

The Role of Alternate Livelihoods and Awareness Creation in Coral Reef Conservation in the Gulf of Mannar, Southeastern India

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ABSTRACT

Growing coastal populations, destructive fishing activities, increasing use of modern fishing crafts and gears and coastal development have already caused considerable damage to a significant part of the coral reef areas in the Gulf of Mannar. It is clear that this to a large extent has been caused by a lack of awareness about the fragility of natural ecosystems among local communities, as well as a shortage of livelihood options. This must be addressed as a central issue in conservation and management initiatives. Activities focusing on viable alternative and additional livelihood options, such as aquaculture, value-addition, exploitation of previously under-utilized resources, and related awareness raising and education were implemented in villages along the Gulf of Mannar coast. Methods and impact are briefly presented and reviewed herein.



Figure 1. Fisher family.

INTRODUCTION

Coral reefs are an important economic resource world wide, but are now suffering from widespread decline due to over-exploitation and damage inflicted by the

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growing populations that utilize them (Pearson, 1981; Connell, 1997; Jackson, 1997). The Gulf of Mannar (GoM), one of the four major reef ecosystems in India, is no exception. Ever-increasing populations and economic and industrial growth adds pressure on coastal resources (Meenakumari, 2005). Over 50,000 people depend on the fishery resources of this reef area for food and livelihood (Patterson et al., 2007), and consequently large areas of reefs in the Gulf of Mannar are disturbed (e.g. Patterson et al., 2007; Patterson Edward et al, this volume). The main challenge the fishery now faces is to balance the needs for resource conservation with the needs of local people, for long-term sustainable management of the ecosystem (Shanthini et al., 2002). It is also clear that resource users, who have a great stake in sustaining their resource base, must be actively involved in this process (Pomeroy et al., 1996).

To address this SDMRI has carried out various pilot activities, research and training programmes, in collaboration with and supported by the Government of India, the Government of Tamil Nadu and the Coastal Ocean Research and Development in the Indian Ocean (CORDIO) programme. The aims of these activities have been manifold, including creation of awareness among stakeholders about the value of corals and associated resources and need for conservation; capacity building on viable alternate livelihood options among natural resource dependent coastal people in order to reduce the pressure on the ecosystem; sustainable utilization of natural resources; encouraging community-based conservation mechanism; and promoting effective but friendly enforcement strategies through education and training. This paper describes some of the approaches used and synthesizes key results and lessons learned from five years of community-based awareness creation and livelihoods enhancement.

Throughout, much focus was placed on women in fishing communities, particularly through Self Help Groups (SHGs). The SHGs, established in all coastal villages, play a major role in generation and wise use of financial resources. In Indian culture, women play

an important role in maintaining the home and family, and it is believed that women are reliable and more likely to pay back borrowed funds, making it easier to sustain microfinance programmes with their involvement. In view of this the Government also encourages SHGs in order to promote development among women. SHGs encourage and help women to save money, enabling them to use available funds for development or particular needs. SHGs lend money to members, e.g. to help households purchase fishing materials and other equipment that can increase household income, for family functions and children's education. This way people can avoid borrowing from moneylenders at high interest rates, which has been found to be one reason for the continued low economic status of households in the area. Each SHG consists of a president, secretary, treasurer and 17 members. The number of groups per village varies depending on the population of the village. A coordinator meets all SHGs in each village once per month, to assess progress and coordinate activities.

Education and Awareness Creation

The lack of knowledge among fisher folk about coastal ecosystems, their ecology and productivity, makes them insensitive to the fragile balance in the ecosystem, and unknowingly they are using destructive fishing methods to save time and effort (Patterson et al., 2002). A survey conducted during 2001 studying the knowledge among fisher folk about the ecological significance of coral reefs, found that awareness was very poor. Twenty nine percent of the men and only 3.1% of the women on the Tuticorin coast were aware of the ecological importance of corals for providing products and services (Patterson et al, 2002). To address this, a series of awareness programmes, were conducted, primarily targeting fisher women in view of their comparatively low awareness, but also since they are in a position to influence both active male fishers and children within their households. Several local-level training programmes and workshops were conducted, providing basic but up-to-date information about resources and ecosystem status and trends,

