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Shrimp Aquaculture: Diseases, Health Management, Exotic Introduction and Regulations

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History of shrimp farming in India

India has vast natural resources suitable for the development of aquaculture in the marine, brackishwater and freshwater environments. A long coast line 8118 km along with 3.5 million ha of estuaries and 3.9 million ha of backwaters, our potential for the development is immense. It is estimated that an area of 1.2 million ha are suitable for the development of brackishwater aquaculture. A major share of this potential area lies in the states of West Bengal (34 per cent) and Gujarat (32 per cent) where they greatly remain under utilized. Andhra Pradesh has been leading the country with its enterprising farmers both in utilization (50 per cent) of the potential land and in quantity produced. The latest estimates places the total brackishwater area developed for aquaculture at 1,90,000 ha with a national average of 16 per cent.

Despite a moderate increase in the total fish production, it is evident from the catch statistics that the marine shrimp landings from our country has stagnated since 2007. Traditional shrimp farming in Kerala (*chemmeen kettu* and *pokkali* fields), West Bengal (*bheris*) and other coastal states has been practiced for centuries and still continued without much interventions in the technological aspects making them a low cost – low profit sustainable production system. Commercial shrimp aquaculture, which was a late starter in front of rest of the world, had its humble beginning in the 80's, as a result of the enthusiasm of enterprising farmers in Andhra Pradesh along with timely interventions from the agencies like MPEDA and CMFRI. The development of hatcheries for seed production of black tiger shrimp (*Penaeus monodon*), the major species used for aquaculture, ensured timely supply of seeds. Consequent to the development of shrimp aquaculture was the development of accessory industries including feeds, additives, drugs, probiotics and equipments. The Indian corporate houses were actively involved in shrimp farming in this early phase of development, possibly following the profitability of the industry in our neighbouring countries like China and Taiwan. The industry showed a steady growth up to 1995 until it was hit by disease problems as well as legal issues leading to the intervention of the Supreme Court of India.

Major diseases problems

Health management has always played an important role in modern shrimp culture. Shrimps have a primitive immune system compared to fishes and are reared in environments where several pathogens are naturally present. The quality of rearing water

has great role in the survival of the shrimps as major fluctuations in water quality may lead the shrimps to physiological stress and thereby increase susceptiblity to pathogenic attacks. Taiwan was the first shrimp farming country to have met with serious setbacks due to health management issues. Consequent to the intensification of farming practices, the incidence of diseases outbreaks also have increased. Diseases of viral etiology are of more significance and have led to huge economic losses in all shrimp farming regions of the world. There are about 20 viral diseases reported from shrimps and the average annual economic losses are in the tune of 1 billion USD. There are no known drugs for viral diseases in shrimp and attempts to develop vaccines have not provided encouraging results.

World Organisation of Animal Health (OIE) has listed 5 viral diseases important for shrimp.

i) **White spot syndrome virus (WSSV)**: It was first detected in north-east Asia in the 1992-93 period and later spread to the rest of the world. It presently reported from most shrimp growing regions of the world. It affects most cultured penaeid shrimps leading to heavy mortalities in 3 to 10 days. Loose cuticle with characteristic white spots and reddish discolouration of the body are common signs of the disease. The virus is transmitted both horizontally and vertically and a large number of crustaceans act as carriers of the virus and aid in transmission. It is the most dreaded disease in the history of shrimp aquaculture affecting all forms of shrimp farming irrespective of the level of intensification and has toppled *Penaeus monodon* from the principal farmed shrimp in the world.

ii) **Infectious hypodermal and haematopoietic necrosis virus (IHHNV) of penaeid shrimps**: First reported in 1981, the virus is widely distributed in the shrimp rowing regions infecting most cultured penaeid shrimps. The infection is commonly called as runt deformity syndrome.

iii) **Taura syndrome virus (TSV)**: Initially reported from the Taura region of Ecuador in 1992, the disease is limited to Americas in native cultured shrimp. It causes severe infection and mortality postlarvae and juvenile *Litopenaeus vannamei*.

iv) **Yellow-head virus (YHV)**: First reported from Thailand in 1990, YHV believed to be present in southeast Asia and Indo-Pacific regions. Principal host of the virus is *P. mondon* and the infected shrimps have characteristic yellowish swollen cephalothorax and hepatopancres.

v) **Infectious myonecrosis virus (IMNV)**: The infected shrimps shows necrosis of skeletal muscle tissue with persistant mortality throughout culture period. It primarily infects *L. vannamei*, but is can cause infections in *P. monodon* also.

Even though not listed by OIE, Monodon baculovirus (MBV) and Hepatopancreatic parvo virus (HPV) are prevalent in the shrimp populations in India. They seldom cause mortalities in the farms, but lead to stunted growth of the shrimps and increase the susceptibility to secondary infections. Bacterial infections caused by Vibrio spp. which are natural inhabitants of our coastal waters also lead to economic losses in shrimp aquaculture.

Better management practices and Biosecurity

Rampant disease outbreaks and economic losses have forced the farmers to adopt better management practices to ensure environmental as well as socio-economic sustainability, health status of the shrimp, food safety of the consumer and profitability of farming operations. It relies on interventions right from identification of farm site, design, seed production, management of water, feed and health of shrimp, food safety and social

responsibility. These are site specific, simple and practical interventions easily adoptable for small scale farmers.

