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SEAWEED PRODUCTION AND UTILIZATION AROUND THE BAY OF BENGAL

An international seminar organized recently by BOBP in Thailand focused on issues, experiences and opportunities concerning seaweed production and utilization. These are discussed in the pages that follow.

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Our readers may recall occasional articles relating our experiences with seaweed farming in India. To say that we encountered "a sea of troubles" would not be understating the situation. Perhaps if we could convene pre-eminent authorities in *Gracilaria* farming, we could find solutions to at least some of the difficulties we encountered. So came into being the idea of a regional seminar on the farming, processing, marketing and resources of *Gracilaria.* And what better venue than Songkhla, Thailand on the southern coast of the Gulf of Thailand? The National Institute for Coastal Aquaculture (NICA) was able to offer superb facilities for the seminar, which was held from 23 to 27 October 1989.

All the BOBP member states sent representatives. In addition, scientists, technicians and business people came from Vietnam, China, Hong Kong, the Philippines, Sweden, the United Kingdom, and the USA. International organizations interested in seaweed production were represented by ICLARM, INFOFISH, NACA and of course, BOBP. There was a good mix of development strategists, scientists, commercial processors and technicians among the 82 participants. The high level of interest was reflected in the lively discussions which followed many of the technical presentations.

The seminar was unique in at least two aspects: it was the first regional convocation of the seaweed industry "fraternity", and there has never been a seminar with such international participation dealing with just one particular genus (although there was some mention of the closely related *Polycavernosa).*

The topical organization of the seminar reflected our interest in applied aspects of *Gracilaria* and included sessions on the status of culture, small-scale processing, marketing, and on the management of natural resources of agarophytes. Twenty-four papers covered these areas of interest, of which seventeen dealt with culture and processing.

Dr Chua Thia-Eng, Director of ICLARM's Coastal Area Management Programme, ably chaired the meeting and guided the discussions. The Deputy Director-General of the Department of Fisheries of Thailand, Ms. Bung-oon Saisisth, set the scene for the seminar in her keynote address. An overview of the status of agarophyte production, processing and marketing led Ms. Saisisth to consider possible socio-economic effects in relation to small-scale fisherfolk, the BOBP target group.

POND CULTURE OF GRACILARIA

Dr. Gavino Trono of the University of the Philippines led off the seminar by reviewing the present status of *Grad/aria* culture. It became clear from his presentation and others in the first session that essentially all cultured *Gracilaria* derives from ponds : open water systems are still quite experimental in tropical waters. We heard from Dr. Wu Chaoyuan of the Academia Sinica, Shandong province, China, that open water culture is operating commercially in the temperate waters of China and we know from literature that such systems have also been developed in Chile's cool seas.

Dr. Trono listed site selection criteria, of which tide level and pond design were particularly important to ensure good flow-through of seawater. Access to both fresh and seawater enable the farmer to maintain salinity at an optimal level for fast growth. Sites should have protection from strong winds, and muddy sand or sandy soil is preferable. In viewing pond production of *Gracilaria* from the BOBP perspective of assisting the small-scale fisherfolk community, several issues arose during discussions. Paramount is the high cost of developing new ponds The soil requirements for pond construction can restrict the spread of the technology. There may be conflicts with mangrove forest conservation if new areas are developed, since such tidal forests are widespread in tropical Asia. Soil acidity could be a very serious problem in ponds established in mangrove forest soils. Reclamation of add sulphate soils is a lengthy and expensive process.

Perhaps it is possible to involve small-scale brackishwater pond farmers in *Gracilaria* culture if one is to judge by the paper presented by Safari Husain from South Sulewesi, Indonesia. Mr. Husain and his colleagues have started a new industry in the southern part of this large, centrally located island. Taking advantage of falling shrimp prices, his company encouraged marginal shrimp farmers to try *Gracilaria* culture. (See "Seminar highlights and sidelights" for the interesting details of. this unique enterprise).

POLYCULTURE OF GRACILARIA

Ruben Barraca has been working with the Marine Colloids Division of FMC International on the island of Bali, Indonesia, developing small-scale open-sea culture of *Eucheuma,* another economically important red seaweed. During the course of his work (See "Seminar highlights and sidelights") he and his co-workers came up with the idea of culturing *Gracilaria* along with *Eucheuma* in the open sea.

Both these papers raised the question of polyculture of *Grad/aria* with other seaweeds or with fish and prawns.

ODUCTION TION: CUSS PROSPECTS MS

Some 80 specialists on the farming and processing of seaweed (Cracilaria) met late October at an international seminar organized by BOBP in Songkhla, Thailand. Charles Angel! reviews the discussions, the learning that emerged and pointers for the future.

(Dr. Trono too had mentioned poly-culture in Taiwan and the Philippines). In pond culture, however, protocols for fertilization regimes for specific soil water types and for maximizing seaweed growth and agar quality are still lacking. The best stocking densities for seaweed, fish and shrimp remain to be worked out, as does the amount of residual stock that should be left after harvesting in order to maximize production. All of the development has been done by trial and error so far - perhaps a fruitful area of applied research awaits some enterprising scientist.

OPEN-WATER CULTURE: THE PROBLEM OF GRAZING

We had hoped to find the "magic bullet" that would solve our problems with seaweed farming in India - alas, the papers and discussions only served to highlight them! Grazing is the problem in open-water culture of tropical agarophytes. Rabbit fish *(Siganus* spp) are the main culprits and they can literally wipe out large seaweed farms. It appears that juvenile rabbit fish are largely to blame; seaweed farms located in shallow seagrass beds are particularly vulnerable, since this is their natural habitat.

Harvesting of seaweed from ponds in Sulawesi, Indonesia.

It may be that open-water culture is only possible where natural stocks of the desired species of *Gracilaria* are found. In practical terms, this may not always be possible. Turbid lagoons may be preferable to more exposed sites. Indeed, results of culture trials in Songkhla lake itself and from earlier BOBP work in Penang seem to bear this out. Fouling by unwanted epiphytes and invertebrates may seriously affect product quality. It is said that open-water culture of *Gracilaria* has been commercially successful in the Caribbean (St Lucia)but such success stories are few and far between.

Mr. Robert Anthony of Beeline Sdn. Bhd., Penang, intervened to inform the participants of his company's work with land based intensive systems and their potential application in Malaysia. While of technical interest, there would be little likelihood of such systems being taken up by fisherfolk because of the high capital cost and the level of managerial expertise required.

We were fortunate to benefit from the long experience of Jack Fisher, whose interventions throughout the proceedings provided insights and new knowledge to the participants.

Women transport harvested seaweed in Mandapam, India.

SELECTION AND SEEDING METHODS

Culture systems of whatever nature require seed stock, and a number of questions arose concerning selection and seeding methods. It was clear that all commercial production in the tropics derives from vegetative propagatron rather than spore-setting. Dr. Chen Jiaxen of NACA descnbed the use of parent plants to seed substrates such as stone blocks planted in open temperate waters in China - an interesting approach that might merit trials in the tropics, particularly in the light of Jack Fisher's work with similar techniques in Hawaii. Ms. Annesty Jayasuriya reported on some success with hatchery spore setting in Sri Lanka, but much more work remains to be done.

As agar yield and gel strength vary greatly with species and even possibly within species according to variety, how does one select the best strain for culture? Until the confusion over the taxonomy of *Grad/aria* is resolved, selection of strains will remain difficult. If there is a high degree of adaptation to micro-environments, as Jack Fisher suspects, how transferable will the results of strain selection be to new environments? Are the best species cultured even now?'Given the number of known species of *Graci/aria,* it was surprising to note that only three (C. *verrucosa, C. tenuistipitata* and *G. edu/is,)* are cultured in Asia.

SEAWEEDS FOR **HUMAN CONSUMPTION**

In the first paper on processing Dr. Goran Michanek (formerly with the University of Goteborg, Sweden, and now retired), provided an interesting perspective on world seaweed production, pointing out that seaweeds used for direct human consumption were worth far more than those destined for industrial use. He asked the audience to consider the nutritional benefits of seaweed consumption, particularly referring to them as a source of micro-nutrients (vitamins and trace elements). Dr. Michanek addressed the problems presented by variations in agar quality and composition as influenced by particular clones, light and nutrient conditions and the interactions of these factors. It all seemed quite complicated, but thought provoking!

Farmed seaweed in China — Dr. Wu Chaoyuan and colleagues from Academic Sinica, Shandong province.

Ms. Richards-Rajaduri of INFOFISH reviewed the processing and consumption of agarophytes in the BOBP region. We learned that the history of agar dates back to seventeenth century Japan! We can imagine consumption of seaweed as a fresh vegetable to be an equally ancient practice; it is found today in such far-flung places as Hawaii, Fiji, the Philippnes, Indonesia and Malaysia. Home production of agar for puddings, soups and jellies can be found in Sri Lanka, so maybe production for local consumption has scope for encouragement, at least in some of the BOBP member countries.

WORLD AGAR PRODUCTION

John Coppen of the Overseas Development Natural Resources Institute (ODNRI), UK, looked at world agar production, estimated at 7,000 to 10,000 tonnes annually and found that about half is from *Grad/aria.* Japan is the top producer and consumer, but depends heavily upon imported *Gracilaria* to meet national demand. In the BOBP region, Thailand, Malaysia and Indonesia are major importers of agar. Focusing on the situation in India (see "Seminar highlights and sidelights"), Mr. Coppen estimated annual production at 75 tonnes, but processing capacity may double if planned units come on line in the next few years.

SMALL-SCALE **AGAR PRODUCTION**

Some papers, presented by Prof. Suwalee Chandrkrachang of the Biopolymer Research Unit, Srinakarinwirot University, Bangkok, Ms. Ineke Kalkman of BOBP and Mr. Ramli Saad of the Fisheries Research Institute in Penang, addressed the problems of small-scale agar production. Professor Suwalee and her team carried out training of housewives in southern Thailand, during April 1989, teaching simple methods of agar extraction using locally available materials and domestic kitchen equipment (See "Seminar highlights and sidelights").

Ms. Kaikman has approached the problem of small-scale agar production with a view to adapting the Thai method to the village situation in Tamil Nadu, India. Inadequate dehydration before sun-drying has proven to be a frustrating problem. In the village setting, the source of heat energy may also present difficulties. Wood is often the only fuel available and it is costly. Another article in this issue describes the work more fully.

Bjorn Lindeblad of BOBP showed how an economic model can be used to set production targets, and demonstrate what technical problems influence profitability and how. By its very presence, Mr. Lindeblad's paper highlighted the paucity of economic data and analysis for various agarophyte production systems now in use or being tested in the region.

GEL STRENGTH

The discussions were often animated, particularly when the subject of gel strength came up. This seemingly mysterious subject turns out to be rather crucial when one realises that international trade in dried *Gracilaria* is based largely on gel strength — the higher the gel strength, the higher the price paid. Even its measurement raised some questions. Although the processing industry recognizes a standard method, it is not always used by investigators. Unlike other countries, the Indian industry does not use chemical treatments to upgrade gel strength. Why is it that Indian *Graci/aria* does not respond to such treatment? Is it because local strains are too high in sulfate or is there some other environmental influence? Is poor post-harvest handling responsible?

