Artificial reefs

Re-greening the seas

Experiments in some fishing villages of south India reveal the economic, social and environmental advantages of artificial reefs

Deep down in the south of India, in the coastal State of Kerala, live about one million people who depend, either directly or indirectly, on small-scale fishing and related activities. In all, there are about 130,000 active fishermen working from the beaches of Kerala.

In recent years, the Trivandrum district of this State has seen attempts to regenerate the capacity of the seas. The work has focused mainly on three communities of about 500 fishing families and, to a lesser extent, on another eight communities.

Over the last three decades, the communities' fishing grounds have been severely depleted and the natural reefs, essential habitats for fish, destroyed. One reason for this is that in the early 1970s, with traditional distant-water fishing grounds being closed to them, the Japanese fishing industry began seeking supplies of fish and prawns. This increased demand encouraged investors in India to purchase shrimp trawlers, and develop export markets in Japan.

There are now plenty of these trawlers fishing in India's coastal waters, doing untold damage to fish stocks and the habitat, which supports them. More recently, as a result of liberalization policies, the Government of India has opened up the country's Exclusive Economic Zone to joint ventures between foreign and Indian companies.

It is said to have issued 170 licences, involving around 800 vessels, but it is not known how many have actually begun operations. While there seems little chance of an easy reversal of these decisions, no further licences are being issued, thanks to protests from the National Fishworkers' Forum (NFF).

Fishing communities in the south-west of India have witnessed this industrial revolution at first hand. The incursions of trawlers into the inshore waters have caused severe depletion of fish stocks and, more importantly for long-term sustainability, led to widespread destruction of the marine environment needed to replenish stocks through providing habitats, shelter, protection, food and breeding sites.

Local studies have shown that many natural reefs have been destroyed. Around 150 species of once common varieties, including 135 fin-fish species, are no longer caught by the artisanal fishermen, because they have been severely depleted by uncontrolled trawl fishing for highly priced prawns for export. During the 1970s, overall fish catches declined and the artisanal sectors catch fell to between 40 and 60 per cent of per-1970 levels.

Artisanal fishworkers in the region have responded to this threat in various ways, including organizing themselves into unions and campaigning for more equitable fisheries development policies, through, for example, the NFF.

Many have also adopted new technology, such as imported outboard motors (OBMs), to compete more effectively with the trawlers for both resource and space on the fishing grounds.

Modern technology

Artisanal fishworkers, however, are handicapped in areas such as access to capital, credit, technology, markets and so on. While the use of modem technology like OBMs may help increase productivity, they also incur significant costs. Often the use of such technologies cause fishermen to change from traditional, selective

techniques to more modem, industrial 'catch-all' methods.

There is also increasing competition from outside investors who see fisheries as a short-term investment opportunity, rather than as a long-term source of livelihood. Such competition can pressure traditional fishermen to adopt more intensive and less selective techniques. The challenge for small-scale and artisanal fisheries, therefore, is to become more productive, without undermining traditional nurturing management systems and depleting the resource base.

As a response to this, fishworkers from several villages in the two most south-westerly districts of India - Trivandrum in Kerala and Kanyakumari in Tamil Nadu - have been engaged in experimenting with ways of rejuvenating the seabed and providing for the *in situ* conservation of fish stocks. These experiments have their origins in the age-old practices of placing coconut fronds and rocks in near-shore waters to attract fish into areas fished by gear worked from the beach. They are also influenced by the traditional belief in the Goddess of the Ocean, who must be treated with respect to ensure she continues to bestow her favours. Local NGOs and external development agencies have been working with local fishing communities, and adding to their traditional knowledge with concepts and knowledge borrowed from other countries.

A recent experiment has been the construction of artificial fish habitats (AFHs). Such artisanal experimentation has a long history. For instance, fishermen operating shore seine nets traditionally used to dump rocks fastened with coconut fronds on the seabed to attract fish close to the shore.

More recently, fishermen using hooks-and-lines came to associate wrecks on the seabed with rich fishing. AFHs, especially Artificial Reefs (ARs), represent a "people's" technology. They form a social and technological response to a fishery crisis, and are based on the fishers' traditional knowledge and understanding of their marine environment.

Local materials

Over the 1980s, the fishermen of the area constructed 19 AFHs, using locally available materials such as concrete well rings, coconut fronds and tree stumps. The site selection and choice of materials were based on the customary and experiential knowledge of the fishworkers.

