

Trend of aquaculture growth in India as a commercial fish farming enterprise with diversification in cultivable fish species and farming practices



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ABSTRACT

India possesses huge aquatic resources and offers potential for aquacultural development. Fisheries and aquaculture in India have emerged as a commercial fish farming enterprise from a traditional household fisheries activity over the last six decades, meeting domestic demand and exporting shrimps and seafood products in the international market and earning foreign exchange. Aquaculture growth is characterized by diversification in cultivable fish species and development of different farming practices for carps, catfish and shrimps. Availability of high quality feed and seed, composite fish culture of mainly carps and introduction of exotic fish species, technological development, induced fish breeding, integrated fish farming, marketing and trade factors have led to this growth with government support.

1. Introduction

Aquaculture in India has emerged as an important economic sector producing fish crop for domestic consumption, and exporting mainly shrimps, over the last decades, from a traditional fish farming sector as a household activities. Over the last six decades aquaculture has been recognized as of national importance and has shown impressive growth, placing fish farming as an important economic enterprise of livelihood. Until late 1950's, aquaculture was in practice in India as a homestead backyard pond activity producing only carp with the input of seeds procured from rivers. India possesses huge aquatic resource and offers immense potential for aquaculture production having favourable tropical climate. Within six decades since 1950 total fish production including aquaculture production has shown a phenomenal growth in India and India has emerged as the second largest country in the world next to China, producing 9.58 million metric tonnes in 2014 from mere production level of 0.75 million tonnes in 1950-51. Utilization of land and water resources, improvement in farming systems and its diversification with varying levels of inputs and intensity, technological development in breeding and culture practices, introduction

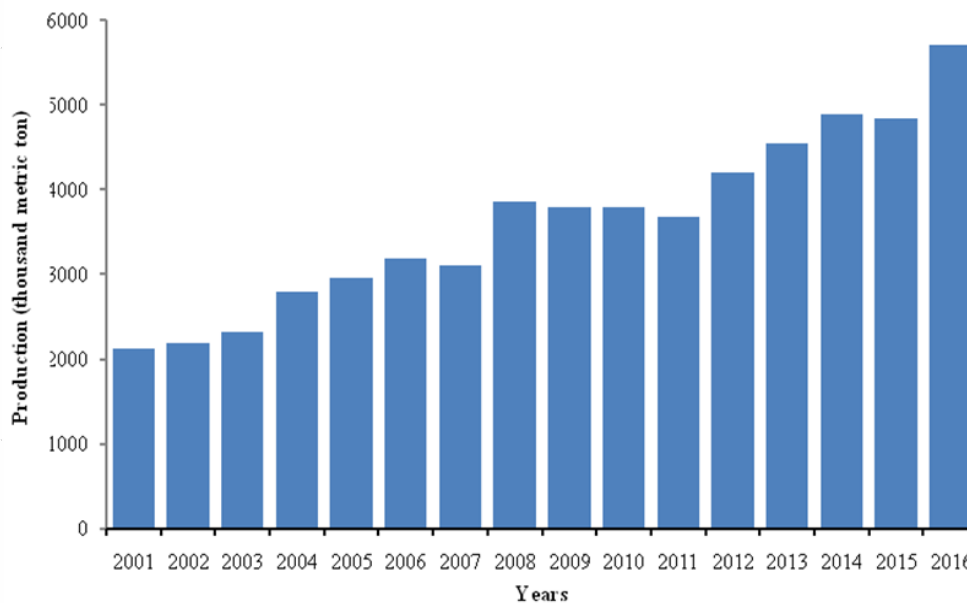
of exotic species, availability of quality seeds and feeds, government supports, efforts of research and development section and extension services from lab to land, all these factors have helped in the progress, supplying valuable protein to consumers and food security.

2. Growth in aquaculture

Aquaculture in India has witnessed both horizontal and vertical expansion over the last six decades with increase in production from 2.12 million metric tonne in 2001 to 5.70 million metric tonne in 2016 (Fig. 1), which is more than double, with an average annual growth rate of more than 4.5 percent over the years.

Indian aquaculture can be basically classified as fresh water aquaculture and brackish water aquaculture and marine aquaculture. Freshwater aquaculture provides more than 95 percent of total aquaculture production with major contributions of carp species and has made more than tenfold increase in production with mean annual growth rate of 6 percent (FAO). Aquaculture is now an important economic and commercial fish farming enterprise, marketing the products of fresh water aquaculture in the domestic market

Fig. 1 Aquaculture fish production in India: 2001 to 2016 (Statista.com/statistics)



and exporting shrimps and freshwater prawn in the international market. With increase in fish production annual per capita consumption of fish in India has increased from 2.85 kg to 9 kg in 2014.