There was disagreement on whether or not village industry could produce an agar of sufficient quality for the market. Several industrialists felt that it cannot and that villagers are better off concentrating on seaweed farming. Others believed that sufficient quality could be achieved. Adaptive research could address the major problems in the village context – filtration, water removal and sanitation. Perhaps improved technology at this level is available from other countries. Japan has had a village industry for centuries. There are many small-scale agar plants in Taiwan – can their experience be applied to local conditions in the BOBP countries?

All BOBP countries import agar, particularly the higher grades. The consensus is that world demand is increasing, but there is a lack of detailed information on the trade. Perhaps a comprehensive study of world demand is needed in order to better guide farmers, processors, investors, and policy makers.

MARKETING.

John Coppen opened the third session - on marketing - with an overview of the world market for agar. After a strong "caveat emptor" to anyone looking at trade statistics, he concluded that world production is somewhere between 7,000 and 10,000 tonnes annually. Of this, about 3,700 tonnes enter international trade.

Dried seaweed (Ceylon moss) has been exported from Sri Lanka since at least the mid-19th century, according to historical data unearthed by Dr. S Subasinghe of NARA. Traders have reported that 1988 exports were only 5 tonnes, compared to 150 tonnes in 1986. Curiously enough, 150 tonnes is what was exported more than 100 years ago! The decline does not appear to be due to the resource base, but rather due to changes in the fishery. In a nutshell, seaweed collection is not competitive with shrimp fishing as a source of livelihood.

Dr. Subasinghe described the interesting local market for dried *Grad/aria* sold in small packets for home production of agar. Porridge flavored with coconut milk and lemon juice is popular among fishermen in the seaweed-producing areas. It is sold by the glass in small roadside stalls. Home-made jellies are also sold.

Dr. Phang Siew-Moi from the Institute of Advanced Studies at the University of Malaya descnbed major features of the agar market in Malaysia (See "Seminar highlights and sidelights"). As it is one of the region's major consumers of agar and agar products to the tune of M$ 6 million annually, the Malaysian market could have a strong impact on future developments in farming and processing in the region.

MANAGEMENT OF GRACILARIA RESOURCE

The final session considered the management of natural resources of *Graci-/aria* and the distribution and relative abundance of agarophytes in India, Indonesia and Thailand (See "Seminar highlights and sidelights"). Dr. Trono emphasized the potential for increased production from well managed natural stocks, citing experiences in Chile as an example. Production there shot up from 80 to 600 tonnes after management measures were introduced!

"Demand for agar is strong enough to stimulate research and development

However, an effective management program depends upon knowledge of the reproduction, growth cycle, growth rates, regeneration capacities, productivity and the influence of environmental factors on biomass production of the stock in question. Only then can we know where the species is abundant, how much and when to harvest and how many times a stock can be harvested during a season. Unfortunately, very little work has been done on natural stocks of agarophytes in the Bay of Bengal region. Stocks are reported to be over-exploited in the main producing area of India, though firm evidence is lacking because there have been no recent surveys of the resource.

Jana Anggiradga, from the Ministry of Science and Technology in Jakarta, reviewed their inventory of agarophytes at 31 locations, mainly in Java, Sulewesi, and Bali. Sin Tookwinas from the Department of Fisheries in Bangkok, described the potential harvest of *Po/ycavernofa* (closely related to *Graci/aria)* from the large number of fish cages in southern Thailand. During the discussions, it was suggested that this might lead to new farming systems: just hang out some old fish net and collect spores!

The confused state of taxonomy came up again, this time as a problem in resource management since species must be clearly known before individual stocks can be identified. Comparative studies of species could also be advantageous for culturists as well as resource managers.

After four days of interesting papers and discussions, it was time for a break. A field trip to nearby Songkhla Lake and a visit to the seaweed enterprise of Mr. Suchart Wongwai provided a glimpse of a promising area for seaweed farming development, *Po/ydavernosa* in this case.

LOOKING **BACK ON THE SEMINAR**

The presentations and discussions at the seminar brought out much that was new to us, and very relevant to BOBP's efforts in *Grad/aria* production and processing. Briefly recapitulating the most outstanding points, we found that our work with open water culture of *Graci/aria* is not likely to be successful. In trying to develop village agar production technology, we will be faced with quality problems and perhaps marketing problems as well, if reprocessing of a low-grade product is considered. Much work remains to be done with village agar production technology if competitive standards of gel strength and sanitation are to be achieved. And it is very clear that much more effort is required to understand and manage natural stocks, which can be a significant source of raw material *if* properly managed.

It may not be possible to pin down with precision world trade in agar, but one thing is sure from all the papers and discussions during four days in Songkhla : demand is strong enough to stimulate research and development in the eastern Indo-Pacific area, and particularly in the ASEAN region. Several countries, particularly Thailand and Indonesia, are taking the lead in developing farming systems. The private sector is paramount in these efforts and we can expect to see modern processing plants set up in several countries in the region. Such a development will undoubtedly stimulate even more interest and investment in both farming and the proper management of natural resources of agarophytes.

VILLAGE-SCALE SEAWEED FARMING AND PROCESSING THE MANDAPAM EXPERIENCE

by Ineke Kalkman

Can small-scale fisherfolk communities in Mandapam, Tamil Nadu, raise their incomes by farming and processing seaweed? The author discusses the chequered progress of a BOBP project

Seaweed collection is an important source of income in many of the coastal villages of Ramanathapuram (Ramnad) district in Tamil Nadu Almost throughout the year men and women go out to the islands of Mannali Hare and Krusadai to collect seaweed The seaweed may be partly dried by the collectors but is usually sold wet to agents for prices which vary according to the species The highest price is usually paid for *Ge/idie//a* spp (Rs 2000/tonne), and the lowest for *Sargassum* spp and *Turbinaria* spp (Rs 80/tonne) with *Gracilaria* spp (Rs 500/tonne) lying in between The agents dry the seaweed and sell it to processing factories Agarophytes like *Gracilaria* and *Ge/idiella* are processed into agar which is used mainly in the food industry in India. *Sargassum* and *Turbinaria* are sources of alginic acid used in the food and textile industries

SEAWEED FARMING

On the face of it then, a stable, well established marketing chain exists So why did BOBP set up an experimental *Craci/aria* farming project in Ramnad?

The reasons are two fold In the first place there is some concern, yet to be substantiated, that the agarophyte resource is diminishing through over exploitation. Although no exact data are available, it is clear that demand for agarophytes is increasing and exceeds supply Furthermore islands in the Gulf of Mannar are to oe declared as a national park or biosphere reserve by the Tamil Nadu Government This move will deny access to these traditional seaweed grounds cutting off an important source of supply and adversely affecting collectors incomes

Early 1987, after a survey conducted by two socio anthropologists and a local motivator aided by the Tamil Nadu Fisheries Department, two villages Vedalai and Chinnapalam — were selected for a BOBP supported farming project More than 70% of the people in these villages are involved in the seaweed business as collectors or agents. The villagers formed committees at both sites and preparatory work with 25 people in Vedalat and 20 in Chinnapalam began April 1988. A total

Harvesting of seaweed in Mandapam.

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of 45 farm plots of 0.1 ha each were established and a spore setting shed with six tanks was constructed in Vedalai.

The first spore setting trials started in August using technology derived from an earlier BOBP project in Penang, Malaysia. Mature seaweed plants are spread evenly on a supporting net floating in a setting tank. At night the plants release spores which settle on to raffia lines wound round a frame lying at the bottom of the tank. After two or three days, the lines are transferred to the farm site and tied between stone posts under the water. The spores should then germinate and grow into mature plants.

Unfortunately, only a few plants grew and after more than a year of trying, the trials were abandoned. Possible reasons for the failure were a lack of mature seed stock, unsuitable farming sites and grazing by rabbit fish *(Siganus* spp) and micro-grazers such as small gastropods.

At the end of 1988, trials with vegetative propagation began. Seaweed cuttings about 5 cm long were inserted into 3 mm high density polyethylene (HDPE) rope at intervals of 10 cm. The ropes were then submerged at the farm plots. Initial outgrowth from the cuttings was promising despite some loss through grazing.

In February 1989, after two to three months growth, 1 tonne of wet *Gracilaria* was harvested from the 4.5 ha site.

Regrowth of the cuttings after harvesting was good until, in April, the rabbit fish came. Their effect was devastating and the 4.5 ha farm was completely wiped out. However, the trials were continued in a smaller area to determine whether the appearance of rabbit fish is only seasonal. There were other problems too. A slimy green pest algae *(Chaetomorpha* spp) caused some *Gracilaria* to die. Extreme low tides left some seaweed lines exposed to the sun with consequent drying out. Some of the cuttings also started to decay and fell away from the ropes.

Since July, three methods of protecting the seaweed from rabbit fish have been tried in both villages. One farm plot (0.1 ha) in each village was covered by scare lines (pieces of plastic or palmyra leaves inserted in 5 mm HDPE rope) which were totally ineffective. In the

Culture operations at Vedalai village And at Chinnapalam.

hope of catching the rabbit fish before they entered the farm, one plot in each village was surrounded by 4 fyke nets with long leaders. Some rabbit fish were caught, but grazing continued unabated. Only after the height of the leaders on the fyke nets was increased — so that they work like a fence — did the seaweed start to grow, and a harvest is expected before the end of the year. Both villages were supplied with expensive netlon mesh material to create fenced pens for the seaweed to grow in. In Vedalai, this has been effective and 200 kg of seaweed were harvested from 1000 m of ropes. In Chinnapalam the fence was partly destroyed by high winds, strong currents and drifting *Sargassum.* In spite of repairing the fence and removing the fish from the pen, growth of seaweed remains poor.

Fencing seems to be an effective means of protection, but how long will the fence last and will the seaweed generate sufficient income to cover its cost and give the farmers a profit?

A costs/earnings study has indicated that one farm (0.1 ha with 3000 m of rope) must produce about 8 tonnes (wet weight) of seaweed to cover the cost of the fence. This also assumes that the seaweed is processed into agar by the farmer himself. Seaweed is usually sold to agents for a low price; for 8 tonnes of *Grad/aria* seaweed the farmer will not get more than Rs. 3,000-4,000. By processing it into agar, the farmer might get a much better price. About 120 kg agar can be produced from 8 tonnes of seaweed. With the price for food grade agar on the Indian market at between 100-200 Rs./kg (depending on its quality), the 8 tonnes of Gracilaria could have a notional value of Rs. 12,000-24,000.

SMALL-SCALE PROCESSING

The economics seem attractive, but can agar extraction be adapted to a village level technology? This is what the BOBP's post- harvest project is trying to find out. A simple procedure to extract agar from seaweed has been developed in Thailand by the Biopolymer Research Unit of Srinakarinvirot University, Bangkok. This produces a crude agar, which could be upgraded and used in the food ihdustry in India. Could this small-scale method be adapted for use in the villages in Ramnad district? To find out, trials with

Field assistant at Mandapam tries out cottage-level method for agar extraction.

Gracilaria have been conducted in a field laboratory in Mandapam since June 1989.

