

Myanmar: Mangrove-friendly aquaculture

U. TIN WIN

Department of Fisheries
Sinmin Road, Ahlone Township
Yangon, Myanmar

Abstract

Myanmar has extensive mangrove forests in Ayeyarwady Delta, Rakhine, and Tanintharyi, but these have been drastically reduced due to paddy rice cultivation. Today, only 382,032 ha remain.

Myanmar is only now starting to modernize shrimp farming. Current government policy supports and encourages foreign investment in shrimp culture.

Brief overview of aquaculture

Aquaculture has a long tradition in Southeast Asia. Ponds and lakes have for centuries been used for fish farming. With the region's rising population and with seas getting crowded with fishers, there have to be other ways to satisfy the demand for additional fish protein. The potential for aquaculture in Myanmar is so good that a large part of the food demand can be met by expanded aquaculture, and in this way taking the pressure off "wild stocks."

Aquaculture and mariculture give small-scale fishers a chance to widen the scope of their activities and provide them additional profits. These may be the best long-term possibilities that enable a lot of people to stay in the fishing sector. Coastal aquaculture has the greatest potential for future development.

History and present status

Fish culture probably began about 1,000 BC in China, possibly due to the desire of an emperor to have a constant supply of fish. Over the years, various principles for fish culture were established by observation. Only later was the scientific basis for these principles understood, and today, these principles are the basis of all aquaculture enterprises. Brackishwater aquaculture, on the other hand, began at a later date, probably in Indonesia, with the culture of milkfish and gray mullet. This, too, became an established part of the rural economy of Asia.

Fish has always provided the main source of protein for Myanmar's people. The consumption rate of seafood is estimated to be 18 kg/person/yr. Myanmar practices extensive fish farming particularly in the Rakhins State adjacent to Bangladesh. While the shrimp industry has developed rapidly in ASEAN countries, Myanmar is only now embarking on modernizing this industry. Current government policy supports and encourages foreign investment in shrimp culture.

The shrimp industries in Thailand, Indonesia, Malaysia and Philippines had confronted problems caused by the uncontrolled development of shrimp culture. Diseases and environmental degradation are problems that confront the industry's sustainability. The conversion of mangrove forest to shrimp farms with its attendant effects on fisheries and local communities has drawn the attention of environmental groups.

Myanmar shrimp farmers are in the fortunate position of learning from the mistake of other countries. The focus of technological development in shrimp farming is now the reduction of environmental impact and the more efficient use of increasingly scarce resources. The Myanmar industry can incorporate these advances through technology transfer and adoption.

Neither intensive nor semi-intensive culture of shrimps has developed in Myanmar though farming of marine shrimps has spread rapidly in Southeast and South Asia. Myanmar's neighbors Bangladesh and Thailand are both major producers of cultured shrimps.

Culture of marine shrimps is a major earner of foreign exchange. There are about 12,000 ha of traditional fish farms in operation which are mainly located in the Rakhine State bordering Bangladesh. The yield is very low, about 100 kg/ha/year. The culture of seabass (*ka-ka-dit*), grouper (*kyauk-nga*), milkfish (*nga-tain*), and mullet (*ka-ba-lu*) is still pilot-scale.

The Myanmar government considers aquaculture in general and shrimp farming in particular as high priority sectors of the economy. Shrimp farming is potentially a very large generator of foreign exchange. If the 40,000 ha can be brought under semi-intensive culture, the export income could be US\$400-500 million. The government at its highest level, the State Peace and Development Council, has established a special program for shrimp culture development. It endorses a strategy which prioritizes semi-intensive culture as the main vehicle for shrimp culture development.

Fisheries, including aquaculture, are considerably important in Myanmar, providing vital sources of food and generating income and employment.

Aquaculture development and mangrove area conservation

The mangrove ecosystem is one of the most productive. It helps maintain the foodweb in aquatic environments, protects the soil, moderates salinity, and provides timber, fuelwood, charcoal and a range of non-forest products. Protection and conservation of mangrove is therefore essential for sustainable food security of coastal communities.

Aquaculture spreads across the boundary between land (shrimp ponds) and sea (salmon cages or artificial reefs). It represents one of the fast-growing sectors of the coastal zone in some countries and is seen as a valuable supplement to local diets and source of foreign currency. Aquaculture may, however, be both a petitioner for a clean environment and a polluter. On the other hand, success in aquaculture may itself pollute the environment. Uncontrolled aquaculture expansion and resulting habitat conversion could reduce biodiversity and the natural reproduction potential of species used in aquaculture.