Among the top leading aquaculture producing countries in the world in 2016, India holds the second position next to China, followed by Indonesia, Vietnam, Bangladesh, Egypt, Norway and Chile.

So far as global aquaculture is concerned, Asia-Pacific region holds dominance accounting 88.5 percent of global production (Table 2).(FAO, 2012) where China contributed highest share in total aquaculture production supplying more than 80 percent. The top ten largest fish producing countries in the world in 2018 are China, India, Indonesia, Peru, United states, Chile, Japan, Thailand, Vietnam and Russia (Table 1). China is the leading country in aquaculture production, the runaway leader. Their aquaculture technologies have been borrowed by many countries in world. The approximated

annual production in China stands at 58.8 million metric tons annually. In India it is approximately 9.58 million metric tons annually (2015) (www.dahd.nic.in) annually. Present fresh water fisheries in India are growing faster than marine fishery. With huge aquatic resources, aquaculture in India has registered a phenomenal growth in farmed fish productions such as fin fish, crustaceans, molluscs and other aquatic animals which was 4549607 tonnes in 2013 (FAO) and was 6.4% of worlds total fish production. Nevertheless, it was long way behind China’s production of 45549738 tonne and 10 times lower than China. In China, almost all of aquaculture productions are consumed in domestic market where as India exports shrimps and freshwater prawns and rest of the total fish and fish products are consumed in the domestic market. Japan produces fish mainly for export. North Africa has recently started aquaculture business as a source of livelihood and earning high profit.

Table 1. Aquaculture production in top 10 countries in the world during 1980 to 2014. (www.fao.org/fishery/collection/global-production/en.global; A statistical analysis of China’s fisheries in the 12th five year period. ,https://www.science direct .com)

| Country | Year-wise production (Unit 10 ⁴ t) | | | | | | | |
|-----------|---|---------|---------|---------|---------|---------|---------|---------|
| | 1980 | 1990 | 2000 | 2010 | 2011 | 2012 | 2013 | 2014 |
| China | 445.54 | 1313.68 | 3617.07 | 5214.90 | 5438.99 | 5727.57 | 5982.47 | 6257.55 |
| India | 244.53 | 379.97 | 560.90 | 847.91 | 798.42 | 908.16 | 919.59 | 959.98 |
| Indonesia | 182.73 | 302.24 | 490.36 | 767.83 | 836.64 | 878.66 | 1001.16 | 1069.06 |
| Vietnam | 55.87 | 93.92 | 218.81 | 508.50 | 535.99 | 579.02 | 601.03 | 631.63 |
| US | 370.75 | 587.12 | 517.45 | 488.42 | 551.07 | 551.18 | 556.33 | 540.18 |
| Japan | 1045.17 | 1036.89 | 583.55 | 478.52 | 433.33 | 428.40 | 426.45 | 431.80 |
| Peru | 270.96 | 687.41 | 1066.39 | 439.06 | 834.14 | 492.14 | 598.00 | 368.86 |
| Russia | 0.00 | 760.41 | 404.77 | 419.03 | 438.37 | 447.63 | 450.33 | 438.68 |
| Myanmar | 58.00 | 74.38 | 119.21 | 391.39 | 414.98 | 446.44 | 471.60 | 504.54 |
| Norway | 240.90 | 175.35 | 319.07 | 369.97 | 342.62 | 347.14 | 332.72 | 363.4 |

3. Diversity of aquaculture

Aquaculture in India has turned into a viable commercial farming practice from a traditional household activity over the last three decades with considerable diversification in terms of species and systems and is now growing at an impressive rate of 6 – 7% annually. Aquaculture sector provides over one third of India's total fish production of 9.58 million metric tonnes since 2012-13 to 2015-16.

With this diversified growth in cultivable fish species and development of different systems of production technique depending upon the regional availability of inputs, India now produces of more than 10 percent of global fish diversity (Hand book of fisheries and aquaculture). Bulk of aquaculture production in India consists of carps and shrimps. As a result of awareness to aquaculture sustainability and considering market demand and consumer choice, the farmers at present are concerned with diversification of species, which consumers will be willing to buy with their rise in income. The demand for various types fish in the market tempted the farmers to cultivate different types of fishes including some indigenous fishes of importance from biodiversity point of view. Besides Indian major carps, the fishes cultured are air breathing fish, singhi, magur, climbing perch, murrels, tilapia, giant river prawn, monsoon river prawn, exotic catfish, big head, silver carp, grass carp, etc. In mariculture, the important species and major cultured mussels are the green mussel, Indian brown mussel, Indian backwater oyster, Japanese pearl oyster and seaweed species. Besides these, ornamental fish culture and seaweed farming have become commercially important for providing livelihood as a small scale activity of the farmers.

