Dynamics of small-scale aquaculture development in India: A review

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Development of small-scale aquaculture has dominated development discourse because of its potential to fight malnutrition and poverty, to ensure food security and enhance the socio-economic condition of people living at the bottom of the pyramid. There are two fundamental approaches to applying aquaculture in developing countries: Improving small-scale, subsistence-level operations to meet immediate local needs or establishing large-scale, commercial industry based on the production of expensive species for export. The latter approach, geared towards increasing cash flow and thereby foreign exchange, may provide some employment for the poor, but mainly benefits only a small sector of society. The former strategy, however, directly benefits a larger number of people, especially the poor, by providing jobs and a modest income as well as a source of inexpensive protein. These two basic approaches are not mutually exclusive, but small-scale aquaculture is the more appropriate approach for rural communities[1]. In addition, small scale aquaculture has been characterised variously as family owned and operated, reliant predominantly on family labour, utilising small areas of land and/or water, and spanning a range of systems; from those involving limited investment in assets and operational costs and comprising but one segment of diverse livelihood portfolios, to others requiring more substantial investments in time, labour, infrastructure and capital.

Fisheries and aquaculture remain important sources of food, nutrition, income and livelihoods for hundreds of millions of people around the world (FAO, 2016). Presently India is the second largest fish producing and second largest aquaculture nation in the world after China. Aquaculture is the world's fastest growing food producing sector. The rapidly growing fisheries sector in India has an annual growth rate of over 7%. India's total fish production rose from 0.75 MT in 1950-51 to 13.75 MT during 2018-19, and inland fisheries presently represents 71% of total fish production of the country. Foreseeing high potential, a "blue revolution" has been initiated in the fisheries sector in order to focus mainly on increasing fisheries production and productivity from aquaculture and fisheries resources, both inland and marine, with the objectives of ensuring food and nutritional security, generating employment and export earnings, ensuring inclusive development and empowering fishers and aquaculture farmers.

Milestones in aquaculture development in India

Year	Milestone
1960	• Induced breeding of carps through hypophysation developed. • Seed rearing protocols developed.
1970	• Grow out technologies of carp and catfish developed. • Government owned and operated hatcheries established. • Fry and fingerling rearing in small ponds promoted. • Cage and pen culture initiated.
1980	• Fish Farmers Development Agency established. • Fish based integrated farming systems popularised. • Pond ecology and water quality studies initiated.
1990	• Synthetic hormone Ovaprim, an alternative to pituitary gland extract, becomes available; private hatcheries started coming up in many parts of the country. • Carp seed production increased manifold: stunted yearling stocking began in Andhra Pradesh. • Genetically improved 'Jayanti' rohu developed.
2000	• Intensification of carp production system. Sardar Darshan Singh of Ludhiana achieves record fish production of 13 tonnes/ha/year. • CIFAX developed as a cure for EUS. • Concept of One stop Aqua Shop emerged from DFID funded project. • Celebration of National Fish Farmers Day started.
2005	• Formulated fish feed industry proliferated. • NFDB established; seed production for diversified fish species gained momentum. • Farm made fish feed popularised for small scale aquaculture.
2010	• FRP carp hatchery becomes popular. • Private entrepreneurs drawn to establish hatchery, farms. • Aquaculture for empowerment of women, livelihood support for economically challenged section of society emphasised. • Aquaculture Field School promoted as a model of farmer-to-farmer extension.
2015	• Business incubation in aquaculture started for promoting entrepreneurship. • Mission fingerlings launched to give boost to larger sized seed production. • Aqua One Centre: An ICT enabled aquaculture support centre established. • Farmer Producer Organisations in aquaculture promoted. • First fish farmer in the country to be awarded with Padmashri: Sri Sultan Singh.
2020	• Ministry of Fisheries formed at the Centre. • Pradhan Mantri Matsya Sampada Yojana launched with a budget of Rs 200.5 million. • Bio-floc/recirculatory aquaculture system started gaining popularity. • Entrepreneurship development in fish value chain stressed. • Sri B.K. Sahoo, CIFA adopted farmer nominated for Padmashri award.

What is small scale aquaculture?

The term small scale aquaculture is often used interchangeably with rural aquaculture. Rural aquaculture is defined as the farming of aquatic organisms of economic importance by small-holders or communities using low external input technology suitable for their resource base. The fish production level in rural aquaculture is generally low and can only be sufficient for household use and family income[2]. To achieve significant production as well as income potential in rural aquaculture sector, the use of chemical fertilisers rather than formulated feed should largely be emphasised. The growth of the aquaculture sector mostly depends on two factors: i) Increasing the area under culture and ii) intensifying production in existing culture systems. The area under culture can be increased by utilising derelict or under-utilised water bodies viz., swamps, saline soils, natural as well as man-made lakes, reservoirs and rivers[2].

Aquaculture being a fast-growing sector in India, contributes a lion's share to the fish requirements of the country. The Fish Farmers Development Agency (FFDA), one of the flagship schemes of Department of Animal Husbandry and Dairying (DAHD), Ministry of Agriculture, Government of India, has made remarkable contributions in improving the average productivity level to 3,000 kg/ha/year as of 2018-19. However, the ponds not covered by the FFDA have a very low productivity. Popularisation of scientific fish farming in such areas is highly recommended.

