural beauty – flat, round, palm-rich islands hemmed in by white sandy beaches, clear lagoons and coral reefs. But for how much longer? This tranquil, natural environment is coming under increasing pressure as the population grows larger and the number of tourist arrivals continues to rise, leading to higher levels of resource exploitation. The notion that the country's coral reefs need to be managed is at last maturing with the realization that the resources are not limitless.

Coral reefs are diverse, intricate and vulnerable marine ecosystems characterized by a complex interdependence of plants and animals. They are, therefore, exceptionally productive and a valuable natural asset. They are also an important tourist attraction. Any nation rich in reefs, or with access to them, like the Maldives, is, therefore, indeed fortunate.

The Maldives consists of some 1200 coral islands of which only around 200 are inhabited. These are separated by geographical constraints, such as inaccessibility and remoteness, but their inhabitants have adopted indigenous strategies to cope with the realities of their situation. Traditionally, the coral reefs have been of central importance to the Maldivians, who have always been dependent on their reef resources for fish, building materials and, more recently, foreign exchange. The significance of the coral reefs is, thus, understandably interwoven with the fabric of the local culture. It pervades rituals and is the subject of popular myths, tales and local history.

Economic significance

In the 1970's, the coral reefs of the Maldives suddenly gained major economic significance with the growth of the tourist industry. Scuba diving and snorkeling contribute substantially to tourism in the Maldives; healthy coral and an .abundance of reef fish have proved of great importance in attracting foreign visitors. But while the riches of the reefs helped to expand the tourist industry in the Maldives, the industry has also had an adverse effect on the country's reefs. As a consequence of a rapidly growing population and the speedy expansion of the tourist sector, more and more construction material has become necessary – and coral sand and nodules, the traditional building materials, are being extracted at a brisk rate.

Of particular concern is the fact that coral mining for building purposes has been destroying large areas of reefs.

This has resulted in fish and other denizens of the reefs being reduced. The islands are also in danger of losing the protection the reefs previously afforded them against the waves.

Overexploited resources

In the Maldives, tuna is the most important fishery resource. The majority of the catch is consumed locally, as most people, given a choice, prefer not to eat reef fish. At present, the country remains one of the world's few genuine pole-and-line fishing nations and the only country where this fishing technique supports a sizeable commercial industry involving the export of frozen and canned fish. But in recent years, exploitation of a number of reef resources has begun, almost exclusively to meet foreign demand. Currently,

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tourists and the salt drying industry are the primary users of the country's reef fish resources.

Until the last decade, the Maldives was without any apparent reef overfishing problem, but, now, signs of overexploitation of certain species are in evidence There is little information available to estimate the extent and severity of the overexploitation of coral reef organisms. However, it is obvious that persistent overharvesting of reef fish was likely to have significant economic and social implications for the islanders. Depleted reefs cannot provide supplementary incomes by way of sale of reef fish, nor would they appeal to tourists.

Reef management

The Maldives is now at a point in time when it is clear to most fisherfolk that the resources of their reefs are finite and can only produce a limited quantity of fish and other useful organisms. It is obvious that something must be done in order to maintain or enhance the potential of the current resource base. These new management challenges have to be met and new responsibilities accepted.

Fisheries management is often assumed to be a governmental responsibility. However, the effective capacity of government agencies to regulate what goes on in widely scattered fishing grounds is limited. This is particularly true in the Maldives. The territorial area is considerable, over 90,000 km2, and only a relatively small proportion of this area, about 300 km2, is dry land.

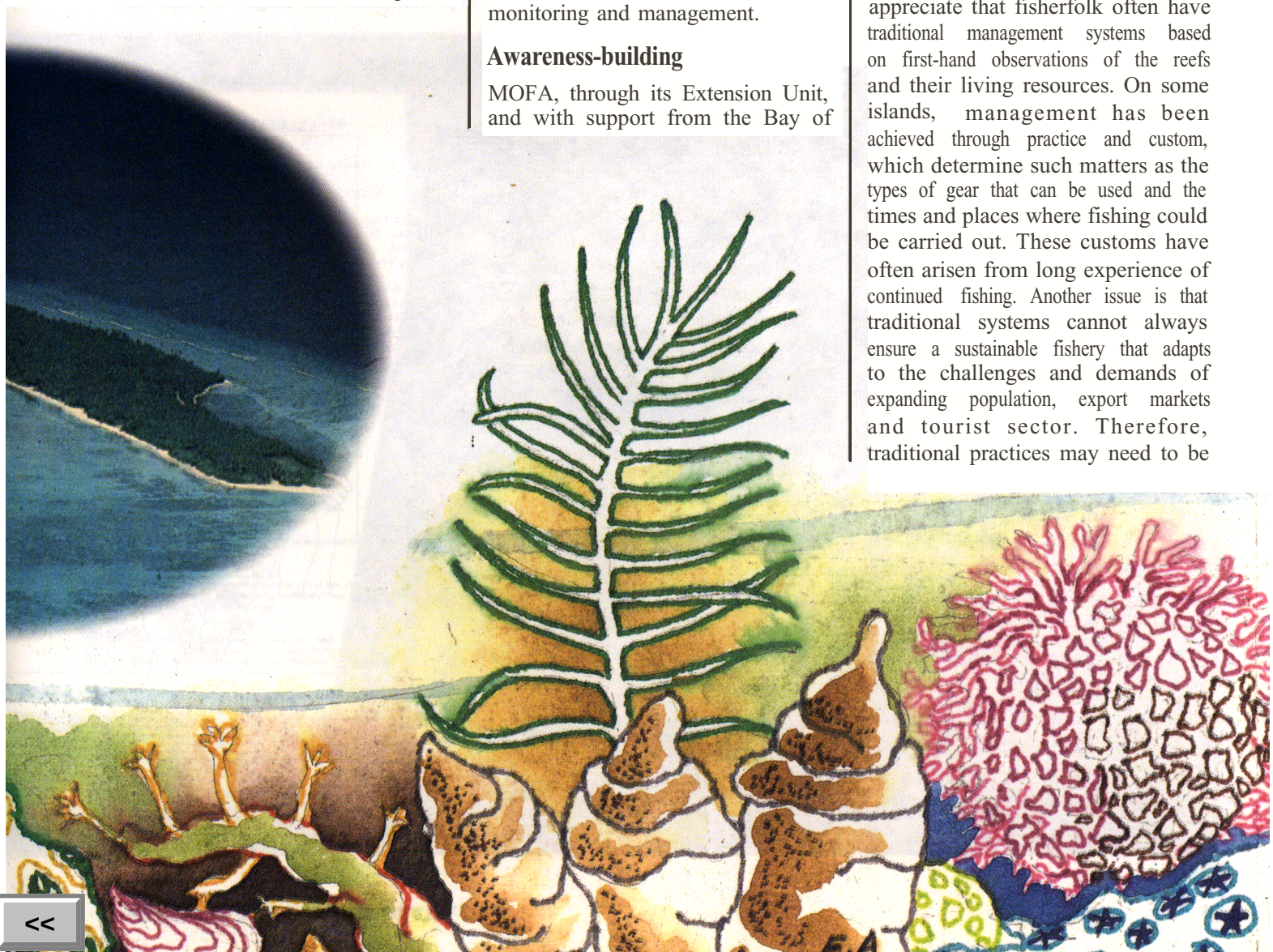
The Ministry of Fisheries and Agriculture (MOFA) is well aware that it cannot manage the reef and lagoon fisheries on its own, due to lack of time, geographical constraints and shortage of trained manpower. Instead, it aims at ensuring that the islanders are provided the knowledge and the support they-might need to locally manage the reefs more effectively. In other words, the Government will be responsible for making national management policy, while the fisherfolk, **with** government assistance, will be responsible for local monitoring and management.

Awareness-building

MOFA, through its Extension Unit, and with support from the Bay of Bengal Programme (BOBP), has been promoting an awareness-building campaign about the reefs and the critical state of beche de mer and giant clam stocks.

Work has commenced on two atolls in the south – Meemu and Vaavu. MOFA and BOBP have visited the project sites regularly for the last two years. Meetings and discussions have been held with the Island Development Committees (IDCs), encouraging the members to think about, and examine, the state of the reefs. Trying to find out how to exploit a limited reef resource at a sustainable level has been the major challenge. Meetings have often been characterized by enthusiastic participation and eagerness to learn more. Mutual trust and respect have been progressively built.

The campaign has been an ongoing process, constantly enriched and inspired by the interaction between the committee members and MOFA officials. It has also promoted the exchange of ideas and information. As a result, the officials have come to appreciate that fisherfolk often have traditional management systems based on first-hand observations of the reefs and their living resources. On some islands, management has been achieved through practice and custom, which determine such matters as the types of gear that can be used and the times and places where fishing could be carried out. These customs have often arisen from long experience of continued fishing. Another issue is that traditional systems cannot always ensure a sustainable fishery that adapts to the challenges and demands of expanding population, export markets and tourist sector. Therefore, traditional practices may need to be



adapted and management may need to be introduced where no tradition exists.

Although the fisherfolk are, to some extent, knowledgeable about their reef environment, they lack a more profound understanding about fish stocks and their interaction with the broader ecosystem. Consequently, the fisherfolk-Government partnership in the development of new management is perceived to be of utmost importance.

