

Workshop summary

BACKGROUND AND WORKSHOP ORGANIZATION

The Fisheries and Aquaculture Department of the Food and Agriculture Organization of the United Nations (FAO) and the Network of Aquaculture Centres in Asia-Pacific (NACA) organized the workshop “*The Future of Mariculture: a Regional Approach for Responsible Development in the Asia-Pacific Region*” from 7 to 11 March 2006. The workshop was conducted in collaboration with the Ministry of Fisheries of the People’s Republic of China and the Guangdong Ocean and Fisheries Administration.

The regional workshop, held in Guangzhou, China, was attended by 51 participants from governments, business, nongovernmental organizations (NGOs), universities and regional and international organizations from mariculture-producing countries around the Asia-Pacific region.

The workshop was convened in response to requests from FAO and NACA members to identify key trends and issues affecting mariculture growth in the Asia-Pacific region, and to strengthen regional collaboration for future responsible development of mariculture. China’s hosting the workshop recognizes the status of China as the leading mariculture country in the world and a major market for mariculture products from around the Asia-Pacific region.

The workshop was organized in complementary sessions. The first sessions comprised presentations and discussions on country trends and thematic reviews on selected key issues. The second sessions continued with three working groups focusing on important topics, namely: 1) Market, Demand and Trade, 2) Livelihoods, Producer Organizations, Technology Transfer and Communications, and 3) Mariculture Species and Systems. The third sessions comprised a “farmer dialogue” and a “trader and marketing dialogue”. The farmer dialogue was made at a large mariculture farming area near Guangzhou, while the trader and marketing dialogue was held at the largest live-seafood market in Asia. These dialogues yielded valuable insights and recommendations from farmers and traders.

The final plenary brought together the working group findings and prepared a framework for regional collaborative action. The workshop participants proposed the establishment of a regional “Asia-Pacific Mariculture Cooperation” initiative to support the development of sustainable mariculture in the Asia-Pacific region. The initiative would facilitate cooperation around the region by promoting responsible mariculture farming technologies, capacity building, market access and effective transfer of knowledge. The platform for the initiative would be the “Asia-Pacific Marine Finfish Aquaculture Network”, which is promoting cooperation in marine fish farming around the region and has been widely seen as successful. FAO and NACA were requested to facilitate and support the development of this new mariculture initiative.

This summary provides the background to the workshop and main findings and conclusions. It is supplemented by further sections providing the thematic reviews commissioned for presentation at the workshop, country/regional reviews, special reviews prepared by participants and outcomes from the farmer and market dialogues. The workshop programme and participant list are given in Annexes 1 and 2, respectively.

WORKING GROUP FINDINGS

Markets, demand and trade

This Working Group discussion focused on maricultured seafood, i.e. products specifically farmed in the sea. It recognized that some lessons could be learned from the shrimp trade, but the group did not discuss shrimp. The factors affecting the demand for farmed seafood were identified as follows: (i) reliable supply, (ii) affordability, (iii) food safety; (iv) traceability and (v) consumer preferences.

Major issues

There is a growing demand in the region for seafood. Urbanization and the wealth of the urban populations are also generally increasing. There are different subsegments of the market – wholesale, domestic, restaurant, supermarket, processors and industry (for non-food use), each with specific demand trends and requirements.

There is a high diversity in fish species, and far less species diversity within the molluscan and seaweed commodities. Marketing chains are a critical factor, as the efficiency of the chain affects the ability to fulfill demands.

Small producers could find it difficult to meet the demands of consumers in terms of quality, reliability of supply, safety of the products and price. On the other hand, the high degree of diversity of species demanded by consumers gives opportunities to smaller or niche producers.

Increasing prices for wild fish and increasing quality of aquaculture products increases acceptability of cultured fish. The price differential between wild and cultured fish in China, Hong Kong Special Administration Region (SAR), for example, is decreasing and prices are getting closer for most species.

For live or fresh fish products, there is still a general preference for wild product over cultured product in the region. However, wild fish quality can be variable and aquaculture offers the potential for a more standardized (or even safer or superior quality) product. This group includes live species such as groupers.

Challenges

There are a number of challenges related to market demand and trade.