Table 1. Distribution of mangroves in Myanmar

Location	Area (ha)	Percent (%)
Rakhine State	64,752	16.9
Ayeyarwady Division	177,256	46.4
Tanintharyi Division	140,024	36.7
Total	382,032	100.0

Mangrove areas

Myanmar had extensive mangrove forest in Ayeyarwady Delta, Rakhine and Tanintharyi. The mangroves in Ayeyarwady Delta has been substantially decreased due to expansion of paddy cultivation to supply rice to the city after the Second World War. However, there was no expansion of the prawn hatchery. The recorded forests of these areas are Rakhine 64,752 ha, Ayeyarwady 177,256 ha, and Tanintharyi 140,024 ha (Table 1). But there is substantial reduction of forest cover in all the areas over the years. The satellite imagery of the Delta in February 1995 indicated 5.8% of forest area remaining in Laputta (in place of 32.2%), and 19.5% remaining forest area in Bogalay (in place of 51.89%). No forest exists in Mawlamyinegyun at present.

Value of mangrove resources

The importance of mangrove to fisheries has been reviewed by MacNae (1974). It is apparent that white (banana) shrimp (*Penaeus merguensis*), probably the most important shrimp species in Myanmar, is dependent on mangrove forests for shelter during its juvenile stage. Other shrimps which have been seen to depend on mangroves at certain phases of their life cycles include *P. monodon*, *P. indicus*, and *Metapenaeus* spp. Htay Aung (1982) noted that the larvae, postlarvae and juveniles of some penaeids enter estuarine mangrove areas in Myanmar, though details are not given.

Causes and consequences of mangrove destruction

Environmental problems faced in Myanmar today are not ones associated with industrialization and urbanization but those related to deforestation and loss of biodiversity. Although Myanmar has a relatively low population density when compared to other countries in the region, its forest resources and natural environment have come under growing pressure. However, deforestation in Myanmar, unlike in some other developing countries, is not the result of commercial extraction of timber but due mainly to shifting cultivation and fuelwood demand.

The country's forests particularly in Ayeyarwady Delta have come under pressure due to its overexploitation for charcoal production. Moreover, as most rural homes in Myanmar depend heavily on fuelwood for cooking, it has resulted in depletion of forest cover in marginal forests outside the reserve forest areas.

Wildlife

There are wildlife inhabiting Myanmar's mangrove forests. Among these are four species of marine turtles (loggerhead turtle, green turtle, hawksbill turtle and olive ridley turtle); the crocodile *Crocodilus*

porosus; the hog deer *Cervus porcinus*; wild pig; wild clog; jackal; samber deer; otters; monitor lizard; wild cat; and elephant.

Uses of forest resources

Mangrove forests provide a wide range of goods and services from which local people in coastal areas have benefited from time immemorial. There is a wide range of direct and indirect products, as follows:

Timber. Under favorable conditions, mangrove trees can grow big. *Rhizophora* ("byuchidauk") over 40 m tall are not uncommon and trees over 62.5 m have been reported (Sukardjo 1978). However, large trees are fast disappearing as most of them are removed before they can attain large sizes. In the Asia-Pacific region, "byuchidauk" is not normally used as timber, although a small amount is used for walling and flooring in Myanmar.

Heritiera formes ("kanazo") is the prime timber species used for house and boat construction, while the top is used for firewood. Timber in the form of poles is in great demand as fishing stakes by coastal fishers. It is also used in the construction industry.

Firewood/charcoal. Firewood and charcoal are the main products extracted from the Delta Working Circle. "Kanazo" the favored charcoal-making species, is now becoming rare. During the past year, yield of 1.68 ton/acre/year was produced and with the manual coupe of 33,280 acres, the turn-out was fixed conservatively at 50,000 tons/year (Working Plan 1958-1970).

The annual fuelwood requirement for Yangon is about 700,000 hoppus tons, and this demand is increasing due to population growth. However, the Ayeyarwady fuelwood production, including some 432,200 hoppus tons of charcoal, is sufficient to meet even over 60% of this demand.

Nipa. The versatile palm has provided useful products to traditional village communities living near or in the coastal and estuarine mangrove forests. A variety of products were obtained from the leaves, the juice or sap from the inflorescence stalk, and the fruit. These uses continue, and some have become the bases for cottage industries and commercial operations. Nipa palm leaves have traditionally been harvested for roof thatching and for walling. In fishing, nipa leaf petioles are used as floats for fish nets, the axes for fish poles, and as rope. Nipa is also used to produce vinegar, alcohol, and other fermented beverage.