Through the awareness-building campaign, many of the fisherfolk in the target area have recognized the need for, and potential benefits of, effective management. They have suffered the consequences of rapid and uncontrolled fishing of certain species. As one fisherman stated: "If we had known more about the consequences of certain kinds of fisheries, we would have been careful from the beginning. But in order to use the reefs in a responsible way in the future, we need access to information and knowledge. We would like to learn to react to problems and pressures before they arise, not when it is too late."

Various media

The islanders' link with the outside world is mainly through the radio, which is an effective way of reaching a lot of people. Therefore, the central idea put forward during the awareness building campaign has been re-emphasized on the 'Fisheries Radio Programme', which is broadcast twice weekly and is popular among fisherfolk. The Voice of Maldives, in co-operation with MOFA staff, has produced several programmes on reef resource management. However, something heard on the radio might only be momentarily remembered. So MOFA staff now face the challenge of deciphering and presenting recent scientific research findings in an easy and accessible language and in a more permanent form.

Given the high literacy level in the country, MOFA and the IDCs have unanimously decided to use the medium of the printed word to convey the message of the reefs. Efforts have been devoted to developing a practical workbook, in consultation with the fisherfolk, which will help to generate an increased awareness of the dynamics of reef utilization and its consequences. Attempts have been made to cast scientific knowledge not only into ordinary language but also in practical terms recognizable to the fisherfolk. This is expected to prove an effective component in the reef management process, as it explains the principles from the Government's and the scientists' position.

A recent, island-based workshop, convened by MOFA and BOBP, provided the forum for thirty or so IDC members and a handful of Government officials to carefully consider the Dhivehi abstract of the handbook and discuss the islanders' role and responsibilities in the local management process. For the document to gain acceptance and be recognized as practical and workable, it was felt necessary that the participants should react to the handbook and air their views and ideas about it. As a consequence, the draft was scrupulously scrutinized and reviewed, chapter by chapter, and content, style, presentation and usage were debated.

Reaching children

Both the Maldivian Ministry of Fisheries and Agriculture as well as the islanders' agreed that greater awareness should be created among the children about the natural wealth they are heirs to. As the schoolchildren of today are the fisherfolk of the future, it was considered desirable to interest them in their environment as early as possible. But schoolteachers expressed concern about the paucity of books which could be used to teach the children about the reef environment. Consequently, MOFA, with Bay of Bengal Programme (BOBP) assistance, has developed a colouring-cum-activity guide book.

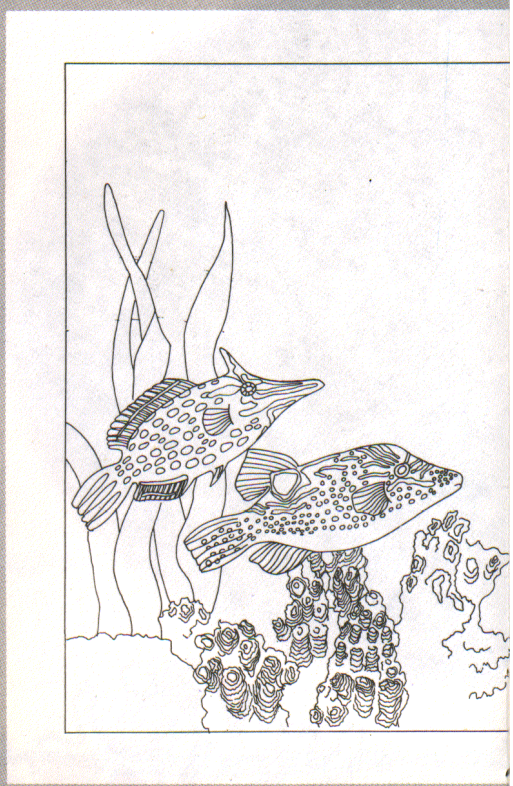
The main purpose of this book is to encourage the children to :

- Critically examine their natural environment;
- Note some of the impacts which humans can have on it;
- Consider what they can do to help safeguard the future of the coral reefs.

The book is so designed as to be used for different age groups in the classroom and on the beach.

Throughout the book, facing pages have, on one side, black-and-white, scientifically accurate, line drawings, which the child can colour, and, on the other, explanatory notes in both Dhivehi and English. The book can be used simply as a colouring book. Or it can be used as a lesson book. Or it can be used as an activity book, to be taken to the beach where the children can try to spot the different coral and reef organisms referred to.

— AMH



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Discussions were exceptionally lively and several recommendations were made.

Based on these suggestions, MOFA is now carrying out the necessary revisions. Pilot testing of the handbook starts in 1994 in Meemu Atoll, on all its inhabited islands. The extension unit staff is planning to visit the islands frequently in order to assist the IDCs with implementation as well as to gather feedback on how to further improve the document and explore possible ways which would assure a more effective execution of local-level management. Gradual implementation on all the inhabited islands is envisaged.

Data collection

Development of an action plan requires knowledge and understanding of the biological characteristics of the resource concerned and of the factors which relate to the past, present and future human use. Some decisions will have to be made in a climate of uncertainty, on the basis of incomplete knowledge and understanding. More data can be added later, but its immediate absence should not be used to delay decisions.

As part of the handbook exercise, an uncomplicated method to collect information and to compile and compare consistent catch data over a period of time has also been evolved. This should assist the fisherfolk in understanding the current status of the reefs as well as in the observation of changes or trends.

The date collection techniques suggested are simple and self-explanatory. The findings are meant to

- be used as indicators of the conditions,
- reveal opportunities and benefits, and
- raise warnings.

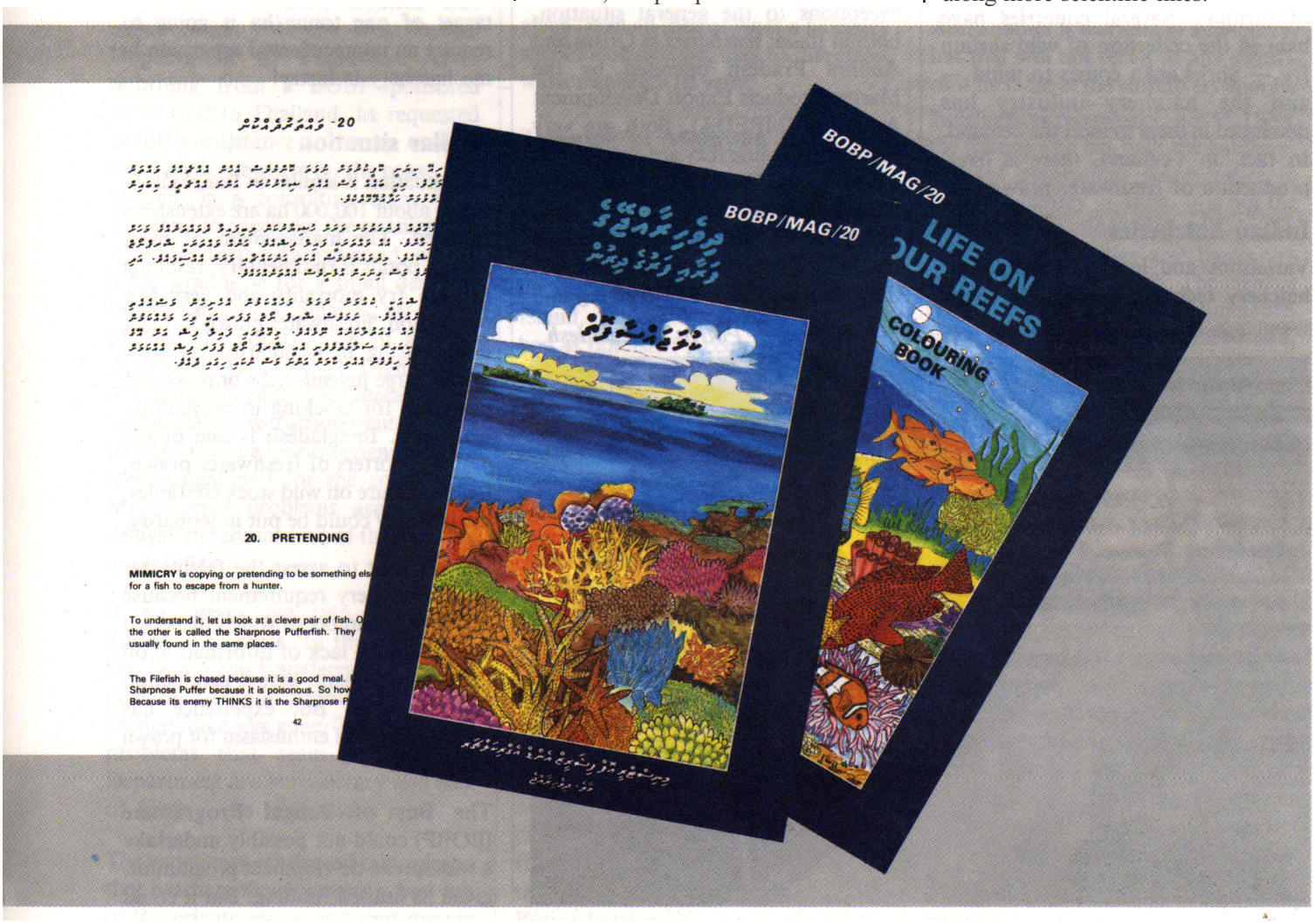
That is to say, when data indicate departure from what can be considered normal, simple preventive measures could be taken and MOFA alerted so that it can, if necessary, bring in more sophisticated techniques to investigate the situation in greater detail.

