

# **CODE OF CONDUCT FOR SUSTAINABLE FISHERIES IN INDIA**

*Adopted at the Workshop on  
Sustainable Livelihoods and Environment  
Management of Coastal Ecosystems*

*Organised by*  
M. S. SWAMINATHAN RESEARCH FOUNDATION, CHENNAI  
*in collaboration with*  
**FAO Bay of Bengal Programme, Chennai and  
International Ocean Institute, Operational Centre (India),**

## PREFACE

The oceans occupy about three-fourths of the Earth's surface and, veritably, ours is a water-planet. The cradles of human civilization have all thrived in the coastal regions of the world. Presently, over one-third of the world's population live along the coastline and the density is expected to increase in future. The oceans, particularly the coastal regions have come under severe pressure to meet the ever-increasing human needs for habitat, food, fuel, recreation, transport, trade and others. Domestic, agricultural and industrial wastes from the land finally end up in the coastal waters stressing the ecosystems further.

The United Nations declared 1998 as the **International Year of the Ocean** to draw the attention of governments and the public to the various issues related to the oceans and to develop programmes for their sustainable management. Agenda 21 of UNCED has been designed to foster an integrated approach to environmental conservation and economic development. We at the M. S. Swaminathan Research Foundation (MSSRF) considered that a Workshop linking the livelihood security of the coastal communities with ecosystem management would be significant as a programme to observe the International Year of the Ocean. It may be stated that right from the inception of the Centre for Research on Sustainable Agriculture and Rural Development (CRSARD) in 1989, one of the major Programme Areas of the Centre has been Coastal Systems Research.

The MSSRF organized the Workshop on "Sustainable Livelihoods and Environment Management of Coastal Ecosystems" during December 10-11, 1998. The FAO Bay of Bengal Programme and the International Ocean Institute, Operational Centre (India) co-sponsored the workshop. The major objective of the Workshop was to standardise procedures for promoting sustainable livelihood security of coastal communities, particularly fishermen and women, and to develop a voluntary Code of Conduct for sustainable fisheries. The workshop was also designed to critically look into the threats to the sensitive ecosystems such as the Gulf of Mannar Biosphere Reserve, and to suggest sustainable management programmes. A public discussion on the subject was organised under the sponsorship of the Hindu Media Resource Centre for Ecotechnology and Sustainable Development.

It is gratifying that the Workshop participants have more than fulfilled the objectives set as seen from the very useful Recommendations. The draft document on "Code of Conduct for Sustainable Fisheries in India" prepared by the MSSRF was discussed and adopted at the workshop. Although the FAO has issued the "Code of Conduct for Responsible Fisheries" in 1995 in the global context, it was considered necessary to evolve a "Code of Conduct for Sustainable Fisheries in India", specific to the Indian context and in the light of our experience in dealing with aspects of management, conservation and development of fisheries. I am very hopeful that the Recommendations of the Workshop will receive due consideration for implementation by concerned governmental and non-governmental organisations and all the stakeholders. For the first time in India a voluntary Code of Conduct for Sustainable Fisheries has been developed and I hope that this will attract widespread public support and will be adopted by all concerned for implementation.

I am grateful to FAO Bay of Bengal Programme, Chennai and its Programme Co-ordinator, Dr. Kee-Chai Chong, and to the International Ocean Institute, Operational Centre (India), Chennai and its Director Prof. R. Rajagopalan for joining hands with us in organising the Workshop and for their financial contributions.

My sincere thanks go to Dr. K. Alagarswami, former Director, Central Institute of Brackishwater Aquaculture and currently Distinguished Fellow, MSSRF, for his dedicated work and detailed planning which were responsible for the success of the Workshop. He along with Mr. M. Jagannadha Rao, IFS, worked tirelessly in organising the Workshop.