Technical challenges include:

- how to keep fish alive until the market;
- how to reduce transportation costs;
- how to make supply consistent/reliable;
- how to make the cultured product closer to the desired quality (comparable to wild-caught type, freshness, smell, fattiness);
- how to ensure the product meets quality requirements;
- how to ensure product safety; and
- how to set up the minimum food safety guideline for the world trade of marine aquaculture products.

Marketing challenges include:

- how to avoid flooding the market;
- how to distinguish between wild and cultured fish (labelling issues);
- how to expand the market;
- how to change consumer habits (i.e. how to shift consumers from live to frozen fish);
- how to get consumers to accept different species;
- how to ensure that farmers get a fair price; and
- how to communicate consumers' needs and preferences to producers.

For “*fresh or frozen mass-produced fish commodities*” there is already a demand for mass-produced fish from mariculture in nearshore and offshore cages. These include such species as milkfish, Asian seabass, cobia, seabream, yellowtail, flounder and turbot, which are now widely farmed. The larger operations have direct sales of fish that are not usually live. There is also a trend towards more convenient products in urban markets. However, prices of fresh and frozen fish will not increase greatly or may even decrease (supermarkets also tend to squeeze prices). If prices are not likely to increase, margins will have to come from improved efficiency. There is some scope to do this without compromising the quality of the product, raising the following points:

- how to get consumers to accept different product form (particularly frozen versus fresh);
- how to make cobia and milkfish more widely accepted in export markets;
- how to popularize Asian species in the European and United States of America markets (models similar to Vietnamese *basa*, tilapia, etc.);
- how to expand markets for milkfish (how to increase production), particularly processed (boneless/cooked);
- how to reduce production cost for Asian seabass fillets (price too low);
- how to improve market diversity via processing or value adding of products;
- how to reduce production costs generally (increase survival, improve health etc.);
- how to get a higher degree of standardization of mass production to ensure acceptability of product in the international market (i.e. the salmon model) – this requires feed control, environmental monitoring, vaccination, no antibiotics, etc.; and
- how to get consumers to accept cultured fish over wild captured fish (quality of cultured product can be better than wild products; e.g. lower heavy metals or other residues).

For molluscs, the issues include:

- very different markets for groups: high-value (abalone, oyster, scallop), and low-value (cockles, clam, mussels);
- sanitary and phytosanitary (SPS) issues (particularly, monitoring of coastal waters for red tide/paralytic shellfish poisoning [PSP], etc., is critical);
- a lack of traceability systems – however, zoning of safe zones and area monitoring allows small-scale operations to work. (Note: urbanization and run off will increase in the short term, thus sites will be more constrained, and coastal land costs will increase, further limiting siting);
- a lack of regular monitoring systems (several countries have regular monitoring systems; others are trying to establish/get them up to standard; Thailand and Viet Nam can export to the European Union due to their monitoring systems);
- inspection by the United States Food and Drug Administration (USFDA) for oyster trade to the United States of America (safe/clean zones defined and inspected by FDA) is currently done for the Republic of Korea;
- importing countries sanction/inspect areas to allow product export; and
- processed products also allow smaller producers to access markets.

For seaweed, there is a need to distinguish between seaweed for food and seaweed for non-food uses. The edible market is saturated in the main markets (China, Japan, Republic of Korea) and thus the main growth area will be for non-food use. The issues include:

- how to enable seaweed producers to market more directly or to value-add (e.g. shortening of market chains; how to get groups of producers linked to more local production of semi-refined carrageenan);

- how to raise volume high enough to force some competition between buyers and prevent them from driving down price;
- how to cope with global price fluctuations;
- how to stabilize conditions so farmers produce more regularly; and
- how to standardize local refining techniques.

There are a number of niche species for mariculture with the following issues raised by the group:

- trade and aquaculture development for a number of species (e.g. sea cucumbers, sea horses) that are listed by the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES); and
- the development of hatchery techniques for marine ornamentals (90 percent captured) and ensure labeling and tracing of their products.

