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# The need for Environment-Development Interface in Shrimp Farming

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## 1. Introduction

Historically, shrimp farming in India was carried out in coastal areas, making use of the low lying areas and tidal flows utilising the naturally available seed resources. During off season (inter-monsoon period) for paddy cultivation, the same fields are utilized to grow trapped in shrimp and fishes for a short period. Rest of the time (monsoon period) paddy is grown. Thus a sort of rotation of shrimp/fish and paddy cultivation has been developed, especially in Kerala. Similar or slightly altered methods were in vogue in West Bengal and Karnataka. With advancements in science and increase in demand for shrimp, the traditional and less productive methods yielded to modern, sophisticated and highly productive methods of shrimp farming which have lead to degradation of environment and triggered socio-economic problems.

Due to rapid development during the past decade, in an unorganised, uncontrolled and unscientific manner, the shrimp farming industry now portrays a gloomy picture for the future. However, it was actively encouraged and production subsidised by the Govt. of India, State Govts. and international bodies like the World Bank, for increasing exports. The protagonists of the industry publicised the meagre increases in production and

export earnings but paid little attention to the brewing socio-economic unrest and the rapid environmental degradation. According to a U.N. report, in 1993, farm raised shrimp accounted for 610,000 whereas wild caught shrimp was 2000,000 in world production, indicating that aquaculture production is not significant.

Subsidies given to the industry are in the form of soft loans, tax holidays, tariff relaxation of imports are made available to the corporations who entered this industry because of the high profit potential. In their rush to garner profits, Govt. have also become party to violations of national land and environmental laws. The fast development of the industry is encouraged by the increasing demand from high income countries with the result that the average production of about 100 Kg/ha in the traditional method increased to 1000 Kg/ha/crop in the semi-intensive and 2000 to 10,000 Kg/ha/crop in the intensive systems. This achievement is not without consequences of social and environmental problems. These are attributed to the loss of land, water and forest wealth compromised for the expanding shrimp industry. Local food and employment generation regressed on account of pollution and degradation of natural resources.

With the multinationals jumping into commercial aquafarming, the survival of coastal ecosystems and the livelihood of people along the coast are stated to be in jeopardy. After the liberalisation process was initiated, aquaculture industry has been getting tremendous boost. Many of the corporate entrepreneurs have gone in for shrimp farming in the coastal areas of Tamil Nadu, Andhra Pradesh, Orissa, Goa, Maharashtra and Gujarat. Many schemes have been sanctioned by the banking system with or without refinance assistance from NABARD. In addition, term lending institutions like IDBI, ICICI, SCICI etc. have also financed these farms in some states.

When the situation has reached alarming proportions, the Supreme Court of India intervened and put a halt to the unregulated growth of the industry and gave several guidelines to be implemented by the State Govts. and the Central Govt. The industry and the Govts. sought a review of the order. In the meanwhile, the Govt. of India introduced an Aquaculture Authority Bill in the Rajya Sabha and got it passed with a view to regulate the development. It is yet to be passed by the Lok Sabha.

In this paper, the two sides of economic development and environment with regard to shrimp farming are reviewed, providing guidelines for a pragmatic and practical approach to shrimp farming in India.

## **2. Present Status of Shrimp Farming**

As of to-day, six methods, of shrimp farming viz., traditional, improved traditional, extensive, modified extensive, semi-intensive and intensive, are in vogue.

The traditional method, practised essentially in Kerala, West Bengal, Karnataka and Goa depends on tidal flow, autostocking, no supplementary feeding and alternating paddy and shrimp/fish crops in 2-200 ha areas. The improved traditional method involves selective stocking and supplementary feeding in ponds 2-5 ha, tidally fed. Extensive method is used in tidal ponds 1-2 ha with natural feeds consisting of clams, snail and artificial feeds. Stocking density is about 20,000/ha. In the modified extensive method, ponds are fertilized and filled in by pumping with provision for water exchange. Formulated feeds are used. Stocking density is 50,000/ha. The semi-intensive method involves preparation of 0.25-4.0 ha ponds, with fertilization, water exchange and usage of aerators, high energy feeds, drugs and chemicals and a stocking density of 15-25/m<sup>2</sup>.

In the intensive method, ponds 0.25-5.0 ha with all the other requirements as in the semi-intensive method are used with, better water exchange, drainage and removal of sludge, stocking density is 20-35/m<sup>2</sup>.