**M. S. Swaminathan**

# **CODE OF CONDUCT FOR SUSTAINABLE FISHERIES IN INDIA**

## **INTRODUCTION**

### **1.1. Value of Indian Fisheries**

- 1.1.1. Fishing has, since India's Independence, emerged as a major food producing sector contributing to food and nutritional security, employment generation, economic and social well being of the people, and as a significant source of export trade, Fish production increased from about 752,000 tonnes in 1950-51 to 4.95 million tonnes in 1995-96. The average annual growth rate from 1990-91 to 1994-95 was 5.7%. The fisheries sector provides gainful employment to about 3.84 million full time or part time fishermen, as also to about 2.12 million occasional fishers, with an equally impressive segment of the population engaged in ancillary activities associated with fisheries and aquaculture. The operational fishing fleet in the maritime States/Union Territories is comprised of 191,207 traditional crafts (of which 31,726 are motorised) and 46,918 mechanised boats. The contribution of fishery sector to the Gross Domestic Product (GDP) was Rs. 109.63 billion in 1994-95 at current prices; in terms of NDP the contribution was Rs. 98.26 billion. The export of marine products earns US \$ 1300 million/annum.
- 1.1.2. The climatic, geographical and biological assets supporting fisheries development are vast with a tremendous amount of water budget and wet lands, a long coastline of 8129 km stretch, a spread of about 500,000 sq. km of continental shelf and an expanse of 2.02 million sq.km of Exclusive Economic Zone under national jurisdiction and the gift of a great biodiversity of aquatic resources of animals, plants and micro-organisms.
- 1.1.3. The second half of 20th Century has seen a great deal of achievements in fisheries development and trade. This has been supported by public policies and plans, R & D work, institutional framework, investments, private enterprise, and field and factory labour by men and women. Lately, challenges of intra- and inter-sectoral conflicts had come to the forefront begging solutions. Fisheries has been sought to be regulated by legislation by the governments at the Centre and States/ Union Territories under the powers of the Indian Fisheries Act, 1897, as also other independent Acts.

### **1.2 Fisheries Potential of Future**

- 1.2.1. The estimated harvestable potential from fisheries resources of India is 3.9 million tonnes from marine capture fisheries, including inshore (2.21 Mt.) offshore and deep sea (1.4 Mt.), and oceanic (0.3 Mt.) realms, and 4.5 million tonnes from the inland sector, including production from both capture and culture fisheries. Of this potential, the present production (1995-96) is 2.71 million tonnes from marine and 2.24 million tonnes from inland sector. The marine production of 2.71 million tonnes comes primarily from the inshore region (upto 50 m depth) and the inward region of offshore (upto 100 m depth). It is obvious that (i) inshore fishery is almost

saturated and needs to be conserved and managed for its sustainability ; and (ii) the scope for increasing production would lie in the offshore and deep sea (upto 500 m depth) and oceanic realms. The inland sector, on the other hand, has an estimated potential of 4.5 million tonnes, of which the present harvest is 2.24 million tonnes, leaving an yield gap of 2.26 million tonnes which has to be realised largely through aquaculture and culture-based fisheries. Sea-based coastal aquaculture has a significant potential, but it is not yet quantitatively assessed. In future, this potential has to be commercially exploited.

- 1.2.2. The above analysis made by the scientists and fishery administrators of the country based on a large amount of time series scientific data on marine capture fisheries and estimates for inland fisheries, points to the future directions of fisheries development. Current development plans are consistent with these directions.

### **1.3 Legal Regime**

- 1.3.1. The Indian Fisheries Act, 1897 was essentially an enabling Act, giving powers to State Governments to enact State Acts and make Rules and Regulations for fishery management. The Act specifically prohibits use of dynamite or other explosive substance in any water, including sea within a distance of one marine league of the sea coast, to catch or destroy any of the fish including shellfish, and also prohibits use of any poison, lime or noxious material into any water with intent thereby to catch or destroy any fish. The Act empowered making rules which may prohibit or regulate all or any of matters concerning erection and use of fixed engines (fixed or stationary gear), construction of weirs, use of nets and fishing in any specified water for a period not exceeding two years. Under the above Central Act, States have enacted legislation and rules and regulations thereof concerning marine/inland fisheries as per their interests on fishery management.