For school children

During the workshop it was also suggested that it would be appropriate to incorporate reef management and subsequent data collection into the Fisheries Science curriculum and teach it from Grade 6 and upwards. The older students could then be involved in the process of gathering information.

Other means of reaching children were also discussed and a colouring book-cum-guide to the reefs is one outcome (see box).

it is MOFA's firm belief that the islanders, who are most affected by coral reef degradation, and their children have sufficient motivation to protect their resources. MOFA's present BOBP-assisted activities are aimed at channelling that motivation along more scientific lines.



Small is Beautiful

Stimulating the Indian and Bangladesh private sectors to establish small-scale shrimp and prawn hatcheries

by C Angell,
(Sr. Aquaculturist, BOBP)

Modern aquaculture is built on a reliable source of 'seed', whether it be fish fingerlings, shrimp post-larvae or seaweed sporelings. Shrimp, prawn and fish culture in India and Bangladesh have a long history, but the industry developed in all of them on the back of natural production of the required seed stock. Wild fry supplies were adequate until aquaculturists began to intensify and expand production. Now, complaints of insufficient fry supply are becoming strident. And shrimp and prawn hatcheries have begun to develop in these countries to meet the demand for seed.

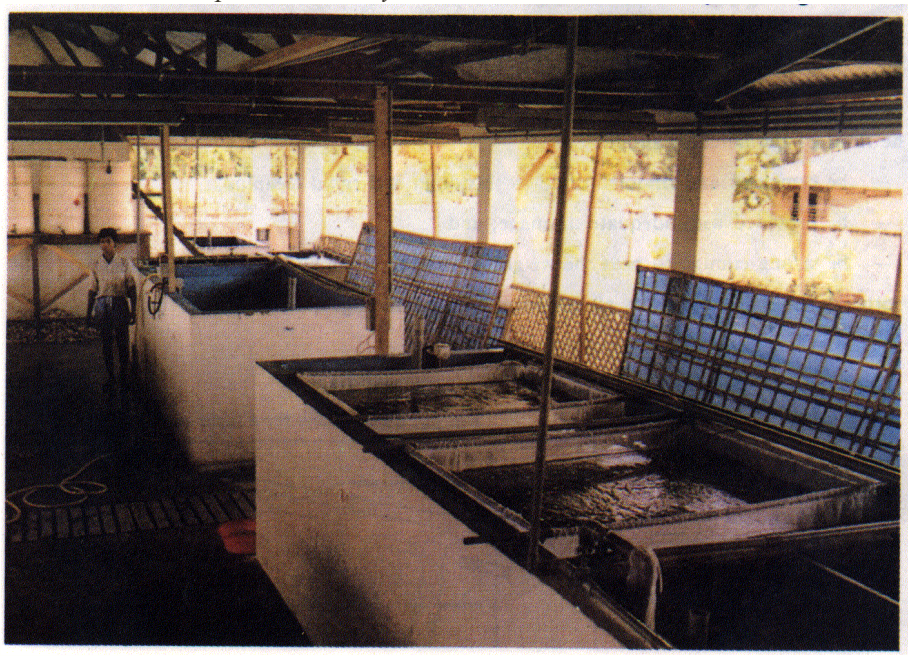
Shrimp hatchery research and development began decades ago in the ASEAN countries and the industry has grown apace there with the expansion of farming. Several countries have banned the collection of wild shrimp fry – Shri Lanka comes to mind – and the hatchery industry has developed in them to meet the demand. In fact, in Thailand, there is over-production of freshwater prawn fry.

Indian hatcheries

Variations and local adaptations of hatchery technology are only to be expected from country to country, and, indeed, this is the situation. But one commonality emerges – the hatchery industries of Thailand, Malaysia, Indonesia and the Philippines are basically small-scale. In India and Bangladesh, on the other hand, investment in hatcheries has, until recently, been in large, centralized facilities. Funding was often provided by international development banks. However, such installations are frequently beyond the capacity of fisheries departments to manage. When viewing the white elephants among them, I am reminded of Schumacher's famous axiom, "Small is beautiful"!

There are, however, two notable exceptions to the general situation, both in India: hatcheries in Orissa and Andhra Pradesh operated by the Marine Products Export Development Authority (MPEDA). Both are very successful because they are operated on a commercial basis and are not under departments of fisheries! Not only have these two hatcheries increased the reliability of shrimp fry supplies, but they have also served as training and demonstration centres. They are relatively large, having installed capacities of 40 and 80 million, respectively.

The small-scale prawn hatchery BOBP established in Potiya, Bangladesh



In their newsletter, *Aquaculture Drops for Farmers* (August 1993), MPEDA claims there are 70,700 ha under culture in India with a total production of 47,000 t. This works out to 665 kg/ha. But compare that with that of Thailand, the leading shrimp culture country in the region, which produces about 2,500 kg/ha! To raise the Indian figure to even one tonne/ha will require an increase in fry supply to around 850 million. This assumes an average harvest size of 40 g and 70 per cent survival from stocking to market size. Since the present supply of wild fry is severely stretched, even a modest target of one tonne/ha is going to require an unprecedented expansion in the hatchery industry!

Similar situation

The situation is similar in Bangladesh, where about 100,000 ha are extensively cultured. The management of most shrimp ponds is rudimentary, resulting in high fry mortality and very low production. Freshwater prawn farming is increasing in popularity, as well. Rather large juveniles, 2 g or more, are preferred for stocking in polyculture with carp. Bangladesh is one of the major exporters of freshwater prawn, but if pressure on wild stock continues, the industry could be put in jeopardy.

It is difficult to assess the freshwater prawn hatchery requirement because of the huge number of widely dispersed ponds and the lack of information on their management, actual production and potential. But experience has indicated a lot of enthusiasm for prawn hatcheries.

The Bay of Bengal Programme (BOBP) could not possibly undertake a widespread development programme, given its limited funding. But it could

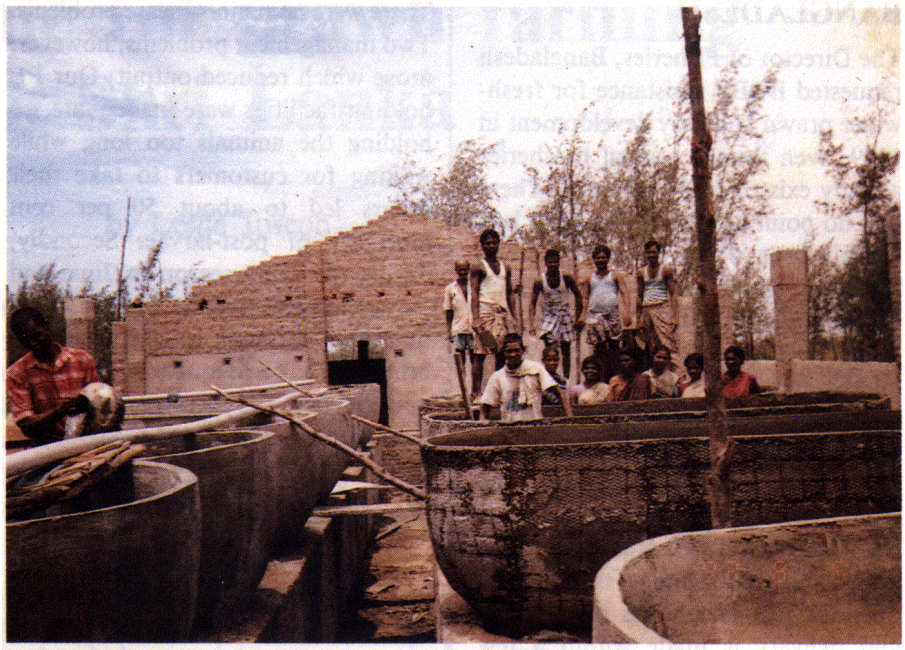
play a catalytic role in introducing and spreading small-scale hatchery technology through training and demonstration. That sounds familiar, but where we were different was in our direct approach to the private sector. Our efforts in India were aimed at tiger shrimp hatchery development and in Bangladesh we concentrated on freshwater prawn hatchery technology transfer. In response to a request for assistance in developing shrimp or prawn hatcheries in India, BOBP financed a demonstration hatchery with the DOF of West Bengal. Not unexpectedly, it wasn't successful. We then turned to the private sector. That was not very successful either. What happened in both instances is briefly described below. But fisheries officials in India and Bangladesh concurred with our suggestion that any effort would best be directed to the small-scale, private sector entrepreneur.

INDIA

The Assistant Director of Brackishwater Fisheries, R C Sen Gupta, was really the dynamo behind our collaboration with the West Bengal Department of Fisheries. After returning from a BOBP-sponsored study tour to Thailand, he requested BOBP's assistance to set up a small hatchery somewhere on the coast. We brought in a consulting team from Thailand to check out the possibilities. Although their plan was good, we felt it too grandiose for a small demonstration hatchery. Ultimately, we agreed to fund the construction of a small 'backyard' hatchery at Digha. The design developed by Sen Gupta seemed feasible and construction went forward in 1990. It was a new experience for the Department and for the contractor. Many small problems arose which delayed the completion of the hatchery until 1993!

It was never put into production during our tenure. In the meantime, Sen Gupta was transferred to another post (a perennial problem), and the driving force was gone. The overriding problems that seem to face the Department are bureaucracy and lack of funds – so what else is new?