Exploring opportunities for derived products/extracts from mariculture

A wide range of derivatives from maricultured products exist but remain to be explored. There are already markets for these but the supply-demand connection has not been adequately developed. Improved refining techniques are required for local extraction. Considerable opportunities exist for diversifying production systems or developing/introducing methods for their extraction; however improved refining techniques are required for local extraction. These products include:

- nutraceuticals,
- feed additives,
- pigments,
- biopolymers,
- lipids,
- proteins,
- bio-active compounds, and
- microalgae for feeds (animal diets – *Spirulina*, *Dunaliella*, etc.).

Sharing of experiences on developing systems

Markets are by their nature competitive. This challenges us to find areas where we can realistically collaborate. In many cases cooperation is not attractive, as it might erode the market advantage of a country or a business. The most likely area for cooperation is in the area of standardization or harmonization to access markets outside the region or to facilitate intraregional trade.

Recommendations

The group identified a number of actions to address the following issues:

Market intelligence and prospective market analysis. There is a need for a clearer analysis of the structure of the emerging/projected demands. In particular, can the expected demand be disaggregated (i.e. how much is going to be for low-value, high-value, fresh, processed, from mariculture, from freshwater, etc.)? Is it possible to predict where these parts of the markets will be and in which countries?

Follow up actions: Analysis by INFOFISH for this workshop should be published as a forward view of mariculture. Specific country and commodity studies are required due to the very high diversity of products and markets at the national level. Generic analysis is not informative enough as to where true opportunities lie. Specifically, studies should identify where the demand will come from and what is the demand by socio-economic groups. A specific analysis should be conducted on mariculture trends, markets and regulations in China.

Facilitate closer cooperation/contact between producers and traders. Knowledge of who produces what and where is valuable, as the lack of knowledge of marketing and transportation channels limits opportunities for development of mariculture.

Follow up actions: Improve information systems between markets and producers. As a first step, more country contacts could be promoted by developing/sharing lists of producer groups/commodities.

Quality, safety and traceability. Harmonization will be key (with international standards and possibly inside the region). The Association of Southeast Asian Nations (ASEAN) has initiated work for processors, but this should be taken to the production level. Thailand is developing an information technology (IT) system for tracing shrimp from Code of Conduct (COC)/Good Aquaculture Practice (GAP) farms to processors, and several countries are also introducing various traceability and testing systems for quality assurance.

Follow up actions: Review of the COC/GAP/Better Management Practice (BMP) systems for the region should be conducted as a basis for development of a basic set of principles from which more specific commodity or system principles or standards could be developed. Harmonization of traceability/safety systems with the needs of importing countries should also be explored. An awareness raising/training course for safety and quality that links the various national initiatives at the commodity or sector level will also be necessary, as is assistance with training in detection/analysis and laboratory standardization.

Approved list/guide on therapeutants for mariculture, emerging issues for health and safety. The Network of Aquaculture Centres in Asia-Pacific Aquatic Animal Health Advisory Group should be approached to provide a specific veterinary guide to diseases and allowed therapeutants, supported by an agreed regional list and awareness materials.

Coastal monitoring systems (environmental monitoring, environmental quality, red tide). There are a number of mariculture zoning and environmental monitoring systems in the region, such as in Thailand (red tide, heavy metals, water quality), Viet Nam, the Republic of Korea (on-line system) and China, Hong Kong SAR.

Follow up actions: There should be a review of the coastal environmental monitoring systems of the region and workshop to agree on major factors and issues for mariculture zoning and environmental monitoring.

Certification and labeling, including ecolabeling. There are an increasing number of certification and labeling schemes emerging in the region.

Follow up actions: Pilot activity should be initiated on labeling according to emerging BMP for some specific pilot sites/commodities. A dialogue towards the emergence of specific commodity (or system-based) BMPs, including BMPs for cage mariculture and mollusc mariculture, should be started.

Regional standards. There is an absence of regional standards for major commodities.

Follow up actions: Regional standards should be developed for all major commodities. Expert consultation on one or two key species for setting out some baseline standards for production and quality should be initiated.

Addressing importing country concerns/demands and changing consumer awareness/preferences. Using the FAO/NACA/World Wildlife Fund/World Bank (WB)/United Nations Environment Programme (UNEP) Shrimp Consortium model, cooperation should be encouraged to start developing issues-based awareness and information for BMPs for the principle mariculture areas.