- 1.3.2. The Marine Fishing Regulation Acts of the Coastal States/Union Territories, based on a central model, has been an important step to harmonise fishing operations. With the advent of coastal aquaculture, steps had been taken to regulate its development. Based on detailed deliberations for over an year with the participation of administrators, experts, farmers and industry, the Government of India (Ministry of Agriculture, Department of Agriculture and Co-operation) issued in 1995 the "Guidelines for Sustainable Development and Management of Brackishwater Aquaculture". The Dr. M. S. Swaminathan Committee constituted in 1994 by the Government of Tamil Nadu to go into the issues of achieving harmony between coastal agriculture and aquaculture enunciated the principal elements of Policy Framework and made detailed recommendations for Sustainable Coastal Aquaculture in Tamil Nadu, which substantially contributed to the enactment of Tamil Nadu Aquaculture (Regulation) Act, 1995.

### **1.4 Paradigm Shift from Development to Management**

- 1.4.1. About three-fourths of the earth's surface is covered by water. Aquatic resources have been harvested as food from the dawn of human civilisation in the coastal areas and river valleys. Growth in human population, ever-increasing demand for

fish, technological advances, and the realisation that fish is one of the best health foods have made fisheries a competitive food trade. It was once assumed that the aquatic resources were an unlimited and inexhaustible gift of nature. However, with increase in knowledge and experience on the dynamics of fisheries and the dwindling yield rates, it has been realised that these resources, though renewable, are not infinite. They would behave the same way as any other wildlife would. Hence, the aquatic resources should be properly managed with the three elements of conservation, management and development (CMD) for sustainable fisheries.

- 1.4.2. As a new millennium is about to dawn, a paradigm shift in approach and action for fisheries from ‘development’ to ‘sustainable fisheries’ has become inevitable in order to ensure that, while meeting the needs of the present generation, the ability of the future generations to meet their own needs is not jeopardised. The Food and Agriculture Organisation of the United Nations (FAO) has defined sustainable development as follows:

“Sustainable development is the management and conservation of the natural resources base and the orientation of technological and institutional change in such a manner so as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development (in the agriculture, forestry and fisheries sectors) conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable”.

- 1.4.3. For India, with issues arising from an open access regime and a significant percentage of population below the poverty line, more particularly in the case of fishermen and women who remain to be socio-economically uplifted, the challenges of sustainable development would be daunting.
- 1.4.4. That the current fisheries development plan reflects a greater commitment to socio-economic upliftment of fishermen can be understood from the statement : “In the development of fisheries, preoccupation with bio-physical processes at the expense of social processes would be detrimental to the overall progress. Men and women should remain at the centre stage and benefits of various development programmes should percolate to the poor fisherfolk and fish farmers. In regard to gender issues, the fishery sector offers maximum equality from among the agriculture and allied sectors” (Working Group on Fisheries Report, 1996).
- 1.4.5. The challenges can be met by setting out a vision for the early part of the 21st century, laying down related policies and strategies and by developing and adopting a voluntary Code of Conduct for Sustainable Fisheries.

## **1.5 FAO Code of Conduct for Responsible Fisheries**

- 1.5.1. The Food and Agriculture Organisation of the United Nations (FAO) after detailed deliberations at various fora of international bodies such as the Committee of Fisheries (COFI) in 1991, International Conference on Responsible Fishing (Declaration of Cancun) in 1992, United Nations Conference on Environment and Development (UNCED) Agenda 21 in 1992, and others, finalised the Code of Conduct for Responsible Fisheries which was unanimously adopted by the FAO Conference on 31 October 1995. The Code sets out principles and international

standards of behaviour for responsible practices with a view to ensuring the effective conservation, management and development of living aquatic resources, with due respect for the ecosystem and biodiversity. The Code is voluntary. “The Code is global in scope and is directed towards members and non-members of FAO, fishing entities, whether governmental or non-governmental, and all persons concerned with the conservation of fishery resources and management and development of fisheries such as fishers, those engaged in processing and marketing of fish and fishery products and other users of the aquatic environment in relation to fisheries”. In the code, the term fisheries applies equally to capture fisheries and aquaculture.