The experience reinforced our opinion that hatchery development is best left to the private sector and that donors should work directly with entrepreneurs to develop the industry. In any event, several small hatcheries are coming up in Digha. Entrepreneurs have seen the results of larval rearing in the Department's small experimental hatchery and the BOBP-financed structure has given them an idea of what a hatchery should look like. So, may be, the effort wasn't entirely in vain!



The ferro-cement tanks in the prawn hatchery being built near Madras by one of the BOBP trainees

Training in Malaysia

In the case of the private sector, the Government of Malaysia agreed to provide training at its National Prawn Fry Production and Research Centre in Kedah, within sight of Penang Island. The centre can only be described as fantastic! Accommodation for trainees is excellent. And the experienced staff have conducted many international training courses. Needless to say, we were very pleased with the positive response from our Malaysian friends.

After placing advertisements in newspapers circulated along the eastern seaboard of India, we selected 18 interviewees out of over 300 applications. Very few could fulfil the financial and business experience criteria we had set. Eight of the interviewees were selected and headed for Malaysia in May 1992 for their training. Two other applicants were slated for freshwater prawn hatchery training, but it proved difficult finding places for them. Ultimately, we trained them in Bangladesh at our Potiya hatchery.

Most of the trainees were from Tamil Nadu, two were from Andhra and the freshwater hatchery participants were from Orissa and West Bengal. Frankly, the result was rather disappointing. To our knowledge, only one of the trainees has built a hatchery! And another is working in a hatchery, but that will not result in any significant increase in the shrimp fry supply.

Judging from the experience of Ms Usha, the trainee who has built the hatchery, it takes tremendous perseverance to build a hatchery in India. It is not the actual construction – that's simple. But local authorities and banks are very difficult to deal with. The investor is working on a stringent timetable. Once a decision is made to go forward, things have to move. It's no news to our readers that officialdom has a totally different timetable! Perhaps the rest of our trainees were discouraged when confronting the bureaucratic tangle. We don't really know for sure. Anyway, the private hatchery that has come up will, we're sure, be a very good model. It was designed by Ms Usha herself, and her husband, who is an engineer. She used the knowledge gained during her training in Malaysia to develop a facility adapted to local conditions and scaled down to her budget. Pavithra Hatcheries is located about 90 km south of Madras on a sea beach with excellent water quality, so good results are anticipated when Ms Usha gets the facility into production.

BANGLADESH

The Director of Fisheries, Bangladesh requested BOBP assistance for freshwater prawn hatchery development in 1989, even though several hatcheries already existed in the country. There was no point in duplicating what had already been done, so we agreed to introduce inland hatcheries which would not require direct access to seawater. Even though freshwater prawns inhabit rivers and flood plains, their larval stages require brackishwater. Such inland hatcheries are widespread in Thailand and the supply of brine from saltpans along the Gulf of Thailand coast is well-organized. Brine is available year-round — the hatchery operator just telephones his supplier and delivery is made within a few hours. In contrast, brine is available only during the dry winter months in Bangladesh. This means the hatchery has to store sufficient quantity for the entire rearing season. Recirculating systems are the only practical way to employ brine when the supply is limited seasonally.

We surveyed possible locations and asked UBINIG, a Bangladeshi NGO, to study the fry-marketing situation in Patuakhali and Chittagong. Although demand for fry was good in both places, the Chittagong market was better organized and would present fewer difficulties. We finally settled on the Fish Seed Multiplication Centre at Potiya, a few kilometres south of Chittagong.

The DOF had also requested that we staff the hatchery as well as build it! At the time we started the activity, one private hatchery was operating in Cox's Bazar so we were able to train there two young biologists who were to work in the Potiya hatchery.

The hatchery went into production in 1991. The system proved capable of producing post-larvae (PL), but we had severe disease problems and were way off our target. However, crucial experience was gained in the management of a recirculating system and we went into the 1992 season feeling confident that PL output could be raised.

PL production during 1992 reached 18 per litre, which is about average globally. Survival was fairly consistent in the batches, averaging 27 per cent. There were no major disease problems. Two management problems, however, arose which reduced output. Our PL holding facilities were inadequate, so holding the animals too long while waiting for customers to **take** their orders led to about 50 per cent mortality of post-larvae. Secondly, during the rainy season in June and July, pond and river levels are so high that it is difficult to catch enough broodstock. Consequently, we could not complete the three rearing cycles we had planned.

Private sector

The 1992 season saw our first attempts at training. Nine government officers, mostly managers of fish seed centres, attended a series of 10-day courses. The results showed the commercial potential of small-scale recirculating hatcheries and we felt confident enough to embark on a private sector promotion programme in 1993.

The objective of the activity was to transfer the technology to the private sector through training and technical support. Candidates were sought through newspaper advertisements. Out of 160 applicants, 18 were interviewed. Ultimately, four were selected. Each participant agreed to construct a hatchery on his land in return for training and technical support in the form of advice and equipment.

The Potiya hatchery was in full operation during the training. Each trainee was given a tank to manage under the supervision of our hatchery staff, Rafiquel Chowdhury, Hironmoy Battacharjee and Shadat Hosein. Three cycles were run with survival ranging from 39 to 49 per cent and PL production averaging 21 per litre, but reaching as high as 33. The first batches of PLs suffered high mortality while waiting for our largest buyer to take delivery, but, after improving coordination with the buyers, it dropped to near nil.

After completing a 35-day course at Potiya, three of the participants undertook hatchery construction almost immediately. One of them is a family operation which has a highly successful carp hatchery near Mymensingh. Their hatchery actually went into production this season. Bacterial necrosis was a severe problem, but, after bringing the disease under control, Jalak Prawn Hatchery sold some PLs. They're looking forward to a successful season in '94.

Proshika is an NGO involved in small-scale fish farming. They wanted a dependable source of fry to supply their 800 farmers. Although their hatchery was completed by September, the larval rearing season was almost over. Everything is ready for start-up next year.

Crescent Farming Complex has been rearing carp, African cattish and dairy cattle. The company knew that freshwater prawns would be a valuable addition to their pond production. But they wanted a dependable source of fry for both stocking their ponds and selling to neighbouring farms. Heavy rains and localized flooding damaged their access road, so construction was not completed until late in the year. Crescent, like Proshika, will be starting up next season.

The fourth company, Catalytic Inc., was set up in collaboration with a non-resident Bangladeshi. The company acquired a site just south of the Potiya hatchery, but had not started construction by late '93. They will have to hurry to be ready for the '94 season which starts in late March!

All things considered, the objectives in Bangladesh were achieved, in that the private sector has now taken up inland freshwater prawn hatchery technology. It will take several years to work out the 'bugs', but the industry has 'gotten' the spark it needed.

Seeds sown

While the BOBP's initiatives in prawn and shrimp hatchery development were not exactly roaring successes, they did stimulate the small-scale entrepreneurs and demonstrated to governments new opportunities. BOBP did, thus, prove a catalytic influence. Next year and 1995 will show how successful that influence has been.

Boom time for prawn farming in Shri Lanka

by Leslie Joseph

Brackishwater culture never had it so good in Shri Lanka! In the Northwestern Province, large extents of land have been cleared and prawn farms have sprung up on them. Commercial-scale prawn fanning, which began in the early 1980s, has continued to grow unabated, and, a decade later, the Ministry of Fisheries and Aquatic Resources (MFAR) still receives two or three new applications a week, seeking approval for new ventures.

Although the boom had its beginnings just over a decade ago, Shri Lanka's foray into brackishwater culture began much earlier. The government set up a brackishwater research station in Negombo in the late *1950's* and a second one in Chilaw in the 1970s. These two stations initially concentrated on the promotion of milkfish *(Chanos chanos)* culture. The fry collected from the wild were reared to fingerling stage in the two stations before distribution to farmers. Under the MFAR pond subsidy scheme, the eleven milkfish farms operating in 1981 increased to *58* in 1987, producing 6.6 t of milkfish.

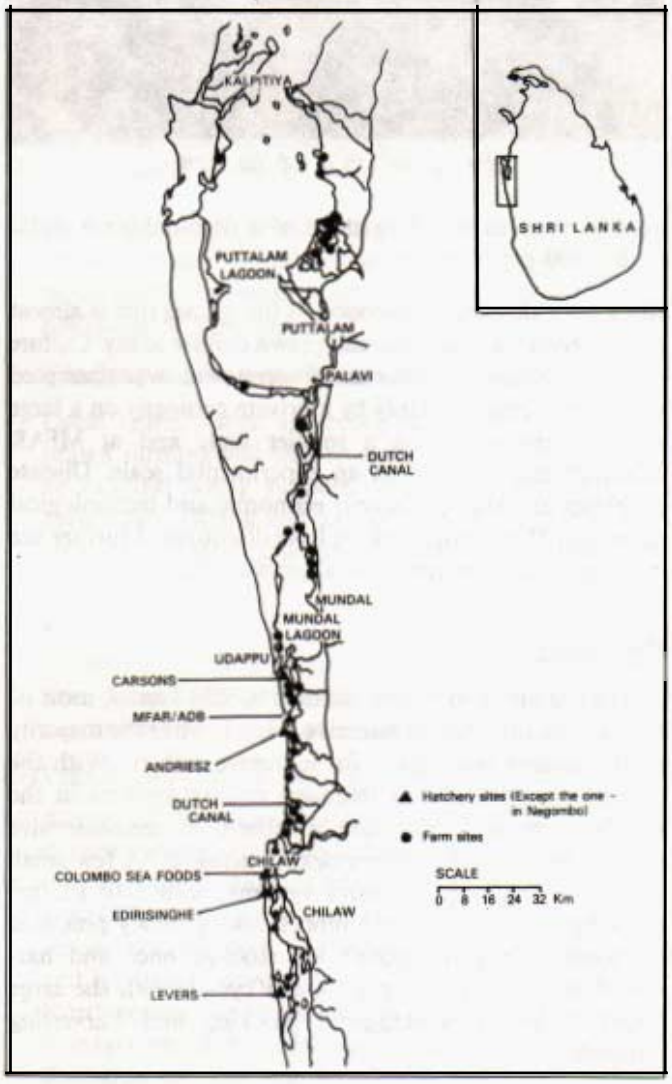
In more recent years, the two stations have engaged in producing post-larvae of the giant freshwater prawn, *M. rosenbergii,* for sale to small-scale pond farmers. Withdrawal of state patronage to inland fisheries and aquaculture since 1990 has resulted in the closure of these stations and a halt to such activities. Culture of bivalve molluscs *(Crassostrea and Perna* sp.), seaweed *(Gradilaria* sp.) and mud crab *(Scyila serrata)* are still in an experimental stage.