In Mandapam the seaweed is cleaned and soaked in fresh water for several hours until it feels soft. It is then heated in water (at a ratio of 1 part seaweed to 10 parts water) over a fire for 2-3 hours. To separate the seaweed from the agar solution, it is filtered through a cotton cloth with the help of a simple hand- operated coconut press (imported from Thailand). The press and the cloth are preheated with hot water to prevent the agar from setting during filtering. The solution cools to form a gel from which the water must be removed to give the final dried product. In the industrial process this is done by freezing and thawing, but this is not practicable at the village level. Instead, the gel is passed slowly through a thick cotton cloth under pressure applied by the coconut press or by two planks and some heavy stones. This is only partially effective, and to remove the remaining water the gel is laid out in the sun until it is totally dry. This can take several days.

Trials in which 0.1 kg of seaweed was heated in l litre of water produced the maximum yield of agar. So far, yields have varied from 10 to 22%, with an average of 15%. This compares well with factory yields of 10.15%. Other trials are being carried out to discover how much seaweed can be handled by one person in a single day. This is important because the farmers' income will depend on the amount of agar they can produce. Processing 2 kg of seaweed per day proved possible and the. agar yield remained around 15%. In economic terms, however, 2 kg of seaweed produces too little agar and the amount was therefore increased to 5 kg per day.

Scaling-up has caused problems, in particular the time (over 3 hours) it takes to filter this much seaweed through the press. A larger press would be more expensive. Water removal is also a problem, and the 5-6 day's of

GRACILARIA FARMING IN SRI LANKA

The population of Puttalam District in western Sri Lanka is a mixture of Tamil, Sinhalese and Christian people, for whom fishing is the main source of income. *Gracilaria* seaweed collected from Puttalam lagoon, mainly between May and November, provides additional income. A small amount of the seaweed is used by the fisherfolk themselves to prepare porridge, but most of it is exported to Japan, where it is processed into agar. In 1986, 150 tonnes of dried *Graci/aria* was exported, of which 70 tonnes came from Puttalam lagoon and 80 tonnes from Trincomalee Bay. Since then, only 5-10 tonnes have been harvested from Puttalam lagoon due to political unrest. NARA (National Aquatic Resources Agency) has conducted a study on the seaweed industry in Sri Lanka, past and present, which gives information and data on seaweed productioo, marketing etc.

All of the export companies in Coiombo would like to increase seaweed exports and are desperate for more supplies. Why don't the people in the Puttalarn area collect more seaweed? The answer to this is a lack of incentive. They earn very little from seaweed because, as in India, they are dependent on agents who keep prices low. Hiring boats and buying fuel are expensive and they would have to go further afield to increase their seaweed haul. If they had their own seaweed farms and were not so dependent on the seaweed agents, could their seaweed businesses become profitable?

Against this background, BOBP started an experimental *Gracilaria* farming project in Puttalam Lagoon in January 1988. The project has a research component, which is conducted in cooperation with NARA and an extension component carried out in collaboration with Sarvodaya Shramadama Sangamaya, a non-governmental organization (NGO).

NARA has concentrated on spore setting trials, with only one success so far. The main problem has been high salinity (from April-October 1989 up to 50 ppt) due to too little rainfall. The research will continue for a further year with particular emphasis on the influence of salinity and nutrient concentration on spore development. NARA is also carrying out a 6-month survey of wild stocks of commercially important seaweeds along the west coast of Sri Lanka.

Sarvodaya has set up one village farm plot in Kunjimattotam. *Gracilaria* is being cultured using the vegetative propagation technique. Outgrowth from the cuttings has been poor, due mainly to high salinity and grazing by rabbit fish. A fence of fish net material was constructed around the plot, but it lasted only a few months. Stronger material (extruded plastic mesh) is now being tried and the experiment is continuing. Another method of propagation is being tried in which seaweed is thrown into the bottom of the lagoon and surrounded by a small fence. The growth of seaweed looks promising with no sign of grazing so far.

Participation of the village people is encouraged through *Shramadanas,* which are community activities organized by the village people who give their labour free for the benefit of all. Men, women and children work a full day at the farm and after work they gather together socially.

Progress at both sites has been slow. Political unrest has severely hampered all aspects of field work. In the hope that the situation will improve, the project has been extended for a further year.

sun-drying is causing problems with bacterial contamination. Work on solving these problems and increasing the daily rate of processing is continuing.

Does a market for the crude agar produced by this method exist? A lot will depend on whether the agar can be processed to upgrade its quality, and if so at what cost. To find out, samples have been sent to commercial processors for assessment. The results will have a great bearing on the future direction of the project.

FUTURE PROSPECTS

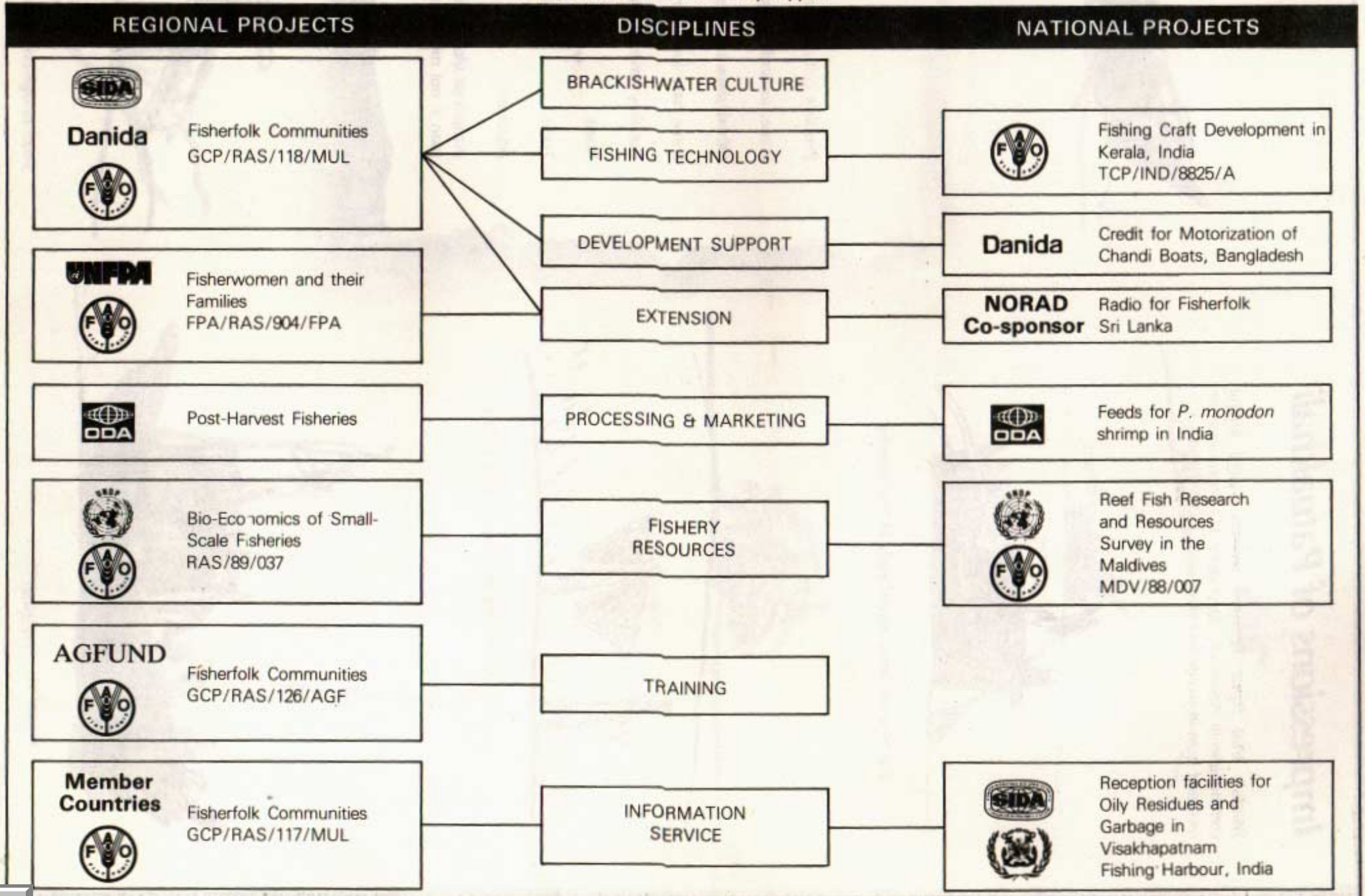
So what does the future hold for these projects?

Farming within the fenced area in Vedalai will continue until August 1990. If after one year there is no evidence that sufficient seaweed can be grown to cover the cost of fencing, the project may have to be stopped. However, if the harvest is promising we should continue and think of expansion. The Chinnapalam site has too many environmental problems like strong winds, pest algae and seasonally extreme low tides to make a successful outcome likely. An option here is to move the project to a new location. But the only suitable area close to the village is the islands, which are the subject of the proposed national park scheme.

If the agar extraction trials succeed and a market for the crude agar can be found, training programmes will be needed to introduce the technology in the villages. BOBP staff involved in the project have been impressed by the level of participation and organization of the people of Chinnapalam and Vedalai. This is largely due to the role of a motivator, who has helped them to organize themselves. This existing organization should ease the introduction of agar production technology in the villages. Agar production is the only way that the people can earn more from seaweed, since the all-powerful agents are unwilling to pay extra for quality improvements such as cleaning and drying. Success in finding a market for the crude agar could reduce the agents' power, and might even allow the people to by-pass them completely. Even if the farming technology ultimately fails, agar production could be carried out with naturally collected seaweed. This requires an answer to the question of diminishing resources, and maybe now is the time to conduct a study of the seaweed resources in the region and how their management should proceed. The next year holds some fascinating prospects for this work.

BOBP projects at a glance

Besides its main project "Small-Scale Fisherfolk Communities in the Bay of Bengal," which is funded by SIDA and DANIDA, BOBP executes several regional (covering two more countries) and national projects sponsored by other agencies. This table gives an idea of all the sponsoring agencies concerned with BOBP work and the projects and activities they support.



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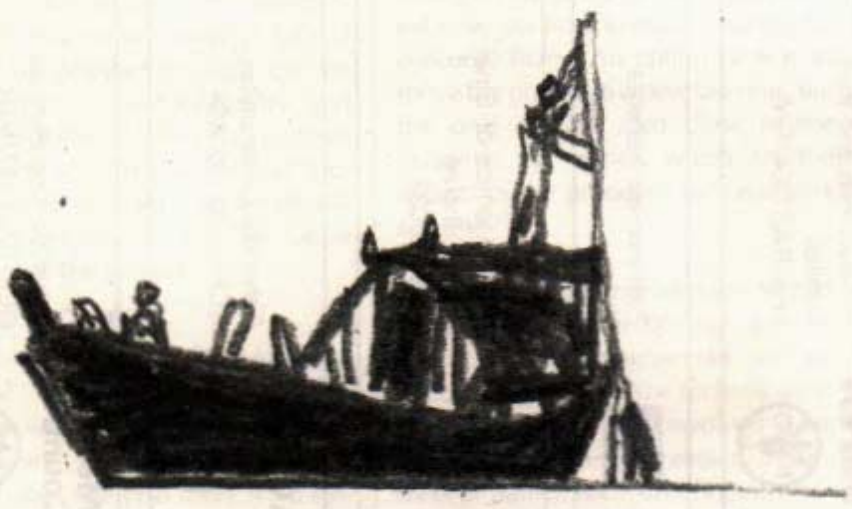
Impressions of Patuakhali

Swedish artist Signar Bengtson recently visited fishing communities in Patuakhali, Bangladesh. His impressions are recorded here in words and sketches.