- 1.5.2. The FAO Code of Conduct for Responsible Fisheries (1995) has 12 Articles dealing with; 1 . Nature and Scope; 2 . Objectives; 3 . Relationship with other International Instruments; 4 . Implementation, Monitoring and Updating; 5 . Special Requirements of Developing Countries; 6 . General Principles; 7 . Fisheries Management; 8 . Fishing Operations; 9 . Aquaculture Development; 10 . Integration of Fisheries into Coastal Area Management; 11 . Post harvest Practices and Trade; and 12 . Fisheries Research. The Code thus is a very comprehensive one, at the global level, for conducting the affairs of fisheries in a responsible manner, and “provides a necessary framework for national and international efforts to ensure sustainable exploitation of aquatic living resources in harmony with the environment”.

## **1.6 Code of Conduct for Sustainable Fisheries in India**

- 1.6.1. The present paper on “Code of Conduct for Sustainable Fisheries in India” is an attempt to put the Code in the Indian context and experience, keeping the framework and substance of the FAO Code (1995) in view, and to bring out expressions which can be contextually understood, appreciated and observed.
- 1.6.2. The Code is addressed to fishing entities whether governmental or non-governmental and all persons concerned with the conservation of fishery resources and management and development of fisheries such as fishers, those engaged in processing and marketing of fish and fishery products and other users of the aquatic environment in relation to fisheries.

## **2. CONSERVATION AND MANAGEMENT OF FISHERIES**

### **2.1 Principle**

The overriding principle of fisheries management shall be long-term sustainable use of fisheries resources with due respect to their biological characteristics and ecological requirements. Management in relation to natural resources involves conservation, sustainable use and equitable sharing of benefits.

### **2.2 Basic Approach to Management**

For sustainable management of fisheries, the basic step shall be problem identification with reference to the resources, ecosystem and stakeholders. Geographically the problems may be local, State level or National. Management approaches may consider the outcome of careful identification of problems and their prioritisation and arriving at the best

possible solution options for management actions, involving the stakeholders, community leaders, social and environmental scientists, besides fisheries experts and administrators in the process. Policy support for management actions may be provided.

### **2.3 Public Awareness**

Public awareness, particularly awareness among the stakeholders, on the imperative of conservation and management for ensuring sustainable benefits from the resources which are, though renewable, not infinite will be an important step. The Government agencies, NGOs, Fishermen/Women Associations, Corporations and Co-operatives may constantly endeavour to create and sustain publicity and awareness programmes.

### **2.4 Regulations**

Exploitation of common property resources with open access and unrestricted entry creates problems in fishery management. It leads to over capacitation of fishing vessels and effort, reduction in catch per unit effort, diminishing economic returns and conflicts between and within sectors. While the Marine Fishing Regulation Acts of the States have addressed some of the issues and demarcated zones of operations, there are still unresolved problems and disputes. For ensuring sustainable fisheries, further regulations as may be required will have to be considered.

### **2.5 Rationalisation of Fishing Capacity with Sustainable Yield**

There is need to assess effective fishing capacity that has been built up over a period of time in the artisanal, mechanised and industrial sectors. Based on their access to the resources and fishing efficacy and estimated sustainable yields, a rational approach to match the fishing capacity with maximum sustainable yields of target species/groups, may be considered. The effect of rationalisation may be continuously monitored for fish stock improvement, production, yield rates and average size of fish caught.

### **2.6 Impact of Rationalisation on Fishermen**

Rationalisation of fishing effort may result in surplus inventory of fishing crafts and gear. These may be redeployed in regions/on resources wherever possible and removed in a rational and phased manner. Where fishermen's livelihood security will be affected in this process alternative sustainable livelihood options should be provided with adequate support.