Policies and legislation

The Government of the Union of Myanmar has promulgated a new Myanmar Forest Policy in 1995. The new law is in line with Myanmar's forest policies focusing on the protection of nature and sustainability of natural resources, on satisfying the basic needs of the people, and on the participation and awareness of the people in biodiversity conservation. The old Wildlife Protection Act of 1936 was replaced with the new "Protection of Wildlife, Wild Plants and Natural Area Law" in June 1994 in order to rehabilitate threatened wildlife and sanctuaries. The government has been extending the protected area to 5% of the country's total, with the long-term objective of increasing it to 10%.

Existing programs on sound utilization of mangrove areas

Model project where mangrove utilization for aquaculture is implemented

In collaboration with the Food and Agriculture Organization, the Myanmar Forestry Department implements the *Environmentally Sustainable Food Security and Micro-Income Opportunities in the Ayeyarwady (Mangrove) Delta Project (MYA/96/008)* in the towns of Laputta and Bogalay. The project area is tidal and heavily influenced by brackishwater intrusion. Tides are semi-diurnal with two lows and two highs in a 24-hour period. The tidal range is about 2.5 m.

Three salinity regimes are identified within the project area: freshwater, low salinity and high salinity. In the freshwater area, there is no brackishwater intrusion, although the influence of the tide reaches well into the regime. Freshwater-emergent vegetation and nipa inhabit the mid- to upper intertidal zone.

Mangrove species are the typical intertidal vegetation of the low and high salinity regimes. Common genera are *Rhizophora apiculata*, *R. mucronata*, *Brugeria* sp., *Avicennia* sp. and *Sonneratia apetata*. Degraded and denuded mangrove stands are invaded by *Phoenix* spp. and three species of the fern *Acrostichum*. Severe deforestation has accompanied the movement of humans into the delta in recent times. Forest reserves in Laputta township stand at 100,000 ha but illegal incursions have left only 40,000 ha intact to some extent. Deforestation has been followed by conversion of degraded land to rice cultivation. Anecdotal evidence clearly reflects the decline in fish landings that has accompanied this destruction.

There are 65 fish and mollusc species and 13 crustacean species harvested commercially. The most important in market value are "hilsa" and sea bass. Economically important crustaceans include the mud crab, freshwater prawn and tiger shrimp.

Two rice crops per year are possible in freshwater areas, but only single cropping is feasible in brackishwater areas. The rice crop in the latter is produced during the southwest monsoon (rainy season). Potable freshwater becomes scarce during the northeast monsoon (dry season).

Current aquaculture activities

The project strategy of aquaculture technology transfer relies on locally available resources to the maximum extent possible (Table 2). This translates into simple, appropriate culture methods using seed stock captured in local waters. Feeds are made from farm by-products such as rice bran and trash fish produced in towns.

Stocking is based on wild fingerlings in the case of seabass, snakehead, and mrigal. Crustacean culture uses juveniles of the giant freshwater prawn *Macrobrachium rosenbergii* and the tiger shrimp *Penaeus monodon*. Juveniles of the latter species are seasonally available.

The project introduced hybrid tilapia broodstock which is now beginning to produce fry and fingerlings in participating villages. Farming of Chinese and Indian major carps was initiated using fry from hatcheries outside the project area. However, hatchery is now under construction in Bogalay which will be able to supply fry and fingerlings to participants.

Seabass, tiger shrimp and mud crab are euryhaline, enabling culture throughout brackishwater areas. Sea bass are amenable to freshwater growout, as well. Freshwater prawns can be cultured up to 10

Table 2. **Aquaculture technologies being promoted in Ayeyarwady Delta**

<i>Classification</i>	<i>Aquaculture technology</i>	<i>Current status</i>
Freshwater	Chinese and Indian major carps	Grass carp, mrigal and rohu fingerlings provided to participants. Full polyculture not yet begun due to shortage of fry and fingerlings
	Hybrid tilapia	Broodstock provided to participants
	Rice-cum-prawn	Limited fingerling production
	Rice-cum-fish	Some participants in commercial production
	Other pond culture	Limited stocking with mrigal wild fry. Sea bass stock and brackishwater ponds
Brackishwater	Sea bass culture in ponds, pens and cages	Sea bass stocked and cultured in ponds and pen. Cage culture not yet initiated
	Silvofisheries	Several demonstration units under construction. Careful economic analysis will be required to evaluate the different systems under construction
	Crab fattening	Participants undertaking crab fattening in small ponds and floating cages. Both fattening and culture pose conservation issues
	Shrimp culture	Juveniles available for stocking from April to August Trials will be started next year
	Bivalve mollusc culture	Spat sources have been identified for <i>Crassostrea belcheri</i> . A culture trial for this species is underway in Laputta

ppt but are best suited to freshwater. Notwithstanding, freshwater fish farming is possible in rain-fed ponds even in brackishwater regimes.