The traditional method of shrimp culture is essentially a small scale agriculture oriented activity, dependent on natural environmental conditions, tidal flow and no external inputs of feed or fertilizers. The industrial aquaculture, on the other hand is purely artificial, large scale, with heavy inputs of feed, fertilizers, other chemicals and drugs, pumping and aeration of water and intensive stocking. During the last decade, several private companies, multinational and transnational bodies entered shrimp farming and invested heavily because of the quick and high returns adopting semi-intensive and intensive methods. While they reaped lucrative harvests for a few years in the beginning, the unscientific methods adopted became an easy prey for devastation by disease in two successive years in 1994 and 1995. This drove many large entrepreneurs helter skelter to find solutions where there are none except to rationalise the operations and adopt scientific methods and professional management. With an apparent lull for about two years facing socio-economic, environmental and legal problems, the industry at present is limping with the disease still lingering in pockets. The average production in small holdings now stabilised at 500-800 Kg/ha/crop.

Traditional aquaculture is part of farming and agriculture carried out by

small farmers on a small scale. Semi-intensive and intensive aquaculture is an industry that is corporate controlled and driven. The multinational corporations controlled the feed industry, the hatcheries, processing plants and the trade. They also used small farmers to produce shrimp by providing the inputs and buying back the produce. Thus, the small farmers are integrated into the industrial system by wooing.

The prominent players in industrial aquaculture are ITC, HLL, Charoen Pokphand of Thailand, Gold Coin Allied Seafood of Singapore, Higa Slu Marn Daichi, Mitsubishi of Japan, Brooke Bond Lipton, Inotec International of France, President Enterprises and Hanaquo of Taiwan.

There was practically no control either in land acquisition (alleged to have been abetted by influential politicians), constructions, investment, displacement of people, environmental damage, conversion of agricultural land, destruction of mangroves, plantations and coastal vegetation, use of chemicals, drugs and antibiotics, indiscriminate discharge of effluents from farms, excavations, fencing, laying of pipelines, use of electrical energy and fuel. All this happened because money has the required power. However, a very important drawback in this development has been the management of the industry by business administrators, personnel managers and chartered accountants except that they recruited a few highly qualified young scientists at lower rungs to work more like labourers. It is not realised that live shrimp cannot be treated as inanimate objects.

Some attempts have been made by the States to regulate the uncontrolled development. The Govt. of Andhra Pradesh issued twenty point guidelines on ad-hoc basis for management of aquaculture in Nellore district but they have not been found mandatory for the whole state. The guidelines do not cover all socio-economic and ecological aspects of coastal habitats. The Tamil Nadu Govt. enacted a Bill for regulation of coastal aquaculture but it was found not in consonance with the notification of the Ministry of Environment and Forests as it permits the establishment of aquaculture units within the 500 m limit at High Tide Level (HTL). The Goa Govt. enacted a Bill to regulate shrimp farming in the state, but as in Tamil Nadu, it conflicts with the notification of the Ministry of Environment and Forests in respect of the 500 m limit at HTL. Based on the guidelines issued by the Ministry of Agriculture recently, the Govt. of Maharashtra prepared a draft legislation and the Govt. of West Bengal issued guidelines. However, the Kerala, Karnataka, and Gujarat Govts. have not yet formulated any guidelines for regulation of aquaculture.

### **3. Shrimp Farming Development along the Coast**

The development of aquaculture along the east and west coasts is somewhat different. The pace of development along the east coast was much faster and mostly of the industrial type. Vast stretches of coastal land was found suitable and was rapidly acquired. Many private companies concentrated along this coast and clustered around. On the contrary, shrimp farming activity along the west coast was mostly traditional and extensive type. Limited number of commercial farms of more than 5 ha are engaged in semi-intensive culture. However, the farms along both sides of the coast have caused innumerable socio-economic, environmental and legal problems.

Along the east coast, some farms are located on the creeks which conflicts with Coastal Regulation Zone (CRZ) regulations, by coming within the 500 m zone at High Tide Level (HTL). No waste water/sediment treatment facilities exist at many farms. Designs of the farms were found defective. Seepage was observed from the bunds and ground water in the vicinity of the farms because saline. Agricultural land, traditional fish farms casuarina plantations and mangrove areas were converted to shrimp farms. Wild shrimp seed are collected along with other shrimp/fish seed which are destroyed. Natural saline canals are obstructed. Access to sea for fishermen was closed. villages came under threat of floods and salinisation of soil and ground water. Intake and discharge points of water for the farms were located close together, causing heavy pollution of water in the vicinity and spread of human diseases. Proper peripheral drainage facilities were not created. Bird sanctuaries have been affected and encroachment in national park area was observed. Denial of job opportunities and reduction of grazing ground was also noticed. Hatcheries are located within 500 m of HTL, which has been permitted.