Big freighter being rowed early in the morning.

Women take fishing gear home after fishing.



Freighter.

Shrimp fis

ON TRA

(Text translated fr

People's cultural heritage has many fa

Some, since the distant past, have be

Others, since early generations, have be

Some have lost their functions.

But they have all been passed on by

Boats.

Tools.

Attitudes.

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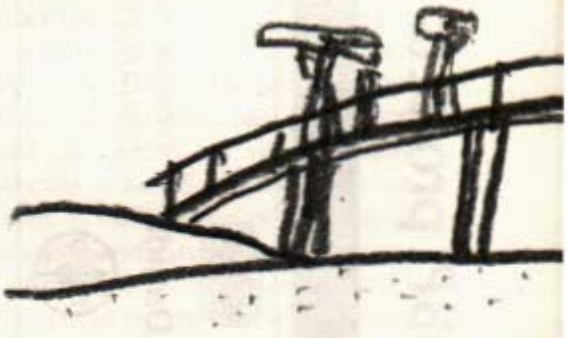

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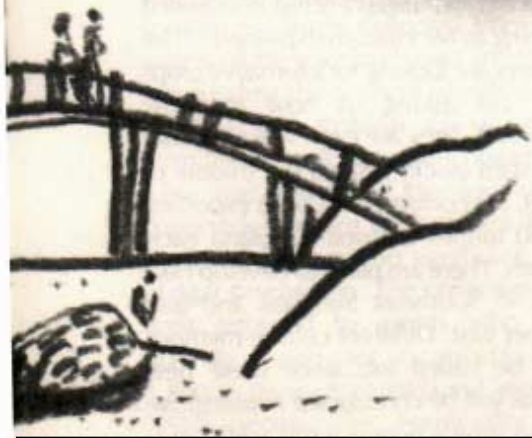
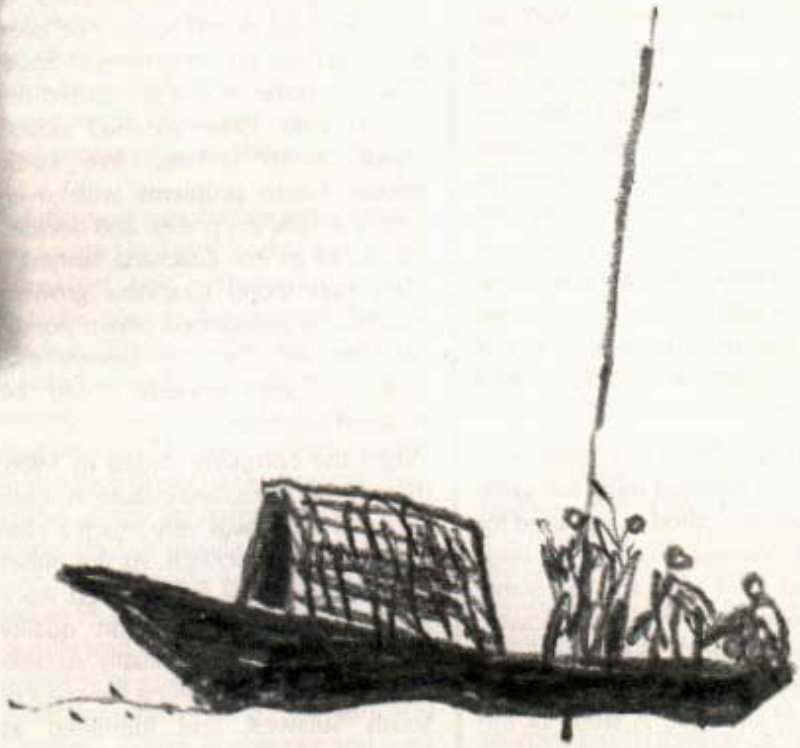




Erecting pole for set bagnet.

SEMINAR HIGHLIGHTS AND SIDELIGHTS

Glimpses into some of the significant papers presented at the Songkhla seminar.

GRACILARIA CULTURE

Of the eight papers presented on agarophyte culture, three dealing with the question of polyculture were of particular interest. Ruben Barraca of FMC International (Philippines) reported his work on the co-farming of *Eucheuma* and *Gracilaria* in Bali, Indonesia. *Eucheuma,* a red seaweed which is a source of carrageenan, is being farmed experimentally at an open-sea site. *Gracilaria lichenoides* was observed growing among the *Eucheuma* plants on the stakes, ropes and rafts. Both seaweeds grew well, but the *Gracilaria* was treated as a weed and removed during regular maintenance operations. However, a chance observation led to a re-assessment of the *Gracilaria* as Mr Barraca explained. "We noticed that the farmers were collecting the *Gracilaria* and selling it to local traders who, after cleaning and drying, sold it in the market at Denpaser. There seemed to be some commercial potential, so we decided to carry out trials to see if it was possible to co-farm *Gracilaria* with *Eucheuma".*

In these trials, wild *G. lichenoides* was collected and cultured using the same floating culture method as was used for *Eucheuma.* Various spacings between the cuttings were tried and the plants were harvested after six weeks' growth. The seaweed stock had increased fourfold during this period, with a dry matter yield of 8.7%. A study of the potential yield and income, based on a 1 hectare farm harvesting *Eucheuma* and *Grad/aria* eight times per year, was carried out. Mr Barraca concluded that *Gracilaria* could be interspaced between *Eucheuma* plants on the same lines, and that co-farming in this way could increase the farmers' incomes by around 50%.

Elsewhere in Indonesia, in South Sulawesi, *Graci!aria* is being cultured on a commercial scale in brackishwater ponds. Safari Hussain, whose company PT Sumber Tirta Sulawesi is undertaking this venture, described in detail how this had been achieved. "Prawn fever started in Indonesia in the early 1980's; some 70,000 hectares of brackishwater ponds have since been developed for prawn farming in South Sulawesi alone. When we started our company in 1986, we had doubts about prawn farming. We could foresee future problems with oversupply and falling prices, and decided instead to go into *Gracilaria* farming". They had found *Graci/aria* growing naturally in abandoned prawn ponds, and this led them to believe that *Graci/aria* and prawns could be cultured together.

When the company started in 1986, there was no *Grad/aria* culture in South Sulawesi and it was very much a case of starting from scratch. At the outset they had difficulty finding seed stock and imported some export quality material from Chile. Eventually, suitable material was located along the coast of South Sulawesi and identified as *Graci/aria verrucosa.* The aim of the venture was to develop a profitable company, at the same time creating an opportunity for the prawn farmers to participate and improve their incomes. Initially, the prawn farmers were sceptical, particularly about the market for their output, and the company had difficulty finding farmers willing to take up seaweed culture. To encourage participation, they provided free seed stock and brochures on farming methods, and indicated their willingness to buy the seaweed once production became established. This approach paid off and eight months after the initial distribution of seed stock 110 tonnes of wet *Gracilaria* was harvested. Of this, 10 tonnes was set aside for seed stock and the remainder converted into 10 tonnes of dried *Graci!aria* which was exported to Japan. A further shipment of 20 tonnes followed in April 1988.

Since then, things have gone from strength to strength. The company decided to develop its own ponds to ensure production of sufficient seed stock of consistent quality to meet increasing demand from interested farmers. A sharp drop in the world market price for prawns since March 1989 has stimulated interest in seaweed farming as Mr Hussain explained. "The farmers are looking for alternative crops and are asking us how to grow seaweed. They are even willing to *buy* our seed stock!". Since the middle of 1989, the company has been exporting 60-80 tonnes of dried *Gracjlaria* each month. There are plans to develop new sites in Southeast Sulawesi and also further east. Different culture methods will be called for, since these new ponds will be constructed in mangrove forests where potential soil acidity may

be a problem. The company is considering building an agar processing plant requiring 50-100 tonnes of raw material per month. Locating the plant in the production area will reduce transport costs and expand market outlets for the farmers.

In conclusion, Mr Hussain said *"Gracilaria* farming in Sulawesi has a bright future. While the company is developing new farm sites of its own, it will continue to involve local farmers. But in order to maintain the farmers' interest, the farm gate price will have to increase".

Mr Suchart Wôngwai of the Biopolymer Research Unit, Srinakarinwirot University (Thailand), gave an overview of his work on establishing the parameters for commercial agarophyte culture. He described the natural habitats *of Gracilaria* and *Polycavernosa* in Songkhla Lake and Pattani lagoon. The optimum conditions were a temperature of 30° C, salinity of 25 parts per thousand and a pH of 7. Conditions should be calm with little wind and the brackishwater should be 1-1.5 metres deep over a sandy/muddy bottom. Experiments had been carried

out to assess four methods of culture, namely polyculture with grouper fish in a sea-cage, polyculture with seafish in a sea- cage, monoculture in a pond and monoculture using rope lines. The seaweed was harvested monthly, and the wet and dry yields calculated. All four methods seemed to work, but the best results were obtained from monoculture using rope lines. The drying ratios were 7 : 1 for *Gracilaria* and 10 : 1 for *Polycavernosa.* Mr Wongwai concluded by describing the characteristics of good quality dry seaweed. This should be black in colour, free of impurities such as shells, rocks and mud and have a moisture content of about 20%. Dry seaweed meeting this standard should fetch a price of US $ 800 per tonne.

PROCESSING

In all, nine papers were presented on various aspects of processing. The agarophyte seaweeds such as *Grad/aria* are the raw material for producing agar, a gum with a range of uses in the food and pharmaceutical industries.

John Coppen of ODNRI (UK) looked in detail at agar processing in India. Three kinds of agarophytes, *Gracilaria, Ge!idium* and *Gelidiella* are used, and are collected from the so-called "seaweed belt" along the southern coastline of Tamil Nadu. Of the *Gracilaria* species, C. *edulis* collected from the waters off the mainland coast and those surrounding the offshore islands is the principal raw material. C. *verrucosa* from the less-salty estuaries is used by a few agar producers. Other species are collected — more by accident than design — but have no significant role in agar production. The collectors sell their seaweed to agents who pay 600 Rs./tonne for *Gracilaria* and 1,800 Rs./tonne for *Gelidium/Gelidiella* (1989 prices). The agents dry the seaweed and sell it to the processors who pay 2,500 to 3,500 Rs./tonne for *Gracilaria* and Rs. 5,000-8,000 for *Gelidium/Gelidie!Ia.* The higher prices paid for *Gelidium/Gelidiella* at both stages reflects the superior quality of the agar produced from these types.