### **2.7 Resource-friendly Fishing**

This would involve measures to avoid destructive fishing and wasting of resources by capture of berried females of lobsters, crabs and other such crustaceans and capture of juveniles of fishes, e.g. sardines, mackerel, pomfrets, seefish and cephalopods. In the case of berried animals facilities should be provided for hatching of the berry and for sea ranching of the larvae. In the case of juveniles of fishes mesh size of the net should be regulated so as to allow them to escape.

### **2.8 Ecofriendly Fishing**

Environment friendly fishing techniques may be encouraged from among the existing ones and innovations towards the same may be developed and promoted with incentives wherever necessary.



## **2.9 Non-target Species**

Capture of non-target species as by-catch should be avoided through use of selective fishing gear and special devices wherever practicable. While problems in its implementation in a multiple species fishery are to be encountered, the by-catch should not be allowed to be wasted and should be arranged to be landed for appropriate use.

## **2.10 Endangered Species and Critical Ecosystems**

Capture of endangered species should not be carried out and where accidentally caught should be returned alive to the sea. Legal provisions will apply. The survival of ecosystems such as mangroves, seagrass beds and coral reefs has become critical due to indiscriminate and heavy exploitation. These ecosystems should be protected and helped to re-establish by possible measures.

## **2.11 Breeding and Nursery Grounds**

Breeding and nursery grounds and peak spawning seasons for the most important species of fish may be determined with the best available scientific information. Closure of such grounds in such seasons for fishing is a fundamental concept in fisheries conservation and management and should be followed by enlisting the co-operation of the stakeholders. Some of the practices already in vogue in certain fisheries should be encouraged and promoted further.

## **2.12 Conservation of Biodiversity**

Biodiversity includes the diverse biological resources in variety and in number that live in harmony with physico-chemical resources of an eco-system. Micro organisms to mammals have their relevance and usefulness in this synergetic, integrated and balanced relationship on a sustainable basis. Human beings are external to this relationship. The marine biodiversity forms the capital asset supporting the livelihood security of the fishing community. It is, therefore, very important to maintain the sustainability of biodiversity, causing no irreversible changes. It is Nature's gift that should be passed endlessly on to future generations.

## **2.13 Resource Enhancement**

Enhancement of fishery resources has become an accepted approach in fisheries management. This can be done through laying artificial reefs in suitable areas of coastal waters and by ranching of hatchery produced seed of selected species of fish and shellfish in natural water bodies. Culture-based capture fisheries should be promoted in appropriate locations and monitored for production enhancement.

## **2.14 Ecosystem Management**

For fisheries environment management, scientific data on environmental impacts of human activities as also self-generated impact of certain types of fisheries such as bottom-trawling will need to be assessed and corrective steps taken where required.. The ecosystems provide valuable services which are invisible such as maintaining environmental health and the basic food chain systems to support the resources exploited, and necessary steps should be taken to ensure sustainability of the services. Remote-sensing integrated, GIS—based data/information base may be used for monitoring and management of critical coastal habitats. Integrated Coastal Zone Management will be one of the best sustainable

management, conservation and development techniques and realistic and serious planning with stakeholders' participation may be carried out to protect and sustainably utilise the Coastal Ecosystems.

### **2.15 Food and Nutritional Security**

In commercial fishing, market forces dictate the development process, more so by the international market than the domestic market. While it is to be appreciated in respect of foreign exchange earnings, equal attention should also be bestowed on meeting the domestic requirements for strengthening food and nutritional security. Strategic support is required for sustainable enhancement of production, preservation and marketing in the domestic sector.

### **2.16 Fisherman-centred Sustainable Fisheries**

At the bottom line of fisheries development are the fishermen and women. The fisherman may either carry on subsistence/artisanal fishing on his own, or work for a share or a wage in someone else's boat. Some have adopted improved and new technologies with own boats and gear. The governments at the Centre and States/Union Territories have, through the Plan programmes, implemented a number of welfare programmes for fishermen. In a voluntary code, his understanding and willing participation and co-operation will be the cutting edge in working towards sustainable fisheries and this should be ensured through appropriate techno-socio-economic approach. It is also necessary to involve resource users and other stakeholders in self-help mechanisms for community based management.