A widespread network of traders works in the delta, marketing fish, shrimp and crabs to major towns, to Yangon and for export. Crab trading is particularly active, stimulated by rapidly growing demand and rising prices.

Identification of target villages and participatory planning

The project undertook town planning exercises in collaboration with other sectoral projects to identify poverty pockets. After the exercises, priority villages were identified with the help of village representatives and available secondary town data.

The project organized orientation and training of project personnel, counterpart department staff, and formed a project team for implementation. The team members and experienced villagers were

also trained in participatory rural appraisal. Baseline data of target villages were gathered and participatory planning was carried out in each of the target villages for income generation, women in development, forestry and environmental conservation. Village organizations were developed based on the bottom-up approach.

Here is an outline of the possible activities for agriculture, forestry, fishery, livestock and home industry sectors for eco-friendly generation and environmental conservation:

Agriculture sector

- Provision of fertilizers, power tillers, pumps, others, to increase yield from marginal land of poor households
- Encourage the making and use of compost to ameliorate effects of salinity and improve productivity
- Provision of soil amendment (lime) to control acidity
- Provision of seeds, seedlings, fruit grafts and vegetable plants for home gardens
- Encourage development of private village nursery for production of fruit and vegetable planting materials
- Initiation of double cropping wherever possible
- Paddy-cum-fish culture subject to permission of appropriate authority

Forestry sector

In villages or adjoining forest areas:

- Afforestation including nursery development by target communities in buffer areas of forests to be conserved
- Plan for maintenance of natural regeneration in and around the area
- Training of villages for participative management of forests within the provision of Community Forestry Instruction by the Forest Department
- Production and distribution of fuel-saving stoves

Villages outside forest areas will take up forestry activities including (1) development of a decentralized nursery for production of seedlings in target villages; (2) production and distribution of fuel saving stoves; (3) bank protection; and (4) planting in unutilized land. Besides awareness generation and sensitization through workshops, seminars, local study tours, essays and drawing competitions in schools were conducted and information-education-communication materials like posters, leaflets, stickers, video were produced.

Fisheries sector

- Construction of nets, traps and gears
- Development of backyard hatchery for production and distribution of fish fingerlings by community initiative, in suitable areas
- Aquaculture of freshwater prawn and fishes
- Semi-intensive culture of tiger prawn
- Crab cage and pen culture
- Pen and cage culture of shells and fishes
- Supply of boats, nets, traps, cage, others
- Setting up of small scale fish feeding unit
- Village scale fish processing facilities

Livestock sector

- Supply of pigs, chicken, ducks, others
- Setting up of feed-making machines in few places based on local available raw materials
- Provision of veterinary medicine, care and training wherever necessary

Other sectors

- Setting up centre for nipa thatch and reed-making for poor women
- Training on weaving and production of traditional ethnic dress
- Fish net weaving center in villages
- Other cottage-scale income generation activities based on natural resources

Development of community-based organizations

The target groups were identified during the process of participatory planning with the help of PRA tools. Gradually groups for income generation activities, women development, environmental conservation and village development extension worker were set up to develop village system, to facilitate income generation, for environmental conservation and women development in village were identified. The village development committee with units composed of the groups above mentioned was formed to coordinate activities.

Capacity building

Community representatives are trained by an experienced team composed of a sectoral specialist, counterpart department staff, and other national resource persons on book and stock keeping, operation of revolving fund, community-organizing skills, participatory planning and monitoring, formation of rules for participatory development activities, and participatory forest management. The trained representatives are responsible for training their own village group members.

Knowledge and skills training for various income generation activities have been imparted by project team members and national and international professionals. This includes training on forest nursery, production of fish fingerlings, stove-making, weaving, vegetable cultivation, vegetative propagation, fish chip making, aquaculture, net weaving, crab fattening, and cage culture.

Participatory technology development trials have been planned for integrated management of land, double cropping, and introduction of new varieties of fruits, vegetable and forest species.