Along the west coast also, most of the farms have created similar problems as those along the east coast. However, a number of brackish water aquaculture units which have been located along the estuaries and river banks have not caused any significant adverse impact on environment, though some are located within the 500 m of HTL. Farms in Goa have not reached that level of contamination due to the availability of abundant brackish water and limited number of farms. There could be a future clash with tourism development. The highly ecosensitive coral reefs near the coast in Gujarat can be endangered if large commercial shrimp farms are located in the salt pan areas.

#### 4. Present trends in Cultured Shrimp Production

According to a latest MPEDA report, the outlook from the country's shrimp farms during 1996-'97 remained at the same level as the previous year even as the prospects for the sector are bleak because of problems on the legal front. The decline in production during 1995-'96 was due to the viral disease. It was kept at the same level in 1996-97 due to legal problems curbing setting up of new farms. Andhra Pradesh continued to be the top producer among the states. There was continued decline in production in the traditional shrimp farming states like Kerala and West Bengal. It was estimated that in 1995-'96, there was a loss of 1,500 t in West Bengal, 3,000 t in Kerala and 20,000 t in Andhra Pradesh and Tamil Nadu due to outbreak of disease. Observance of crop holiday in 1995-96 due to outbreak of viral disease in the farms lead to a drop in production in the main growing areas.

The details of area (hectares) under shrimp farming and production (tonnes) in different States during the years 1995-'96 and 1996-'97 are given below:

| State/area/production |            | 1995-'96 | 1996-'97 |
|-----------------------|------------|----------|----------|
| (1)                   |            | (2)      | (3)      |
| West Bengal           | Area       | 34,660   | 42,605   |
|                       | Production | 23,445   | 19,949   |
| Orissa                | Area       | —        | —        |
|                       | Production | 6,000    | 6,805    |
| Andhra Pradesh        | Area       | 50,000   | 60,249   |
|                       | Production | 27,140   | 30,577   |
| Tamil Nadu            | Area       | 2,879    | 640      |
|                       | Production | —        | 1,129    |
| Kerala                | Area       | 14,658   | 14,658   |
|                       | Production | 9,000    | 8,225    |
| Karnataka             | Area       | 3,500    | 3,500    |
|                       | Production | —        | 2,300    |
| Goa                   | Area       | —        | —        |
|                       | Production | —        | 580      |
| Maharashtra           | Area       | —        | —        |
|                       | Production | 740      | 523      |
| Gujarat               | Area       | —        | —        |
|                       | Production | —        | 572      |
| Total                 | Area       | 1,19,000 | 1,36,000 |
|                       | Production | 70,573   | 70,686   |

\* Not from the entire area due to viral disease. Source: MPEDA report

## **5. Experience of other Countries**

Shrimp production varies widely from year to year and place to place. Till 1988 Taiwan was the world's largest producer. However, a major disease outbreak in 1988 led to the collapse of the industry which was not yet recovered. China then led world production till 1993 when its production declined for the same reason. Today Thailand is the world's largest producer of shrimp. In India though farming activities are on a low key in certain areas, there are yet no signs of full revival on account of the disease persisting. This was compounded by extensive pollution of water, environmental degradation and socio-economic conflicts. Commercial shrimp farming failed mainly due to these reasons.

In spite of high productivity and the profits that accrue to the industry, shrimp farming has not proliferated in the U.S. or in any other industrialised country. Instead, U.S. investment and involvement in aquaculture has grown in countries like Mexico and Ecuador. Western hemisphere accounts for less than 25 per cent of the world shrimp production. This indicates that the environmental destruction caused by intensive shrimp farming is one of the major factors for its spread in the Third World countries, even though the main consumers of shrimp in the world are in affluent countries. In India, the damage caused to ecology and economics by aquaculture was estimated to be higher than the earnings from the sale of coastal aquaculture produce. That may be the reason for the European and American countries for not permitting their sea coasts to be exploited for shrimp farming.

