

**Table 34. Summary of the Responses of Public**

Sl.No	Impacts of Shrimp Farming	No. of Responses
<i>Positive impacts</i>		
1.	Generation of employment opportunities	475
2.	Improved standard of living in rural areas	834
3.	Better infrastructure facilities in rural areas	818
4.	Increased revenue to the government	172
5.	No environment pollution	768
6.	Provision of good education due to increased wealth	476
7.	Utilization of saline barren land	114
8.	Earning valuable foreign exchange	86
9.	Benefits to coastal population	34
10.	Appropriate technology for utilization of coastal saline barren lands	30
11.	Less pollution comparing to agriculture	52
12.	No negative impact on coastal fishing activity	54
13.	Opportunity to develop cyclone and tidal wave affected areas	14
14.	Improved health care due to increased wealth	4
15.	No spreading of disease to human beings	12
<i>Negative Impacts</i>		
1.	Polluting the environment	6
2.	Destruction of mangrove forests	4
3.	Salinisation of drinking water source	13
4.	Salinisation of surrounding land	4
5.	Degradation of agricultural land	4
6.	Habitat destruction	2
7.	Loss of biodiversity	1
8.	Unemployment of landless labourers	3
9.	Alienation of small and marginal farmers	1
10.	Spread of disease among human beings	2
11.	Loss of access to water front	1
12.	Spread of fish diseases	1
13.	Alterations in traditional ecology and livelihood systems	1
14.	Decline in coastal fishery resources	3
15.	Chemical and pesticide pollution	1
16.	Irreversible damage to coastal environment	1
17.	Declining marine fish catches	1
18.	Destruction of marine fishery resources	5
19.	Loss of grazing land	2
20.	Decrease in price of wild caught shrimp	1
21.	Obstruction of drainage canals	1

18. Attention should be focused on educating the farmers with the latest technology to control virus and other diseases through field demonstration.
19. Aquaculture waste are rich in nutrients and can be utilised by integration with other aquaculture/ agriculture production systems.
20. It is suggested to form coastal “aquaculture clubs” whose main aim should be to disseminate the current information on diseases, environmental pollution, latest technique, etc, ultimately to develop sustainable model of shrimp aquaculture.
21. Sustainable shrimp farming is possible provided the planning process is scientifically carried out with due regards to the ecological and social needs. The main reason for current conflicts in coastal shrimp aquaculture development relate to improper site selection and poor design of the shrimp ponds.
22. One of the major reason for social opposition appears to be due to the lack of community interaction while planning the projects. Semi-intensive and extensive shrimp culture can be carried out in eco-friendly manner.
23. Guidelines for future:
  - a) Balanced plans for coastal shrimp culture development and management.
  - b) Establishment of Environment Impact Assessment (EIA) programmes.
  - c) Regulation and monitoring of shrimp culture management method.
  - d) Treatment of shrimp culture wastewater wherever necessary.
  - e) Assessment of the carrying capacity of the surrounding ecosystem.
  - f) Appropriate regulation and enforcement mechanisms for pond construction and management, mangrove protection and use of wetlands

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## 7.0 Sustainable Shrimp Aquaculture

### 7.1 Introduction

Sustainability is defined by FAO as “the management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such development conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable<sup>126</sup>”. This definition was further refined and split into three separate components – social sustainability (SS), economic sustainability (EcS) and environmental sustainability (ES)<sup>127</sup>. The UN



World Commission on Environment and Development defines sustainable development as “*meeting the needs of the present without compromising the ability of future generations to meet their needs*”.

The impact of shrimp farming detailed in the foregoing chapters has clearly indicated that the magnitude of impact varies with the location and site characteristics of the farm, the type of culture system, intensity of culture, quality of inputs, management practices, and the awareness of the farmers. The impact assessment analyses show that shrimp farming has positive impacts like increased income, utilization of unproductive saline fallow lands, employment potential, foreign exchange earnings and food and nutritional security of the rural poor. There have been, as indicated earlier, some negative impacts, especially on the resource use and social conflicts among different stakeholders. The following paragraphs discuss mitigation methods which on adoption by the stakeholders (e.g. shrimp farmer, government) can bring in sustainability in the farming practices

### 7.2 Shrimp Farming Practices

This Hon’ble Court has permitted the operation of “*traditional and improved traditional types of technologies as defined in Algarswami’s report which are practiced in the coastal low lying areas*” within the CRZ. Further, permission has been granted for *adopting improved technology for increased production, productivity and return with prior approval of the “authority”*. Although beyond the CRZ, this Court has put no restriction on the type of technology to be adopted, however it has been directed that any aquaculture activity including intensive and semi-intensive which has the effect of causing salinity of soil, or the drinking water and which would have other adverse impact on the environment shall not be permitted by the authority set up for the purpose.

It is also an established fact that the impact of nutrient and sediment loading in the natural ecosystem is essentially dependent on the type of technology followed and the level of inputs used during the culture period. It is well recognised that increased stocking of postlarvae will lead to increased use of feed and the associated nutrient load in the shrimp farm wastewater, irrespective of the type of culture technology followed. Hence, keeping all these aspects into consideration and to promote sustainable shrimp aquaculture in the country, the Aquaculture

<sup>126</sup> Barg, U.C. 1992. Guidelines for the Promotion of Environmental Management of Coastal Aquaculture Development. FAO Fisheries Technical Paper. 328

<sup>127</sup> Goodland, R. and H. Daly. 1996. Environmental Sustainability: Universal and Non-negotiable. Ecological Applications, 6(4):1002-17

Authority considered stocking density as the major criteria for permitting sustainable shrimp farming activities. The Authority has fixed optimum stocking density of postlarvae at a maximum of 6 nos/ m<sup>2</sup> for farms located within the CRZ and up to 10 nos/ m<sup>2</sup> for farms outside the CRZ. It was observed that at these stocking densities, the nutrient loading was insignificant.

### 7.3 Farm-Level Mitigation Measures

Implementing relatively simple mitigating measures at the farm-level by the individual farmers and by the farmers' associations in an area where the farms are clustered together, will help to a large extent in development of sustainable shrimp farming. Some of the common measures are as follows:

#### 7.3.1 Location and Siting

Careful site selection and location of the farm can prevent conversion or pollution of sensitive habitats, salinisation of agricultural land and freshwater aquifers, spreading of disease, problems of access, etc. The farm siting should take the following into consideration:

- distance between other farms
- distance from agricultural lands
- distance from village and freshwater source
- proper soil quality to prevent seepage
- access to water front
- adequate rain and floodwater drainage

#### 7.3.2 Construction and Design

Adoption of appropriate design and construction methods will help avoid some of the possible impacts. Salinisation of adjacent soils can be controlled by adequate compaction of the dyke during construction. Provision of a trench surrounding the farm will prevent saline water seepage into the adjacent soils. Incorporating a buffer zone all around the farm depending on the soil quality and the nature of the surrounding environment will minimize the impacts. Planting this buffer zone with mangrove vegetation will provide protection from storms and erosion. Mangrove plantation in wastewater channels can also help in absorption of organic matter and nutrients and thereby reduce the nutrient load in the open waters.

When the source water quality is poor or turbid, it is essential that an intake reservoir is included in the design of the farm. This reservoir will act as the settlement tank for the water as well as it can be used for chlorination and other treatments. Larger farms above 5.0 ha should have an Effluent Treatment Pond (ETP), to reduce the nutrient load in the wastewater. The ETP may include settlement tanks and bioremediation tanks. The possible methods of effluent treatment are summarized in Table 35.

**Table 35. Common Methods of Effluent Treatment**

Method	Benefits
Settling ponds	Removal of particulate organic matter denser than water, but not efficient with phytoplankton
Mussel, Oyster and Sea cucumber	Removal of particulate organic matter and phytoplankton from water column.
Sea weeds	Removal of dissolved nutrients (Nitrogen and Phosphorus) from water column.
Mangrove	Removal of particulate organic matter and nutrients.