identification particularly of economically important or threatened species, community based conservation, coral reef conservation rules and regulations, as well as enforcement mechanisms. The process also served to exchange ideas and experiences among the stakeholders, particularly on traditional management systems, their success and shortcomings. The awareness programmes were particularly targeted towards families that were involved actively in removing live and dead corals from the islands for burning lime and for construction materials, covering topics such as the ill effects of coral quarrying, the loss of habitat for many fin and shellfishes, as well as erosion and the loss of natural barriers that can protect from waves and natural disasters.

A survey in 2004 indicated there was considerable improvement in the awareness level among the fisher folk (Patterson et al., 2005), and in the aftermath of the 2004 Indian Ocean Tsunami there was a tremendous change in peoples' attitudes. Most people felt that coral reefs saved coastal communities from the tsunami, villagers on the Tuticorin coast voluntarily stopped coral mining and dynamite fishing completely stopped in Thirespuram village. In the Gulf of Mannar, women in fishing communities turned out to be the most effective educators of working male family members, e.g. in promoting fishing methods that do not cause damage to the environment. They are also able to inform a larger constituency through Self Help Groups about conservation and resource management that can sustain livelihoods for future generations. It was also clear that carrying out educational and awareness activities in the local language increases the impact and success rate. Further, it was found that although India has all the necessary rules and regulations for protecting coral reef ecosystems, in most cases the primary stakeholders, i.e. villagers and natural resource users, as well as to some extent the implementing authorities, were not fully aware of these. Most importantly greater awareness among the coastal population is needed, as well as greater participation in the formulation and implementation of such



Figure 2. Vermi-compost training.

regulations. Environmental education should be a life-long process for all sections of the population (Vijaya et al., 2005).

Alternate Livelihood Schemes

In view of the high dependence on coral reef resources in the Gulf of Mannar, the concept of livelihood enhancement becomes very important for resource management and conservation of biodiversity. It seems clear that in a context such as that of the Gulf of Mannar, conservation programmes can be successful only if they also address the plight of the local populations, assisting them to develop suitable and viable alternate or supplemental livelihoods.

Through implementation of livelihood pilot projects on the Tuticorin and Vembar coasts of the Gulf of Mannar, SDMRI seeks to train and empower women (through SHGs) and men to earn additional income while reducing dependence on reef resources. This promotes conservation and sustainable resource use while actually increasing household income and enhancing socio-economic status. Experience has shown that e.g. crab and lobster fattening, development of value added products, cephalopod culture, and vermi-compositing are some of the alternate livelihood schemes that are viable (Patterson, 2003; Patterson et al., 2005; DST Project Report, 2006). These are described in more detail below.

Crab and lobster fattening

Among crustaceans, the crabs and lobsters are

particularly valuable resources supporting an important fishery in the Gulf of Mannar. The daily catch of this fishery includes molted crabs (e.g. mud crab, *Scylla serrata* and blue swimming crab, *Portunus pelagicus*) as well as molted and under-sized lobsters (*Panulirus homarus*, *P. polyphagus* and *P. versicolor*). Molted crustaceans have recently shed their carapace, and the new carapace remains very soft. These are locally called “water crabs” or “water lobsters”, and as they do not fetch a high price in the market are usually discarded or sold for a low price. Culturing these crabs and lobsters until the carapace hardens and a normal market value can be obtained is called fattening. Crabs and lobsters are landed throughout the year in the Gulf of Mannar, including a lot of molted individuals, on average 7-10% of mud and blue swimming crabs and 8-10% of lobsters.

Fattening of the mud crab takes 21 to 24 days, while the swimming crabs' carapace hardens within 7 to 9 days. For lobsters the process takes about 25-30 days. Growing out under-sized lobsters requires 3-4 months. The crab and lobster fattening utilizes catch that would otherwise have been discarded dead, and provides an additional income of between Rs.1000 to 1500 per person involved per month. Under-sized lobster constitutes about 2-4% of the total catch. Though it is not a good practice to collect under-sized lobster, these are caught during regular fishing with small meshed gears, and fattening was suggested to increase their value. At the same time fisher folk were advised not to collect juvenile lobster and informed about the pitfalls and implications for the sustainability of the fishery.