## **6. Environmental Impact**

The impact of shrimp culture on the environment depends on the type of culture adopted. While the traditional or extensive methods employed up to about the year 1990 have had no adverse effect on the environment, the semi-intensive and intensive methods have posed serious threats to the environment and the fragile coastal ecology. The following major consequences have resulted from large scale shrimp farming in the country.

### **6.1. Pollution**

The untreated effluents discharged from shrimp farms directly or indirectly have polluted coastal waters, estuaries, creeks and back waters. Residual chemicals, drugs, antibiotics, decomposed and unused artificial feeds contributed to the toxic nature of the effluents. At present about 78,000 t of



artificial feeds are used in aquaculture but all that is not utilised by shrimp. The chemical reactions cause hypereutrophication developing massive algal blooms and reduction of oxygen, over accumulation of detritus at pond bottom and poor quality of water leads to profusion of ciliates and other protozoans which cause respiratory and gill diseases in shrimp. Discharge of effluents in the vicinity of the farms releases high levels of nutrients and solids contaminating the aquatic environment and was reported to have caused itching, scabies and fever in human beings. Due to pollution of mud flats of Pulicat lake, flamingoes and other birds deserted the area. It was estimated that about 2.37 million cubic meters per day of effluents are generated from aquaculture farms along the east coast. Andhra Pradesh has a lion's share of 2.12 million cubic meters per day. Often, solid wastes are dumped in the open or filled in land. Sediments, suspended solids and dissolved nutrients discharged from ponds affected the marine environment.

## **6.2. Destruction of Mangroves**

Due to expanding shrimp culture, large areas covered by mangroves have been reported to have been destroyed. The loss of mangroves has ecological, economic and social impacts. Their removal has implications on the sustainability of several coastal activities. The major effects are coastal erosion, changes in pattern of sedimentation, and shore line configuration making coastal areas more vulnerable to storm damage, salinity intrusion, loss of breeding and nursery grounds of fishes and crustaceans, decline in the availability of shrimp and fish post-larvae, decline in fish catches of traditional fishermen, reduction in recruitment to sea fisheries, decrease in yields of traditional shrimp ponds, change in the condition of soil and physico-chemical properties of water, loss of their filtration capacity, reduction in population of animal species (biodiversity) and disturbances in ecological balance.

## **6.3. Impact on Coastal Landuse**

While development of shrimp culture increased the efficiency of utilisation of coastal land (unutilised agricultural land, derelict salt pans, deltaic regions, lake areas, mud flats, traditional shrimp farms, mangrove areas) leading to higher income generation, coastal agricultural land has been extensively converted into shrimp farms leading to salinisation of soil and ground water. Adjacent fertile land became unproductive. Casurina and coconut plantations have been effected. Pond construction accelerated soil erosion. Sediments and silt got washed into coastal waters polluting them

with heavy organic loads. After 5 to 10 years of use, shrimp ponds became useless for shrimp culture or agriculture. Tidal waves and sea water entered coastal areas due to change in land configuration.

#### **6.4. Socio-economic Impact**

Although shrimp farming increased the standard of living, income, land value, job creation and land use efficiency, it created social rest and displaced coastal communities and rural and weaker sections of the people. This is because industrial aquaculture has been in the hands of large private companies to whom the benefits accrued. The promises made by them to improve community development were never realised. At best, some local developments took place in the form of laying roads, and getting power supply, though primarily in their own interest. Having parted with their small cultivable lands, the rural people had no means of sustenance. It is alleged, influential politicians have played their own role to grab the land from local people. Fisherman lost their free access to the sea. Effluents discharged from farms were reported to have caused decline in their catches, the value of average shrimp catch dwindling by 10 times after one year of operations of aquafarms. Capture and destruction of wild seed for farming added to the problem. Drinking water resources in coastal areas decreased and ground water became saline. Due to obstruction of saline canals, flood threats to villages increased.