Source: Macintosh and Phillips (1992)

The following account details the best management practices with respect to some of the important activities followed in shrimp aquaculture:

Aquaculture Authority has evolved Guidelines for Effluent Treatment Systems, which will be mandatory for farms of above 5.0 ha size. About 65.0 % of the total area under shrimp farms in the country is less than 5.0 ha and the nutrient load from each of the small-sized farms may not be high. However, concentration of such small farms in a given coastal area or creek may lead to cumulative nutrient loading, which may have adverse impact on the environment. In such cases, common wastewater treatment facility becomes necessary and should be developed by the group of farmers located in that area. This also calls for a close co-operation among the group of farmers to ensure that the wastewater released does not contain excess nutrients and conforms to the prescribed standards.\*

### **7.3.3 Operation and management**

Proper management practices will help in reducing the nutrient load in the wastewater, maintain a healthy and congenial environment in the shrimp pond and prevent disease outbreaks. The Guidelines issued by Aquaculture Authority for improving production and productivity in improved traditional system of farming lists the best management practices, which will increase production and at the same time reduce the environmental impacts to a large extent. The inputs/ farming practices which require consideration are as follows:

#### ***Seed quality***

Most of the pathogens are transmitted both vertically and horizontally. Vertical transmissions can be avoided if good quality seed is procured from shrimp hatcheries and to achieve this objective, seed testing should be made mandatory for the hatcheries. Capture of wild shrimp larvae for stocking should be strictly prohibited. This will prevent indiscriminate killing of fish and shrimp seed caught as by-catch along with the shrimp postlarvae. The MPEDA has initiated registration of shrimp hatcheries and voluntary code of conduct has been developed for hatchery operators to provide quality seed to the farmers. For shrimp seed standardization and certification, a model bill may also be considered by the Government of India which could be subsequently adopted by the coastal states and union territories as their legislation. The model bill will help the states to have a harmonized legislation, which is necessary to provide legal support to meet the quality requirements of seed for healthy growth of the shrimp aquaculture sector.

#### ***Feed quality***

Since feed is an important source of nutrients for the growth and health of the farmed organisms, the feed quality plays a crucial role in the water quality management and subsequent nutrient loading in the wastewater. The following parameters in feed quality should be given consideration while selecting the feed for shrimps:

- Feed should be with optimal protein levels and with high digestion and assimilation efficiency
- Feed conversion ratio should be optimal
- Feed should be low in phosphorus
- Water stability should be between 4 – 6 hours
- Farm made fresh diets should be avoided
- Feed stored for a long time should not be used since aflatoxins may be present in such feed

#### ***Feed management***

Proper feeding management can effectively reduce the nutrient load in the wastewater and also reduce the feed cost. The feeding schedule should be followed as per the following guidelines:

- Feeding levels should be adjusted according to biomass based on average body weight and estimated percentage of survival arrived at from the weekly sampling of shrimp stock
- Rate of feeding should be regulated using feed check trays
- Feeding frequency should be increased to 4 – 6 times
- Feeding ration should be more during night than day
- Feed should be given in feed trays rather than broadcasting them over the pond to avoid wastage

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\* Guidelines for Sustainable Development and Management of Brackishwater Aquaculture, Ministry of Agriculture, New Delhi

### ***Health Management***

Disease prevention in shrimp stock requires a series of measures at the farm level operation and management.

- ✦ Pathogen- free seed
- ✦ Good quality treated water
- ✦ Maintenance of optimal water quality parameters during the culture period
- ✦ Sound technical capacity and infrastructure to identify and check disease outbreaks
- ✦ Improved understanding of disease epidemiology and rapid diagnosis of disease
- ✦ Maintenance of water quality within optimal limits to avoid stress to the shrimp stock
- ✦ Use of probiotics
- ✦ Greater awareness on disease and health management aspects

### **7.4 Mitigation through Regulation**

Farm level mitigation measures can assure environmental sustainability to a large extent. However, social impacts such as resource use conflict, equity issues, conversion of mangroves and agricultural land, soil salinisation, salinisation of freshwater resources, employment, access, flooding, etc., need strict government regulation. Circulation of a model bill by the Central Government can ensure uniformity in the legislation to be adopted by the coastal states and union territories.

#### **7.4.1 Legislation on Aquaculture**

Government regulations are important component of management in supporting aquaculture development, maintaining environmental quality, reducing negative environmental impacts, allocating natural resources between competing users and integration of aquaculture into coastal zone management. In most of the countries, aquaculture being of recent origin, has commonly been regulated under the laws governing water resources, fisheries, agriculture or industry. This generally leads to some confusion among the different users. Adequate consideration should be given to legal and social aspects, policies laid down and enforced through dedicated aquaculture legislation, so that under no circumstances the carrying capacity of the ecosystems is exceeded and socio-economic norms violated. In this regard, the research and developmental agencies have to evolve a holistic approach to the development of aquaculture, taking into consideration the technical and socio-economic factors.

Entry 57 of List 1 of Seventh Schedule of the Constitution specifies *Fishing and Fisheries beyond Territorial Waters* as Union subject, whereas Entry 21 of List II speaks of *Fisheries* as a state subject. Reading both the entries together, it follows that control and regulation of fishing and fisheries within territorial waters is the exclusive province of the state, whereas beyond the territorial waters, it is the exclusive domain of the Union. Aquaculture being an integral part of fisheries falls under a common fisheries legislation in the states and is often not being recognised as the aquatic equivalent to agriculture. Further the fisheries legislation of most of the states and union territories is based on the Indian Fisheries Act of 1897, which was enacted mainly for conservation of the open water fishery.

There is a need for strong scientific support to evolve policies and legal framework for coastal aquaculture, particularly on the area-wise carrying capacity of coastal and marine ecosystems, the impact of wastewater from shrimp farms on the open water systems, wastewater treatment systems, etc. Guidelines evolved for sustainable aquaculture should be supported by a legal framework, so that its implementation becomes easier. There is an urgent need for increasing awareness amongst the stakeholders and the general public about shrimp aquaculture. It is also essential that environmental scientists should assist the sector by clearly distinguishing between actual and hypothetical environmental hazards resulting from aquaculture practices.

Though we have fairly elaborate policies and legislation governing issues related to industries, there is no specific environmental legislation designed specifically for aquaculture or shrimp farming. It is only recently that the Aquaculture Authority has been set up with powers to issue license by the union government and an Aquaculture Authority Bill is in the process of consideration by the Parliament. To ensure sustainable

development of shrimp aquaculture and optimum utilization of the coastal resources, it is essential that the following key issues should be considered in the proposed legislation on aquaculture:

- ✦ environment impact assessment
- ✦ siting of the farms in relation to other farms, agricultural land, mangrove, etc.,
- ✦ wastewater water quality standards
- ✦ waste water treatment to conform to the standards
- ✦ licensing and mandatory code of conduct
- ✦ handling of diseased stock and notification
- ✦ transfer and introduction of exotic stock, quarantine, disease certification

#### 7.4.2 Zoning and Integrated Coastal Zone Management

When shrimp aquaculture development started, low-lying intertidal mudflats, marshes, mangrove and other wetlands were considered suitable for shrimp farming, since land was easily available and considered as “waste land” not fit for any other production activity. In some countries, the governments themselves encouraged conversion of some of these wetlands and considered aquaculture as a method of reclaiming the otherwise unusable area. However, with the better understanding of the ecological significance of such wetlands, it has become essential that they be protected.

Zoning coastal areas for multiple users, is one of the widely accepted methods that can avoid possible conflicts arising out of competition in resource use. Zoning should be undertaken most effectively as part of a broader Integrated Coastal Area Development (ICAM) and Integrated Coastal Zone Management (ICZM). Joint Group of Experts on the Scientific Aspects of Marine Pollution observed in 1996 that “*Comprehensive area-specific marine management and planning is essential for maintaining the long-term ecological integrity and productivity and economic benefit of coastal region*”. Development of ICZM plans is a participatory and strategic planning process that should involve:

- ✦ issue identification and assessment
- ✦ public education
- ✦ stakeholder consultation
- ✦ prioritizing the issues
- ✦ formulation and adoption of a management plan and
- ✦ capacity building among different stakeholders

The ICZM plans should be made operational through:

- ✦ land- use zoning and allotment of buffer zones
- ✦ regulations, including licensing for permitted activities
- ✦ non-regulatory mechanisms – guidelines, technical assistance and extension, voluntary agreements, adoption of best management practices
- ✦ construction of infrastructure
- ✦ continuous voluntary monitoring

The integration of shrimp farming into coastal area planning and management is an important step towards making it sustainable. But it will be effective only when the policies are well defined and state-level authorities with broad powers and responsibilities are established. As per the orders passed by the Supreme Court on 18.4.1996 in W.P. No. 664 of 1993, all the coastal states and UTs were directed to prepare and submit their respective Coastal Zone Management Plans (CZMPs) by the end of June, 1996 to the Central Government. Preparation of these plans involves categorisation of the CRZ areas into CRZ- I, CRZ-II, CRZ-III and CRZ-IV in accordance with the guidelines given in CRZ Notification, 1991. The Ministry of Environment and Forests was also directed to examine and approve the CZMPs submitted by the coastal states/ union territories by the end of September, 1996. Accordingly, all the coastal states and union territories have submitted their respective CZMPs and the Ministry of Environment and Forests have approved the same on September 27, 1996 with

certain conditions and modifications. All the developmental activities in the CRZ are required to be implemented as per the provisions of the CRZ Notification, 1991 as amended from time to time and the approved CZMPs.