3.1. Freshwater aquaculture

3.1.1. Trend in production and in structure

Aquatic resources for freshwater aquaculture comprise about 2.36 million ha of ponds, tanks. Besides ponds and tanks freshwater aquaculture is undertaken in lakes, irrigation canals, reservoirs and paddy fields. As reported by FAO 2014, only about 40 percent of these available resources are being utilized in fish production because of technical and market issues. Nearly 60% of resources remain unutilized.

Freshwater aquaculture comprised mainly carp species which alone was responsible for as much as 4.18 million tonnes out of total aquaculture production of 4.43 million tonnes in 2012-1 and exhibited an annual average growth rate of over 6 percent within the period from 1980 to 2010, production increased from 0.37 million tonnes in 1980 to 4.03 million tonnes in 2010, more than tenfold increase. Three Indian major carps namely catla (*Labeo catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*) constitute the bulk of production in freshwater, nearly 70 to 75%, the remaining 25 to 30 percent of production are comprised of silver carp, grass carp, common carp and catfishes. As a larger part of the available area remains unused, there is immense scope of increasing freshwater aquaculture production through expansion of area for culture especially the abandoned mining areas filled with water.

The technological breakthrough through induced breeding of carps through hypophysation in 1957 had revolutionary impact on freshwater aquaculture in India which resulted in significant development in this sector. With standardization of induced breeding technology, improved hatchery systems and composite carp culture with three Indian major carps and three exotic carps including silver and grass carp and common carp laid the basis of carp polyculture system. Carp is the main important species, the second important species are three exotic carps are silver carp, grass carp and common carp. Other type of carp species such as minor carp (*Labeo bata*) for which high regional market demand exists and freshwater aquaculture offers potential to culture but commercial farming of these species has not yet undertaken.

Beginning of composite fish culture and production of carp through induced breeding has made possible of scientific foundation of fish culture in India. Intensity in operation and the coverage area increased thereafter in other states. Andhra Pradesh, Panjab, Haryana, Maharashtra, etc. made investment in fish culture on a commercial scale. West Bengal is leading state in India in fish seed production, whereas Andhra Pradesh is now the leading state in India in carp production. Average productivity increased from 600/kg/ha/yr from still water ponds in 1974 to 2900 kg/ha/yr by 2013-14. The impact of research and development in breeding over the last six decades have made carp farming as an important economic enterprise, making fish farming remunerative and satisfying consumption demand for fish of rising population.

3.1.2. Catfish production

Due to high nutritive value and delicate taste, live fish or catfish has high demand in the market. Freshwater Aquaculture sector is characterized by the features of culturing all varieties of carps, catfishes and freshwater prawns. An obligatory air breathing catfish known as magur is the most preferred indigenous catfish in India. Standardization in its breeding and development in farming techniques had led to growth of catfish culture. Current production rate is 10 ton per hectare, but the target was set to attain 40 to 50 ton per hectare (Jelto). Culture of this fish is carried out on a large scale along the north eastern regions of India, mainly in the state of Assam in cage culture.

Singi, Pangasius and tilapia are some other varieties of catfish cultured in freshwater and also in sewage fed wastewater. Pangasius culture was initially began in West Bengal and Andhra Pradesh, sourcing of which is Thailand through Bangladesh and later on extended to other states. It is a fast growing fish species with commercial importance. The government has set guideline for its production to make it eco- friendly as there is question of environmental sustainability issue with the production technique used in its culture.

3.1.3. Freshwater prawn

Culture of freshwater prawns became attractive with successful breeding and larval rearing of giant river prawn and monsoon river prawn. Production of freshwater prawns

has made production structure of aquaculture more diversified. The main purpose of diversification is for increasing overall fish production level of the country and to increase in market share.