### **7. Implications of Coastal Regulation Zone (CRZ) Rules and Supreme Court Order**

The ministry of Environment and Forests Govt. of India issued a notification dated February 19, 1991 under clause (d) of subrule (3) of rule (5) of the Environment (Protection) Rules 1986 where it was declared that coastal stretches of seas, bays, estuaries, creeks, rivers and backwaters which are influenced by the tidal action (in the landward side) upto 500 m from the High Tide Line (HTL) and the land between the Low Tide Line (LTL) and the HTL are Coastal Regulation Zone (CRZ). Various restrictions have also been imposed by the Govt. of India in this zone, especially prohibition of any constructions and establishment of industries. However, various expert committees which reviewed the development of shrimp farming in different States found violation of CRZ rules by the shrimp farming industry. Therefore, the Supreme Court, in their order dt. December 12, 1994 directed the States not to permit the setting up of any industry or construction of

any type on the area at least upto 500 m from sea water at the maximum high tide. The States filed their replies to the write petitions, over which the Supreme Court ordered that an expert committee be constituted by the National Environmental Engineering Research Institute (NEERI) to visit the various farms which are being set up in the coastal areas in Andhra Pradesh, Tamil Nadu and Pondicherry and submit a report. On submission of the report, the court also wanted a report for other States. Based on these reports, the court in their order dt. March 9, 1995 directed that no further farms be set up, agricultural land or salt farms be converted for aquaculture, no ground water be drawn for aquaculture, free access to sea for fishermen should be provided and freshwater for drinking should be provided where necessary. The court further directed that all aquaculture farms be informed accordingly and opportunity given for representation, if any, before the matter is finally disposed off.

On Dec. 11, 1996, the Supreme Court passed the land mark judgement, the salient features of which include constitution of an Authority by the Central Govt. to regulate aquacultural activities, strict adherence to CRZ rules, all aquaculture units within CRZ to be demolished by March 31, 1997, affecting several aquacultural farms set up by transnational corporations in an estimated 1,00,000 acres of ecologically fragile land along the 6000 Km long coast line. Permit traditional and improved traditional methods of aquaculture; agricultural lands, salt pans, mangroves, wet lands etc. are not to be used for aquaculture, no aquaculture industry shall be constructed within 1000 m of Chilka lake and Publicat lake (those already within the limit to be destroyed by March 31, 1997 and compliance report submitted by April 15, 1997), aquaculture industry other than the traditional and improved traditional may be constructed outside the CRZ and outside 1000 m of Chilka and Publicat lakes (those already in operation to get authorisation from the Authority before April 30, 1997), aquaculture industry which is hazardous to health and detrimental to fauna and flora shall not be allowed; compensation to be paid to affected people; loss to ecology and environment and compensation to affected people have to be assessed by the Authority, determine the compensation to be paid by the polluters, the Authority to formulate schemes for recovery of ecology, workmen in continuous employment for more than one year be paid compensation and in addition paid six years' wages and gratuity. This compensation should be paid before May 31, 1997. Violation or non-compliance of the orders shall attract the provisions of the Contempt of Courts Act. The industry,

Central Govt. and State Govts., sought a review of the judgement. The Supreme Court extended the date to April 30, 1997. The ruling on the renew petition of the government is yet to be given.

This judgement was meant to save the livelihood of over 100 million people. However it has serious implications for the aquaculture industry. It halts the development process. Exports may stagnate. When farms are closed down, assets are expected to be zero. Entrepreneurs have to pay compensation to affected people. Banking and financial institutions will find it difficult to recover loans. The corporate bodies which have invested lot of money and the financial institutions which have encouraged the development and advanced credit made their own pleas for survival, but the court after critically examining all issues halted the lop sided development which has violated rules and came in conflict with social justice, economic development and environmental protection. The Ministry of Agriculture got an Aquaculture Authority Bill passed by the Rajya Sabha but further action by the Central Govt. and Supreme Court are awaited. While the Bill appears to be a strategy of investors and bankers to protect their capital, the movement of ecologists and others is to protect the coastal ecosystem and livelihood of coastal communities.

## **8. Sustainable Development and Sustainable Shrimp Farming**

The report of the Brundtland Commission 1987 defines sustainable development as "development that meets the needs of the present without compromising the ability of the future generations to meet their own needs".

On this basis, many experts are advocating adopting the concept of sustainable aquaculture basically stressing the need for environment - development interface. Economic development is basically destructive because it involves both depletion and pollution. The principle of sustainable aquaculture should be to organise economic activities so as to promote economic development without unduly depleting the resources or wantonly destroying the environment. Economic development is necessary for reducing poverty and increasing the standard of living but this process is concomitant with the occurrence of unfavourable consequences. Shrimp farming had raised the questions of environmental degradation and its adverse impact on the well being of coastal populations. Indigenous population has suffered the most. Environmental degradation can be stopped only when man does not seek to control nature and instead seek its co-operation. Conducting shrimp farming in a natural, traditional way is a case in point. The

ecological recovery suggested by the Supreme Court is possible through proper utilization of inputs and effective protection through village based social organisation. Community participation in the management of natural resources is an essential aspect of shrimp farming. Therefore, it is necessary to evolve a development process that will lead to greater equity, growth and sustainability.