For the most part, India's agar factories are located in Tamil Nadu close to the "seaweed belt". There are a few factories also in Kerala and Andhra Pradesh. The term "factory" is used in a broad sense and covers units whose outputs range from 2 kg to 60 kg of agar per day. The newest factories plan to produce up to 100 kg per day. Two grades of agar are manufactured : food grade which is usually produced in mat form, and IP grade which conforms to Indian Pharmacopoeia standards and is usually sold as a powder. For food use, paleness of colour is usually deemed more important than gel strength, and *Gracilaria* (which is cheaper and easy to bleach), or *Cracilaria/Gelidium* mixtures are the usual raw materials. Where high gel strength *is* required, *Geiidiumalone* is used to produce food grade agar. In the main, IP grade agar is produced from *Ge!idium* or *Ge/idle/Ia.*

Regardless of size, almost all of the factories use the same basic method of processing. The seaweed is cleaned and then softened by immersion in dilute hydrochloric acid. After washing to remove all traces of acid, the seaweed is boiled in water for between 1.5 and 3 hours depending on the quality and nature of the raw material. The extract is filtered and run off into trays where it cools into a gel. Yields of agar are usually around 10%. The bulk of the water is removed using a freeze/thaw process, after which the agar is bleached using hypochlorite solution. After a final cold water wash, it is then laid out on mesh screens to dry in the sun. Drying is sometimes completed using a hot-air drier. For IP grade agar, particular care is taken to avoid contamination during handling and drying. Unlike *Grad/aria* from other sources, Indian material does not seem to respond to alkali treatment as a means of increasing the gel strength,

which at 100 - 150 g/cm2 is typically only half that of agar produced from *Gelidium* or *Gelidiella.*

The Indian agar industry is based on a fairly sophisticated process. Dr Mathew from CIFT (India) outlined research carried out in India over the last 40 years on small-scale agar processing. This work has concentrated mainly on refinements to the basic technique and ways of scaling it down. It has not, however, met the need for an unsophisticated technology suited to the rural village level.

The work of Prof. Suwalee Chandrkrachang at the Biopolymer Research Unit (BRU), Srinakarinwirot University (Thailand) holds out the promise of such a technology. Thailand is keen to reduce its agar imports through a programme of seaweed production and processing that includes providing employment and income for the impoverished coastal population. BRU has developed a simplified method of agar extraction suitable for introduction to the rural areas. The method uses ordinary domestic kitchen equipment to produce a crude agar which can be used locally in food and desserts, or sent to a central processing plant for upgrading. In April 1989 the method was successfully introduced in villages in Songkhla, Satul and Trang provinces. The exercise was carried out by a mobile training team who distributed extension aids such as video tapes and leaflets to reinforce the demonstrations. BRU hopes that this technology will be suitable for adoption by all the countries in the BOBP region. However, what is termed village-level technology in one country may not be so in others. This has been illustrated by the need to further simplify the BRU method for use in BOBP's seaweed farming activities in India, as described by Ineke Kalkman elsewhere in this issue.

TRADE AND MARKETING

The session on marketing and international trade – in which three papers were presented – confirmed many people's feeling that there is a scarcity of reliable information and data on this subject. John Coppen of ODNRI (UK), opened the session with an overview of international trade in agar within the BOBP region. He began with a warning that trade statistics are a minefield of erroneous and conflicting information that should be treated with caution. "The statistics are ultimately only as good as the person who completes the customs form or the one who interprets it. Items may be misclassified", he said, citing the example of so-called "Danish agar", which is not agar at all but a carrageenan-type gum.

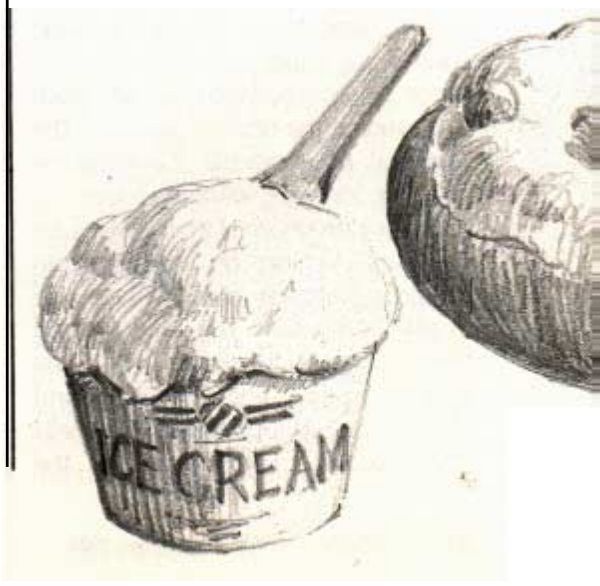
A recent (1988) estimate puts annual world production of agar at 7,000 -10,000 tonnes. Other sources estimate that about half of the 7,000 tonnes of agar produced in 1984 was made from Gracilaria. Demand for agar in the BOBP region is met largely by imports, which have been fairly consistent at around 700 tonnes per annum since 1980. However, some BOBP countries do manufacture their own agar. On an industrial scale, India produces around 75 tonnes per annum and expects to increase this to 140 tonnes over the next few years. Indonesia currently produces 10-20 tonnes per annum and a large expansion of their industry is planned. Thailand is manufacturing on a pilot scale at present, but would like to expand in order to reduce its level of imports.

Thailand, Malaysia and Indonesia account for most of the agar imports within the BOBP region. Imports into Thailand, 277 tonnes worth Bht 112.9 million in 1987, come mainly from Japan but with an increasing amount from Chile. Malaysia's imports have been fairly consistent at around 250 tonnes per year during the 1980's. Indonesia imports agar from a variety of sources. In 1987, this amounted to 140 tonnes valued at US $526,000. India's demand for agar is met primarily by domestic production, although a small amount (4.7 tonnes in 1986) of higher grade bacteriological/pharmaceutical agar is imported each year. Sri Lanka and Bangladesh import very small quantities and neither is thought to have any significant local production. Overall the BOBP region imports around 700 tonnes of agar per year, around 20% of total world trade in agar.

Exports of agar are recorded by four BOBP countries – Thailand, Malaysia, Indonesia and India. In 1987, these totalled 19 tonnes, although the figures from Thailand and Malaysia probably represent re-exports. The main destination for Thai agar has been the USA. Indonesia exported 9 tonnes in 1988, mainly to Singapore. Indian exports, which have been as high as 22 tonnes in 1984, are known to originate from local production. Several countries have purchased Indian agar at one time or another, but not on a sustained basis.

Dr Subasinghe of NARA (Sri Lanka) reviewed the marketing of seaweed in Sri Lanka. At present the seaweed industry is geared to the export of dried *Gracilaria.* This peaked at 150 tonnes in 1986, most of which went to Japan. There has been no *Grad/aria* collection in the Trincomalee area for the last two years, due to ethnic unrest. In consequence, exports of dried *Graci!aria* fell to 10 tonnes in 1987 and only.5 tonnes in 1988. However, there appears to be a renewed demand as evidenced by a recent order for 20 tonnes from Japan. The agarophyte industry in Sri Lanka can only develop if constraints such as lack of resource data, variability in expOrt demand and competition from imported agar are removed.

In the final paper, Dr Phang Siew-Moi from the Institute of Advanced Studies, University of Malaya described the agar market in Malaysia. Import statistics are rather difficult to gather because agar is grouped with other vegetable gums in a single category. Imports have been increasing since 1980, but there have been ups and downs due to a rather



severe recession between 1984 and 1987. Most of the agar is imported as agar strips which are used in the preparation of jelly desserts. In 1988, Malaysia imported 169 tonnes of agar strips valued at M$ 6.4 million from Korea which is its main supplier. The other main category of agar import is bacteriological grade agar, for which the import market has been estimated at around M$ 2 million. Malaysia also imports flavoured powdered mixes from Thailand, Indonesia and Japan, and processed agar-based products from and through Singapore.

Given such a strong national demand for agar, there is scope for developing a culture and processing industry. There is an abundance of sheltered, clean water and a good infrastructure. Malaysia has close ties with the Muslim countries in the Middle East and might eventually open up export markets there. At present though, there is a lack of technical expertise and a need for further research into culture technology. A domestic agar industry would face competition from imported agar and other vegetable gums. Dr Phang felt that any development should concentrate on food grade agar. One company is already investing in *Gracilaria* farming and processing in a substantial way, and all-in-all the prospects for the future seem bright.

RESOURCE MANAGEMENT

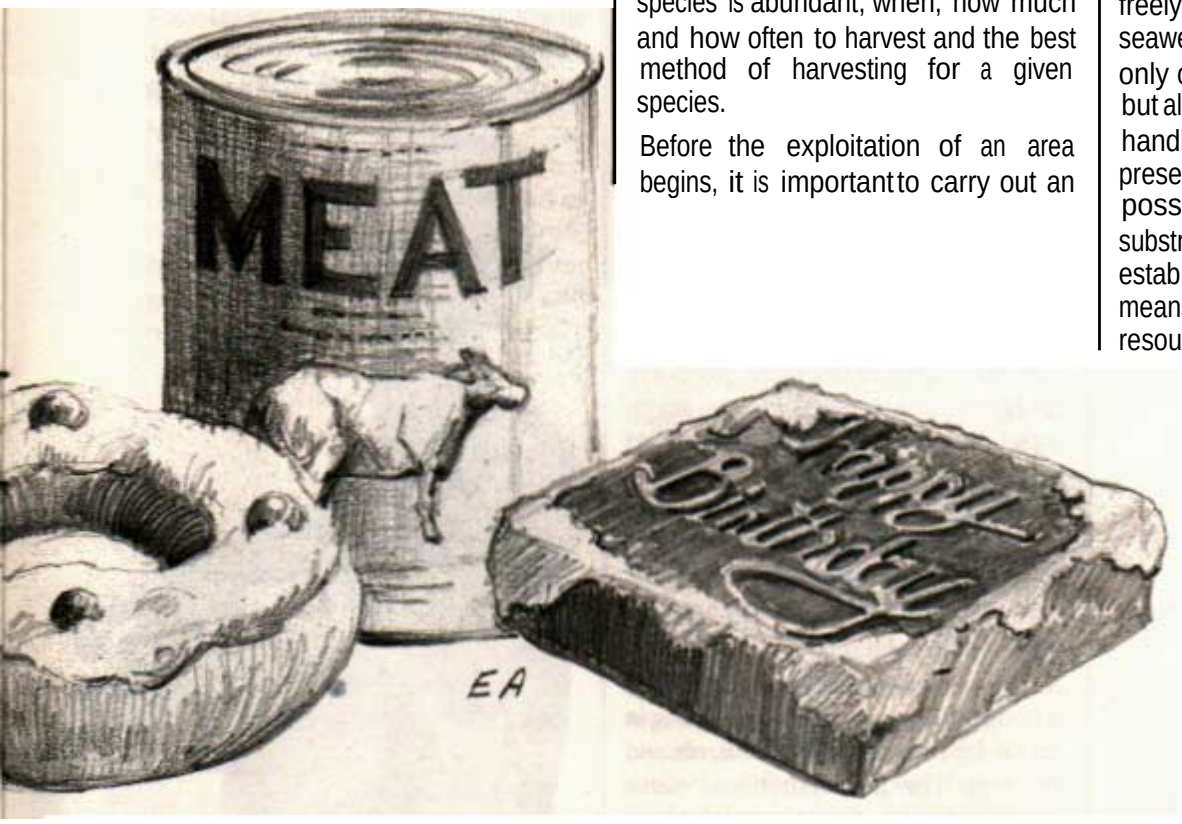
It was clear from the session on management of natural resources that, compared to the world's other oceanic regions, information about the biology and resources of *Graci/aria* in the Indian Ocean is scarce. Several people suggested that natural resources of *Grad/aria* in the countries around the Bay of Bengal were limited or being over-exploited. However, there was no evidence to support this. What is needed is a well-designed and comprehensive survey. Such a survey could clear up the confusion over taxonomy once and for all, and pave the way for the introduction of effective management measures to increase the productivity from natural stocks and prevent over-exploitation.