Principles of biosecurity, a set of practices aimed at reducing the probability of disease occurrence and its spread, was also incorporated into the existing culture practice. Other than stocking disease free seeds, to prevent the entry of pathogen into the culture system, all the possible horizontal routes of transmission have to be closed. Disinfection of pond bottom helps in eliminating pathogens persisting in soil. Disease carriers like crabs, contaminated land animals and birds, contaminated feed, utensils, personnel etc. pose a threat to farming. Fencing to prevent entry of crabs, animals and birds is a common management measure resorted to now. Disinfection of water in reservoir ponds couples with the practice of zero water exchange system helps in preventing pathogen entry through water. Tyre-bath, foot-bath and hand wash are provided to avoid contamination from personnel. WTO has also made it mandatory to document health history and disease status of importing and exporting countries.

Introduction of *Litopenaeus vannamei*

In the last decade the aquaculture production of shrimps peaked in 2007 and later in 2009 fell to levels as low as that in 1995. Farmers lost confidence in the sector leading to a consequent decline in the area utilization along with the fall in production. The impacts of quality stipulations, fluctuating prices and antidumping duties slapped on the Indian exporters have together led to a slump in the rate of progress of the shrimp aquaculture industry. This has further increased the risk in operations in addition to decreasing profit margins.

The search for an alternative shrimp species suitable for farming ended with the specific pathogen free (SPF) *Litopenaeus vannamei* (whiteleg shrimp or Pacific white shrimp), a natural inhabitant of eastern Pacific Ocean along the coasts of South America at a temperature of about 20^{o} C. the national committee on introduction of exotic species in Indian waters approved experimental culture operations the species and it was introduced to India for experimental farming and seed production trials on a pilot scale in 2003 under controlled biosecure conditions. The Ministry of Agriculture, GoI constituted a study group for risk analysis of introduction of *L. vannamei* and as per the recommendations, it was decided to allow registered hatcheries and farms with biosecure facilities to import SPF *L. vannamei*. It is decided to have only single point entry for L. vannamei to ensure safety and the broodstock were quarantined at the centralized facility of Rajiv Gandhi Centre for Aquaculture in Chennai before handing over to the importer. Nine broodstock suppliers were selected by the CAA for procurement of SPF *L. vannamei*. Presently 74 hatcheries are permitted to import brood stock and are supplying seeds to CAA approved farms for culture. The inspection team of CAA has approved 468 farms with a water spread area of 3971.46 ha for culture of *L. vannamei*. With an average production of 7.5 t/ha/year the *L. vannamei* production reached 80717 tons in 2011-12. Small scale farmers have adopted to cluster management by forming cooperatives or unifying under self help groups to obtain approval of the CAA for *L. vannamei* farming.

Regulations in shrimp farming

The dynamics of Indian shrimp farming was always controlled by the enthusiasm of the enterprising farmers. Unlike other sectors of food production, shrimp farmers always went ahead of the scientific community in India and welcomed ideas and technology from foreign experts. The need of regulations in the sector was felt in the early 90's itself, and the

supreme court verdict in 1996 in response to a public interest litigation (PIL) banned all forms aquaculture other than traditional farming within the coastal regulation zone (CRZ) and stipulated compulsory registration of all farms from Aquaculture Authority. Under the Environmental Protection Act, 1986 Aquaculture Authority was set up in 1997 to regulate the sector with its head quarters in Chennai. Considering the need for a stronger legislation to safeguard the interest of all the stakeholders of the coastal areas along with preservation of the fragile ecosystem, the Government of India passed the Coastal Aquaculture Authority (CAA) Act, 2005. The authority is empowered by the provisions of the Act, Rules and Guidelines to regulate coastal aquaculture and to ensure sustainable development without damaging the ecosystem.

The authority can make regulations regarding the construction and operation of farms within the coastal area, inspect the farms for ascertaining environmental impacts, register them, can order the demolition of polluting farms, etc. It will be the agency to fix standards in the sector with regard to inputs liks seeds, feed, additives, chemicals and drugs, etc. used in the farm in addition to ensuring protection of both ecologically and socially sensitive areas from being converted to aquafarms. According to the Act, all coastal aquaculture farms should be registered with the authority, usually for a period of 5 years. Construction of new farms within the 200m from the highest high tide limit is prohibited in the coastal regulation zone, however, farms constructed before the enactment of CAA and non-commercial research farms by the agencies of government are permitted to operate. The authority has a District Level Committee and State Level committee to verify applications for registration of the farms which are disposed in a time bound manner. Further, the authority can collect samples from the farms, analyze them, close down facilities for unsustainable practices and recommend for punishment of individuals involved.

The authority issues guidelines for sustainable aquaculture practices. It has prohibited the use of 20 pharmacologically active substances and set residual levels for permitted substances. Management of waste water is another major concern and it is mandatory for farms with more than 5 ha area to install effluent treatment system and the authority has stipulations for different water quality parameters at discharge points in estuarine areas and coastal marine waters. Farms with more than 40 ha area need to conduct Environmental Impact Assessment at the planning stage and should have an Environment Monitoring and Management Plan.

Conclusion

A quantum jump in the production (220,000 mt in 2011-12) of farmed shrimp in the country was achieved by the introduction of L. vannamei. With more farmers falling line for biosecure shrimp farming, the production trend is likely to continue in the near future. The high stocking densities and production has increased the yield in shrimp farming by several times. The fluctuation of price in the international market is likely to fluctuate due to the increase in production. The vast potential for developing a strong domestic market would be the ideal to sustain the industry. The present achievements in quantity has come without much increase in the water spread area for culture, and given the potential for systematic development of shrimp farming in states like Gujarat and West Bengal, the future of aquaculture industry looks bright. However, adherence to principles of biosecurity will remain critical in averting disasters of pathogenic origin.

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