#### **7.4.3 Zoning and Management of Carrying Capacity of the Waterbodies**

Though zoning and allotment of land for different activities will resolve resource conflicts to a large extent, to prevent nutrient loading in the ecosystem, the type of culture system and the magnitude of intensification permitted should be clearly defined for each zone based on the carrying capacity of the zone. The carrying capacity or environmental capacity of a water body can be defined in terms of nutrient loading as the level of nutrients which can be assimilated or dispersed by the water body without exceeding the permissible levels. It essentially depends on the hydrological conditions such as tidal amplitude, tidal current, wind and wave action and ecological conditions. The nutrient load from all the different activities should not exceed the carrying capacity of the water. This should be regulated through environment monitoring and voluntary code of conduct for different stakeholders.

#### **7.4.4 Guidelines and Codes of Conduct and Practices**

Codes of practice is a generalized and agreed form of mitigation for the impact of a sector or sub-sector. In fisheries and aquaculture sector various codes of conduct have been developed. Salient features of some of the important codes and their usefulness in bringing sustainability in shrimp aquaculture in the country are detailed in the following paragraphs. It is needless to mention that these codes should be fully integrated into the development and management of shrimp aquaculture in the country.

##### ***FAO Code of Conduct For Responsible Fisheries***

The first international symposium on Sustainable Fish Farming held in Oslo, Norway in 1994 produced a set of guidelines for sustainable fish farming. This was followed by the FAO Code of Conduct for Responsible Fisheries (CCRF) adopted by 168 countries, including India in 1995. The CCRF is one of the most important international instruments devised for wholesale management of the living aquatic resources of our planet. The effort that has gone into the Code is perhaps its main strength. It is all-inclusive and all-encompassing. The Code is global in scope and is directed toward members and non-members of FAO, fishing entities, organizations of all kinds, fishers, people engaged in the processing and marketing of fish and fishery products – in short everyone concerned with conservation of fishery resources and management and development of fisheries. This CCRF sets out principles and standards of behaviour for responsible practices in fisheries including aquaculture.

The CCRF has 12 Articles of which Article 9 on aquaculture development calls for a legal and administrative framework to facilitate the development of responsible aquaculture. It states that aquaculture development plans and strategies should be regularly updated to ensure that the development is ecologically sustainable. States should ensure that the livelihoods of local communities, and their access to fishing grounds, are not negatively affected by aquaculture development. The said Article 9 of the Code and its salient features are set out below:

##### ***Article 9 Aquaculture Development***

##### ***9.1 Responsible development of aquaculture, including culture-based fisheries, in areas under national jurisdiction***

*9.1.1 States should establish, maintain and develop an appropriate legal and administrative framework which facilitates the development of responsible aquaculture.*

*9.1.2 States should promote responsible development and management of aquaculture, including an advance evaluation of the effects of aquaculture development on genetic diversity and ecosystem integrity, based on the best available scientific information.*

*9.1.3 States should produce and regularly update aquaculture development strategies and plans, as required, to ensure that aquaculture development is ecologically sustainable and to allow the rational use of resources shared by aquaculture and other activities.*



- 9.1.4 *States should ensure that the livelihoods of local communities, and their access to fishing grounds, are not negatively affected by aquaculture developments.*
- 9.1.5 *States should establish effective procedures specific to aquaculture to undertake appropriate environmental assessment and monitoring with the aim of minimizing adverse ecological changes and related economic and social consequences resulting from water extraction, land use, discharge of effluents, use of drugs and chemicals, and other aquaculture activities.*

**9.2 *Responsible development of aquaculture including culture-based fisheries within transboundary aquatic ecosystems***

- 9.2.1 *States should protect transboundary aquatic ecosystems by supporting responsible aquaculture practices within their national jurisdiction and by cooperation in the promotion of sustainable aquaculture practices.*
- 9.2.2 *States should, with due respect to their neighbouring States, and in accordance with international law, ensure responsible choice of species, siting and management of aquaculture activities which could affect transboundary aquatic ecosystems.*
- 9.2.3 *States should consult with their neighbouring States, as appropriate, before introducing non-indigenous species into transboundary aquatic ecosystems.*
- 9.2.4 *States should establish appropriate mechanisms, such as databases and information networks to collect, share and disseminate data related to their aqua culture activities to facilitate cooperation on planning for aquaculture development at the national, subregional, regional and global level.*
- 9.2.5 *States should cooperate in the development of appropriate mechanisms, when required, to monitor the impacts of inputs used in aquaculture.*

**9.3 *Use of aquatic genetic resources for the purposes of aquaculture including culture-based fisheries.***

- 9.3.1 *States should conserve genetic diversity and maintain integrity of aquatic communities and ecosystems by appropriate management. In particular, efforts should be undertaken to minimize the harmful effects of introducing non-native species or genetically altered stocks used for aquaculture including culture-based fisheries-into waters, especially where there is a significant potential for the spread of such non-native species or genetically altered stocks into waters under the jurisdiction of other States as well as waters under the jurisdiction of the State of origin. States should, whenever possible, promote steps to minimize adverse genetic, disease and other effects of escaped farmed fish on wild stocks.*
- 9.3.2 *States should cooperate in the elaboration, adoption and implementation of international codes of practice and procedures for introductions and transfers of aquatic organisms.*
- 9.3.3 *States should, in order to minimize risks of disease transfer and other adverse effects on wild and cultured stocks, encourage adoption of appropriate practices in the genetic improvement of brood stocks, the introduction of non-native species, and in the production, sale and transport of eggs, larvae or fry, brood stock or other live materials. States should facilitate the preparation and implementation of appropriate national codes of practice and procedures to this effect.*
- 9.3.4 *States should promote the use of appropriate procedures for the selection of brood stock and the production of eggs, larvae and fry.*
- 9.3.5 *States should, where appropriate, promote research and, when feasible, the development of culture techniques for endangered species to protect, rehabilitate and enhance their stocks, taking into account the critical need to conserve genetic diversity of endangered species.*

**9.4 *Responsible aquaculture at the production level***

- 9.4.1 *States should promote responsible aquaculture practices in support of rural communities, producer organizations and fish farmers.*
- 9.4.2 *States should promote active participation of fish farmers and their communities in the development of responsible aquaculture management practices.*

- 9.4.3 *States should promote efforts, which improve selection and use of appropriate feeds, feed additives and fertilizers, including manures.*
- 9.4.4 *States should promote effective farm and fish health management practices favouring hygienic measures and vaccines. Safe, effective and minimal use of therapeutants, hormones and drugs, antibiotics and other disease control chemicals should be ensured.*
- 9.4.5 *States should regulate the use of chemical inputs in aquaculture, which are hazardous to human health and the environment.*
- 9.4.6 *States should require that the disposal of wastes such as offal, sludge, dead or diseased fish, excess veterinary drugs and other hazardous chemical inputs does not constitute a hazard to human health and the environment.*
- 9.4.7 *States should ensure the food safety of aquaculture products and promote efforts, which maintain product quality and improve their value through particular care before and during harvesting and on-site processing and in storage and transport of the products.*

The Second International Symposium on Sustainable Aquaculture, Oslo, 1997 reviewed the potential and constraints for aquacultural development and its sustainability in the light of Article 9 of the FAO Code of Conduct and felt that for aquaculture potential to unfold, it is imperative that the relevant sectors contribute to its development in a spirit of mutual responsibility for the common benefit of humanity and not be misguided by short-term sectoral interests and recommended certain guidelines in 1997 which were adopted by the FAO in 1998. These sector-wise guidelines are as follows:

***Each State should:***

1. *establish an aquaculture development plan based upon the need for food security, rural development, disease control, biodiversity and sustainable use of resources. The context of integrated use of water resources and of potential production areas should be applied.*
2. *establish and implement a national strategic development plan, which identifies and designates areas and resources important for future aquaculture or other food productions, and protects them from being irreversibly allocated to other purposes.*
3. *ensure co-ordination between relevant governmental departments, and implementation of participatory planning processes involving local communities and all stakeholders, in the development of aquaculture.*
4. *establish, implement and enforce appropriate laws and regulations to ensure responsible aquaculture, including food safety, environmental safety and ethical criteria and the protection of the rights of indigenous people and local communities.*
5. *establish and implement a licensing or regulatory system governing the use of exotic species, including genetically modified organisms and organisms from breeding programs, with due considerations to human health and to impacts of escapees.*
6. *be appreciative of the difficulty that allowing aquaculture to develop in response to market demand can generate problems of equity, for example if aquatic resources currently consumed by the poorer section of the community are to be used as feed for aquaculture.*

***Producers and industry should:***

7. *take full advantage of new technologies and management procedures that can improve quality and quantity of aquaculture products and reduce risk of adverse effects on the environment and on the livelihood of other people including future generations.*
8. *strictly abide by the internationally agreed food safety, environmental safety and ethical criteria if genetically modified organisms, chemo-therapeutants or hormones are utilized in the production.*

9. *develop standards and practices, which embody ethical principles for ensuring health and welfare of fish and shellfish and for slaughter practices.*
10. *become increasingly customer-oriented in defining quality attributes and strengthen dialogue with the consumer. In particular, the industry has an independent responsibility to provide adequate product and production information on all issues recognized to be of consumer concern.*

***The scientific and technological community should:***

11. *give a priority to domestication of relevant aquaculture species, involving control of the whole life cycle and thus allowing genetic improvement. As the economic costs of domestication efforts are high, concentration will be on few species. However, this should not preclude the evaluation of alternative species.*
12. *give a priority to the development of integrated, polyculture-based fish farming for omnivorous or herbivorous species, specially those useful in utilizing organic wastes.*
13. *give a priority to the development of sources for animal feed other than fish protein and fish lipid.*
14. *recognize the responsibility to develop and make available the best technology, in particular for the efficient use of the resources and for avoiding harm to the environment.*

***Intergovernmental organizations and development agencies should:***

15. *recognize the potential of aquaculture to contribute significantly to the world's aquatic food supply and support its realization.*
16. *require, as a precondition for involvement in aquaculture development projects, that all parties abide by these guidelines.*
17. *give a priority to transfer, adaptation and implementation of technological innovations, capacity building, training and education in order to harvest the full potential of aquaculture in developing countries.*

***Code of Conduct for Thailand Shrimp Farming Sector***

Leader of shrimp aquaculture and the world's biggest farmed shrimp exporting country, Thailand, signed a code of conduct to counteract accusations of environmentally damaging practices and present itself to international markets as a sustainable, eco-friendly industry. It subscribes to policies in the following areas.

1. *Environmental protection: Integrate technically proven and cost effective methods to protect the environment;*
2. *Regulatory compliance: Comply with all regulatory requirements pertaining to the marine shrimp culture industry in Thailand.*
3. *Quality and Safety: Ensure shrimp products are of the highest quality and facilities are operated in a safe manner for workers.*
4. *Efficiency: Develop, design and operate facilities based on the efficient use of energy, resources and materials*
5. *Social responsibility: Develop opportunities for small-scale farmers to operate marine shrimp farms*
6. *Education and training: Improve the awareness of the industry, producers, buyers, consumers and the public of the importance of sustainable marine shrimp culture industry practices.*
7. *Public Consultation: Encourage public consultation in planning and management of the industry.*
8. *Location: Locate shrimp culture operations within areas that minimise environmental and social impacts*

9. *Continual improvement: Establish ongoing programme to improve environmental performance and take preventive and corrective action where necessary.*
10. *Research and development: Support R & D for sustainable marine shrimp culture practices*
11. *Monitoring and auditing: To evaluate performance of industry, facilities and potential impacts on the surrounding environment, and*
12. *International trade: Communicate and consult with importing countries about Thailand's commitment to sustainable development.*

Most of the countries have developed their own guidelines for various aquaculture activities taking the FAO Code of Conduct as the basis. In India, guidelines for sustainable shrimp farming were first issued by the Ministry of Agriculture in 1995, taking into account the problems encountered in shrimp farming in the country. More recently, Aquaculture Authority had issued Guidelines in 1999 for Improvement of Production and Productivity from Traditional and Improved Traditional methods of Shrimp Farming. In countries like India, where large number of small farmers are involved in shrimp farming, the implementation of voluntary code of conduct will be successful only when the awareness of the farmers is enhanced through training and other capacity building exercises.

While the FAO's Code of Conduct stipulates actions to be taken by states, interest groups or institutions public or private, who are involved in or concerned with aquaculture, government agencies would have to play a key role in enhancing effective collaboration with and among many players, in order to promote sustainable development of aquaculture. Responsibilities for sustainable aquaculture development will need to be shared among government authorities, aquafarmers, manufacturers and suppliers of aquaculture inputs, processors and traders of aquaculture products, financing institutions, researchers, special interest groups, professional associations, non-governmental organizations and others so as to minimize potential social conflicts and environmental issues that may come in the way of sustainable and responsible development.

#### **7.4.5 R & D Support from Government Institutions**

Research support is very much essential for the sustainable development of shrimp farming. The research needs in the present context are:

- ✦ Assessment of carrying capacity or assimilation capacity of each creek system with reference to nutrient loading from shrimp farm wastewater.
- ✦ Cost-effective wastewater treatment techniques for different systems of shrimp farming (e.g. large individual farms, small farms located in a cluster)
- ✦ Development of rapid diagnostic techniques for identifying shrimp diseases and developing suitable control measure
- ✦ Development of specific pathogen-free broodstock and larvae
- ✦ Development of disease resistant varieties of shrimps through selection and domestication.
- ✦ Development of low protein – high energy shrimp feed
- ✦ Development of Environment Monitoring Models
- ✦ Testing of the efficiency of probiotics and immuno-stimulants in controlling shrimp diseases

#### **7.4.6 Development of Model Sites**

To demonstrate environment-friendly and sustainable shrimp aquaculture and also to set examples for future adoption by the farmers/ states, it is essential to set up models on both the east and west coast. These models will also be used for awareness raising amongst fish farmers and school and college youth on harmonization of aquaculture and the environment. Similar models have been developed and demonstrated in countries like Thailand and have been very useful in propagating sustainable and responsible shrimp farming practices.

#### **7.4.7 Extension support**

There is a general lack of technical support to the shrimp farmers. Most of the problems encountered by the farmers are because of the wrong practices adapted by them due to ignorance and the lure of making more money. BFDAs and State Fisheries Departments are ill equipped to cover the vast area that has been developed. Most of the farmers are illiterate and are entirely dependent on private “consultants” or the technicians from feed companies for technical support. The so called “consultants”, in most of the cases, are people without any practical experience in shrimp farming and they take advantage of the situation. A strong technical support is necessary to enable the shrimp farmers to adopt the best management practices. The shrimp farming technology should be continuously reviewed and improved. Such improvements should be communicated to the farmers through established extension methods and on-farm trials, trainings, etc.

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## 8.0 Role of Government in the Development of Shrimp Aquaculture

Development of shrimp aquaculture as a part of the Plan Programmes of the Government of India and the coastal states and union territories started during the Fifth Five-Year Plan Period with the basic objectives of optimum utilization of coastal saline areas and providing employment and livelihood security to the weaker sections of the community. With the advent of modern shrimp aquaculture and its adoption in the coastal states by entrepreneurs, government expanded its role by setting up of district-level agencies and providing a level-playing field to the small-scale farmers. This Chapter details the role of various government agencies in development of shrimp aquaculture in the country.



### 8.1 Ministry of Agriculture, Government of India

The Government of India has implemented a number of schemes for development of scientific shrimp farming in the country, which include survey of potential area for shrimp farming, pilot projects for demonstrating technologies, guidelines for the state governments and externally-aided programmes funded by agencies like UNDP and World Bank.

#### 8.1.1 Pilot Project on Brackishwater Aquaculture

A pilot project on brackishwater aquaculture was initiated in all the coastal states during the Fifth Five-Year Plan Period (1974-1979) with a view to demonstrating the viability of shrimp farming. A one-time central grant amounting to over Rs. 12.5 million was provided to the coastal states for construction and operation of a model 50 ha shrimp farm in each state.