The farms

All existing prawn farms are located in the Northwestern Province. However, prawn farming in Shri Lanka actually began on the east coast. A small farm began operations in Batticaloa in the late 1970s. The Government, realizing the potential of such development, offered various incentives, including tax benefits. The banks were also willing to give loans. These enticed some small-scale entrepreneurs and a few large multinational companies into prawn farming in the early 1980s. Civil disturbances in the North and East around this time put paid to the pioneering venture in Batticaloa, but the development was rapid on the northwestern coast.

Of the 64 farms approved by MFAR, upto mid-1993, 39 have been developed, the pond area under water being *527* ha out of the approved total of 1325 ha (see table alongside). All farms are constructed on land categorized as shrubland, mangroves and sparsely used cropland adjoining brackishwater areas. Most of this land is marginal for agricultural development and is lowlying. The MFAR classifies all farms less than 4 ha as small farms and those above 4 ha as large farms. In addition to private land, MFAR allocates, to prospective farmers, Government land

Distribution of shrimp farms and hatcheries in Shri Lanka



Prawn farms (categorized by size) and area cultivated

		Govt. land	Pvt. land	Total
No. of farms approved		37	27	64
No. of farms developed		20	19	39
Pond area approved (ha)		1124	201	1325
Pond area developed (ha)		440	87	527
Farms categorized by size	4 ha	5	15	20
	4-10	11	8	19
	10-20	8	3	11
	20-30	5	—	5
	30-40	5	—	5
	40-50	1	—	1
	50-60	—	1	1
	200-300	2	—	2
		37	27	64

Two ponds in a 1.6 ha farm

on a 33-year lease and payment of a nominal lease rental of Rs. 500 per acre.

Black tiger shrimp, *P monodon,* is the species that is almost exclusively used in commercial prawn culture today. Culture of white shrimp, *P indicus* and *P merguensis* was attempted in the early 1980s, notably by a private company on a large scale, a few others on a smaller scale and at MFAR brackishwater stations on an experimental scale. Disease problems and the subsequent economic and technological success of *P monodon* culture have discouraged further use of these species in commercial prawn culture.

Operations

At the beginning of prawn farming in Shri Lanka, most of the large farms adopted intensive culture, while the majority of the smaller ones opted for extensive culture. With the outbreak of diseases in intensive culture systems in the mid-'80s, most farms have switched to semi-intensive culture, with 15-20 PL/m^2 stocking densities. A few small farms still maintain extensive systems, with 5-10 PL/m^2 stocking densities. The common stocking policy practised is monostocking (all ponds are stocked once and harvested at the end of the grow-out cycle), with the large farms following a staggered stocking and harvesting schedule.

The farms maintain a water depth of 0.75-0.9 m and depend on aeration with paddle wheels (4-8 per ha). Exchange of water in grow-out ponds usually increases from 10-15 per cent during the first months to 30 per cent during the last month. All farms depend on imported formulated feed, except for one company which manufactures a complete pelletized formulated feed for use in its farms and for sale to small farmers. Its share of the market is reported to be around eight per cent; the rest is imported, mainly from Taiwan. The food conversion rate is estimated at 1.8. Some of the small farmers have achieved a rate of 1.4-1.5. Harvesting is done 3-4 months after stocking, at an average size of 35-40 g.

Hatcheries

The seven operating hatcheries provide all the post-larvae for the industry. Six are located in the Northwestern Province, while the seventh and the oldest is in Negombo, in the Western Province. All except one are privately owned. The hatchery constructed by the MFAR with assistance from the ADB (Asian Development Bank) has remained closed since 1991, pending sale, following MFAR's withdrawal from aquaculture.

All the hatcheries produce *P. monodon* post-larvae and their combined rated capacity is 160 million post-larvae per year. Current demand is assessed at 120 million per year. However, due to various reasons, there are still occasions when farmers do not get their requirements in time. The production during the first six months of the current year is estimated at 32 million. Irregular and short supply of brooders is recognized as the main cause for the poor performance of the hatcheries. Disease is another reason. All brooders are collected from the wild. They are purchased from fishermen at Rs. 450-500 per gravid female and Rs. 200-300 per mature male/female. A private company is now attempting to produce broodstock from land-reared prawns, to reduce reliance on wild broodstock.

The most common disease now prevalent in the hatcheries is the attack on post-larvae by the ciliate ecto-commensels, *Vorticella.* Mortalities are also reported due to fungal, *Leginidium,* attacks. Large hatcheries earlier faced significant post-larval mortality due to bacterial attacks, mostly *Vibrio* sp. This problem is reported to be under control now, with the adoption of better hatchery husbandry practices.

Production and marketing

The volume and value of shrimp exports from 1984 to 1992 are shown in the table below. Exports have declined since 1989. Over the past six years, shrimp have been the most important single item of seafood export, accounting for 56 per cent of the total volume and 66 per cent of the total value. Since all farmed prawns are exported, it can be assumed that less and less wild (captured) shrimp and prawns are being exported in recent years. No information is available on the proportion of cultured prawns in the total shrimp exports in recent years; this is perhaps a consequence of the disbanding of the Inland Fisheries Division of MFAR. However, a 'guesstimate' is around 950 t of cultured prawns exported in 1992.

Production of shrimp from marine capture fishery and brackishwater culture, and volume and value of shrimp export

Year	*Shrimp production from capture fishery*	*Shrimp production from brackishwater culture*		*Shrimp exports*	
	Qty. (t)	Qty (t)	Value (Rs. 10^6)	Qty. (t)	Value (Rs. 10^6)
1984	4081	10	1.5	2600	n.a
1985	4192	50	8.5	1648	303.3
1986	4311	200	40.0	1973	427.9
1987	4461	375	88.0	1231	339.1
1988	4635	500	200.7	1826	526.8
1989	4704	600	n.a	2598	767.2
1990	4469	500	n.a	1855	472.8
1991	5176	n.a	n.a	943	454.0
1992	6470	n.a	n.a	1246	613.1

Source : Siriwardena (1990), Planning Division, MFAR

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Exports are mainly to Japan (70 per cent), USA (13.5 per cent) and Europe (16 per cent). Of the 29 registered seafood exporters in Shri Lanka, nine are involved in shrimp exports and five of them also possess processing facilities. Exported shrimp comprises of 75 per cent frozen/headless/shell-on, 10-15 per cent frozen/head-on/shell-on and 10-15 per cent frozen/headless/peeled and de-veined.

The economics

The economics of prawn farming are very impressive indeed. The production cost of one kg of prawns of 35-40 g average weight is Rs. 200-250*, of which 50-60 per cent is spent on feed. The current sale price is 350400 Rs/kg. Most farms achieve a production of 2.5-3 t/ha in one culture cycle. The total cost of developing a one hectare pond (land, pond construction, equipment/machinery, seed and feed, labour etc.) up to the completion of the first culture cycle is estimated at Rs. 1 million. Such projects start to pay off from the first year.

Regulation and monitoring

The development of prawn farming is regulated and monitored by MFAR through an interministerial scoping committee. It is made up of representatives from 10 or 11 agencies/institutions. Scoping committee approval is required for all farms above 4 ha. In the case of small farms less than 4 ha, the provincial fisheries administration will coordinate this activity. Under the amended National Environmental Act, No. 47 (1980), of the Central Environmental Authority, MFAR is the Project Approving Authority (PAA) charged with ensuring the availability of high-quality enviromnental information in development activities related to fisheries and aquaculture. The PAA can call for an IEE (Initial Environment Examination) or an EIA (Environmental Impact Assessment) from the prospective farmer. EIAs are required for projects likely to have significant impacts on the environment. Scoping committee approval is granted only after successful completion of an IEE or EIA, which may include a public hearing process.

Constraints

A number of technological, social and environmental issues or constraints have surfaced in the Northwestern Province as prawn farming expands. These include :

TECHNOLOGICAL CONSTRAINTS

- Insufficient supply of fry. The actual production in hatcheries is below capacity and irregular due to reasons already stated. A few more large-scale farms plan to build their own hatcheries. Development of pond-reared broodstock is still in an experimental stage.
- The industry is almost entirely dependent on imported feed, which represents 40-60 per cent of the total operational cost.
- Diseases, such as black//browngill syndrome, bacterial infection *(Vibrio),* viral MBV infections and ectoparasitic infections are common in hatcheries and grow-out ponds.