During recent years, freshwater prawn farming sector witnessed impressive growth. Among the cultivable freshwater prawns, the giant river prawn dominated the commercial freshwater prawn farming sector due to its some cultivable attributes and marketing factors such as - i) very fast growth, ii) suitable for joint culture with finfish namely Indian major carps and iii) high market demand both in domestic and international market. The production yield level in monoculture of giant river prawn is about 1.0 - 1.5 tonnes/hectare in a 7-8 months production cycle with single stocking and single /multiple harvesting.

Another feature of aquaculture is wastewater aquaculture, paddy cum fish culture and integrated fish farming. Indonesia increased aquaculture production more than India and obtained the second largest position after 2014 in aquaculture production through integrated fish farming rice cum fish culture.

3.2. Brackish water aquaculture

India has an estimated total estuarine area of 3.9 million hectares of which 1.2 million hectares of coastal salt affected lands have been identified to be potentially suitable for brackish water shrimp farming. Of this, about 15 percent of the potential area has been used in aquaculture. About 9 million hectares of salt affected land has been estimated in the hot semi arid eco region of northern plains and high lands in the states of Haryana, Rajasthan, Uttar Pradesh, Maharashtra and Gujarat with surface and sub-soil saline water.

Shrimp farming is fast growing in Gujarat, West Bengal, Tamil Nadu, Kerala, Maharashtra and in Andhra Pradesh. Andhra Pradesh and West Bengal are the main producers of brackish water aquaculture. There are now 429 FFDA and 39 Brackishwater Fish Farmers Development Agencies, for promoting freshwater and Coastal aquaculture. MPEDA has been established for promotion in export fish and fish products.

This sector includes culture of i) Shrimp mainly the native giant tiger prawn, (*Penaeus monodon*) and ii) Exotic white legs shrimp (*Penaeus vannamei*). The culture process followed semi intensive technique in farming shrimps and 90 % of farmers hold areas of less than 2 hectare water area. Production of exotic white legs shrimps was granted permission for culture after a study of its risk analysis since 2009 and a guideline for farming practice has been laid down by the Government. Production of white leg shrimps is mainly for exports. Among the states, Andhra Pradesh is the highest producer of this shrimp, area of farming increased from 7128 ha in 2011-12 to 20198 ha in 2012 -13 and production increased from 75385 mt/ha/yr in 2011-12 to 133135 mt /ha/yr in 2012-13. (MPEDA, Kochi). Total area under this shrimp culture in India expanded from 7837 ha in 2011-12 to 22715 ha in 2012-13, a threefold increase and production increased from 80717 mt/ha/yr in 2011-12 to 147516 mt/ha/yr in 2012-13 (MPEDA, Kochi). Within a year production has been doubled with a three times increase in area of cultivation. But it reflects diminishing return productivity. So the production technique needs modification

with increase in other inputs such as investment in fertilizers, pumps and construction, in addition to import of vannamei brood stock. By 2013, 136 hatcheries were allowed for importing vannamei brood stock for production and supply of quality vannamei seeds to farmers.

Over the last decades prawn production from brackish water aquaculture has shown impressive growth. In recent years large scale development of shrimp farming happened only after 1988-89 with the establishment of shrimp hatcheries by the MPEDA. In shrimp culture, 90 percent of shrimp producers hold lands less than 2 hectares.

The brackish water aquaculture offers potential for exports. But the land resource used falls short of the required amount to meet the export demand. Only 15% available resources has been utilized till 2013. Apart from the giant tiger prawn, certain marine /brackish water fish /shrimp species such as milk fish, pearl-spot, and mullets have shown a lot of promises for commercial aquaculture in such inland saline soil/water areas. Production potential ranging from 0.5 to 3 tonnes /hectare/year has been demonstrated from such waters.

4. Conclusion

The results of the study indicate that production plan and programme was in keeping with market needs. Production is market oriented, but not adequate to meet fish demand of rising population. The major benefits of present aquaculture in India are as follows:

- i. meets domestic demand of quality animal protein for rising population in India.
- ii. providing employment to more than 15 million people directly and indirectly.
- iii. generates Forex earning to the tune of USD 5 billion (2013-14)
(source: Aquaculture in India/animal healthindia.com)

The costs associated with aquaculture are operational, environmental and other risk factors causing outbreak of diseases and mortality among fish species. Quality control and follow up of safety measures in production will help in promoting exports of aquaculture products, thus making aquaculture sector in India more commercially enterprising and economically important.

Aquaculture whether in freshwater or in brackish water or in mariculture has its impact on environment, as fishery activity creates an externality problems, resulting in social costs polluting environment by some culture practices. Hence there is need for proper management for sustainability in aquaculture along with environmental sustainability.

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