#### 8.1.2 Centrally Sponsored Scheme

New beneficiary-oriented brackishwater aquaculture programmes were introduced under centrally sponsored sector during the Sixth Five-Year Plan Period (1980-1985). These programmes envisaged development of brackishwater area for aquaculture and establishment of shrimp hatcheries for production of quality shrimp seed.

#### 8.1.3 Integrated Brackishwater Fish Farm Development

During the Seventh Plan Period (1985-1990), a centrally sponsored scheme was initiated with the main objective of utilizing the country's vast brackishwater resources for fish/ shrimp culture and 39 Brackishwater Fish Farmers' Development Agencies (BFDAs) have been set up in coastal states/ union territories which provide technical, financial and extension support to shrimp farmers. Assistance under the scheme is provided for establishment of shrimp farms and shrimp hatcheries. The state and union territory governments are given assistance for establishment of demonstration-cum-training centres as well as for strengthening of the Technical Units in the Directorate of Fisheries. This scheme has continued during the Eighth and Ninth Five-Year Plans also and the achievements of BFDAs set up in the states and union territories are summarized below (Table 36).

**Table 36. Achievements of BFDAs since Inception till 1999 – 2000**

S. No	State/ UT	BFDAs (nos)	Water area covered (ha)	Farmers trained (nos)	Beneficiaries (nos)
1	West Bengal	3	3 386	9 475	4 044
2	Orissa	7	12 533	3 972	9 003
3	Andhra Pradesh	6	847	1 854	1 181
4	Tamil Nadu	5	1 679	258	1 097
5	Kerala	7	1 077	2 217	1 069
6	Karnataka	2	930	2 012	439
7	Goa	1	161	167	167
8	Maharashtra	4	570	1 515	213
9	Gujarat	3	1 674	367	658
10	Andaman & Nicobar Island	1	-	-	-
	<b>Total</b>	<b>39</b>	<b>22 857</b>	<b>21 837</b>	<b>17 871</b>

#### 8.1.4 UNDP Coastal Aquaculture Project

Coastal aquaculture projects were set up in different states/ union territory (Vansi Borsi-Gujarat; Asangaon-Maharashtra; Benaullim- Goa; Poyya- Kerala; Pollekuru- Andhra Pradesh; Alampur-West Bengal) with the technical and financial assistance received from the United Nations Development Programme. These facilities were created as demonstration centres.

#### 8.1.5 Guidelines for Classification, Use and Lease of Brackishwater Lands

Policy initiatives were taken for the allotment and lease of government land by the state governments and suitable guidelines were prepared by the Ministry of Agriculture and circulated among the coastal states. The guidelines *inter-alia* stipulated the following:

- (i) About 60.0 % of the brackishwater areas involving less capital investment may be given on lease to target group fishermen and small and marginal farmers who may take up extensive or semi-intensive farming. Such farmers should be given financial and technology support by the government, through the central and state schemes.
  - (ii) About 20.0 % of the brackishwater areas which need medium-size capital investment may be leased to medium entrepreneurs having financial backing and technology support for taking up intensive\* and semi-intensive brackishwater farming.
  - (iii) The balance of the land available after utilization as (i) and (ii) above, and involving high investment may be leased to the progressive entrepreneurs who may have financial backing and management capacity for introducing advanced technology for intensive\* farming to obtain high production.
- A lease for about 10 years may be considered with suitable provisions for taking back the land from the possession of the allotted farmers, in case the allotted land remains unutilized for more than one year from the date of allotment.
  - The entrepreneurs should also give an undertaking that the intensive and semi-intensive technology developed in the farm should be made available to the Government free of cost for further extension of the technology.

\* Through the Guidelines on Development of Sustainable Brackishwater Aquaculture, the Ministry of Agriculture prohibited intensive shrimp farming in 1995

### 8.1.6 Mapping of Brackishwater Area for Aquaculture Site Selection

The Ministry of Agriculture had entrusted the work of preparation of coastal land use maps in all the maritime states to Space Application Centre, Department of Space, Ahmedabad, using remote sensing data. The work was taken up in 1990 and initially three states – West Bengal, Orissa and Andhra Pradesh were covered under the programme. The study also covered the socio-economic dimensions of brackishwater aquaculture and development of a Geographical Information System package. In all 93 maps were prepared covering the three states on a scale of 1:50 000, showing wetlands, land use pattern of the adjoining shore upto 1.5 km, high water line and brackishwater bodies.

Subsequently, in 1991, the study was extended to other coastal states *viz.*, Tamil Nadu, Kerala, Karnataka, Goa, Maharashtra and Gujarat and the union territory of Pondicherry and Andaman and Nicobar Islands. In all 275 maps were prepared for identifying potential brackishwater areas for shrimp farming.

The main purpose for using the remote sensing data for identification of potential brackishwater sites and preparing detailed master plan, was to eliminate the ecologically sensitive/ fragile areas from being converted into shrimp farms and also develop it as an eco-friendly sustainable activity.

### 8.1.7 The World Bank Project

In 1992 – 1993, a World Bank assisted Shrimp and Fish Culture Project was taken up for implementation for a duration of seven years with the following major objectives:

- The most marginal of the coastal saline soils will be brought into productive use at a very low cost. In the project sites no mangrove forest would be sacrificed, nor would any agriculture land be converted into brackishwater aquaculture.
- The most economically distressed segment of the coastal population (*i.e.*, fishermen) will be offered an alternate economic activity that is compatible with their social and cultural milieu and which will reduce pressure on the coastal fisheries, forests and other natural resources.
- Construction and maintenance of shrimp farm infrastructure will create additional employment for local population.
- Ancillary activities such as processing and marketing of product or the manufacture and sale of feed will create additional employment opportunities in the non-fishing sector.
- An activity will be developed that will serve as an “indicator industry” for the health of coastal waters. Shrimps are quite sensitive to many of the common aquatic contaminants of industrial or agricultural origin. The creation of a large economic interest vested in the continued good health of the coastal ecosystem was considered as the best monitoring program for all types of pollution or environmental degradation.

The project was completed during December 2000 and a total area of 775 ha has been developed for Shrimp aquaculture in the coastal states of West Bengal, Orissa and Andhra Pradesh.

### 8.1.8 Formulation of Guidelines for Sustainable Development and Management of Brackishwater Aquaculture

In May, 1994, the Ministry of Agriculture, constituted a committee for drafting guidelines on development of sustainable brackishwater aquaculture. The committee comprised experts from various agencies involved in the development of shrimp farming in the country. The terms of reference for the said committee included review of the present status of shrimp aquaculture in the country *vis-à-vis* its socio-economic and environmental impact and drawing up suitable guidelines, indicating the measures to be adopted in the environmental monitoring and environmental management plans of shrimp aquaculture projects, for mitigating the adverse impacts, if any, of aquaculture on the environment and *vice-versa*.



The Guidelines formulated by the expert committee outlined measures to be adopted for :

- development of aquaculture as an eco-friendly activity,
- reducing the adverse impact of waste-water discharged from shrimp aquaculture units,
- treatment of such wastes, and
- mitigation of adverse impact of shrimp culture on environment.

Some of the important measures suggested in the Guidelines *inter-alia* include:

- i) preparation of a master plan for development of aquaculture using remote sensing data,
- ii) undertaking an environmental impact assessment study at the planning stage itself for all aquaculture units above 10 ha size,
- iii) discouraging conversion of mangrove and productive agricultural land for shrimp farming,
- iv) creating buffer zones between adjacent aquaculture units for secondary aquaculture purposes,
- v) avoiding use of chemicals, etc.,
- vi) improving the water and soil quality,
- vii) culture management and waste water management/ treatment methodologies,
- viii) incorporating an environment monitoring and management plan in all aquaculture units above 40 ha size,
- ix) using waste water discharged from aquaculture units for secondary aquaculture purposes, and
- x) prescribing standards for waste water discharge and their disposal.

The Guidelines were provided to all coastal state and union territory governments and other end users for compliance.

## **8.2 Indian Council of Agricultural Research**

An All India Coordinated Research Project on Brackishwater Aquaculture was implemented by the Indian Council of Agricultural Research (ICAR) through the Central Inland Fisheries Research Institute, Barrackpore during the period 1973 – 1984 with centres in West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Kerala and Goa. The results obtained from the project were instrumental in initiation of various policy initiatives on shrimp aquaculture by the Government of India.