Follow up actions: A memorandum of understanding (MOU) should be developed between partners for a consortium model, with institutions to start developing issues-based awareness and information on principle mariculture areas – linked to BMP development for specific mariculture systems. Potential partners include: NACA, FAO, WWF, the Secretariat of the Pacific Community (SPC), the Southeast Asian Fisheries Development Center (SEAFDEC), UNEP, etc.

Access to finance for small-scale aquaculture. The Asia-Pacific Rural and Agricultural Credit Association (APRACA) has contact with national-level finance institutions and FAO, and APRACA have already done some work on financing of inland small-scale fisheries. With larger-scale mariculture aquaculture operations, there will be increasing interest in insurance (possibly for farmers who are organized and under BMP schemes).

Follow up actions: Initiate some financial analyses of risk versus income for aquaculture financing. Also explore whether this can be linked to implementation of BMPs. Engage with financial institutions (through dialogue with APRACA).

Explore opportunities for derived products/extracts from mariculture. A wide range of derivatives from maricultured products exist and remain to be explored. Markets for these already exist; however, the supply-demand connection has not been adequately developed. Considerable opportunities exist for diversifying production systems or developing/introducing methods for their extraction. These include:

- nutraceuticals,
- feed additives,
- pigments,
- biopolymers,
- lipids,
- proteins,
- bio-active compounds, and
- improved refining.

Follow up actions: Link to agricultural research institutions that are developing these products and their applications (link this to the supply end). Identify what they are looking for and determine where the raw products are and (possibly) primary processing could be done. Potential partners include NACA, SEAPLANT.NET, FAO, Australian Centre for International Agricultural Research (ACIAR) and others.

Livelihoods, producer organizations, technology transfer and communications

Major issues

Producer organizations and alliance networks are essential to the efficient development of business functions and industry representation functions for the mariculture sector of Asian economies. Producer organizations and alliance networks can prosper if – and only if – the following elements are available, accessible and effectively utilized:

- appropriate local, national and regional plans, including legal parameters that effect the industry;
- fair markets that include awareness of culture practices that relate to product quality and food safety and link effectively with market requirements;
- finance and insurance on equitable terms;
- knowledge, information, tools and skills relevant to appropriate technology,

markets, business management practices, environmental considerations and social impacts; and

- essential infrastructure, goods and services, including communication and logistical links.

Challenges

Organize producers, support alliances and build networks that will:

- facilitate the formation and operation of producer organizations through effective networking;
- facilitate the development of organizational initiatives that increase the market power of farmers, create a self-sustaining mechanism for the rapid dissemination of technology, stimulate experience sharing, foster implementation of better management practices and increase the strength of producer enterprises in negotiations with suppliers of inputs, buyers and financial service providers;
- establish networked knowledge and information centers with one-stop shops that provide advice on business planning, finance and compliance issues; and
- foster good social responsibility by industry stakeholders.

Further strengthen national and regional coordination in mariculture policy and planning, by:

- identifying priorities, constraints and opportunities for regional collaboration;
- integrating mariculture into overall coastal zone management and planning processes;
- facilitating the engagement of producers in mariculture policy development processes; and
- formalizing mariculture operations as legitimate users of coastal areas and resources (zoning and licensing).

Link to fair markets by:

- engaging regional institutions in facilitating market access;
- developing awareness concerning culture practices (including technology, product quality and food safety, linked with market access requirements);
- developing value-chain transparency through dissemination of market-related knowledge, information, tools and solutions;
- facilitating development of specific value chains from source to market;
- establishing and promulgating industry-standard quality protocols and procedures that are practical for producers to use; and
- tying in regional facilities with the capacity to provide testing and technical support for verification and certification processes that support marketing.

Link to fair finance and insurance by:

- facilitating business development service providers (BDSP) that serve as interfaces between banks and producers;
- facilitating risk reduction measures;
- providing training in better farm and business management practices;
- assisting in implementation of standardized financial procedures;
- providing advice on the organization and management of credit unions and other self-financing arrangements;
- facilitating access to low-cost sources of credit through producer-based credit unions and revolving funds that encourage use of better management practices by members; and
- assisting banks to develop financial products that are appropriate for small and medium-scale producers.

