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Development of Aquaculture in India

Challenges and Opportunities

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CHAPTER 18

Impact of Aquaculture on Environment and Need of Sustainable Practices

B. Chakravarthi and M. Vasantha Lakshmi

Aquaculture provides food security to the people and plays vital role in the economy of the country. Over recent years Aquaculture has led to substantial socio-economic benefits. But on the other side of the coin certain environmental issues have been arising which need attention of farmers, researchers and governments as well. In order to achieve the immediate objective of economic growth, culture practices were aimed at gaining maximum profit over the shortest period of time. Production systems have moved from managing the environment to intensive commercial practices characterized by high stocking densities and feed inputs and excessive mechanization pushing harvests beyond carrying capacities. The discharge of effluents released from Aquaculture is another problem. The coastal zone bears most of the ecological consequences of aquaculture development. These include habitat loss, excessive harvest of wild seed, damage to by catch, introduction of exotic species, escape of cultured species and spread of diseases etc. Coastal aquaculture causes salination of drinking water wells and farm fields and resistance exists against the conversion of farmland for aquaculture. The negative impact of shrimp culture on Mangroves is highly considerable, more than a third of mangrove forests have disappeared in the last two decades globally due to shrimp culture.

In India there is a lack of awareness about long-term sustainability with regard to fisheries and aquaculture. Unsustainable aquaculture will only generate short and medium term profits at the expense of long-term ecological balance and social stability. There are a number of alternatives for sustainable development of aquaculture which include ecological aquaculture, organic aquaculture, composite fish culture, integrated aquaculture and closed recirculatory systems. There is every need to integrate the objectives of economy, society and nature for sustainable development.

Aquaculture not only provides food security but also plays vital role in the economy of the country. India offers a huge potential for aquaculture development with a coastline of 7,517 km and an extensive river and canal system of about 195.210 km, consisting of 14 major rivers, 44 medium rivers and numerous small rivers and streams (de Jong J.2017). Importance of Aquaculture can be recognized by the 11-fold increase that India has achieved from .75 million tons in the year 1950-51 to 9.6 million tons during 2012-13 with an average annual growth rate of 4.5 percent which placed India in the second position globally. Aquaculture over recent years has led to substantial socio-economic benefits such as increased nutritional levels, brought vast un-utilized and under-utilized land and water resources under culture. But on the other side of the coin certain environmental issues have been arising which need attention of farmers, researchers and governments as well.

To achieve the immediate objective of economic growth culture practices were aimed at achieving maximum profit over the shortest period of time. Production systems have moved from managing the environment to intensive commercial practices characterized by high stocking densities and feed inputs, single species cultivation, discharge of effluents and excessive mechanization pushing harvests beyond carrying capacities (William A Wurts 2007). The coastal zone bears most of the ecological consequences of aquaculture development. These include habitat loss, excessive harvest of wild seed, damage to by catch, introduction of exotic species, escape of cultured species, spread of diseases, interactions with wild species, misuse of chemicals and antibiotics etc. In the brackish water sector there were issues of waste generation, conversion of agricultural land, salinization, degradation of soil and the environment due to the extensive use of drugs and chemicals, destruction of mangroves and so on.

Mangrove conversion to shrimp ponds is the single major factor that has contributed to the negative press received by aquaculture. In the Godavari delta area of Andhra Pradesh, India about 14 percent of the aquaculture farms have been constructed on mangrove lands. Shrimp aquaculture is responsible for about 80 percent of the conversion of mangrove land. Shrimp ponds are often located in sparse mangrove forest (Hein LG 2000). Southeast Asia has 35% of the world's 18 million ha of mangrove forests, but has also suffered from the highest rates of mangrove loss e.g., 70–80% in the Philippines and Vietnam for the last 30 years. Around half of the 279,000 ha of Philippine mangroves lost from 1951 to 1988 were developed into culture Ponds; 95% of Philippine brackish water ponds in 1952–1987 were derived from Mangroves. Globally, more than a third of mangrove forests have disappeared in the last two decades, and shrimp culture is the major human activity accounting for 35% of such decline. Thailand is considered to be an extreme example of this problem, as mangrove cover in this country was halved from 1960 to 1996.

Approximately 200,000 ha of mangroves were deforested, with a third of the area being transformed into shrimp farming ponds (Aksornkoae & Tokrisna, 2004). This transformation results in loss of essential ecosystem services generated by mangroves, including the provision of fish and crustacean nurseries, wildlife habitat, coastal protection, flood control, sediment trapping and water treatment. Fish pens and cages also degrade near shore habitats through their physical installations on sea grass beds and sediment communities, or through deposits of uneaten feeds.