The first brackishwater experimental fish farm was constructed by the ICAR at Kakdwip, West Bengal. Various technologies were developed for scientific farming in tide-fed systems. During the same period, the Central Marine Fisheries Research Institute, Cochin, carried out research on the development of hatchery technology for penaeid shrimps. By 1975, life history of different species of commercially important penaeid shrimps were completed and a small-scale hatchery technology was standardized. With the increasing importance on brackishwater aquaculture, a full fledged research institute on brackishwater aquaculture was proposed and the Central Institute of Brackishwater Aquaculture (CIBA) was established in 1987 with headquarters at Chennai and centres at Kakdwip in West Bengal, Puri in Orissa and Narakkal in Kerala. The mandate of the Institute is as follows:

- To conduct research towards supporting sustainable and responsible development of aquaculture in brackishwater systems in different agro-ecological regions
- To develop eco-friendly and economically-viable culture technologies towards greater productivity and production of fish, shellfish and other aquatic organisms in brackishwater areas through a multi-disciplinary matrix approach to production and management
- To provide policy support for environmental and natural resource management and socio-economic development related to brackishwater aquaculture activity
- To develop strong database and information management system

- ◆ To undertake human resource development and transfer of technology programmes and to provide consultancy services

Being a nodal institute for brackishwater aquaculture in the country, CIBA has been extending technical help to farmers, entrepreneurs in various aspects of shrimp farming. It is also assisting the central and state governments in formulating policies and guidelines on sustainable shrimp farming.

Fisheries Colleges under the State Agricultural Universities of ICAR are also giving able research and human resources development support for the shrimp farming sector.

### 8.3 Marine Products Export Development Authority

The Marine Products Export Development Authority (MPEDA), an autonomous body under the Ministry of Commerce is promoting production of cultured shrimp with a view to augment supply of shrimp for export. The Authority is implementing several schemes for promotion of shrimp aquaculture. The important ones are as follows:

- ◆ extending technical assistance on turn-key basis to farmers from selection of site, construction of farm, etc., to harvest of shrimps
- ◆ imparting training to shrimp farmers, especially those belonging to the weaker sections (Schedule castes/ Schedule tribes)
- ◆ demonstrating latest culture techniques to the shrimp farmers
- ◆ liaison with state governments/ research institutions, financial institutions, insurance companies, etc., for solving the administrative, technical and financial problems faced by the shrimp farmers
- ◆ extending financial assistance for setting up of farms, hatcheries etc.

To enable the shrimp farmers to adopt eco-friendly techniques, the MPEDA is also providing financial assistance for setting up effluent treatment units in farms. It has introduced the 'code of conduct' to be followed by hatcheries so that the farmers are ensured of healthy seed (postlarvae).

### 8.4 Aquaculture Authority

#### 8.4.1 Constitution of the Authority

Following directions of this Hon'ble Court, Government of India issued Gazette Notification (No. 76 dated 6.2.1997) constituting Aquaculture Authority with the following members and with powers and functions detailed in the following paragraphs:

**Members:**

- |                                                              |   |                  |
|--------------------------------------------------------------|---|------------------|
| 1) A retired Judge of High Court                             | - | Chairman         |
| 2) An expert in the field of Aquaculture                     | - | Member           |
| 3) An expert in the field of pollution control               | - | Member           |
| 4) An expert in the field of environmental protection        | - | Member           |
| 5) A representative of the Ministry of Environment & Forests | - | Member           |
| 6) A representative of the Ministry of Agriculture           | - | Member           |
| 7) A representative of Ministry of Commerce                  | - | Member           |
| 8) (To be appointed by the Central Government)               | - | Member Secretary |

### ***Powers:***

Powers under Section 5 of the Environment (Protection) Act for issuing directions and for taking measures with respect to the matters referred to in Clauses (v), (vi), (vii), (viii), (ix) and (xii) of sub-section (2) of Section 3 of the said Act.

### ***Functions:***

- 1) to ensure that no shrimp culture pond can be constructed or set up within the Coastal Regulation Zone and upto 1000 m of Chilka Lake and Pulicat Lake (including bird sanctuaries namely, Yadurapattu and Nelapattu);
- 2) to ensure and give approval to the farmers who are operating traditional and improved traditional systems of aquaculture for adoption of improved technology for increased production;
- 3) to ensure that the agricultural lands, salt pan lands, mangroves, wetlands, forest lands, land for village common purposes and the land meant for public purposes shall not be used or converted for construction of shrimp culture ponds;
- 4) the Authority shall implement the “Precautionary Principle” and the “Polluter Pays Principle”, by adopting the procedure described in the Supreme Court Order dated 11.12.1996 in Writ Petition (Civil) No. 561 of 1994;
- 5) the Authority shall also regulate the shrimp culture activities outside the Coastal Regulation Zone areas and beyond 1000 m from the Pulicat Lake and Chilka lake and give the necessary approvals/ authorization by the 30<sup>th</sup> April, 1997;
- 6) the Authority in consultation with expert bodies like National Environmental Engineering Research Institute, Central Pollution Control Board, respective State Pollution Control Boards shall frame scheme/ schemes for reversing the damage caused to the ecology and environment by pollution in the coastal States and Union Territories;
- 7) The Authority shall ensure the payment of compensation to the workmen employed in the shrimp culture industries as per the procedure laid down in the Supreme Court Order dated 11.12.1996 in Writ Petition (Civil) No. 561 of 1994;
- 8) To comply with the relevant orders issued by the concerned High Courts and Supreme Court from time to time;
- 9) To deal with any other relevant environment issues pertaining to coastal areas with respect to shrimp culture farming, including those which may be referred to it by the Central Government in the Ministry of Environment and Forests;

#### **8.4.2 Activities undertaken by the Authority**

The Authority has held 21 meetings since its inception in February 1997 in different coastal states and union territories for effective implementation of the Supreme Court’s directives. The progress achieved in the implementation of the directives is as follows:

- Laid down Rules and Procedures for issuing of licenses for shrimp farms
- Constituted State and District Level Committees to assist the Authority for issue of licenses
- Released advertisements to create awareness among the farmers regarding the functioning of the Authority
- Prepared the following guidelines to promote sustainable shrimp aquaculture
  - (i) Guidelines for Adopting Improved Technology for Increasing Production and Productivity in Traditional and Improved Traditional Systems of Shrimp Farming

(ii) Guidelines for Setting up of Effluent Treatment System in Shrimp Farms

- Organized seminars and meetings with experts and various stakeholders to obtain their views and suggestions on sustainable development of shrimp aquaculture
- Although the Coastal Regulation Zone Notification is in vogue since 1991, the High Tide Line is yet to be completely demarcated in the various coastal states and union territories as per the Notification. Without fixing correct HTL for the whole country, classifying Coastal Regulation Zone into I, II, III and IV will be very difficult. In the absence of HTL, fixing the position of the farms in relation to HTL is also a problem. At the instance of the Authority, the Ministry of Environment & Forests, Government of India, have authorised the following seven agencies for demarcation of High Tide Line (HTL) and Low Tide Line (LTL) in the Coastal Regulation Zone:
  1. Space Application Centre, Ahmedabad
  2. Centre for Earth Sciences Studies, Thiruvananthapuram
  3. Institute for Remote sensing, Anna University, Chennai
  4. Institute for Wetland Management and Ecological Designs, Kolkata
  5. Naval Hydrographer's Office, Dehradun
  6. National Institute of Oceanography, Panjim
  7. National Institute of Ocean Technology, Chennai

As a follow up, general guidelines for demarcation of HTL and LTL were also issued by the Ministry of Environment & Forests to all the coastal states/ union territories requesting them to take up demarcation of HTL and LTL along their Coastal Regulation Zones using the general guidelines, with the assistance of any one of the seven authorized agencies. Even with such directives, only few states could complete the process of marking the HTL.

The absence of baseline data on the environmental conditions in the various estuaries and creeks before the initiation of shrimp farming, is hindering the preparation of guidelines on "Polluter Pays" principle. After discussions with specialists in the field, the Central Marine Fisheries Research Institute, under the Indian Council of Agricultural Research, has been entrusted with the job of drafting the guidelines for the implementation of "Polluter Pays" principle.