Link to knowledge, information, tools and skills by:

- identifying and mobilizing regional institutions that can support development of effective “solution providers” to provide specialized technical and business

functions to mariculture value chains;

- developing a directory and a network of mariculture training providers;
- developing or translating appropriate syllabus and technical training materials in languages relevant to the region;
- promoting education and training in mariculture, livelihoods building and communication skills for farmers, extension workers and trainers; and
- engaging producers in the cycle of innovation and knowledge development.

Link to essential infrastructure, goods and services by:

- promoting the development of and ensuring access to essential infrastructure and services (e.g. moorings within designated mariculture zones);
- building efficient networks linking to essential farm inputs such as quality feed and seed, health advice, equipment supplies, market information and finance; and
- providing rapid access to technical services and information such as health management and environmental forecasting.

Recommendations

Value chain development. Select a few value chains that are of general regional significance and facilitate their development. Possibilities suggested for consideration include cage culture of tropical finfish for live markets, seaplants for specialty ingredient and agricultural uses, and bivalves for general nutritional purposes.

Identify and mobilize regional institutions that can support development of effective “solution providers”. These can provide: business development advice and assistance; delivery of technical and business training; diagnostic, testing and treatment services; and linkages to the essentials of enterprise management and operation.

Geographic Information System (GIS). Mobilize regional institutions in development of a comprehensive mariculture-oriented geographic information system (GIS) for coastal regions. This can provide information that is of crucial importance to integrating mariculture into coastal zone management programmes, guidance as to seasonal management of mariculture operations, and a platform for the delivery of technical and market information.

Human resource development. Place special emphasis on institutional collaboration in human resource development. Suggested measures include: facilitating regional cooperation in development of education and training materials in the key languages of mariculturists in the region, developing networked technology transfer initiatives, and collaboration on the delivery of effective education to the locations where mariculture is practiced.

Regional cooperation. Coordinate participation of regional institutions in promoting infrastructure development and financial facilities that support the mariculture industry by encouraging private-sector initiatives (e.g. in providing finance); promoting institutional networking, both in-country and regionally; convincing institutions such as the international finance institutions (IFI) to fund infrastructure projects that support mariculture; and facilitating means by which mariculture organizations and stakeholders can be made aware of infrastructure and financing opportunities.

Mariculture species and systems

Major issues

Seedstock supply – Major issues include:

- availability (farmers have difficulty obtaining seedstock of the species that they would like to raise; for example, seedstock of lower-value groupers are available, but there is limited supply of the higher-value species desired by farmers);
- more information is needed on target species (e.g. growth rates) to allow farmers to make informed choices);
- price (cheaper seedstock would help reduce production cost);
- larval rearing technology (potential application of extensive larval rearing to improve cost-efficiency of production);
- quality (quality of seedstock is variable, and there are high levels of deformity in seedstock from some hatcheries; development of specific-pathogen-free (SPF) certification for seedstock is urgent);
- genetic management (source, quality and management of the broodstock, and the need for and the impacts of domestication of hatchery broodstock);
- over-production (there is overproduction of certain species, e.g. high production of green grouper has led to lower price);
- social issues (e.g. what are the benefits from as well as disadvantages of small, medium and large-scale hatcheries?);
- research and development in hatchery production (species, efficiency) (funding of research and implementation of outcomes);
- use of recirculation systems to improve biosecurity (improved water treatment technologies);
- high mortality in the nursery phase due to cannibalism, etc.; and
- layer of farmers/suppliers/middlemen in the supply chain and impacts on price.

Feeds – Major issues include:

- aquaculture feed in the Asia-Pacific region is largely dependent on “trash” fish;
- cost of feeds is important for farmers to reduce production costs;
- pellet diets are not available for some cultured species (the diversity of species produced in the Asia-Pacific region acts as a constraint in that different feeds need to be developed for different species or species groups; in addition, specialized feeds for different species or species groups may only be produced in relatively small quantities, precluding feed companies from utilizing economies of scale and resulting in a relatively expensive diet);
- farmers are often reluctant to adopt pellet feeds for a variety of reasons (farmers interviewed at Nan’ao Bay said they had heard that the use of pellet feeds resulted in lower-quality fish, for which the farmer received lower prices; consequently, they were reluctant to adopt pellet diets);
- it may be necessary to implement incentives or disincentives to facilitate pellet feed adoption by farmers; and
- the impacts on product quality of pellet feeds are not well documented.

