Regional Review on Existing Major Mariculture Species and Farming Technologies

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Overview of commodities and systems

Mariculture is here defined as 'in sea aquaculture'. The major species groups maricultured in the Asia-Pacific region are: marine finfish, crustaceans, molluscs, echinoderms and aquatic plants.

Marine finfish aquaculture in the Asia-Pacific region is exceptionally diverse. Japanese amberjack (*Seriola quinqueradiata*) makes up 17% of regional marine finfish production. Most marine finfish production is from small-scale, often family-operated farms. However, the limited availability of costal cage sites has led to the adoption of European-style cages which allow farming in more offshore areas. In the future, it is likely that Asian-Pacific marine finfish aquaculture will diverge into small-scale production systems, culturing a diversity of species, and large ('industrial') scale aquaculture farming species where production efficiencies will be essential, such as cobia (*Rachycentron canadum*).

Mariculture of crustaceans is largely limited to tropical rock lobster (Family Panuliridae). Lobsters are farmed in staked or floating cages, or in submerged cages. Seedstock supply is entirely from the wild – juveniles are collected using wooden or stone substrates in which holes are drilled to attract settling pueruli.

Molluscs are widely cultured in the Asia-Pacific region, and range from low-value high-volume commodities (such as mussels) to high-value low-volume commodities (such as pearl oysters). Molluscs are important for small-scale or artisanal aquaculture and fisheries throughout the region.

Sea cucumbers are cultured in ponds, and also using rafts and cages. Demand for sea cucumbers (mostly from China) remains strong and prices high. There is potential to develop sea cucumber culture for co-culture with shrimp, or for bioremediating nutrients from shrimp ponds or other coastal aquaculture systems. Sea cucumbers are also potential sources of neutraceutical and pharmaceutical compounds.

Seaweed culture is a major component of Asia-Pacific mariculture. Some seaweeds are cultured for direct consumption (e.g. *Caulerpa*), while others are cultured for their polysaccharides for alginate and cargeenan production (e.g. *Kappaphycus*).

Priorities for R&D and extension

Some species are dependent on wild seedstock and there is no developed hatchery production technology; consequently there is a need to maintain and manage wildstocks.

Promotion of small scale hatchery technologies is essential to stimulate the development of aquaculture in coastal communities. As part of this, there is a strong need to improve the quality of hatchery reared finfish fingerlings. In hatcheries,

especially if restocking / escape to the wild is occurs, then there are issues with the genetic quality of stocks

The environmental impacts of mariculture will be an increasing problem as intensity of production increases. Tropical mariculture has received much less attention than temperate systems and the impacts may be quite different. The carrying capacity and loadings that are possible or appropriate in tropical systems are still unclear and requires attention for the purpose of effective zonation and coastal resource management

Much Asian-Pacific mariculture relies on the use of 'trash' fish as feed, so the development of appropriate formulated feeds is a priority. While formulations exist for many species, a major constraint is promoting farmer adoption of these feeds.

Markets and trade issues are critical, particularly where farmers are shifting between commodities. Some species, such as groupers, are traded in small quantities and even moderate increases in production can have substantial market impacts. For this reason, improved market intelligence for farmers is a priority issue.

Access to higher value markets is an opportunity but requires a far higher degree of management, and may require improved technologies (e.g. for transport of live fish).

The potential of low-trophic-level species as a means to reduce the impacts of higher trophic-level-species (i.e. to balance nutrient release) requires more work. One of the major issues is that many low-trophic-level species are low-value commodities, and this reduces their attractiveness to farmers. For example, in China, there is a general trend away from seaweed production to production of more lucrative species, such as marine finfish.

Integrated mariculture has been proposed as a means to mitigate the environmental impacts of mariculture. Most research on integrated aquaculture has been done in 'closed' systems such as coastal ponds. The adoption of similar approaches in open systems is problematic because there is little knowledge of nutrient flows and process associated with tropical mariculture. The scale of the system may also be a constraint – it may require 1.7–3.0 tonnes of seaweed to absorb the nitrogen output from 1 kg of marine finfish production.

Best management practices are being developed at several levels. At the higher level, BMPs may take the form of Standards such as the recently developed Standards for the Live Reef Food Fish Trade. These rely on more detailed documentation, such as the guides that have been developed through the Asia-Pacific Marine Finfish Aquaculture Network on feeds and feed management for cultured grouers, and small-scale hatchery technology for marine finfish. These guides have been translated into local languages to facilitate their use by farmers.

From an overview of mariculture technology development in the Asia-Pacific region, there are two major future trends:

1. There is a move to increasing intensity of production
2. There is a shift away from low trophic level species towards higher value high-trophic-level species.

One effect of the increased production of high-trophic-level species is that there will be an increased reliance on low value/'trash' fish resources as feeds. The environmental impacts of increased production, unless alleviated, will lead to localised pollution and will promote increases in disease prevalence.

To mitigate against this will require more effective coastal planning to limit overloading of the coastal environment. Integrated farming may assist in mitigating this but the management and economics of this are still uncertain. Research and development into alleviating environmental impacts of mariculture is a priority issue. Information transfer and communication will be important in transferring improved management approaches and facilitating uptake by farmers and by management agencies.