SOCIOECONOMIC CONSTRAINTS

- User conflicts between large-scale entrepreneurs and small-scale farmers for scarce land and the sharing of water resources.

* US $ 1 = SL Rs. 50 appx.

Water exchange in one of the ponds in the 1.6 ha farm

- For reasons of security, large farms almost always employ labour from outside the area. Employment opportunities for locals in prawn farming are, therefore, negligible or non-existent.
- Poaching is also a widespread problem.
- Local communities are concerned that expansion of prawn farming will lead to salination of drinking and agricultural water supplies, and threaten traditional agriculture, fishing and animal husbandry practices as well as village expansion and other development activities.
- Prospective farmers are often required to develop infrastructure facilities on their own. In remote farm sites, the cost of supply of electricity could be prohibitive, particularly for small-scale farmers.

ENVIRONMENTAL CONSTRAINTS

- Almost all the farms (big or small) in operation along the northwestern coastal belt depend on a common water source – the Puttalam Canal (the Dutch Canal). There is already concern that pollution in the canal system is beyond optimal levels. A major feature in the unplanned and haphazard development of shrimp farming in the Northwestern Province is the absence of a water management/distribution plan. The impact of effluent discharge too has not been fully monitored. Heavy sedimentation is also reported in the water source.
- Destruction of large extents of mangrove and interference with irrigation and drainage systems are also matters of concern.

Expansion to other areas

The total extent of brackishwater areas in the country has been estimated at 120,000 ha, consisting of extensive lagoons, tidal flats, estuaries, mangrove swamps etc. The shallow lagoons, mangrove swamps and saline marshes, estimated around 6,000 ha, represent potential areas for aquaculture. With an improvement in conditions in eastern Shri Lanka, large areas suitable for prawn farming would be made available for the industry. The MFAR has already received proposals for two farms from the south coast. The experience gained and the lessons learnt over a decade of prawn farming in the Northwestern Province will come in handy when the industry expands to other areas.

POLEKURRU REVISITED

BOBP's Senior Aquaculturist made a return visit in late 1993 to the site of a demonstration pond complex in Andhra Pradesh, India. In this article, CHARLES ANGELL reports on the shrimp culture boom underway around this complex.

Shrimp farmers in India are taking off long after the starting gates opened in the ASEAN countries, but at the rate they're going, they won't take long to catch up!

If anyone doubts the benefits of the new liberalized investment policy in India, a trip to Polekurru, in Andhra Pradesh, would be illuminating. The shrimp culture 'boom' along the coast of Andhra Pradesh today owes much to easier investment and import procedures that are a far cry from the situation back in 1980 when the Bay of Bengal Programme (BOBP) began its involvement with shrimp culture demonstration at Polekurru.

I visited the site of the former BOBP project for the first time in 1986. The State and Central Governments were beginning to perceive coastal aquaculture, particularly shrimp farming, as an avenue to better income for coastal dwellers. A few schemes for poverty alleviation through shrimp culture were already in operation, others were on the drawing boards. Some private projects had also been initiated. In fact, a pump-fed farm had been operating for five years, its owner Mr Damisetti Sathiraju, a real pioneer.

But all these budding attempts at shrimp culture relied totally on very seasonal wild fry collection. In those days, there wasn't a hatchery to be seen along the entire coast of Andhra Pradesh and Orissa.

The scene has dramatically changed, with shrimp ponds everywhere in the area now and still more being built. Mechanical hoes are being used to build ponds as fast as possible. And hatcheries have come up and continue to come up.

Reasons for change

Two developments have helped to spur the industry's take off. The lack of quality feed had been a major constraint faced by shrimp farmers all along the coasts of the country in the early days. But now, thanks to encouragement and support from the Marine Products Export Development Authority (MPEDA), feed can be imported free of duty. The increasing rate of growth of shrimp culture has sparked the interest of several major feed mills in Thailand and Taiwan. Feeds manufactured by Gold Coin and President of Taiwan, CP and Aquastar

Catching fry with pushnets in the becalmed waters of the Bay of Bengal near Kakinada

of Thailand and one or two Japanese manufacturers are now available in the country. The second development is that, as shrimp landings from the capture fishery continue to decline, processing plants are beginning to compete for cultured shrimp. To get an edge, several of them advance feed to farmers, even at a 10 per cent discount, in a buy-back arrangement.

Most of the farms S B Sarma, Fisheries Inspector, took me to a adopt a conservative approach to management, stocking at low rates ranging from 15,000 to about 30,000/ha. Although the full potential of the ponds may not be realized, the farmers are well aware that low stocking markedly reduces their risks, while providing an acceptable margin of profit. The farmers can harvest two crops during the year, but yields seemed to vary widely from one farm to the next.

Several farmers were interviewed and reported results as shown in the table below. During some visits, supervisory staff were not present and it was not possible to get any details of investment cost and financing arrangements. Management practices were similar among the farms. The average production cost was around IRs 100* per kg.

Availability of fry

Farmers use fry from both hatchery and wild sources. Survival of TASPARC** and OSPARC*** fry has been good, but fry supplied by a hatchery near Madras gave poor results, possibly due to the quality of transport or packing arrangements.

The fry market in Kakinada

There is usually considerable variation in these arrangements among hatcheries, reflecting the range of management skills of the respective staff.

Wild fry invariably outperform hatchery PL's. The astronomical prices, up to 1500 IRs/thousand during the peak stocking season, reflect the farmer's strong preference. Sales are so brisk at this time of the year that sorting is perfunctory at best. Some farmers are already complaining of pest species that contaminate their fry purchases. In comparison, hatchery fry sell for around IRs 200!

As more hatcheries come up around Kakinada, production should increase. And hatcheries are coming up quickly! Although we were denied admittance to a few, we were able to observe several, including one just beginning construction and another under construction. Sri Aquaproducts has located its 50-million capacity operation on a beautiful beach just north of Kakinada. The hatchery cost IRs 50,000,000 to construct, and employs one technician and 15 assistants. The hatchery is modelled after the TASPARC facility operated by MPEDA. Seawater quality should be excellent. Cónsultancy services were provided by a local company. We could only observe Keijan Aquatec's hatchery from a distance, but were informed that the planned capacity is 50 million. Kalyana Seafoods is

Profiles of some typical farms around Polekurru and Kakinada

No.	Water surface (ha)	Stocking rate (no./ha)	Yield (kg/ha)	Feed	Ownership/Financing
1	45	50,000	800-900	CP	Private, state bank loan. IRs 12,000,000 investment cost.
2	24	20,000	520	Aquastar	Private, IRs 3,000,000 investment cost. MPEDA subsidy.
3	22	25,000	600	Waterbase	Private, Cooperative bank loan.
4	25	15,000	200	Doughball	Scheduled caste estate.
5	11	20,000	550	CP	Private, IRs 640,000 investment cost. Finance from informal sector at 36% interest.
6	6	30,000	200	CP	Private, MPEDA subsidy. Bank loan.
7	3	30,000	150	Local	Centrally sponsored scheme.
8	12	200,000	1250	Hanaqua	Private intensive culture using high salinity water.

* US $ 1 = IRs 31 appx; ** The Andhra Pradesh Shrimpseed Production and Research Centre *** Orissa Shrimpseed Production and Research Centre

building a freshwater prawn hatchery, but we were not able to get a look at it. Sri Aquafarms is constructing a 100-million capacity hatchery as part of its vertically integrated farm in Palmanpat village. Judging from the present trend of hatchery construction around Kakinada, a small-scale demonstration hatchery would probably stimulate a lot of interest.

Fry collection and marketing

Seed collectors are prospering, too! Sarma estimated the increase in their ranks by estimating the number of nets which could be made from the netting material sold in Kakinada. Since there are only a few shops which sell it, his estimate of *50,000* new collectors in 1992 is probably close! Many tailor shops are now exclusively stitching nets — no time for fashion! Fry-catchers use both stakenets and pushnets and fish in shallow water in the open sea. We saw men, women and children working their nets. Women and children generally use the small pushnets. They can catch up to 2000 fry a day in the peak season, but the average is about 1000 per day.

The marketing system is much better developed than in West Bengal. Oxygen packing is used in all the centres because fry have become so valuable. We visited market centres in the off season, October, and the price of fry was ten times that in West Bengal! There are many small centres where the brokers dig a pit of several cubic meters volume in which they suspend a *happa.* These brokers sell to farmers and other middlemen from West Godavari District. Gangaraju, one of the brokers at the Godavari Fertilizer Creek market, told us that he sells *50,000* fry daily during the peak season, but sales drop to 10-15,000 in the offseason. He holds fry in the *happa* for 1-5 days, but mortality is about 10 per cent daily. On top of that, there's transport mortality, Gangaraju figures it at 10-15 per cent.

Polekurru farm

What of the BOBP demonstration farm on Polekurru Island? Did it have any influence on these developments? According to D S Sharma, Deputy Director of Fisheries, Brackishwater, the project was, and is, an important centre for training and demonstration. More than 200 government staff and farmers have learned the basics of shrimp farming at the facility. Since BOBP days, the DOF has improved the site, installing a modern pump station. Most of the participants in government-supported schemes for disadvantaged groups have trained at the farm. Sharma says the main problem now is funding. The farm could play a much greater role if only the minimum financial requirements were available.