Environmental impacts – Major issues include:

- there is a need for integrated coastal zone management, including zoning for areas selected for mariculture production; and
- there is a general lack of knowledge of environmental impacts, particularly the impacts of aquaculture on the environment (there is a better appreciation of the impacts of the environment on mariculture production, for example, the impact of red tides on mortality).

Health – Major issues include:

- in many areas, there is a lack of diagnostic support for mariculture (consequently, farmers rely on their own experience or anecdotal information to diagnose and treat disease problems);
- farmers may not appreciate environment–disease interactions, so that they may not realize that negative environmental impacts affect their production;
- there is a need for specific pathogen free (SPF) certification schemes; and
- the impacts of transboundary movements and introductions need to be addressed.

Chemicals – Major issues include:

- the widespread use of unregistered or inappropriate chemicals to treat disease, which has environmental impacts and food safety implications;
- the possibility that different regulation levels for exported and domestic products exist;
- the need to harmonize chemical regulations (e.g. for chemical registration);
- the need for better education of farmers and extension agents on chemicals, such as types and dosages; and
- the need to tackle chemical-related problems on a farming-area basis because residues affect a whole area and farm clusters.

Implementation – Major issues include:

- the need for guidelines (BMPs as well as regulations);
- the need to develop incentives or disincentives (e.g. market access); and
- the need for certification of extension workers and fish health providers.

Production technologies – Major issues include:

- current production technologies (cage design, etc.) restrict mariculture to largely inshore areas (improved technologies (cages, moorings) will be necessary to move into offshore waters);
- there is a need to continue to support the development of small-scale farms with appropriate infrastructure and materials;
- much mariculture in the Asia-Pacific region is undertaken in typhoon-prone areas (production systems need to take into account the impacts of typhoons and other severe environmental conditions);
- mariculture development will need focus on reducing production costs to remain profitable in the face of increasing production (increased mechanization of farming, particularly large-scale farming, is likely to be necessary);
- better knowledge of site selection issues is required;
- environmental impacts and their assessment are becoming increasingly relevant in terms of public perception of aquaculture and as a source of local self-pollution;
- social aspects of mariculture are poorly known; and
- for capture-based aquaculture, that better knowledge of the seed resources and the impacts of their harvest are needed.

Better management practices – Major issues include:

Siting of mariculture:

- clear definitions are needed;
- carrying capacities of coastal tropical environments are not well known;
- assessment of carrying capacities and impact is system and/or scale- dependent;
- a guide for siting is needed; and
- the applicability of temperate models (salmonid models) to mariculture in tropical regions needs to be determined.

Gaps in licensing, policy and implementation including:

- basic guidelines and recommendations for site selection and zoning by technical experts are needed;
- technology (computing power) should be used;
- GIS for aquaculture coastal zoning is needed;
- an information hub to centralize information is required;
- environmental monitoring is needed;
- an integrated aquaculture approach (tackling issues at a larger scale, such as a whole bay) is needed; and
- carrying capacities (depending on species and production system) should be determined.

Opportunities and constraints to mariculture development**Opportunities – These include:**

- increasing affluence in Asia is driving expanding markets for aquatic products (e.g. in China, more people are eating out in restaurants; live marine finfish, previously regarded as a luxury product, are now accessible to many Chinese);
- an ecosystem approach to mariculture development would enhance its long-term sustainability;
- opportunities for developing information services and networking will support this rapidly growing sector;
- many of the markets (e.g. in China) are located inland and far from the production sites; there is a need to develop more cost-effective transport systems to deliver product to these markets;
- development of sustainable mariculture can reduce the reliance on capture fisheries, easing pressure on over-exploited fisheries;
- certification and traceability programmes will benefit producers by increasing consumer confidence in the quality of the end product (however, concerns remain over the social equity of implementation of these schemes, as large commercial aquaculture concerns are more likely to be able to implement them, while small-scale farmers may find compliance difficult or costly, and thus be placed at a disadvantage); and
- mariculture in Asia-Pacific is notable for the high diversity of production as compared with aquaculture in Europe or North America (this provides opportunities for farmers to switch between commodities in response to factors such as price and risk; however, it also dilutes the research and development effort and results in a diversity of products that may not reach adequate economies of scale, for example, different marine finfish species require different grow-out diets and there can be no generic “marine finfish” diet).