Dr Gavino Trono of the University of the Philippines emphasised the need for effective management measures. *Grad/aria* was the only agarophyte being cultured on a commercial scale, but even so a large proportion of world demand was being met from natural stocks. For agarophytes as a whole, production is expected to rely on natural stocks for the foreseeable future. Information on biological aspects (see main article) was essential to answer questions on where the species is abundant, when, how much and how often to harvest and the best method of harvesting for a given species.

Before the exploitation of an area begins, it is important to carry out an inventory of the stock. This requires proper taxonomic identification of the species involved. The quality of the agar obtained should be assessed, since this will determine the market price of the seaweed. The level of any existing seaweed production in the area should be determined by interviewing seaweed gatherers and market vendors. This should produce data on types and amounts which, when compared with the potential biomass production of the area, will indicate the scope for further exploitation.

The final step in the introduction of a resource management scheme is to organise the gatherers into self-managed production groups. Only bona fide members would be allowed access to the seaweed, and the amount each could harvest would be determined by equal sharing of the biomass available for cropping. The rules of the group and peer pressure among the members should ensure that no one exceeds their fair share.

Another means of increasing the resource came out in the presentation by Sin Tookwinas from the Department of Fisheries (Thailand). Species of *Polycavernosa,* an agarophyte closely related to *Gracilaria,* seems to grow freely in the fish cages at Songkhla. The seaweed was observed growing not only on the ropes and net of the cages, but also on solid debris such as broken handlooms and pieces of tree trunks present in the water. This raises the possibility that creating artificial substrates may provide assistance in establishing the plants, and may be a means of enhancing the natural resource biomass.



What you can do with seaweed — a montage of Gracilaria pr9ductS.

Population and Development in the Bay of Bengal Region

by Ute Heinbuch

A new subproject under the BOBP umbrella sponsored by the UNFPA (United Nations Population Fund) seeks to improve the incomes and living standards of women from fishing communities, and strengthen health, nutrition and population education. This article analyzes the project's rationale.

There are approximately 500,000 fishermen, with their families, living in the seven coastal states bordering the Bay of Bengal; a total fisherfolk population of about five million. They usually live in small coastal villages with fishing and fishery-related activities as their main source of income.

The fishing villages are often located in remote areas, where land is least productive and subject to sea erosion. Economic and social infrastructure is generally lacking Access to basic facilities, such as clean drinking water, health services, schools, electricity, communication, etc., is often a serious problem, particularly for small island communities.

The standard of living in fishing communities is generally low, often even lower than in neighbouring farming communities. Characteristics are: low and unevenly distributed incomes, indebtedness, sub-standard housing, illiteracy, maluntrition, high infant and child mortality and accordingly low life expectancy at birth. In addition, fisherfolk communities are often subject to social discrimination and form the lowest strata of society.

In view of such marginal living conditions, fisherfamilies are dependent on all the available manpower to ensure the survival of the family. Hence children of both sexes are considered important contributors to family incomes. They are involved in fishery-related as well as household activities from an early age, but often at the expense of primary school enrolment. Sons in particular are considered a direct economic asset for the family, above all in coUntries like India and Bangladesh, while daughters are mostly needed for helping with household tasks. Consequently the desire for children and hence fertility levels are quite high in fishing communities. Often they tend to be higher than the national average.

But despite the contributions of children, family incomes remain meagre mainly due to low productivity. This can partly be attributed to the fact that the quantity and value of the fish landed is detetioriating, with all its negative implications for household food security. Not only are incomes from fishing activities low, thus leaving the household with limited purchasing power to meet its daily maintenance needs, but since fisherfamilies in general tend to sell almost all of their often small catches rather than use at least part of it for home consumption, they are facing considerable nutritional problems. These problems are aggravated by the fact that fisherfamilies usually have only limited access (if at all) to agricultural land which is often of poor quality, thus making it difficult or nearly impossible for them to meet the family's food demand on a subsistence basis.

As a result malnutrition is widespread among fishing communities, affecting in particular the well-being of infants and children. The poor nutritional status combined with the general lack of health services make for a high incidence of infant and child mortality in fishing communities. But as demographic research has shown, infant and child mortality rates on their part are an important determinant of high fertility. In rural areas in developing countries parents generally have to make sure that they will end up with a certain number of living children at the end of their reproductive period as a source of security for their old age. This motive might be even stronger for socially discriminated fisherfamilies in their remote villages. Result: they, are caught in a vicious circle of high infant and child mortality – high fertility – increasing difficulties to meet family demands – increased risk of mortality, etc.

Women as childbearers and rearers are of course mainly affected. Not only are early marriages followed by frequent and many pregnancies but they are a threat to the women's physical well-being. In the Maldives, for example, women on an average marry as early

as 15 years old and have seven to eight pregnancies during their reproductive period. Due to these pregnancies being too early, too many and too close, Maldivian women face a high risk of dying as a result of child-bearing. But increasing family sizes also requires continuously more contributions from women in order to guarantee the survival of the family. The role of women in fishing communities is in fact manifold : besides their responsibilities as mothers and wives, they do play an important role in the fisheries sector, e.g. in processing, distributing and marketing the fish. Economic constraints might make them participate in non-fisheries related activities also. In Tamil Nadu for example, during the off-season, women are partly involved in the production of handicrafts.

But although women play such a vital role in the family and society, their decision-making power on productive as well as reproductive matters is often quite limited.

In view of the negative implications of the high population growth rates for socio-economic development, almost all of the countries around the Bay of Bengal have implemented national family planning programmes in the past. India was actually the first country in the world to establish such a programme as early as 1952, followed by Sri Lanka in 1956, Malaysia in 1966, Indonesia in 1968, Thailand in 1970, and Bangladesh in 1971.

Although some of these programmes have shown remarkable success in reducing fertility rates, they have often neglected fishing communities. Part of the reason might have been the remoteness of fishing villages with their general lack of access to social and health infrastructure, which usually includes the dissemination of family planning services as well.

But what can be done to achieve a more balanced socio-economic and demographic development in fishing communities? In response to these challenges the most recent approach of BOBP is a subproject directly addressed to population and women issues, which is funded by the United Nations Population Fund (UNFPA).

In acknowledging the vital role of women in production and reproduction, this subproject under the BOBP umbrella will emphasize three main aspects:

- to increase the incomes of women in fishing communities in order to improve the standard of living of their families;
- to improve the status of women in fishing communities in order to strengthen their decision-making power in production and reproduction;
- to provide health, nutrition and population education relevant to fishing communities.

In terms of population education, messages have to be linked to the living conditions in fishing communities. This comprises for example the interrelationships between human, material and natural resources in coastal areas at present and in the future. The high population growth rate in fishing communities is leading to more and more people who depend in one way or the other on existing fishing resources. On the other hand, increasing population pressure might lead to overfishing, diminish fishery resources and further aggravate the economic situation of fishing households.

Although this aspect is of importance for the whole fishing community, fisheries extension workers and fishermen should be the one most concerned. They might not always be fully aware of the specific nutritional and health problems fishermen's children are facing, but they are increasingly aware of the rising economic constraints they face to support their families. This can be taken as an entry point to address population education messages directly to men, who are usually difficult to reach, and to increase awareness among themselves and communication with their wives on this important aspect of thier life.

Another aspect of major importance to population education is the relationship between nutrition, proper child spacing and maternal and child health.

Attitudes towards child bearing and rearing are a very sensitive area in human life and to bring about changes requires careful approaches and timing.

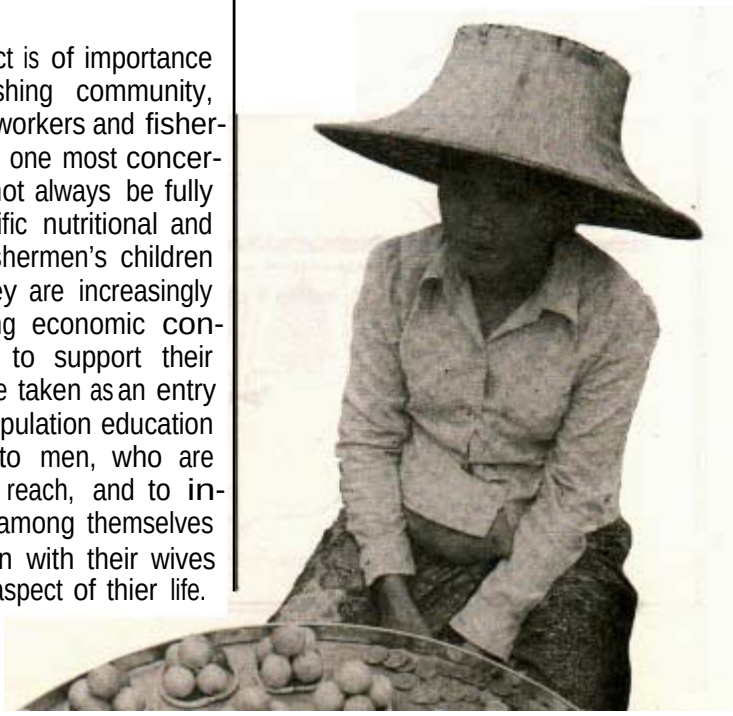
However, there are some indications that changes are already underway in fishing communities. In the upazila of Patuakhali, Bangladesh, for example, awareness of the negative implications of population increase in fishing communities on their socio-economic development seems to be increasing among fisheries extension officers.

In fishing villages of Tamil Nadu, India, women are realizing that even with the contributions of serveral sons it is increasingly difficult to support a large family. Therefore they would like to limit the number of their children.

In the Maldives awareness of a proper spacing of births as an important aspect of child development is growing among women.

All this leads to the hope that the new BOBP subproject might be a helpful and worthwhile effort in achieving a more balanced socio-economic and demographic development in fishing communities.

To ensure that the activities of the subproject reflect the needs of women from fishing communities, and that management is feasible for implementing agencies, the main sub-project phase of 3½ years will be preceded by a six-month preparatory phase during which workplans will be evolved for each country on the basis of needs.



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Capture of flying fish techniques old and new

by Ulf Nystrom

Capture of flying fish constitutes an important traditional fishery along the Coromandel coast of India. The season is short; end May to mid-July. During this period, one species of flying fish species, in particular, the Coromandel flying fish *(Hirundichthys coromande/ensis),* comes close to the continental shelf for spawning.

Flying fish shed their eggs on any floating materials, any shape or form. The eggs have sticky threads with which they attach to any floating objects at or close to the surface of water. During the spawning season, the flying fish aggregate around logs, bushes and other floating debris to which they attach the eggs.