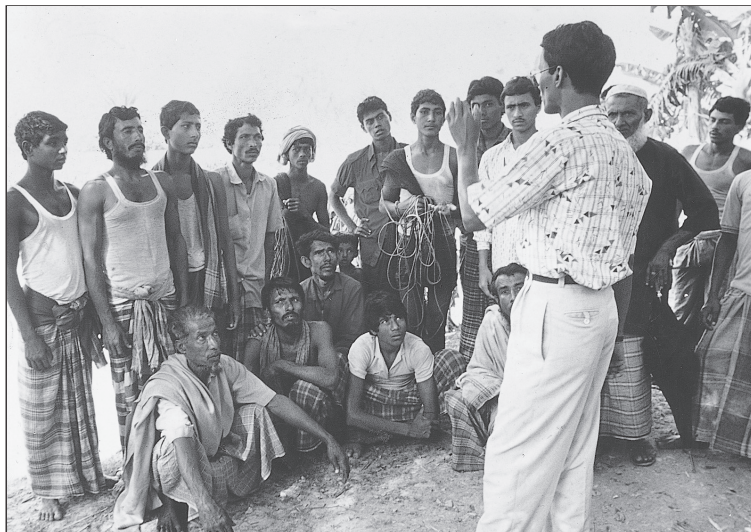
A clarification application on the Supreme Court's Judgement dated 11.12.96 has been filed in the Supreme Court on 9.6.2000 seeking clarification on the Court's observation in and around Chilka area in view of certain ambiguities. Pending this clarification, permissions regarding setting up of shrimp farms in and around Chilka have not been issued by the Authority.

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## 9.0 Conclusions and Future Plan of Action

### 9.1 Conclusions

During the past two decades aquaculture has become the fastest growing food-producing sector and is an increasingly important contributor to national economic development, global food supply, food security and nutrition. Aquaculture comprises a whole range of users, systems, practices and species, operating through a continuum ranging from backyard household ponds to large-scale farms. Aquaculture complements other food production system, and integrated aquaculture can add value to the current use of on-farm resources. Aquaculture can be an entry point for improving livelihoods,



planning natural resource use and contributing to environmental enhancement. While poorly planned and managed shrimp aquaculture operations have resulted in negative impacts on ecosystems and communities, aquaculture has also been negatively impacted by other unplanned activities.<sup>128</sup>

Enhancing food security and alleviating poverty are major and complementary national priorities. Aquaculture has a special role in achieving these objectives because, first, fish is a highly nutritious food that forms an essential, if not indispensable, part of the diet of a large proportion of the people in the country. Second, while aquaculture contributes to the livelihoods of poor farming households in most parts of the country including coastal areas, there is a huge, unfulfilled potential, as aquaculture is a relatively recent and underdeveloped sector as compared to agriculture and animal husbandry.

Shrimp aquaculture in its traditional form has been an important source of food and livelihood for coastal people. The development of commercial shrimp aquaculture in the country started in early eighties. During the early nineties, shrimp aquaculture developed rapidly in the east coast states of Andhra Pradesh, Orissa and Tamil Nadu. Lack of regulation governing establishment of shrimp farms, led in some places to improper siting, overcrowding, changes in land use pattern and conversion of other habitats. Subsequently, during 1995, development of shrimp aquaculture received setback due to outbreak of viral disease and the reported problems faced by some coastal communities. The complaints included decline in quality of agricultural lands, salinisation of ground water resources, destruction of mangroves, decline in catches of shrimp and fish, nutrient loading in coastal waters, change in biodiversity, prevention of access to coastal areas for traditional users, flooding of villages, deterioration of human health, displacement of labour, etc.

Traditionally, shrimp farming has been practiced in India in inter-tidal areas where complete draining of water is difficult and the cost of construction is higher. Scientific shrimp aquaculture practices include drying of the pond, tilling, liming, application of manure and fertilizers, seeding, and harvesting. In other words it is agriculture under water. The only difference is that in agriculture the crops manufacture their own food while for shrimps, feed is provided from outside. With the advent of scientific farming, there was a shift from inter-tidal area to

<sup>128</sup> NACA/FAO. 2000. Report of the Conference on Aquaculture in the Third Millennium, 20-25 February 2000, Bangkok, Thailand. 120 p

supra-tidal areas, which led to conflicts regarding salinisation of adjoining lands and freshwater aquifers through seepage. Studies have, however, shown that salinisation of soil and drinking water resources due to seepage from shrimp farms is site-specific and is dependent on the quality of the soil, level of compaction of the dykes, level of usage of the freshwater and distance from the farm. In some places there is no effect on soil or freshwater resources adjacent to shrimp farms, while in other places though there is salinisation, it is restricted to a short distance from the farm. Provision of buffer zones between the different land use areas, depending on the soil quality, will resolve this conflict.

It is evident that aquaculture is less polluting as compared to many other coastal activities (e.g. industries). The traditional and extensive systems of farming, where low-density stocking is practiced, are practically non-polluting. Shrimp farm wastes are biodegradable and do not contain any toxicants. Over-crowding of shrimp farms may lead to 'self-pollution' and the shrimp farms are the first to be affected by such overloading because shrimps are more sensitive to changes in water quality. Outbreaks of shrimp diseases have been attributed to this type of self-pollution. To mitigate the impact of nutrient loading in the ecosystem, use of effluent treatment is made mandatory, by Aquaculture Authority, for large farms.

Coastal areas of the country have vast resources of saline affected fallow lands which cannot be used for any productive purpose. Presently, about 10.0 % of the resources available are being utilized for shrimp aquaculture. Shrimp aquaculture requires natural resources like land, water, and biological resources like seed and feed. Growth and survival of the shrimps are dependent on the quality of water available and polluted water seriously affect the production and productivity of shrimp aquaculture.

Shrimp farms have been constructed on variety of coastal lands – intertidal fallow land, dry and saline fallow land, unproductive and marginal agricultural land, and to a lesser extent in wetlands like marshes and mangroves. Land-use conflicts have arisen in some places where large farms have been established. Majority of the farmers in the country follow traditional, improved traditional and extensive system of farming. Majority of the farmers (90%) are small/ marginal with farm size less than 2.0 ha. In the process, shrimp aquaculture has contributed to rural employment and economic development of coastal villages and helped to raise the foreign exchange earnings of the country.

Aquaculture should be considered as a regulated activity within the CRZ since it requires good quality saline water in sufficient quantities. Shrimp aquaculture outside CRZ will require laying of pipelines which requires high investment and will prevent the small farmers from taking up shrimp aquaculture. Sustainable shrimp farming can be developed when it is ensured that it will not adversely impact the environment and it will not displace existing activities which provide employment or produce food (rice, salt, etc.) to coastal communities. However, these can be achieved if three major aspects are taken into consideration - (i) location and siting of the farm, (ii) concentration of farms in a given area and (iii) the level of stocking density.

## **9.2 Plan of Action**

The following Plan of Action is proposed for orderly growth and ensuring sustainability in the shrimp farming practices in the country:

Availability of suitable areas for farming coupled with infrastructure facilities such as road and electricity can lead to concentrations of shrimp farms in a given area. States should prepare master plans and consider setting up of 'aquaculture estates' in such areas with adequate forward and backward linkages.

Farmers should be advised to form local associations or farmers groups for resolving conflicts in water usage and other related activities. Shrimp farming through co-operatives should be encouraged to improve their socio-economic conditions.

Integrated coastal zone management plans should be prepared for each coastal state/ union territory with zoning for different activities. Buffer zone depending on the quality of the soil, should be provided between a shrimp farm and (i) agricultural land, (ii) village settlement and freshwater source, and (iii) the neighbouring farm for preventing salinisation of soil and freshwater aquifers and to avoid ‘self pollution’.

Continuous monitoring of the environment in areas of intense farming activity should be taken up to identify the impact levels before any damage occurs to the environment. R & D support is required in developing models for assessing the ‘carrying capacity’ of various creeks and canals. Technical and extension support should be made available to the farmers. Wastewater treatment should be made compulsory and common effluent treatment plants should be set up for treating the wastewater of small farms.

A systematic study should be carried out regarding the land-use pattern within the CRZ and a proper land lease policy should be adopted, which will minimise the conflict between the different users and make the landless labourer become an aquafarmer.

Since most of the impacts are site-specific, it is essential that EIA and environment monitoring are made mandatory for larger farms. Farm siting and design approval should also be mandatory.

Best farm management practices will reduce the level of nutrient loading in the environment and lead to good growth and survival of shrimps. Guidelines already issued by the Aquaculture Authority for increasing production and productivity from improved traditional method of farming should be followed. Government should provide complete research and training support to the farmers in adapting eco-friendly technologies.