Constraints – These include:

- intense competition in what is effectively a global market for seafood products;
- in some Asian countries, aquaculture is less attractive to young people as a career choice than alternatives (a “drift” of young people from the rural areas to the cities would reduce labour available for aquaculture);
- market chains in many countries are poorly developed, which decreases the profitability of mariculture enterprises;
- environmental degradation leads to less efficient production because of water quality-induced stress and increased prevalence of disease; and
- mariculture in the Asia-Pacific region still relies mainly on “trash” fish as a feed source.

Better management requirements

A cross-cutting need with regard to improved management of mariculture in the Asia-Pacific region is strategic planning for aquaculture production, including market demands and forecasting. More specific requirements for better management are noted below.

Seed stock supply:

- research, technical support and training for hatchery and nursery development; and
- and implementation of certification schemes based on BMPs to provide assured quality seed stock.

Feeds:

- availability of pellet feeds for specific aquaculture commodities (specific feeds will need to be formulated for species or groups of species); and
- incentives to use pellet feeds and disincentives to the use of trash fish are necessary to facilitate adoption of pellet feeds by farmers.

Environmental impacts:

- technologies (such as GIS) and databases to support coastal zoning and site selection;
- implementation of environmental monitoring systems;
- investigation of potential for transferring models and monitoring systems from temperate mariculture to tropical systems; and
- research in integrated mariculture to alleviate nutrient impacts in coastal and marine ecosystems.

Disease:

- improved diagnostic support;
- improved information and education for farmers; and
- legislation and enforcement of animal health issues.

Chemicals:

- responsible use of chemicals and therapeutics, incorporating incentives (education, technical support) and disincentives (monitoring, market access restrictions).

Production technologies:

- engineering to support offshore mariculture (however, many offshore areas in Asia are relatively shallow and thus inappropriate for adoption of deep-water systems being developed in Europe and North America);
- research, technical support and training in cage and other production systems design and management; and
- adoption of recirculation technology (in Asia, this has best application in hatchery and nursery facilities to support improved biosecurity).

Future cooperation

The Working Group discussed the Asia-Pacific Marine Finfish Aquaculture Network (APMFAN) as a model for the proposed Asia-Pacific Mariculture Cooperation. APMFAN uses the following mechanisms to promote coordination and cooperation:

- Website (www.enaca.org/marinefish);
- electronic publications (e-mail – more than 900 subscribers);
- print publications;
- training courses;

- regional technical workshops;
- technical advice; and
- development of BMPs.

Cooperation objectives

Proposed objectives of the proposed Asia-Pacific Mariculture Cooperation include:

- support and develop sustainable growth of the mariculture industry in the Asia-Pacific region;
- promote the production of quality products to consumers addressing human health issues;
- intensify regional cooperation and promote knowledge transfer; and
- ensure that mariculture development contributes to sustainable livelihoods in coastal communities.

Mollusc aquaculture cooperation

The Working Group proposed the development of a mollusc aquaculture network along the lines of the marine finfish network coordinated by NACA. This network could incorporate other invertebrates such as sea cucumbers.

Work packages

The Working Group developed concept proposals for work packages to address the issues raised during the workshop.

Short-term work packages

Development of low-cost cages. Cooperation on low-cost cage technology could be undertaken by linking existing projects in Viet Nam and Philippines. Aspects of the work would include economic evaluation and design aspects (engineering). There was general interest in this topic from the countries represented in the Working Group, but particularly from the Islamic Republic of Iran and the Pacific Islands region.