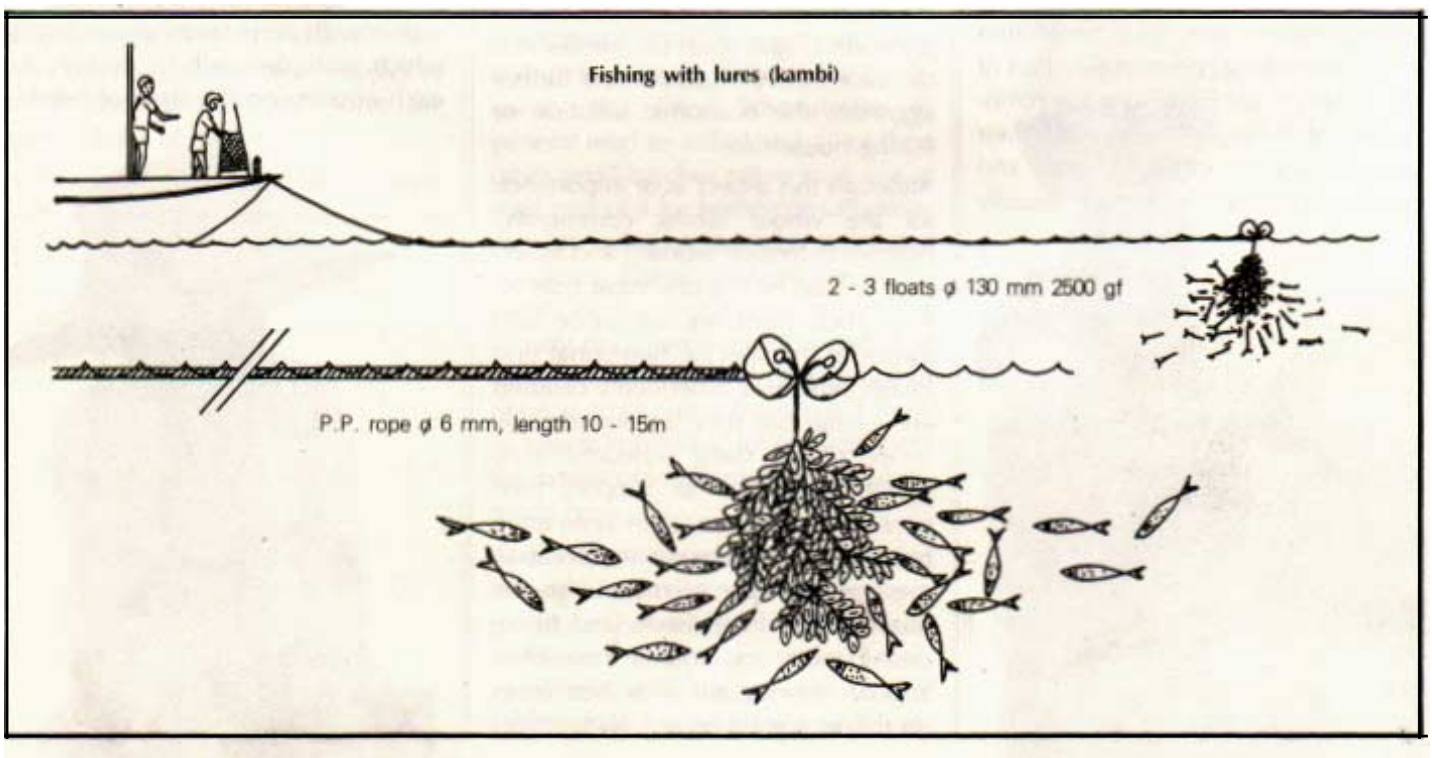
This behaviour is made use of in the traditional lure method for flying fish, which is simple but very efficient. A specially built 7-log kola kattumaram, sturdy enough to reach the fishing ground, is used for the fishing operation. Fishermen carry with them bundles of screw-pine leaves, or the leaves of some leguminous shrub locally known as "kambi", to be used as lures to attract the fish. When the fishermen reach clear, dark blue water, they let down lures from the kattumaram on 10 - 15 m long ropes and hold them in a half submerged position with the help of floats. Fish gather aroimd the lures to spawn and while they are preoccupied with the egg-laying process, fishermen draw the lure towards the kattumaram and quickly scoop out the fish using scoop nets.

When there are a lot of flying fish around ready for spawning, the lure method described above is very efficient. Sometimes though, the fish do not aggregate quickly and fishermen have to wait 2 -3 hours before pulling the shrubs and scooping the fish. If there still isn't enough flying fish to scoop, fishermen surround the brush with a small-mesh gillnet and the fish get entangled. But quite often, predators like dolphin fish and sharks scatter the aggregating flying fish when you are just about ready to start scooping.

Flying fish can be caught not merely by lures and scoop and by small-mesh gillnets, but also by larger-mesh driftnets during the non-spawning period. This was shown during trials at Besant Nagar, Madras *(Bay of Bengal* News, September 1987), where driftnets of mesh size 55 mm stretched mesh captured big species of flying fish. Each of these nets is 72 m long and 45 meshes deep. Netting is of monofilament twine dia. 0.20 with a hanging ratio of 74 per cent.

Early 1989 a BOBP boat, IND-20, started fishing in Thirumullaivasal. While its main purpose was to demonstrate offshore fishing using large-mesh driftnets and longlines for tuna and sharks, a seasonal fishery for flying fish was also commenced in April.

A driftnet identical to that in Besant Nagar was used in Thirumullaivasal. Result: big species like Sutton's flying fish *(Cypselurus suttoni)* and Indian spotted flying fish (C. *spi/opterus)* were caught instead of the usual small species. These big species were not yet ready for spawning at the time of capture. Around mid-May the smaller species started to aggregate, and the lure fishing started. Since big flying fish were still to be had, the fishermen took out to sea a half set of gillnets (10 pcs) along with the lures. There was good fishing with lures for about 10 days, then catches fell when the aggregating flying fish decreased in abundance. Predators also started to become a problem at the same time.



'Combination' method : **small-mesh gillnets in conjunction with lures and big** gilinets without lures

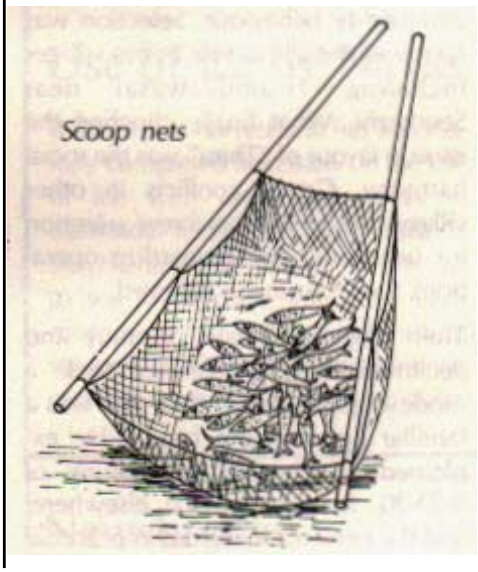
A new technique was then attempted. Two bundles of lures were tied to a drift gillnet, of 33 mm stretched mesh. This net was then placed in between the 55 mm nets and the "kambi" shrub and let out. After about two hours of drifting the net was pulled. Catches appeared to be good. A second haul also yielded a similar good catch.

This "combination" of gillnetting and the traditional technique was then used on the boat for the rest of the season. A second 33 mm mesh net was added to increase the catches. The advantage of this method lies not merely in reducing soaking time (since you do not have to wait for the fish to aggregate), but also in thwarting the predators. Since the flying fish are caught in the net when they get close to the lure, there is never a shoal for predators to scatter. The predators sometimes damage nets though, which is difficult to avoid.

Using the three different fishing techniques – driftnet for big flying fish, driftnet for small flying fish with attached lures, and the traditional lure fishing – the IND-20 usually returned to beach with good catches, far better than those of local craft. By May-end, the crew stopped using the traditional method with scoop-net. But fishing was successfully continued, often using the "new" technique for small flying fish in combination with gillnets for big flying fish. Some local kattumaram fishermen picked up the new technique of lures attached to small mesh gillnets, and tried it themselves with some success.

By mid-July, the flying fish fishing operation was stopped when the season apparently ended, and the boat resumed driftnetting and longlining operations for large pelagic species.

Some statistics. From mid-April to mid-July, 42 fishing trips were made for flying fish. The total weight of fish landed was 7,800 kg of small flying fish species and 1,000 kg of larger flying fish species, fetching a slightly higher price of Rs.5.70/kg compared to Rs. 5.00 for the small species. This gave a total value of almost Rs. 34,000. On an average, 210 kg of flying fish valued at Rs.800 were landed daily, quite impressive in comparison with local craft.

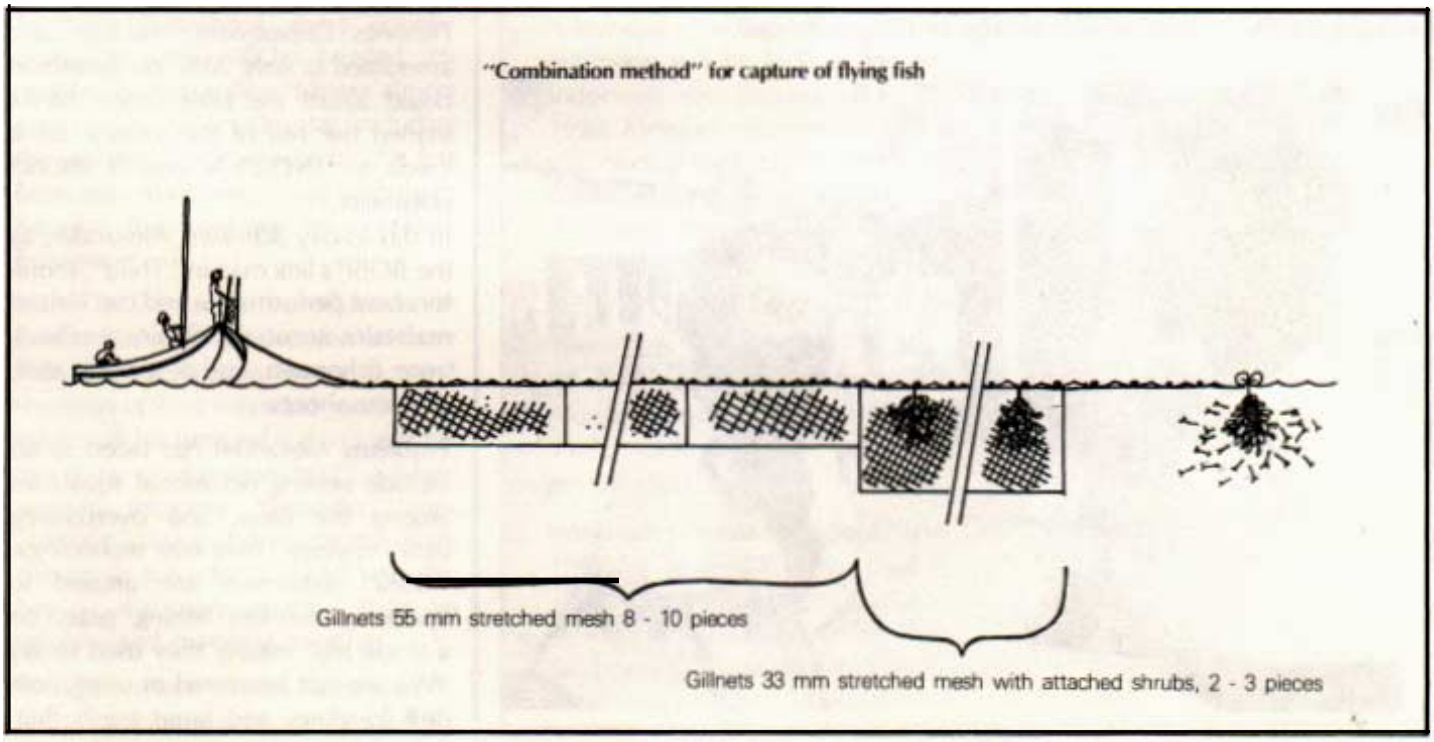


The Thirumullaivasal trials showed that it's possible to capture flying fish more efficiently than is done traditionally. Catches from the traditional "lure" fishing are good for approximately four weeks; but in combination with small-mesh gillnets, catches can be sustained over a longer period. IND-20 fishermen used the traditional method for one week, then started to use small-mesh gillnets with attached lures – the catches remained commercially feasible for another month and a half.