When I first visited Polekurru, the participants in government-funded schemes were having problems managing their operations. The situation has improved considerably, with the widespread use of pumping, the costs of which are shared by participants in the various schemes, and the ready availability of feed on buy-back arrangements with processors.

The other side

But there is another side to all this. Proliferating shrimp ponds have raised environmental concerns and caused social tensions in almost every country in the region. Sadly, there are no baseline studies in the East Godavari District on which to establish a monitoring programme. A guesstimate is that about 10 per cent of the new farms are constructed on agricultural land, mainly rice paddies. Many farms are built in the upper reaches of the intertidal zone where negative impacts may be minimal: But there are reserved mangrove forests, particularly around Polekurru Island. Vigilance will be required to prevent encroachment. In the absence of a coastal zone management plan, the mistakes of an earlier age are likely to be repeated.

Sharma rightly expresses concern at the explosive development. He foresees possible pollution problems, but there is no regulatory framework within which to encourage rational development, he points out. Indeed, I observed several farms which were experiencing disease problems caused by low salinity stress. Many farms are served by inadequate drainage and water supply canals; in fact, several of them often use the same canal for both purposes! These are design and siting problems which are well known sources of disease and crop failure.

Growth and protection

The industry is still young and shows promise in and around Polekurru. Most of the input constraints are on the way to solution. Yet, there are intimations of problems in siting and farm management. Now is the time for the Fisheries Department to work hand-in-hand with farmers to upgrade skills as well as evolve a rational coastal zone plan which will encourage healthy growth of the industry, while protecting the environment on which it ultimately depends.

Nursery ponds built by fry-catchers near Kakinada

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Awareness campaign for cleaner fishery harbours

BOBP's experience in promoting cleaner fishery harbours is from implementing pilot projects, supported by the International Maritime Organization (IMO), in Vishakhapatnam, India, and Phuket, Thailand. Both projects served to upgrade reception facilities for garbage and oily wastes – the two main pollutants in fishery harbours. More important than the projects themselves have been the learnings from them. The main constraints to clean fishery harbours are:

- Lack of enforceable rules to prevent pollution.
- Insufficient income, due to low service charges to maintain waste reception facilities.
- Reluctance of the municipality to handle wet fish waste unless suitably collected.
- Disregard for the cleanliness ethic.
- Ignorance of the effects of pollution on public health and fish quality.

The two projects have shown that upgrading reception' facilities for garbage and oily wastes is not a difficult task and co-operation between the harbour authorities and the municipality can be achieved, if the effort is made. But the most important factor to achieve a cleaner fishery harbour is co-operation from the community and active participation by the users in mitigating harbour pollution, especially when there are no enforceable regulations.

Improvements cannot take place without changes in attitudes and behaviour among harbour-users and administrators. There is a need, therefore, to:

- Increase awareness of the need for, and benefits of, cleaner fishery harbours.
- Increase awareness among policy-makers and harbour administrators of the benefits and mechanisms of developing cleaner fishery harbours.

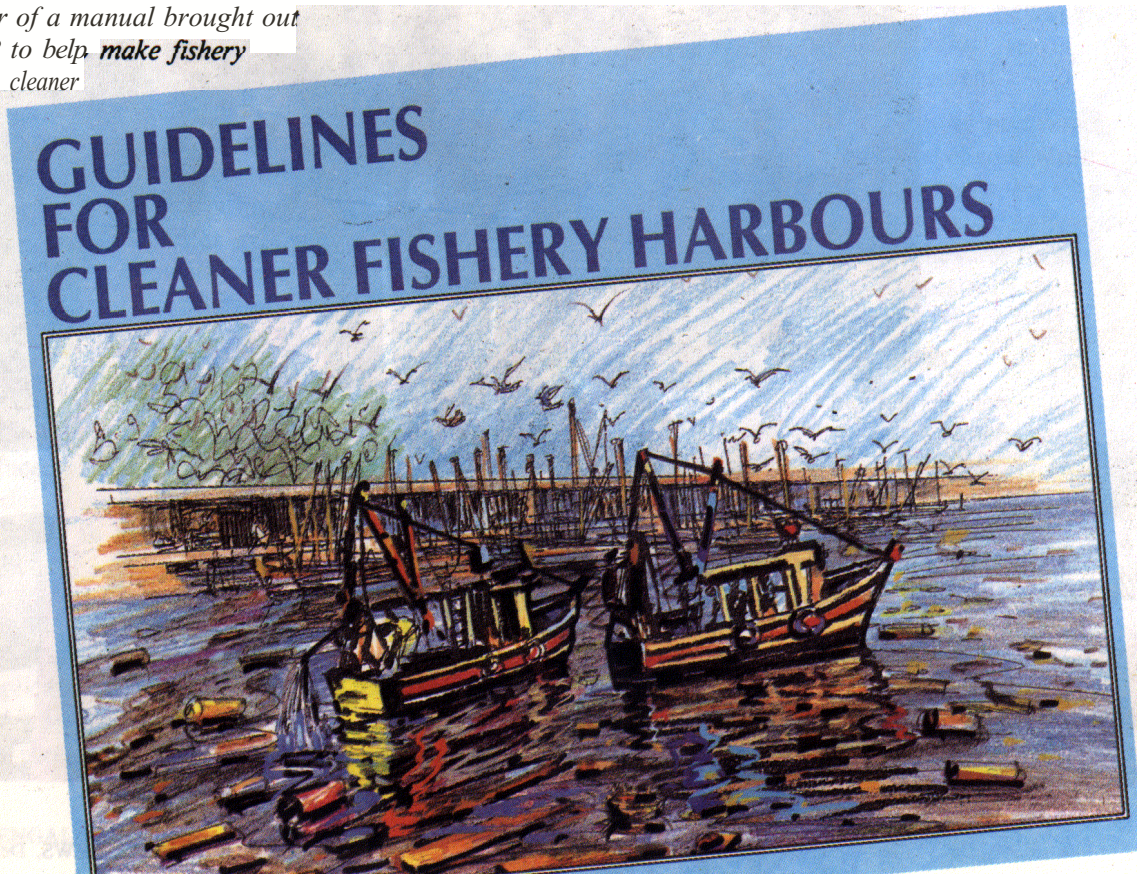
These are the objectives of a new project, just commenced, again with IMO support, in the Maldives and Shri Lanka. The activities will be:

- Awareness campaign design and implementation, based on analysis of the knowledge, attitudes and practices of the target groups.
- Communication material for a multimedia awareness campaign.
- Support to organizational channels, *viz.* government communication units, NGOs, voluntary groups and religious institutions.
- National workshops to strengthen fishery harbour management and facilitate changes in operational practices by bringing together various civic authorities to share knowledge and resolve operational problems collectively.

Successful completion of this project, together with the learnings from the Vishakhapatnam and Phuket projects, should then make it possible to consolidate a strategy to promote cleaner fishery harbours in the region and beyond.

R. Ravikumar
Conmltant. BOBP

The cover of a manual brought out by BOBP to help make fishery harbours cleaner



Learning to plan and manage small-scale, fisheries projects

The experience of a BOBP Post-harvest Fisheries Project workshop in training NGOs working with fisherfolk

by

A Kamila* and D King**

The Bay of Bengal Programme's (BOBP) Post-harvest Fisheries (PHF) project was approached in 1991 by a few nongovernmental organizations (NGOs) in the Kanniyakumari and Ramanathapuram Districts of Tamil Nadu, India, to arrange a programme to upgrade the skills of the NGOs in planning technical and nontechnical projects and preparing project proposals for funding agencies. The PHF Project responded by holding a microlevel workshop in Nagercoil early in 1992, but learnt from the experience that not only was there a need for such workshops but that the workshop needed to be more comprehensive, with participation from fisheries institutions essential.

To consider and develop the best methodology for the conduct of such workshops, the PHF Project, in January 1993, held a preliminary meeting with experts from the Central Institute of Fisheries Technology (CIFT), Cochin, Kerala, the Mangalore College of Fisheries, Karnataka, and the British Council. With all concerned agreeing to work together in future such workshops, the role of the various institutions involved was determined as follows:

- The Mangalore College of Fisheries/CIFT would design the course curriculum in consultation with the British Council and concurrence of the PHF Project.
- The PHF Project would select the NGOs by inviting NGOs to sponsor participants.
- The British Council would look after the administration of the training programme.
- CIFT would provide the technical inputs on fisheries, including sending scientists for the workshops.

A series of four training workshops on Project Planning and Management were subsequently planned for during 1993-95. The first of these workshops was conducted as a residential programme in Mangalore during November 16-27, 1993, with participants from NGOs with whom the PHF Project

Shalini Rajneesh, Collector of Mangalore, inaugurating the Workshop on Fisheries Project Planning and Management, organized by the BOBP Post-harvest Fisheries Project

Representatives fromNGOs in Tamil Nadu and Andhra Pradesh who participated in the BOBP Post-harvest Fisheries Project's Workshop in Mangalore

has been working on its 'Itinerant Fisherwomen Development Project'.

Twelve' participants with different backgrounds – eleven representatives from 6 NGOs in Tamil Nadu and Andhra Pradesh and one Field Officer from the PHF staff – attended the workshop. About half of them were new to the fisheries sector. Most of them were middle management personnel in their respective organizations, possessed expertise in social development and had experience of working with the poor in different sectors and communities.