Low technology hatchery systems for bivalves. This proposal is to adopt or adapt low-technology/high-volume hatchery technology for bivalves as is being done in Hainan (China). Countries where this technology has potential application include Thailand, the Philippines and the Pacific Islands. This technology adoption was also requested (through FAO) for the Democratic People's Republic of Korea.

Live feeds. This proposal is to improve the production (culture densities, reliability) of live feeds such as micro-algae, rotifers and copepods. It was noted that copepod culture is particularly important for marine finfish larval rearing, including cobia culture. Specific aspects that this project would address are:

- supply of axenic starter cultures, possibly from a centralized repository;
- enhanced self-reliance (extension of isolation and culture techniques to allow use of locally isolated organisms); and
- increasing culture density to improve cost-effectiveness of hatcheries.

Aquatic animal health. Specifically, this proposal is to develop and implement a training programme for extension staff to become “para-vets” to support improved aquatic animal health in the region. Staff would be trained to lower than veterinary standards, but would be provided a higher level of training than extension staff. Some support material already exists (e.g. NACA/FAO aquatic animal health guidelines). The project would be strongly linked to BMP projects.

Longline culture of bivalves. This proposal is to extend the existing large-scale longline culture techniques for bivalve culture to countries not currently practicing these techniques. Potential source countries are China, New Zealand, the Republic of Korea and Japan.

Recirculation technology. There is significant interest in recirculation technology among countries represented at the workshop. The most obvious application of recirculation technology in mariculture in the Asia-Pacific region is to support improved biosecurity in hatcheries and nurseries.

Seaweed diseases. The Working Group felt that collaboration with ongoing research in China on seaweed diseases would benefit other countries.

Longer-term work packages

Vaccine development. Efforts to develop vaccines for finfish should be linked. There is ongoing research and development in Viet Nam and Taiwan Province of China, among others. Opportunities for strong linkages with the private sector exist.

Ecosystem approach to aquaculture. The major overall objective of this project is to develop an ecosystem approach to aquaculture management involving all stakeholders. The ecosystem approach includes ecological, social and economic aspects as the three legs for sustainable aquaculture, thus assuring farmers their immediate and future livelihood and business.

Specific objectives would be to:

- collate information needed to develop an Ecosystem Approach to Mariculture (EAMAR), including:
 1. output: general minimal information needed for the implementation of EAMAR (general information on carrying capacity);
 2. activities: Workshops to define and collect minimal scientific, social and economic information needed for EAMAR; and
 3. indicator: to be developed.
- develop and implement coastal management and zoning plans based on EAMAR, including:
 1. output: aquaculture zone mapping for some or all countries;
 2. activities:
 - i. GIS workshop including all stakeholders,
 - ii. how to implement realistic and durable Environmental Impact Assessments (EIAs); and
 - iii. polyculture, integrated aquaculture to reduce nutrient impacts.
 3. indicators: implementation of GIS-EAMAR zoning in some countries.
- training on BMPs and EAMAR for cage mariculture; and
- integrated monitoring of environmental conditions to support adaptive management, reduce environmental impacts and prevent the occurrence of environmental conditions that trigger such adverse phenomena as red tides.

Genetic improvement. Research on genetic improvement of freshwater species (e.g. tilapia) has provided substantial benefits to farmers. There are opportunities to undertake similar projects with marine finfish. There are plans to undertake selective breeding work with cobia in Viet Nam (funded by the Government of Viet Nam and Norway).

Triploid molluscs. Investigate the potential for wider adoption of triploidy for mollusc production.

Integrated mariculture. Integrated mariculture can reduce environmental impacts of aquaculture requiring feed inputs.

FINAL DISCUSSION AND WAY FORWARD

The final session of the workshop discussed the overall workshop findings and made recommendations for follow-up actions.

The country representatives and mariculture experts were in agreement as to the need for a regional mariculture programme, based on the findings of the workshop. Various participants made interventions to support strengthening of regional cooperation in mariculture. A summary of these interventions, including offers of assistance, is provided in Annex 3.

The participants recommended that NACA and FAO develop the regional mariculture programme to address the needs and recommendations identified above. In particular, NACA was requested to prepare and integrate the programme into its regional intergovernmental work programme and FAO was requested to provide facilitatory assistance to initiate the programme.