SDMRI trained over 300 fisher women and men in crab and lobster fattening in Tuticorin and Pudukottai Districts respectively. The District Administration provided all infrastructure and facilities for the fattening unit for women SHGs in Tuticorin District. Similarly, in Pudukottai District, the District Administration provided financial assistance to women SHGs to set up fattening units. As it is relatively simple, many of those trained remain actively involved in this venture, and crab and lobster fattening is

increasingly common and considered a viable alternate livelihood that can provide additional income for fishers. Based on the successes in Gulf of Mannar, other coastal areas in Tamil Nadu, including Pudukottai District, have also implemented similar fattening schemes.

Value addition of under-utilized marine resources, e.g. gastropods

The Gulf of Mannar has numerous mollusk resource species, and gastropods such as *Chicoreus ramosus*, *Pleuroploca trapezium*, *Lambis lambis* etc., have traditionally been harvested for the beautiful shell and expensive operculum. Nowadays, skin diving for mollusks has reduced considerably, and most of the landings are by-catch from the finfish and shellfish fisheries, and shells are mainly used for ornamental purposes and in the lime industry. Although delicious and rich in nutrients, utilization of gastropod meat has been very limited, mainly due to conservative food habits among coastal dwellers and lack of knowledge of the potential of gastropods as a food source. Consequently enormous quantities of potentially valuable, protein-rich mollusk meat was earlier discarded or sold for a low price. In order to make use of this available resource, value addition was suggested, whereby additional income to fisher households is generated by increasing the value of harvested mollusks through processing.

Through SHGs, fisher women were trained in the development of several value added products, such as pickles, soup powder, chutney powder, smoked products and wafers. Over 250 fisher women have been trained so far. Meat of gastropods is now regularly consumed by villagers, and fisher women can earn a minimum of Rs.1000 per month by selling the processed products in their villages and at local markets. The activity has been highly successful in utilizing an available by-catch that would otherwise have been discarded for improving nutrition and income.



Figure 3. Shore seine - catch.

Cephalopod culture

At all fish landing centers in the Gulf of Mannar, cephalopod eggs are found in the by-catch throughout the year, indicating that the cephalopods breed continually. Two species of cephalopod eggs are common, namely the big fin squid (*Sepioteuthis lessoniana*), and Pharaoh's cuttlefish (*Sepia pharaonis*), while eggs of the spineless cuttlefish (*Sepiella inermis*) are less commonly found although they occur in small quantities. Large quantities of eggs from trawl nets are discarded without any use on a daily basis. To find ways to utilize this potential but wasted resource, SDMRI through a Govt. of India research project, standardized techniques for culturing cephalopod eggs collected from trawl nets to juvenile and adult stages.

The cephalopod culturing trial involved simple technology and included the following steps: collection and identification of eggs, transportation, incubation, embryonic (intracapsular) development, maintenance of the hatchlings and juveniles and adults, feeding, behavioral and growth studies and disease management. Eggs were collected from fishermen or where they had been abandoned on the shore and immediately transported to the culture lab in a container with continuously aerated seawater. The eggs were carefully acclimatized to the lab water temperature for about 1 hour, after which they were

rinsed with filtered seawater in order to remove any adhered dirt. The eggs were then dipped in a mild solution of Oxytetracycline antibiotic (2 mg / 500 ml) for a couple of minutes, and egg capsules were removed from the clusters using clean scissors, in order to prevent infections or microbial growth on the egg stalks, which are tied together during the time of egg laying. During incubation eggs were kept in perforated plastic baskets in one cubic meter seawater tanks, with an 80% daily water exchange. The bottom and sides of the tanks were scrubbed daily and any accumulated dirt was siphoned out. Eggs were turned once per day to prevent fungal infection, and eggs with dead embryos were discarded. Detailed culture techniques, including infrastructure, feed, and problems are explained in the DST Project Report (2006).