The combination method with 55 mm mesh size gillnets seems to be of doubtful utility. Since only 8- 10 pieces can be used in one set, catches of big flying fish were insignificant. It might be better to exclude them and instead add another two pieces of 33mm nets with attached lures to make four. This set of nets should then be intensively used in combination with the traditional method all through the season. A local "kola-kattumaram" could probably also carry the same amount of fishing gear.

Since there are no spawners among the big flying fish caught, attaching lures on to the 55 mm nets would hardly be of any use. A larger fleet of nets might yield good catches. 25 - 30 pieces of 55 mm driftnets could be used in one set.

This method has not yet been commercially tried out in Thirumullaivasal, though it proved effective in Madras. More trials are planned for the next season at Thirumullaivasal.



A. Alexander

"I know almost everyone in Thirumullaivasal, including the women
It has been easy to communicate with them, since they see me as a fellow-fisherman."

How do you introduce new technology in a fishing village? Answer: by preparing the community, explaining the technology, encouraging people's participation, anticipating and solving problems. Gradually, if the technology is right, it will spread.

This is the strategy BOBP is trying to pursue in Thirumullaivasal, Tamil Nadu, where the state fisheries department is introducing the fibreglass beachcraft IND-20 developed by BOBP. The craft was a hit in some centres of Orissa and Andhra Pradesh; it was believed that a community development worker could aid the process of initiating, demonstrating and transferring the technology in Tamil Nadu.

Fortunately, BOBP had such a community development worker at hand: Antony Alexander, 27, who hails from a fishing family of Kanyakumari district, has a basic degree in economics and a master's degree in social work: the right combination of aptitude, skills and knowledge. Alexander has been associated with BOBP since 1987 — hisS earlier stint was at Besant Nagar, Madras, where BOBP was trying to find ways to help the kattumaram fisherfolk there.

Alexander's first task in introducing IND-20 to Tamil Nadu was to help select the site. Over a four-month period, Alexander and a few other staff surveyed 20 to 25 coastal villages of Thanjavur district and studied their suitability for beachcraft operations from the standpoint of fish resources, shore infrastructure, beach configuration, fish marketing, fishing gear, and community behaviour. Selection was narrowed initially to four or five villages including Tirumullaivasal near Seerkazhi. What finally clinched the issue in favour of "Thiru" was the social harmony. Group conflicts in other villages could hamper crew selection for beachcraft and jeopardize operations too, Alexander believed.

Then began a period of study and acclimatization. Alexander took a modest apartment on rent, and was a familiar figure at the beach. He explained to fisherfolk the features of IND-20, its performance elsewhere, and the need for trying out its potential in Tamil Nadu. He recruited four young fishermen — Vetrivel, Balan, Kalimuthu and Mani — as crew.

The IND-20 moved to Thirumullaivasal early 1989. (See feature "IND-20 comes to Tamil Nadu," September 1989 *Bay of Bengal News).* The highlights of the boat's performance at "Thiru" have been

- Earnings of Rs. 115,000 over 10 months (highest daily earning being Rs. 5,000) and a net profit of nearly Rs. 49,000.
- Demonstration of new fishing methods to local fishermen
- A successful training course for fishermen and officals in July
- A seminar on bank credit for IND-20 boats, organized by the Tamil Nadu fisheries department in November. Participants met in Seerkazhi, visited "Thiru" to see boat operations and talk to fishermen.

Alexander has played a key role in these activities. He was the first person to emphasize that bank credit was vital if IND-20 was to help fisherfolk. Fishermen had told him that they could pay up 20% of the boat cost; since the Fisheries Department's subsidy also amounted to only 20%, no fisherman could afford the boat unless banks loaned the rest of the money. Bank credit for IND-20 is now a distinct possibility.

In day-to-day activities, Alexander, as the BOBP's link man in "Thiru", monitors boat performance and catch data, maintains accounts, obtains feedback from fishermen, assists visiting staff, problem-shoots.

Problems Alexander has faced so far include settling occasional squabbles among the crew, and overcoming their "coyness" over new technology. "Thiru" fishermen are unused to operating different fishing gears on a single trip; initially they used to say "We are not interested in using both drift longlines and large mesh drift-

Alexander with masterfisherman Aruldas in Thirumullaivasal.

nets . . On occasions the crew have wanted to fish inshore from where seerfish could be had easily; but Alexander dissuaded them : "Inshore catches are for traditional craft. IND-20 is an offshore boat".

Consultant Oyvind Gulbrandsen, the main designer of the IND-20, visited Thrumullaivasal early December to study the use of sails aboard IND-20. Despite rainy weather, Oyvind sailed on the boat and liked the way the sails performed. As is his wont, Oyvind plied Alexander with questions — about the sails of traditional craft, about details of IND-20's performance and the fishermen's response to it, about the fishing community in "Thiru"; there was little that Alexander could not answer. "There's a good extension man out here", said Oyvind happily.

Alexander believes that there is ample scope for technology extension in Thirumullaivasal. Hailing as he does from Kanyakumari, where motorized kattumarams are aplenty, where fishing with trolling lines and hooks and lines is quite advanced, and where fishermen venture northwards every year in quest of better fishing grounds, Alexander is a bit sorry that fishermen in Thirumullaivasal are unfamiliar even with trolling lines. These have now been introduced in "Thiru"; the use of drift longlines for shark has also been demonstrated, and this could turn out to be significant . . . "We have made a good beginning.., perhaps in a few years these fishing gears will be common here," says Alexander.

To bring that about, some positive extension work will be needed, by people like Alexander. "I know almost everyone in Thirumullaivasal, including the women", says Alexander. "It has been easy to communicate with them because they see me as a fellow-fisherman".

Such is Alexander's influence in Thirumullaivasal that the women there sometimes seek his assistance to mend the ways of their wayward youth. "He wastes all his time, why don't you tell him to be more responsible?", a fisherwoman implores Alexander, complaining about her teenage son. Alexander has a friendJy chat with the boy — it's more effective than an impassioned mother's nagging.

In other words: set a fisherman to reform a fisherman! **S.R.M.**

Use of ice by Navas

BOBP's post-harvest unit has successfully completed field trials on the use of ice with motorized navas in Kakinada. It has been demonstrated that Navas which take an ice box out to sea to preserve fish catch earn more money than those without an ice box. BOBP is now planning an extension scheme for the use of ice boxes among Nava fishermen, beginning late January 1990. Arrangements are also being made for a state government subsidy scheme for the purchase of ice boxes by fishermen.

A video film has been made on the use of ice with Navas. It is in English, and a Telugu version is being prepared.

Newsbriefs

— A four-day consultation on fisheries extension will be held in Medan, Indonesia from January 18 to 20, 1990. Member-countries of BOBP will discuss their experiences and possible new approaches and directions. The next issue of *Bay of Bengal News* will report on the consultation in detail.

— The 14th meeting of BOBP's Advisory Committee will be held in Medan from January 22 to 24, 1990, soon after the extension consultation.

We regret an error in the September 1989 *Bay of Bengal News,* page 7. The cost of the crab trap introduced in 1987 in Ranong province, Thailand, was 50 baht, not 150 baht.

— Clinton Fernando, our National Credit Officer in Colombo, died suddenly in December. Ever the quintessential banker, his heart was, in Negombo, where he lived among fisherfolk communities. For them he often loosened purse-strings, his own and banks'. Appropriately enough, he helped initiate BOBP work on a credit project for Sri Lankan fisherfolk. Unfortunately, he did not live to see it through.

Fish van of Chettinagar: A boon for fisherwomen

Fisherwomen walking with headloads of baskets — that's an image of symmetry and beauty that delights photographers, but it also highlights the drudgery and travail in the daily life of fisherwomen.

For about a dozen fishing villages near Pondicherry, such drudgery is happily a thing of the past. A van picks up women fish vendors every morning and evening, and drops them at Pondicherry. The women sell the fish to retailers at the Jawaharlal Nehru retail market there, or retail the fish themselves, and return home by the same van or on their own.

The Rs. 1.4. lakh van was acquired through funds from DANIDA (Rs. 50,000), the state fisheries department (Rs. 20,000) and a bank loan (Rs. 78,000). But it's the initiative and enterprise of the Chettinagar Fisherwomen's Co-operative Society, particularly of its president, that made the scheme possible. The villages served by the scheme (Anumanthai kuppam, Chettinagar, Nochikuppam, Koonimedu, Mudaliyar kuppam, Anichan kuppam, Pudukuppam, Pillai chavadi, Boomiar palayam, Chinna-mudaliyar chavadi) find it a boon, because public bus services are irregular and uncertain, ply only on main roads and do not enter villages, and often refuse to transport fish baskets.

The BOBP's post-harvest fisheries project was requested to monitor the van's operation and help ensure its full utilization. The project conducted a pre-operational study on the van in April. It also took part in the first six-monthly review of the van operation, held late November 1989. Nearly 100 fisherwomen took part in this review meeting; so did Tamil Nadu fisheries officials including Mrs. Mekala Devadoss and Mr. S. Pandurangan, Deputy Directors of Fisheries. It was agreed that the van had generated a healthy profit (Rs. 25,000 over six months), but this was nat sufficient to cover depreciation.

Meeting of the Chettinagar fisherwomen's co-operative society.

Efforts will now be made to improve economic viability so that the scheme can be continued and the incomes of women fish vendors improved.

"The Chettinagar experience is significant" says Mr. Isaac Rajendran, who helped study the van's operation on behalf of BOBP. "We hope similar fish vans start operating elsewhere in India and beyond".

The Chettinagar fish van.

BAY OF BENGAL NEWS

Bay of Bengal News is a quarterly publication of the Bay of Bengal Programme (BOBPL A regional programme of the FAO (Food and Agriculture Organization of the United Nations), it started in 1979 and covers seven countries around the Bay of Bengal Bangladesh, India, Indonesia, Malaysia, Maldives, Sri Lanka, Thailand. The BOUP's main goal is to assist governments to improve the conditions of small-scale fisherfolk communities. It is funded mainly by Sweden and Denmark, Besides, the ODA (UK) implements and funds post-harvest activities under the BOBP umbrella. AGFUND (Arab Gulf Fund for United Nations Organizations) funds training activities. UNFPA (United Nations Population Fund) supports a project to improve the conditions of fisherwomen.

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