ICAR Research Institutes should work more closely with the Aquaculture Authority in developing guidelines for EIA, wastewater treatment, fixing of standards, assessing the carrying capacity of different estuaries and canals and in training state fisheries extension personnel.

Effective national institutional arrangements and, policy, planning and regulatory frameworks in aquaculture and other relevant sectors are essential to support aquaculture development. Aquaculture should be pursued as an integral component of development, contributing towards sustainable livelihoods for poor sectors of the community, promoting human development and enhancing social well-being.

Aquaculture policies and regulations should promote practical and economically viable farming and management practices that are environmentally responsible and socially acceptable. National aquaculture development processes should take place within the framework of relevant national policies, regional and international agreements, treaties and conventions. In pursuing development, states, the private sector, and other legitimate stakeholders should cooperate to promote the responsible growth of aquaculture. The ‘precautionary principle’ and ‘polluter pays’ principle should be enforced whenever necessary.

Legislation should be enacted to regulate the following:

- ✦ preventing construction of shrimp farms in mangrove areas, other sensitive areas and in agricultural land
- ✦ siting of the farms in relation to agricultural land/ village
- ✦ compulsory EIA for larger farms
- ✦ wastewater quality standards and Effluent Treatment Plants
- ✦ use of chemicals and drugs
- ✦ licensing and mandatory application of code of conduct

Future investment in aquaculture should be made with long-term strategies in mind to ensure sustainability. Adequate public sector finance for capacity building, institutional development and infrastructure, is indispensable for the coastal communities to obtain the full advantages of a well-managed and efficient shrimp aquaculture sector.

The constraints in farming can be highly complex and often of technical/ technological nature. However, overall success of farming may depend largely on economics and social issues. The challenge will be to focus on meeting social needs-*i.e.* food security, poverty, livelihoods, community development, etc. rather than solely trying to produce fin and shell fish. This can be achieved though investing in human resources including existing and future aquaculturists as well as government and non-government agencies and institutions. Investing in training, education, extension, information and communication are important in this respect. Use of modern information and communication tools and methods such as the internet, and other state-of-the-art communication methodologies will have to be given due consideration.

It is also essential that an enabling environment, with an appropriate policy, legal and institutional framework to facilitate access to key development resources, such as financial resources and knowledge is provided. There is a strong need for greater emphasis on institutional support, that is support not only to government and public sector agencies dealing with administration, extension, and research and development, but also to organizations and institutions representing private sector, consumers and other stakeholders.

Finally, stakeholder participation and community-based participatory approach in aquaculture development decision-making, and policy planning should be duly considered. Aquaculture's potential for social empowerment should be harnessed, and the involvement of more women in aquaculture development should be given due respect. The trust between producers and consumers needs to be improved and avenues must be found to achieve this.

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## *Acknowledgement*

Aquaculture Authority sincerely acknowledges the cooperation received from the following national and international organisations in preparation of this report. A large number of responses were also received from the public and fisheries scientists offering their valuable suggestions for development of sustainable shrimp aquaculture and the Aquaculture Authority expresses its thanks to all of them.

Aquaculture Foundation of India, Chennai, India

Australian Centre for International Agriculture Research, Canberra, Australia

Bay of Bengal Programme, Chennai, India

Central Institute of Brackishwater Aquaculture, Chennai, India

Central Institute of Fisheries Education, Mumbai, India

Central Marine Fisheries Research Institute, Kochi, India

Central Pollution Control Board, New Delhi, India

Centre for Development Studies, Thiruvananthapuram, India

Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai, India

Consumers Association, Yendangandi, India

Department of Economics, University of Madras, Chennai, India

Department of Environmental Sciences, Cochin University of Science & Technology, Kochi, India

Department of Fisheries, Government of Daman & Diu, India

Department of Fisheries, Government of Andaman & Nicobar Islands, India

Department of Fisheries, Government of Andhra Pradesh, India

Department of Fisheries, Government of Goa, India

Department of Fisheries, Government of Gujarat, India

Department of Fisheries, Government of Karnataka, India

Department of Fisheries, Government of Kerala, India

Department of Fisheries, Government of Lakshadweep, India

Department of Fisheries, Government of Maharashtra, India

Department of Fisheries, Government of Orissa, India

Department of Fisheries, Government of Pondicherry, India

Department of Fisheries, Government of Tamil Nadu, India

Department of Fisheries, Government of West Bengal, India

Department of Microbiology, Goa University, Goa, India

Department of Primary Industries, Cairns, Australia

Development Law Service, Food and Agriculture Organisation, Rome, Italy

Directorate General for Development, European Economic Commission, Brussels, Belgium

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### *List of Abbreviations*

A & N Islands	-	Andaman and Nicobar Islands
ADB	-	Asian Development Bank
Anim. Sci.	-	Animal Science
AP	-	Andhra Pradesh
BDL	-	Below Detectable Level
BFDA	-	Brackishwater Fish Farmers' development Agency
BOBP	-	Bay of Bengal Programme
BOD	-	Biochemical Oxygen Demand
CIBA	-	Central Institute of Brackishwater Aquaculture
CICEF	-	Central Institute of Coastal Engineering for Fishery
CIFE	-	Central Institute of Fisheries Education
CIFNET	-	Central Institute of Fisheries, Nautical and Engineering Training
CIFRI	-	Central Inland Fisheries Research Institute
COD	-	Chemical Oxygen Demand
COFI	-	Committee of Fisheries of FAO
CPCB	-	Central Pollution Control Board
CRZ	-	Coastal Regulation Zone
CZMP	-	Coastal Zone Management Plan
DEPT	-	Department
DOAC	-	Department of Agriculture and Cooperation
DOD	-	Department of Ocean development
DOF	-	Department of Fisheries
DPI	-	Department of Primary Industries
EcS	-	Economic Sustainability
EEZ	-	Exclusive Economic Zone
EH	-	Eastern Hemisphere
EIA	-	Environment Impact Assessment
ETP	-	Effluent Treatment Pond
ETS	-	Effluent Treatment System
FAO	-	Food and Agriculture Organization
FSI	-	Floor Space Index; Forest Survey of India
GDP	-	Gross Domestic Product
GOI	-	Government of India
Govt	-	Government
GSR	-	Government Supplement rules
Ha/ ha	-	Hectare
HTL	-	High Tide Line
ICAM	-	Integrated Coastal Area Management
ICAR	-	Indian Council of Agricultural Research
ICMAM	-	Integrated Coastal and Marine Area Management
ICZM	-	Integrated Coastal Zone Management
IDBI	-	Industrial Development Bank of India
IFCI	-	Industrial Finance Corporation of India
Kg/ kg	-	Kilogram
kg/ ha	-	kilograms per hectare
Km/ km	-	Kilometre
l	-	litre
LTL	-	Low Tide Line
m	-	meter
m <sup>2</sup>	-	square metre
MAX	-	Maximum

mg	-	milligram
mg/l	-	milligram per litre
MOEF	-	Ministry of Environment and Forests
MPEDA	-	Marine Products Export Development Authority
MS	-	Mid Stream
MSSRF	-	M S Swaminathan Research Foundation
MT	-	Metric tonnes
NACA	-	Network of Aquaculture Centres in Asia-Pacific
NEERI	-	National Environmental Engineering Research Institute
NGO	-	Non-governmental Organization
NH <sub>3</sub>	-	Ammonia
NIO	-	National Institute of Oceanography
nos.	-	numbers
NRSA	-	National Remote Sensing Agency
OAL	-	Overall Length
PCR	-	Polymerization Chain Reaction
PL	-	Postlarva
PL20	-	Postlarva 20
PO	-	Pond Outlet point
ppm	-	Parts per million
ppt	-	Parts per thousand
R&D	-	Research and Development
Rs.	-	Rupees
SEAFDEC	-	South East Asian Fisheries Development Centre
SIS	-	Sea Water Irrigation Systems
SS and LUO	-	Soil salinity and Land Use Organization
Sq. Km	-	Square Kilometre
SS	-	Social Sustainability
TDS	-	Total Dissolved Solids
TIR	-	Tambak Inti Rakyat
TN	-	Tamil Nadu
UN	-	United Nations
UNDP	-	United Nations Development Programme
USA	-	United States of America
UT	-	Union Territory
WH	-	Western Hemisphere
WWF	-	World Wide Fund for Nature

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