Supply of inputs

Participating village groups were provided inputs like fertilizers; seeds; planting material tillers; pumps; various types of fishing nets, traps, twines; livestock such as pigs, chicken, ducks, among others; feeds; and fish fingerlings. Several centers have been set up in villages either by groups or individuals for production of forest seedlings, fish fingerlings, supply of fish nets and traps, and fuel-saving rice husk stoves.

Extension mechanism

Each Village Development Committee (VDC) constructs a room for displaying various extension materials for income generation, environmental conservation, health, education, and water supply and sanitation; and an office for village development activities. About 25 centers have already been set up. VDCs act as extension agents of the village, providing information about technology and other messages from the project that can improve the villages. Extension materials like leaflets, booklets, comic books, and posters are produced, focusing on conservation and income-generation

activities. Villagers are taken on study tours to other villages which have achieved success, conservation, income generation and women development.

Micro-income generation and environmental conservation activities

The landless poor of project villages proposes income-generation activities based on their resources, knowledge and skills. The project also provides training on income generation opportunities and allows recipients to participate in technology development trials.

Villagers plant trees in unutilized areas and develop forest nurseries for the sale of seedlings. They are also motivated to take up bank protection. Fuel-saving and rice husk stoves are also introduced to minimize the use of wood.

Recommended approaches (national and regional levels)

Like in other countries, the responsibility in Myanmar for coastal zone management is fragmented along sectoral lines or between various departments and ministries. The agencies responsible for particular resources usually manage and operate independently of each other and the mechanisms for interministerial coordination on natural resource management issues still need to be established. At present, there is no well-developed arrangement for managing the country's coastal and marine zone. Much of Myanmar's coastline is sparsely populated and features natural ecosystems which have suffered relatively little exploitation except the Ayeyarwady Delta.

ICZM approaches will be considered in the future to establish an appropriate policy, planning and regulatory framework to ensure that the coastal zone is indeed managed well. The innovative strategy being applied in Ayeyarwady Mangrove Delta is still in juvenile stage. The generation of environmental awareness is deemed essential to its success.

Biodiversity conservation in Ayeyarwady Delta will greatly help preserve the rare species of plants and animals as a national heritage to future generations. Certain forest reserves should be maintained in perpetuity and managed purely for the conservation of biological diversity.

The following recommendations are made to improve coastal zone management in Myanmar.

- (1) Develop the ICZM approach involving close cooperation between line agencies on the national and local levels
- (2) Develop regulations for comprehensive management in coastal zone and marine resources exploitation
- (3) Define clearly the responsibilities of agencies and departments and strengthen institutions involved to improve coordination and their regulation roles
- (4) Develop the coastal and marine environmental monitoring and marine resource information system

Concluding remarks

Aquaculture has only really started to develop rapidly in the past few decades, due to better knowledge of cultured species, improved methodologies and techniques in breeding and nutrition, and increasing demand for food fish of high-value species such as shrimps, seabass and groupers. In recent

years, attention has focused on developing intensive shrimp culture for export while marine fish culture is not yet as intensive as that of crustaceans. But intensive shrimp culture may have a negative impact on coastal capture fisheries and the environment. In Thailand and Vietnam, mangrove deforestation for expanded shrimp culture activities has resulted in the loss of habitats for breeding and spawning of a number of commercially important species of fish, crustaceans and molluscs and could have a long-term negative impact on coastal fisheries.

Mangrove deforestation also has an impact on shrimp culture itself. The success of the latter (when traditional culture method is used) depends on stocking of wild-caught postlarvae. For intensive shrimp culture, the number of wild-caught spawners may decrease because wild shrimp population also use mangrove swamps as its feeding ground.

Other negative effects of mangrove destruction to make way to shrimp ponds include water pollution from pond effluents; sedimentation from the release of solid materials from ponds; interruption of the tidal water flow regime; introduction of disease-causing organisms; loss of natural shrimp and fish stock due to increased pollution or product contamination due to indiscriminate use of chemicals. In recent years, an epidemic was prevalent among intensively cultured fish and shrimp in a number of Southeast Asian countries; this might have been due to mismanagement in fish culture, e.g. high stocking density and overfeeding. Chemicals and antibiotics have also been used in fish and shrimp culture to prevent and control bacterial and viral diseases; however, their implications on human health are not clear.

In order to ensure the sustainable development of aquaculture, it is important to bear in mind the interdependence of technology and natural resources under various socioeconomic settings.