Many aquaculture farms in Asia stock wild-caught juveniles rather than hatchery-reared post-larvae derived from wild spawners or brood stock. Collection of such 'seed stock' can have major consequences for wild fisheries in terms of high rates of by catch. In shrimp culture, the favoured species, Penaeus monodon, constitutes a very small proportion of wild juvenile and adult populations. For every fry of P. monodon, up to 330–475 other shrimp fry are caught in Malaysia and the Philippines. Given a yearly collection of one billion P. monodon in Bangladesh, the amount of by catch destroyed is likely to have important consequences for marine food webs.

The greatest number of introductions of exotic fish and crustacean species outside them natural range has occurred for aquaculture purposes. The potential negative effects of such introductions include the degradation of host environment, disruption of the host community, genetic degradation of the host stock, and the introduction of diseases and parasites. Disease risks are particularly acute: almost all of the 20 identified viruses in marine shrimp have been described in cultured animals. Impacts from disease have also been observed in the case of transfers of species within their range. In recent years, Viruses, notably the White Spot Syndrome Virus (WSSV) and Yellow Head Virus, have caused catastrophic multimillion dollar crop losses in shrimp farms across Asia. The origin of the WSSV pandemic has been traced to the import into Japan of infected hatchery produced P. japonicas from Chinese hatcheries in 1993. Since the mid-1990s, the shrimp aquaculture sector has been suffering from the so-called white spot disease, a viral disease that was introduced to India in 1994, most likely with brood stock imported from Southeast Asia (Hein LG 2000).

Pumping large volumes of underground water to achieve brackish water salinity in the1980s to mid-1990s led to the lowering of groundwater levels, emptying of aquifers, land subsidence and salinization of adjacent land and waterways in Southeast Asia. Even when fresh water is no longer pumped from aquifers, the discharge of salt water from shrimp farms located behind mangroves still causes salinization in adjoining rice and other agricultural lands. The development of low salinity shrimp farming in Thailand paved the way for industry expansion into rice paddies and other inland sites.

Though living resources are self-renewable, they have to be utilized rationally on a sustainable basis in harmony with the environment. The rapid expansion of coastal aquaculture has serious environmental and socioeconomic consequences, which include large-scale removal of valuable coastal wetlands, land subsidence, acidification, salinization of groundwater and agricultural land, and subsequent loss of goods and services generated by natural resource systems. Practices that are environmentally non-degrading, technically appropriate, economically viable and socially acceptable should therefore be promoted through integrated planning and management within the framework of coastal area management (Chua TE.1992).

Sustainable development is 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 sustainable development conserves land, water, plant and animal genetic resources.

Aquaculture, in common with all other food production practices, is facing challenges for sustainable development. Most aqua-farmers, like their terrestrial counterparts, are continuously pursuing ways and means of improving their production practices, to make them more efficient and cost-effective. Awareness of potential environmental problems has increased significantly. Efforts are under way to further improve human capacity, resource use and environmental management in aquaculture. COFI emphasized enhancement of inland fish production through integrated aquaculture-agriculture farming systems and integrated utilization of small and medium-size water bodies.

Unsustainable aquaculture will only generate short and medium term profits for multinational corporations at the expense of long-term ecological balance and social stability. An unsustainable aquaculture development could exacerbate the problems and create new ones, damaging our important and already stressed coastal areas. Sustainable development alternatives are needed to ensure that in the future aquaculture can contribute to the growing need for seafood products. The sustainable development includes- "the management and conservation of natural resource base, and the orientation of technological and institutional change in such a manner to ensure the attainment and continued satisfaction for present and future generations. Such developments conserve land, water, plant and genetic resources as well they are environmentally non-degrading, technologically appropriate, economically viable and socially acceptable.

There are a number of alternatives for sustainable development of aquaculture which include ecological aquaculture, organic aquaculture, composite fish culture, integrated aquaculture and closed recirculatory systems. Ecological aquaculture has been defined as- "an alternative model of aquaculture

research and development that brings the technical aspects of ecological principles and ecosystem thinking to aquaculture and concerns for the wider social, economic and environmental context of aquaculture".

There are few main principles of ecological aquaculture:

- To preserve the form and function of natural resources
- To ensure trophic level efficiency
- To use native species so as not to contribute to biological pollution
- To share the practices and information on a global scale
- To ensure that system is integrated into the local economy and community in terms of food production and employment to encourage natural biological cycles in the production of aquatic organisms
- No use of synthetic fertilizer or other chemicals in production
- Use of polyculture technologies whenever possible

Recirculating systems conserve water and allow control of environmental factors,predators and introduction and transfer of diseases. This system has less impact on environment because of their close nature - wastes and uneaten feed are not simply released in the ambient environment. In recirculating system, wastes are filtered out of the culture system and disposed of in a responsible manner.

Ecological aquaculture focuses on the development of farming systems that protect the environments in which they are situated and enhances the quality of these environments while at the same time maintaining a productive culture system. Finally, there is every need to integrate the objectives of economy, society and nature for sustainable development as proclaimed in the Rio Declaration on Environment.

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