### **2.17 Livelihood Security**

Fishermen/women engaged in subsistence, small scale and artisanal fisheries and those engaged as fishing labour, by and large, live below the poverty line. Seasonality of fishing deprives them of their day-to-day earnings during the lean season. There are migratory fishermen who shift from place to place and they live in thatched huts on the beach. They do not know any other occupations. Fisheries management programmes should have built-in approaches to ensure their livelihood security. Empowerment with appropriate technical skills and logistic support in alternative/additional livelihood options should be provided. Ecovillages with ecotechnology jobs should be created. There are non-fishing communities in the coastal belt who are similarly placed as fishermen. They should also be considered as stakeholders in regard to coastal marine ecosystems and provided opportunities for enhancing livelihood security.

### **2.18 Solving Conflicts**

Fishermen should be encouraged more and more to settle fishery conflicts and disputes of a local nature by themselves by evolving a code of conduct, Such an approach produces lasting solutions.

### **2.19 Aquaculture . Alternative/Additional Options**

It would be ideal to inform, educate and train fishermen and women in alternative/additional employment and production options that are available in aquaculture which are economically viable and environment-friendly. The effort should be supported with an institutional framework for technology and input sourcing including financial arrangement.

## **2.20 Database**

Fishermen should be trained and encouraged in recording as far as possible and furnishing catch and related data on their fishing trips/voyages to an authorised person/ official at the village/panchayat/fisheries office as reliable statistics are an essential prerequisite in fisheries management. Similarly, the authority should disseminate relevant information to the fishermen in a manner that they can appreciate and use it for their benefit.

## **2.21 Research**

In multispecies tropical fisheries, especially coastal fisheries, management options impose certain limits and would need finer resolutions of a great deal of quality scientific data to enable formulation of conservation and management measures. Research efforts may be further strengthened to obtain the best scientific evidence to formulate management policies. Remote Sensing based forecasting may be further strengthened.

## **2.22 Participatory Research**

More of participatory research/investigations between scientists, extension workers and fishermen should be encouraged and appropriately supported. This can provide information which may lead to bottom-up planning for sustainable fisheries.

## **2.23 EEZ Resources**

With regard to resources in the offshore, deep sea and oceanic regions of the Exclusive Economic Zone which are presently under-exploited/unexploited, conservation and management measures for some of the resources specifically shrimps and deep-sea lobsters for which resources data are available are immediately necessary. For other resources such as deep-sea fishes, mesopelagics and migratory oceanic tunas and tuna-like fishes in the Exclusive Economic Zone for which some exploratory survey data are available but commercial fishing of any significance is yet to start from the Indian side, appropriate conservation and management measures will have to be formulated after acquiring the best scientific evidence.

# **3. AQUACULTURE DEVELOPMENT AND MANAGEMENT**

## **3.1 Imperative of Aquaculture**

It has been realised at the global level that aquaculture or farming of aquatic organisms is the only way of increasing production of fish/shell fish/aquatic plants to bridge the growing gap between demand and supply in the context of stagnation in production from capture fisheries. There is no gainsaying the fact that India is in the same situation and should continue to accord high priority to sustainable aquaculture development.

## **3.2 Existing Guidelines**

India has formulated certain measures for proper development of aquaculture. These are contained in the Government of India “Guidelines for Sustainable Development and Management of Brackishwater Aquaculture” (1995), Tamil Nadu Aquaculture (Regulation) Act 1995 and also provisions in the Coastal Regulation Zone (1991) Notification of Government of India, under the Environment (Protection) Act.

### **3.3 Aquaculture Zones**

After careful cross-sectoral and inter-disciplinary analysis and assessment, areas and locations predominantly suitable for aquaculture may be declared as aquaculture zones. Coastal areas which are already salinised and areas which are agriculturally unproductive or only marginally productive may be included in this zone.