Growth of embryos over time was observed. The incubation period was found to be different for the three cephalopod species: 21 ± 2 days in *S. pharaonis*, 15 ± 2 days in *S. inermis* and 17 ± 2 days in *S. lessoniana*. Cephalopods grow very fast and as a result they require large quantities of feed, initially live feed and later dead fish. Prior to undertaking large-scale culture, feed availability must be thoroughly investigated. Without sufficient feeding the animals can show cannibalistic behavior. Some cephalopods, mainly squids, show schooling within about 20 days after hatching. If separated from the school their behavior becomes erratic, and so cephalopods should be raised in groups rather than individually. Similarly, keeping cephalopods in small tanks appears to stress the animals. During mating, male cephalopods may engage in mock battles for access to females, which damages their epithelium leading to mortality. At such times, the males and females could be segregated. As cephalopods are in high demand particularly for the export market, cephalopod culture could be a viable additional income-generating activity for local people. In the domestic market, *S. pharaonis* fetch a market price of Rs. 100/kg, while *S. lessoniana* Rs. 110/kg. and *S. inermis* Rs. 20-40/kg. Cephalopod culturing techniques have been disseminated to local fisher folk



Figure 4. Vermi-compost pit in the backyard of fisher women.

in order start small-scale cephalopod cultures using discarded eggs from the by-catch, and SDMRI has trained 19 local fisher folk on a trial-basis. While this can provide an opportunity to utilize a so-far wasted resource in a useful manner to increase income, it could also extend to replenishment of natural stock and supporting management and conservation. However, further pilot trials are needed before the activity can be scaled up.

Vermi-composting

The role of earthworms in the breakdown of organic debris and in the soil turnover process was first highlighted by Darwin (1881). Vermi-composting is a simple and eco-friendly method of converting diverse biodegradable wastes from e.g. household and livestock into biofertilizer using earthworms. The vermin-compost contains all major and micro nutrients, humus and organic matter, which are essential for plant growth and soil health, making it highly useful for soil enrichment. The process does not require sophisticated instruments and involves relatively little work, and it can provide additional income to rural women, unemployed youth and school children (Balamurugan and Patterson, 2005).

A pit approximately 1m deep is dug in the soil and

a 5 cm layer of broken bricks or pebbles are spread at the bottom, covered by a thick layer of sand as this helps drain excess water. A layer of soil is spread on top of the sand, moisturized, and inoculated with locally collected earthworms. Small lumps of cow dung are placed over the soil and covered with bio wastes such as dry leaves. The pit is then filled with alternating layers of cow dung and bio waste, and water added until the pit is moist throughout, but not wet. The pit is kept covered with coconut or palmyrah leaves to prevent birds from feeding on the worms. Once per week the content of the pit is turned for uniform conversion. As the compost is getting ready the content turns into a soft, spongy, sweet smelling, dark brown compost. The appearance of juvenile earthworms by this time is a healthy sign. After 60 days no additional water is added, which compels the worms to move into the vermi bed, which facilitates harvesting of the compost without damage to the worms. The harvested compost is placed as a heap on solid ground and in the shade, facilitating any worms still present in the compost to move to the lower layer from where they can be recovered and transferred to a new composting pit.

SDMRI has trained over 300 fisher women from coastal villages in Tuticorin coast in vermi-composting, many of whom are keeping composts in their backyards and generating additional income through selling the product locally. A vermin-composting pit owner earns about Rs. 1500 to 2000 per crop.