The early experiments demonstrated the vulnerability of AFHs to damage by the monsoon, and to burying in sand and silt. On the positive side, they also

demonstrated that the vegetation used in the construction decays and provides important nutrients.

In 1989, the Programme for Community Organization (PCO), a local Trivandrum-based NGO, initiated a joint project with representatives from three fishing communities, based on the lessons learned from the early experiments. While the economic costs of the earlier experiments had been nominal, levels of investment required for this joint project were substantially higher. The new experiments involved the construction of purpose-built AFH modules in bamboo and concrete, followed by their aggregation into artificial reefs. The objectives of the project were to establish three ARs around the villages of Puthiathura, Thumba and Adimalathura. The local NGO raised half the costs and fishworkers, the balance.

The ARs were established at sites selected by the fishers and lowered into position from aboard local *kattumaram* craft. Systematic studies of their effectiveness were undertaken by PCO in collaboration with the Intermediate Technology Development Group (ITDG). In each case, the reefs were found to act as fish aggregating devices, significantly enhancing catches. It was also found that there was rapid colonization of the ARs by resident fish varieties.

However, there is also a danger that when ARs are used as fishing grounds, increased pressure can be applied to already overexploited fish stocks. Indeed, for this reason, the International Centre for Living Aquatic Resources Management (ICLARM) has warned against using ARs as fishing grounds. A longer-term strategy, therefore, needs to be worked out on how ARs should be used in the future.

The studies also showed that the AFH modules were susceptible to 'gliding' in different directions as they were put in position. If ARs were to become anything more than mere aggregating devices, their concentration had to be increased. Thus a technique for lowering and accurately placing reef modules on to the seabed was devised, using a rope-and-pulley system.

In January 1995, a team of oceanographers from Southampton University visited south India at the invitation of the NGOs and the Government of Kerala. On filming and analyzing the ARs, they observed that these are stable and the modules' surfaces are well colonized by marine life, providing protection and food for reef-dwelling fish.

The variety of life forms is not as complex as that found on natural reefs, but, with time, as the surfaces of the ARs mature, a greater diversity is expected to develop.

Fishers, on seeing the video of the ARs carefully positioned on the seabed and surrounded by fish, have reinforced their impressions of the value of this technology. This experimentation will not, by itself, solve the problems of artisanal fishers in south India.

Marine reserves

If large enoughand they would need to be about 10 to 50 times biggerARs can serve as underwater barriers to prevent the encroachment into near-shore waters of destructive fishing gear such as bottom-trawls. They can also provide refuge for fish. Dispersed over wide areas, ARs may serve as marine reserves and important breeding and conservation areas.

ARs a stand-alone technology, ARs are unlikely to form the basis of a viable artisanal fishery in the future. In a

liberalized market, fishers have to cope with rising costs of fuel, motors and other equipment, all of which are now in common use as artisanal fishers struggle to compete with larger-scale operations. Consequently, ARs in themselves have a relatively low priority in fishing communities.

Nonetheless, the enthusiastic feedback from the fishers, and the interest shown by other communities, spurred other local NGOs to participate in further experiments. The South Indian Federation of Fishermen Societies (SIFFS), representing around 6,000 fishermen, also became interested.

The news of the success has spread and ARS have now been taken up by the Government of Kerala as instruments to involve fishing communities in rebuilding their depleted fishery. The scale of this work is now at least ten times greater than what was initially begun. Further, interest in these experiments has also been aroused internationally.

The challenge for the future is to enable more local communities of artisanal fishers, who are the true guardians of marine resources, to develop such technologies, using participatory approaches that are environmentally efficient in sustaining fish stocks. However, this alone will not do.

Also needed are economic tools to analyze social and environmental costs, and the development of management systems, which fully include community institutions as crucial stakeholders in the preservation of marine resources for the food security of all.

Such tools need to evaluate the economic costs and benefits of investing in certain fishing practices, while at the same time assessing the costs of degrading the ecosystem, the costs of lost opportunities for food production and livelihoods, and the costs of reduced amenities.

Evidently, artificial reefs can play a roleat the community and government levelsin fostering awareness of how to maintain the diversity of fish stocks and the need for sustainable fisheries management. ARS also provide a focus for the debate on issues of ownership and control of the coastal commons and on matters of ecosystem rehabilitation.

Furthermore, they have a potentially important role to play in demarcating exclusive community-controlled fishing zones, and thereby facilitating sustainable community-based management of fish stocks on the basis of 'harvesting' rather than 'hunting'.

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