### **3.4 Aquaculture Exclusion Zones**

Similarly, Aquaculture Exclusion Zones in areas of ecological, biological and cultural significance may be identified and notified.

### **3.5 Beneficiaries**

Aquaculture may be promoted primarily in favour of fishermen and fish farmers, rural communities, Small Farmers Aquaculture Estates, Women's Development Corporations, and producers organisations. Reaching the unreached and including the excluded should be the major approach in organising aquaculture enterprises.

### **3.6 Industrial Aquaculture**

Industrial aquaculture enterprises may be supported on a selective basis based on social commitment, productivity, zero-pollution and other benign qualifications.

### **3.7 Environment Assessment and Monitoring**

Effective procedures for environmental assessment and monitoring and aquaculture-specific effluent discharge standards may be formulated and implemented with the aim of minimising ecological and related economic and social consequences.

### **3.8 Diversification**

Diversification of aquaculture with rotation of crops and polyculture practices aimed at synergetic use of resources and ecological balancing may be encouraged.

### **3.9 Genetic Diversity and Ecosystem Integrity**

Fish breeders and farmers may adopt practices which do not erode the genetic diversity, do not adversely affect natural populations in the wild and do not impact ecosystem integrity.

### **3.10 Introduction and Transfer of Exotic Species**

Introduction and transfers of exotic species and live material should not generally be allowed save in exceptional cases with the approval of a National Committee and where Codes of Practices and Procedures for Introduction and Transfer of Aquatic Organisms could be followed. Quarantine procedures, facilities and control mechanisms may be established for the purpose. Such Codes may also be followed within the country where species, breeders and seed materials are to be transferred from one ecological region to another.

### **3.11 Genetically Altered Stocks**

The ethics of genetic alteration of fish stock should be carefully evaluated. Effects of genetically altered stocks in aquaculture and culture-based fisheries may be monitored and minimised.

### **3.12 Co-operative Action by Farmers**

Co-operative action in use of water resources for drawal and discharge is to be ensured in the interest of the farmers and environmental considerations. This is particularly important during disease outbreaks in the farmed stocks.

### **3.13 Judicious Use of Water Resources**

Land-based aquaculture would face constraints of water resources in quantity and quality and therefore water should be treated as a precious resource and used most judiciously. Wherever possible treatment and re-use of water may be resorted to. Sustainable water budgets may be worked out for different types of production systems.

### **3.14 Seed Certification**

Seed Certification procedures may be evolved so that farmers use robust pathogen-free seed for stocking to minimise risks of disease outbreaks in the growout systems.

### **3.15 Aquaculture Feeds**

Feed quality and use of excess feeds are often held responsible for waste loading of nutrients and organic matter in the ponds. Feed additives for growth promotion and disease resistance would also reach the environment through uneaten feed. Intensive research on nutritional requirements of candidate species, selection of raw materials, feed additives, feed processing and field trials may be encouraged to minimise environmental problems attributed to aquaculture feeds as also to economise on cost of production. The farmers should be educated and trained in proper selection and use of ecofriendly feeds.

### **3.16 Use of Fertilisers, Drugs and Chemicals**

Use of manure, fertilisers, drugs and chemicals and therapeutants including antibiotics in some cases are often held responsible for some of the environmental impacts and also as potential human health hazard. These are used largely empirically for promoting natural productivity, maintaining water and soil quality and for treating aquatic disease problems in some cases. Collaborative research effort on these materials and their efficacy as suited to aquaculture situations is necessary to bring out aquaculture-specific materials and grades. Marketing of such drugs and chemicals for aquaculture purposes should be certified and regulated. Prophylactic use of antibiotics in aquaculture should be prohibited. Formulation of sound and effective regulatory instruments on the production, distribution and use of chemicals and drugs for aquaculture use is necessary. Aquaculture farmers should be educated and trained in proper and effective use of these inputs.

### **3.17 Effluent Treatment and Solid Waste Disposal**

A great deal of responsibility rests with the aquaculture farmers in proper disposal of waste water and pond sediments in a manner that there will be no environmental consequences. Cost effective and technically sound effluent treatment facilities in individual holdings, or common facilities for small farmers should be provided. Pond sludge and sediments should not be disposed off into water ways. These may be treated and stacked within the farm area for possible use as soil subsequently.

