

**Mariculture potentially provides an income or food for local people in and around an MPA and when carried out in an environmentally sound way it can ease pressure on marine resources. However, some mariculture operations cause problems and may have a negative impact. An MPA manager needs to be aware of both the benefits and disadvantages in order to respond to investor proposals, and to decide whether to become actively involved in such enterprises.**

Mariculture is the farming of marine species, whereas aquaculture is the farming of any aquatic creature and often refers specifically to freshwater activities. The farming of a single species is called monoculture, and the growth of several species together is termed polyculture. The contribution to world fish production of farmed aquatic foods, particularly salmon, trout, carp and tilapia species, has been increasing rapidly over the last 20 years, and now exceeds 30%. Mariculture has been tried in the WIO in many places, but only a few species have been commercially farmed on a long-term basis. Many projects have been hampered by a lack of aquaculture traditions and technology or by local political instability and economic uncertainties.

Aquaculture can be carried out in two ways. Extensive farming means animals or plants are grown in the natural environment relying on natural foods, using low densities of wild-caught juveniles or natural settlement of larvae. Costs are usually quite low, as are yields. Intensive mariculture requires maintenance of animals and plants at very high densities, often in enclosed ponds or cages; they are usually fed special diets and possibly antibiotics, and fertiliser may be added to boost production. Investments are usually high and profits are expected to be considerable.

## ENVIRONMENTAL ISSUES

Depending on the location and species involved and the way in which it is carried out, both extensive and intensive mariculture can cause environmental damage in the form of:

- Destruction and conversion of natural habitats (e.g. mangroves for shrimp farms; seabed for intertidal species) and loss of productive fishing grounds;
- Pollution from uneaten feeds or waste products (e.g. faeces), cleaning fluids and antibiotics in the feeds, and excessive sedimentation from cleaning of ponds;
- Introduction and escape of exotic species (see sheet K5) or disease vectors such as viruses.

## SPECIES INVOLVED

**Algae (seaweed)** - See case study.

**Bath sponges** - These can be grown in the sea from small cuttings fixed to lines, with minimal environmental impact. Sponges are farmed in the Mediterranean, parts of SE Asia, and the Caribbean but this has not yet been tried in the WIO. Although technically simple, commercial sponge farming is often not commercially successful as demand fluctuates and is generally low, with farms prone to disease.

**Crustaceans** - Shrimp, prawns and crabs are widely cultured and are the most commercially attractive marine species for mariculture. Penaeid mariculture accounts for up to 30% of world production of shrimp and there are operations in the Seychelles, Madagascar and Mozambique. Shrimp farms require ponds. The simplest systems obtain water and stock through natural flushing and little or no feed is given; annual production is about 400-900 kg/ha. With greater investment, intensive ponds with pumped water, formulated feeds and higher pond-stocking densities, and hatcheries, can produce 7,000 kg/ha annually. Mud or mangrove crabs (*Scylla* spp.) can be produced in extensive on-growing and fattening operations (ranching) using wild-caught juveniles. Crabs can also be polycultured with fish and shrimp, an operation currently undergoing trials near Mombasa. Juvenile crabs can also be produced in hatcheries, but the process needs further refinement. The common spiny lobsters (*Panulirus* spp.) are difficult to culture because of technical problems in rearing their larvae.



Seaweed farming, as seen here on Zanzibar's east coast, may be an option for reducing pressure on wild resources in an MPA.

**Molluscs** - Pearl oysters (*Pinetada* spp.) can be cultured for pearls, and mangrove or rock oysters (*Crassostrea*) and the mussels (*Perna viridis* and *P. perna*) for their meat. All rely on natural settlement of the seed (spat) onto surfaces or areas of seabed that can be visited periodically for harvest and to remove predators. Giant clams (*Tridacna* spp.), two species of which occur in the WIO, have been farmed in the Pacific and in SE Asia, and offer potential

(with demand by the aquarium trade and for meat). The blood cockle (*Anadara* spp.) and pen shell (*Pinna* spp.) are fast growing intertidal species widely collected as food, and with potential for culture. Although there is potentially demand for these species, very few attempts have been made at culturing them in the WIO.

**Holothurians** - Certain species of sea cucumbers are being successfully farmed in the Pacific (e.g. Solomon Islands and Japan) and there is potential for this in the WIO.

**Fish** - Most fish farming in the WIO involves freshwater species (e.g. carp, trout and tilapia). However, some *Oreochromis* tilapia tolerate brackish water and may be acclimatised to full strength seawater. Other candidates include rabbitfish (*Siganus* spp.), milkfish (*Chanos chanos*) and mullet (*Mugil* spp.). These fish are desirable on the local market but not to exporters, and so economic margins are marginal. Nevertheless, MPAs experiencing fishing pressure on natural stocks might benefit from the development of small-scale fish farms.

#### KEY POINTS FOR THE MPA

- ❑ Mariculture may be appropriate in or adjacent to an MPA if it helps to generate income, employment and food for local communities, and thus reduce pressure on natural resources, provided it is carried out in an environmentally and socially sound manner and developed with the local communities.
- ❑ MPA managers should consult guidelines for investment in mariculture enterprises (e.g. those for Tanzania and Mozambique - see below) before approval of any project.
- ❑ If a proposal is provisionally approved, MPA managers should ensure that a detailed independent EIA is undertaken (as required by most countries).
- ❑ If an operation goes ahead, a monitoring programme should be set up to assess impact on the natural environment; the skills and experience of MPA staff may need to be strengthened to interpret monitoring results.

#### Sources of further information

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[www.fmcbiopolymer.com](http://www.fmcbiopolymer.com) – importing seaweeds from the WIO.

### CASE STUDY

#### Seaweed farming in the WIO

Two species of the red seaweed *Eucheuma* have been cultivated widely in the WIO since the late 1980s. Asian strains are used, grown from cuttings attached to rafts or strings staked to the seabed in shallow clear inshore waters. The harvested seaweed is dried and exported to factories in Europe and the USA where it is processed to extract carrageenan, a substance used as a thickener in products ranging from paints to tooth pastes and foods. Farming is expanding rapidly, offering a relatively simple income generating activity for coastal communities.

It is conducted within several MPAs in Tanzania including Mafia Marine Park and Mnazi Bay-Ruvuma Estuary Marine Park, and in collaborative fishery management areas in Tanga region. It was discouraged in Moheli Marine Park, Comores, and Kisite Marine Park, Kenya, because of concern that it might cause damage and conflict with the MPA objectives, but operations in more environmentally suitable adjacent areas were promoted. Considerable experience now exists in the WIO that should be used when MPAs are deciding whether to support this activity directly. Guidelines for seaweed farming are included in the general mariculture guidelines published by the Tanzania Coastal Management Programme.

Key issues to consider are:

- Although often promoted in the hope that the increased revenue will result in a reduction in fishing pressure, this may not happen as seaweed farming suits women in particular, and men may continue to fish.
- Unless carefully planned, seaweed farming may conflict with other uses of an area as boats can cause damage to the rafts and lines. A zoning plan, developed with users of the area, can reduce this risk.
- Income from seaweed farming can fluctuate due to crop losses from predation, poor weather conditions, and market issues.
- The long-term environmental impact of seaweed farming in terms of spread of introduced species, shading of benthos and increased nutrients has not been determined. The Asian species and strains seem to have no negative impact when farmed in SE Asia, but major problems arose in Hawaii where they began over-growing coral reefs. In the WIO, no serious negative impacts have been determined so far, though a more thorough EIA is required.