DISCUSSION AND CONCLUSION

Realizing the importance of the reef ecosystem of the Gulf of Mannar, the Government of Tamil Nadu (GoTN) created a Marine National Park covering the 21 islands in the area in the 1980s. The Government of India (GoI) declared the Indian part of Gulf of Mannar a “Marine Biosphere Reserve” in 1989, covering an area of 10,500 km² between Rameswaram and Kanyakumari. Awareness about the importance of managing coral reefs and reef resources and

conservation became broader among all sectors and stakeholders in India after the 1998 global coral bleaching event, largely as a result of a number of international and national initiatives such as Global Coral Reef Monitoring Network (GCRMN), Coastal Ocean Research and Development in the Indian Ocean (CORDIO), Global Environment Facility-United Nations Development Programme (GEF-UNDP) and Indian Coral Reef Monitoring Network. Further, activities carried out through the CORDIO network since 2002, such as reef monitoring, restoration, capacity building among reef dependent fisher folk, creation of alternative livelihoods and awareness initiatives, as well as programmes by the Union Ministry of Environment and Forests, have greatly contributed to knowledge about the area and an understanding of how to address the issues and threats it is facing (Patterson, 2003; Chellaram and Patterson, 2005; Mathews and Patterson, 2005; Patterson, et al., 2005; Wilhelmsson et al., 2005; Patterson, 2005; Patterson et al., 2005; Patterson and Samuel, 2005; Patterson et al., 2006; Mathews and Patterson, 2006; Chellaram et al., 2006; Patterson et al, 2006; Patterson et al., 2007). The 2004 Indian Ocean tsunami made people more aware of the importance of islands and reefs, and the fisher folk along the Gulf of Mannar voluntarily came forward to end coral mining. Further, the Gulf of Mannar Biosphere Reserve Trust, formed by the GoTN to implement the GEF-UNDP project “Conservation and sustainable use of Gulf of Mannar Biosphere Reserve’s coastal biodiversity”, has taken the initiative to undertake job oriented trainings targeting fisher youth from the area, in order to facilitate diversification of income generating activities and take pressure off reefs and the fishery resource.

However, in spite of these efforts the Gulf of Mannar is still under considerable stress. Destructive resource utilization practices are proving difficult to stop completely due to the high dependence of a large number of poor coastal people on reef resources for their livelihood. In addition, businesses such as the lime industry particularly on the Tuticorin coast have

exploited the situation of high poverty among fisher folk by using them for illegal coral mining activities to obtain raw materials. Population growth, low literacy level and crowded fishing grounds continue to pose a threat to the reef resources, and fishing remains the only traditional profession recognized by and familiar to many poor fishermen.

Dealing with this situation requires long-term, broad and diverse efforts, including continued development of viable alternate livelihood options along with awareness creation and environmental education, which can gradually create a change. It is also essential that fisher women are encouraged to take a lead role in generating household income, thereby reducing the pressure by the predominantly male fishers on the marine environment. This requires increasing the literacy levels among women in fishing households, as well as providing e.g. vocational training, which is currently being addressed by SDMRI.

It must be noted that, in spite of many steps taken by the Government and other organizations in providing alternate livelihoods, the schemes mostly fail because activities or plans are not appropriate and require engagement and commitment in the long-term, beyond the scope of most interventions. In most cases, funding is available only for training fisher folk, but not for supporting start-up activities on a large scale. Many of the schemes also prove not to be viable as there is a mismatch between the skills and desires of the people, the activities being promoted, and market forces. In order to be able to change opinions and attitudes as well as traditional ways of living among poor fisher folk, sufficient technical and financial support is required.

Through programmes supported by CORDIO and the Government of India, SDMRI has successfully developed and implemented a number of alternate livelihood options on a pilot-scale, such as crab and lobster fattening, development of value added products from under utilized marine resources and using hygienic post harvest techniques to enhance quality, and vermi-composting. The schemes are

successful because the products have good market demand and there is a tie-up between producers and markets, and because facilitation, monitoring, support and technical advice for the activities has been sufficient over time. Importantly, the buy-in and support from district administrations has greatly increased sustainability and scaling-up of the activities, including e.g. the spread of crab and lobster fattening to other parts of the Tamil Nadu coastline after successful piloting in Tuticorin.

It is important to note that any alternate livelihood scheme should be based on local resources and a clear need, and underpinned by sound technical, financial, and market knowledge. Agencies involved in livelihoods enhancement activities should consider these aspects for greater sustainability and greater employment and food security benefits to local populations in the longer term. When implemented well livelihoods enhancement can constitute an essential part of conservation and management of marine resources.

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