### **3.18 Coastal Farms**

Sea-based coastal aquaculture activities may also ensure that they cause minimal sedimentation in the farming areas. Siting of open-sea farms should also proceed after environmental impact and carrying capacity assessment.

### **3.19 Appropriate Siting and Responsible Practices**

Social and ecological consequences of aquaculture can be reduced to the minimum and acceptable levels by proper siting, appropriate farm plan and construction and responsible practices. Overcrowding of farms in any given area will lead to disastrous consequences for the enterprise itself besides its potential for negative ecological consequences.

### **3.20 Assessment of Carrying Capacity**

Carrying capacity of the environment should be assessed and extent of farms to be permitted should be within the capacity limits taking also into account the types of farming and management practices proposed to be adopted.

### **3.21 Social and Environmental Sustainability**

Social sustainability of aquaculture should be ensured by respecting the traditional customs and livelihood rights of local people and reducing to acceptable levels social consequences resulting from extraction of ground water, land use, discharge of effluents and use of drugs and chemicals. Besides it is of utmost importance to specifically protect access to fishing grounds, drinking water security and crop security of adjoining areas. This would preclude use of underground sweet water for use in coastal aquaculture farms and include steps to prevent salination of agricultural land.

### **3.22 Soil Integrity**

Ecological security would also include soil integrity. Soils in aquaculture farms should not be allowed to become irredeemably degraded. Top soil of aquaculture farms should be stored for eco-restoration purposes when needed.

### **3.23 Product Quality and Food Safety**

Aquaculture industry should ensure food safety of the products through adequate sanitary and phytosanitary measures and enhancement of value by maintaining product quality to international standards.

### **3.24 Low External Input Sustainable Aquaculture (LEISA)**

Aquaculture merits unequivocally the status of a premier food producing sector. How it is practised for achieving long-term sustainability is important. Learning lessons from agriculture, integrated technological packages for Low External Input Sustainable Aquaculture (LEISA) will have to be developed and promoted. LEISA should attempt to substitute chemical inputs with biological inputs and should aim at semi-intensive culture practices. It is also essential that economic profitability is integrated with equity and environmental and social sustainability.

### **3.25 Local Association for Sustainable Fisheries and Aquaculture**

Fisheries development is being looked after by a hierarchical system of administration which executes the policies and programmes of the government. Resource management and conservation with the participation of fishermen/fish farmers has not taken roots yet. For achieving the goals of sustainable fisheries, Association for Sustainable Fisheries and Aquaculture with representation from the fisherfolk, other stakeholders, panchayat, scientific community, fishing industry, fish trade and fisheries administration may be formed at the local level for each village or group of villages.

### **3.26 Integrated and Sustainable Coastal Area Development**

Sustainable aquaculture is one of the most productive uses of land and water resources. Aquaculture faces many challenges from other competing uses of the physical resources and those of environmental concerns. If practised and managed in an appropriate and responsible manner, aquaculture can be a self-cleaning industry. A voluntary Code of Conduct is essential to achieve such a status. Basically aquaculture should be integrated and harmonized with the overall development and management plans for the ecosystems. To promote integrated sustainable coastal area development pilot projects to demonstrate harmonious and mutually beneficial development of agriculture, agroforestry, animal husbandry, aquaculture, coastal tourism and other compatible activities may be considered to be set up with State support, one in each State. This will serve as the ultimate model for Integrated Coastal Zone Management.

### **3.27 Public Policy**

Aquaculture has potential for ensuring the food and nutritional security of the growing population of the country, for accelerating socio-economic development of the under-privileged sections of fishermen and fish farmers, for generating opportunities of direct and indirect employment in the rural sector and for augmenting the export earnings. Appropriate public policy, legal and institutional framework conducive for sustainable development and management of aquaculture may be formulated, adopted and implemented.