While inviting sponsorship of participants from the NGOs, the PHF Project had mailed questionnaires to the NGOs seeking information on, among other things, the major problems which they faced in carrying out their present work, and the type of improvement needed. Most replied that lack of finance, knowledge of fish marketing, unity and motivation were the major constraints faced by the fisherfolk communities and that these were what the NGO personnel had to tackle. Some participants also stated that they faced problems due to a lack of knowledge of post-harvest fisheries technology and in planning projects with cost-benefit analysis studies.

The course started with a module on Participatory Rural Appraisal (PRA) and its application to assess the needs of communities and identify projects. Marine resources and project identification and planning were taken up in subsequent sessions. The technological aspects of handling harvested fish were taught through hands-on training methods, with participants handling, grading, icing, packing, degutting and curing fish under the supervision of trainers. A field visit to the fishing harbour to observe the handling of fish and curing yards proved an eye-opener to those new to the fishing sector.

At the request of the participants, evening sessions were arranged in the hotel where the participants stayed. During these sessions, groups met CIFT scientists to discuss and understand the technical details of various fish products which they felt could be tried in their respective areas. The allocated half-an-hour per group was not sufficient, but the scientists promised help when the groups started the projects.

Discussions on management, marketing fish and the institutional aspects of project planning did not enthuse the participants, but the sessions on the the financial aspects of project planning and accounting techniques unexpectedly turned out to be rather lively. Participants were requested to prepare and present project reports on fisheries development activities selected by them. Three of the seven reports presented were on conducting awareness sessions and better fish handling techniques in their fisherfolk communities, while the others pertained to the development of a cool-chain, fish meal, fish oil and fish flakes.

A course manual developed by Mangalore College of Fisheries was used throughout the course by the participants as reference material.

An evaluation of the training workshop has since been carried out by an external team comprising of a fish technologist and a sociologist specialized in training programmes. Their report is awaited. Two more questionnaires were distributed at the end of the course, one on the topics covered and one on the manual, to obtain feedback on the participants' opinion of the PHF Project and to improve the course content.

The training programme provided a unique experience whereby participants from different backgrounds had an opportunity to undergo such training and, at the same time, share their own experiences with their peers.

Most of the participants were quite positive about the training programme, but felt the need for more practicals, hands-on-experience and field visits. The'organizers respond: "The course was comprehensive, given the time-frame. But, certainly, revision is necessary." While a structured follow-up programme, is not envisaged, improvements are being planned for the next workshop.

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** Post-harvest Fisheries Adviser.

NEW PUBLICATIONS

BOBP/WP/89** — **Studies of** Interactive **Marine** Fisheries **of Bangladesh.

The Bangladesh Department of Fisheries, with the assistance of BOBP, conducted a two-year (1989-91) biosocioeconomic assessment of the estuarine set bagnet fishery. In order to make the assessments, needed for management purposes, it was necessary to gather information on other interactive fisheries: the marine set bagnet, trammelnet, bottom longline and shrimp trawl fisheries. This report contains information about the catch rate, seasonality, catch effort, biological parameters and cost and earnings in the estuarine set bagnet and the interactive fisheries.

BOBP/WT/90** — Socioeconomic Conditions **of** F.stuanne **Set Bagnet Fisherfolk in Bangladesh.

This working paper, a companionpiece to BOBP/WP/89, reports on a socioeconomic survey of selected estuanne set bagnet (ESBN) fishing villages in Bangladesh. The survey was conducted to obtain baseline socioeconomic parameters that are relevant to the management of the ESBN fisheries. It deals with village profiles, households and population structured according to sex, age, education, income-generating activities and income. Also discussed are opportunities for generating income from sources other than the ESBN fishery. The survey was based on a sampling of six villages, each one identified in each of the six strata into which the estuanne areas of Bangladesh was divided.

BOBP/REP/60** — **Improving Fisherfolk Incomes through Group Formation and Enterprise Development In Indonesia.

This report describes the process, achievements and learnings of a subproject which set out to identify and demonstrate ways to improve through micro-enterprise development the earnings and socio-economic status of fisherfolk in coastal communities in Lakgkat District, North Sumatera Province, Sumatera, Indonesia. The subproject initially set out to help establish institution-based credit programmes for fisherfolk, but changed direction when participatory appraisals showed there was really no need for credit supply and the aim of income-generation could be better met through strengthening the credit-receiving mechanism and enabling better and more effective management of enterprises. The subproject mobilized six fisher-folk groups, assisted in promoting savings, helped the groups to set up enterprises, provided credit through revolving funds and helped the groups to build their managerial skills.

*BOBP/REP/63 — Small-scale Oyster Culture **on the West Coast of Peninsular** Malaysia.*

This paper describes small-scale oyster culture trials carried out in the states of Kedah and Perak on the west coast of Peninsular Malaysia Rafts and longlines were found to be economically viable and the technology was transferred to fishermen. Spat of the slipper oyster, *Crassostrea ireda!ei,* were transplanted from the east coast of Peninsular Malaysia to the west coast sites.

Small-scale depuration units were established at farm sites and a series of market promotions successfully undertaken. Hatchery seed production and remote setting were also done. Artificial spat production was necessary to supplement short supplies of wild spat.

BOBP/MAG/15** — **Guidelines for Fisheries** Extension in the Coastal Provinces **of** Thailand. **(In Thai)

This document brings together the learnings of an extension project in Ranong, Thailand, and information from various sources on extension approaches leading to the development and management of fisheries in coastal areas of Thailand. The intention is to make available material in convenient form, to provincial fishery officers, fishery biologists, fishery extension officers and fisherfolk, to facilitate and guide their efforts.

BOBP/MAG/16** — **Safety at Sea** — Safety **Guide for Small Offshore Fishing Boats.

The expansion of the offshore fisheries in Shri Lanka resulted in a relatively high accident rate. A Bay of Bengal Programme (BOBP) subproject looked at this problem in order to advise on safety at sea and offer advice on search-and-rescue for the offshore fisheries. Information, it was decided, should be provided as a first step to making a safer fishing boat. The purpose of this manual is to assist the latter effort.

The manual cOvers aspects of safety that are relevant to all decked fishing boats less than 12 m in length, but it deals more in detail with engine installation, since engine breakdown leads to drifting, which is a major cause of fishing boats being lost. The manual indicates practical solutions to safety problems faced by multiday offshore boats off Shri Lanka and elsewhere.

The Guide, with its detail, is intended to be of practical use to boatbuilders, boat-owners and fishermen, as well as to teachers in fisheries training schools and extension field officers dealing with small-scale offshore fisheries.

***BOBP/MAG/17** — **Guidelines for Cleaner** Fishery Harbours*

This colourful booklet is a result of a felt need to educate those involved with fishery harbours on the typical pollutants that degrade the environment, including harbour waters, and how to mitigate the problem.

BOBP/MAG/18** — **A Handbook of** Oyster **Culture In Malaysia. (In Malay/English)

This manual is based on oyster culture technology that was transferred to fisherfolk of the west coast of Peninsular Malaysia. It is a practical manual which, it is hoped, will be of use to oyster farmers, government officials and investors. The manual describes various, methods of oyster culture which have been found to be profitable during the course of the project.

Methods for spat collection from wild stock, as well as the use of hatchery-produced spat are described. The best grow-out methods are explained and investment costs are given for different sized enterprises. Techniques for marketing oysters and the importance of depuration are explained.

*BOBP/MAG/19 — Management of Fisherfolk Microenterprises — **A Manual for Training of Trainers.***

BOBP has, in its work with small-scale fishing communities, seen a need for alternative employ-ment opportunities in coastal areas where fish resources are heavily exploited. The creation of small village businesses is one strategy for individual upliftment as well as strengthening village-level economic development. Experience has shown that many very small businesses or microenterprises fail due to lack of managerial skills. This practical manual on small business development is a means to provide already existing as well as future microenterpnses with on-the-spot managerial advice.

The manual will be of help to NGOs already involved with fisherfolk as well as those interested in such work, in the training of village-level field workers. Translation, adaptation and reproduction of this document is encouraged.

BOBP/MAG/20** — **Life on Our Reefs** — **A Colouring Book.

This colouring-cum-information book on coral reefs for schoolchildren evolved out of the effort of a subproject in the Maldives. The focus of the subproject, guided by the fisherfolk, was on building awareness and beginning the consultative processes that would, in time, lead to partici-patory management of coral reef resources. In doing so, the subproject also reached out to schoolchildren in the islands, the future fisherfolk of the Maldives, through this book. The text, in both Divehi and English, is aimed at primary schoolchildren (6-14 years). The book is intended to be used as a colouring book as well as a reader.

BAY OF BENGAL NEWS

Bay of Bengal News is a quarterly publication of the Bay of Bengal Programme (BOBP), a regional fisheries programme which covers seven countries around the Bay of Bengal — Bangladesh, India, Indonesia, Malaysia, Maldives, Shri Lanka and Thailand. The Programme plays a catalytic and consultative role : it develops, demonstrates and promotes new methodologies, techniques, technologies or ideas to help improve the conditions of small-scale fisherfolk communities in the member countries. The BOBP is sponsored by the governments of Denmark, Sweden and the United Kingdom, by member governments in the Bay of Bengal region and also by UNDP (United Nations Development Programme). The main executing agency is the FAO (Food and Agriculture Organization of the United Nations).

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