Besides other salient features of sustainable development in the context of shrimp culture, the Supreme Court felt the precautionary principle and the polluter pays principle are essential features. The precautionary principle provides for prevention of environmental degradation and the polluter pays principle provides for compensation for pollution affected people as well as the cost of reversing the damaged ecology. These two principles are stressed because these are the most important adverse effects of shrimp farming.

## 9. The Future

The future of aquaculture industry appears bleak if the present state of affairs continues. No, doubt, aquaculture development is quite suited for Asian countries, including India, because of the geographic location in the tropics, the vast resources and suitable climate. But the development was unusually rapid and unscientific with utter disregard to the environmental and socio-economic considerations. India being primarily an agricultural country, aquaculture is more suitable to be done on similar lines as agriculture by farmers in small holdings rather than by multinationals and transnationals on an industrial level.

All the evils seem to have originated from large scale pumping of sea water over long distances in coastal areas to interior sites and then discharge untreated effluents from the farms into the nearest creek or canal which would empty out into the sea. In certain cases, the same creek or canal serves as the supply channel. Once this type of usage of sea water for culture is prohibited, most of the problems of pollution, salinisation of land and ground water and shrimp diseases can be effectively controlled. Therefore, shrimp farming on a sustainable basis can be done in brackish water, estuarine, deltaic, river mouth and mangrove regions. Moreover, it is on record, better growth rates and production of shrimp are obtained in brackish water of suitable salinity but not in sea water or diluted sea water. The preferred species is tiger prawn which has shown rapid growth in brackish water. Though the industry needs large quantities of salt wa-

ter and suitable land which they managed to get near the coast that has not proved environmental friendly besides creating other socio-economic problems. Vast brackish water areas are still available in the country for shrimp production. On the other hand, inshore waters have to be used for production of marine organisms like pearl oysters (for pearl production), mussels, sea cucumbers finfish and sea weeds for which technologies have been developed but commercial sea farming not yet undertaken.

Aquaculture and agriculture have similar operations - preparation of ponds (fields), fertilization, stocking (sowing), nursery rearing, growing and harvesting. Shrimp farming is a professional and technical activity, best supervised by qualified scientists. Success cannot be achieved simply by dumping money which has been the main reason for failure. Lessons have not been learnt from experience of other countries. History has been repeated. All remedies suggested and advice invited from experts have not solved the problem. Prevention would have been better than cure, but it is too late. However, the following approach is suggested.

### **10. Pragmatic and Practical Approach to Shrimp-farming**

1. Aquaculture in brackish water areas should be done by farmers, in small holdings, not exceeding 10 ha each. Production is not expected to be high but it will be environment friendly and sustainable.
2. The farms are not to be clustered together so that pollution of environment is avoided.
3. The farms should be located very close to the estuaries, brackish waters, backwaters, lagoons, river mouth areas and deltaic regions to avoid pollution of water, sedimentation, salinisation of soil and water, taking advantage of natural conditions. To this extent, the CRZ rules will have to be modified.
4. 'Agricultural land, mangroves, coconut groves, casuarina plantations should not be converted into aquaculture farms. However, derelict salt pans can be used. No aquaculture should be permitted around salt water lakes.
5. Laying of long distance pipelines for pumping sea water, construction of jetties into the sea, usage of ground water, fencing of farms should be prohibited.
6. Capture of wild seed for shrimp culture should be prohibited.

7. Usage of drugs, chemicals and antibiotics in shrimp farming should be prohibited.
8. The principles of social equality, nutritional security, environmental protection and economic development should be integral to shrimp farming.
9. Species, other than tiger prawn should also be cultured.
10. Farmers have to be educated, trained and technical knowledge imparted to them. Institutions concerned with shrimp farming and extension should be given this responsibility.
11. A total review of shrimp farming at village, district and State level all over the country should be conducted by empowered technical committees for each State and re-organise the present faulty system.
12. Based on the review mentioned above, a long-term plan of action for orderly and sustainable growth of shrimp farming should be drawn. An authority composed of experienced scientists in aquaculture and related fields should monitor and regulate the development.