Freshwater aquaculture represented 34 percent of inland fisheries production in the mid-1980s and has now increased to about 80 percent in recent years (DADF, 2019). India is bestowed with 3.15 million ha of reservoirs, 2.42 million ha of ponds and tanks as well as 0.19 million ha of rivers and canals. This indicates the huge potential for the development in aquaculture in India. However, only around 50% of ponds and tanks are being used currently for aquaculture. These resources may be used for enhancing fish production. Production packages developed for perennial water bodies are required to be suitably modified to suit the culture environment for seasonal water bodies. Location-specific package of practices also need to be developed for remote places.

Paradigm shift in small scale aquaculture

Components	Small scale aquaculture – then	Small scale aquaculture – now
Aim	Food security	Improving farmers' income level
Focus	Enhancing productivity	Profitability
Major players	State department of fisheries	Multiple stakeholders – public as well as private; donor agencies
Transfer of technology approach	Input intensive Blanket recommendation of practices	Knowledge intensive Location specific technology modules/business plan
Role of farmers	Farmers are seen as passive recipients of technology	Farmers are seen as innovators and entrepreneurs
Outreach activities	Focused on men	Emphasis on mainstreaming women
Dissemination of technology	Poor participation of stakeholders	Active stakeholder participation Farmer to farmer extension through aquaculture field school
Source of fish seed	Wild collection from river, mixed seed, bundh breeding	Hatchery produced seeds, small indigenous freshwater fishes, off-season availability
Size at stocking	Spawn/fry (15-20 mm)	Advanced fingerlings (40-60 mm) / stunted yearlings (150-250 g)
Culture technique	Traditional/extensive culture	Semi-intensive culture
Supplementary feeding	Broad casting/ball feeding	Farm made feed, floating pellets
Average yield	400-500 kg/ha/year	3,000 kg/ha/year
Types of aquaculture technologies	Hapa breeding, fish seed rearing, poly-culture/ composite fish culture, integrated farming	Circular/FRP hatchery, mixed carp culture, culture in seasonal water bodies, ornamental, value addition, organic aquafarming, species diversification, bio-floc/RAS

Aquaculture for rural livelihood development

Aquaculture has contributed to strengthening livelihoods and food security in southeast Asian countries, contributing to the livelihood of the poor farmers through improved food supply, income and employment. Effective extension services have contributed to increased aquaculture production and have the potential to contribute to the economic development of rural fish farmers. The rural women of south 24 Parganas perform many fishery activities starting from fish seed collection up to fish marketing and have contributed to improving the income of their families. Aquaculture is a viable option for rural development and plays quite a substantial role in improving the livelihoods of the fish farmers in Vietnam in terms of increasing satisfaction with economic gain. Poor households exhibited high adoption of aquaculture technologies in rural Vietnam although researchers are sceptical about the introduction of alien technologies.

A small-scale aquaculture project implemented in Nepal has resulted in improved nutrition and income for rural households. The project 'Women in Aquaculture in Nepal' has led to a seven-fold increase in per capita consumption. Community management of fisheries received a boost from the Cambodian government and participation of women therein has also strengthened governance of fishery resources. Several researchers in India too have documented the contribution of small-scale aquaculture in strengthening rural livelihoods.

Aquaculture Field School - a novel extension approach.

Dimensions of small-scale aquaculture development

Promoting the spirit of entrepreneurship

Farmers usually experiment with their limited resources and available technologies for maximising returns. The next generation of fish farmers are increasingly bringing in new techniques and are willing to take risks. The characteristics of present-day aquaculture are quite different from the past. Candidate species and the combinations reared by fish growers have changed. Composite carp culture in its strict sense has probably become a thing of past. Consumer preferences too are increasingly shifting towards non-conventional species which is probably driving farmers to introduce diversified species. It's the market and profit consideration that decide the rural aquaculture landscape. Promoting the spirit of entrepreneurship in aquaculture is emphasised. Fisheries-

Harvesting in a community pond.

based start-ups and enterprises are already attracting rural youth to be part of the entire fisheries value chain. With the state doing its bit, now it is time for the farmers to switch from semi-intensive culture to commercial production, from household-level production to fishery-based enterprises, and to migrate from small-scale production to embrace the entire value chain: Fish breeding, seed rearing, feed manufacture, input supply, marketing, and value addition.

Horizontal extension – the Aquaculture Field School way

To facilitate farmer-to-farmer extension the ICAR-Central Institute of Freshwater Aquaculture (CIFA) has piloted a few aquaculture field schools (AFS) in the states of Odisha, West Bengal and Chhattisgarh. AFS is a school without walls for improving decision making and problem solving by the fish farming community. The AFSs are becoming popular destination for the fish farmers. Farmer-to-farmer approaches are recognised by FAO as a key aspect of participatory extension methods. This approach of extension with no physical inputs would certainly be sustainable in the long run. As a novel approach for facilitating horizontal extension, AFS needs scaling up so that it benefits more and more fish farmers.

Plugging research extension gaps with Aqua One Centre

Aqua One Centre, a new initiative of National Fisheries Development Board (NFDB), Hyderabad, is an ICT enabled aquaculture support service that facilitates the wider dissemination of newer aquaculture technology and innovation to the

Fish farmers' collective, Maa Kharakhai Farmer Producer Company, Kendrapara.

Bhargavi Fish Farmers Producer Company, Khordha.

Women beneficiaries collecting harvested carps.

fish farming community. It will function in complementarity with existing public fisheries extension systems. Aqua One Centres will provide aquaculture support services such as pond monitoring, input management, health diagnosis, water analysis and advisory services. It is expected that the centres will bridge the research-extension gap and make aquaculture support services available to fish farmers and seed growers at their doorstep. ICT tools are poised to play a major role in this endeavour. During 2018-19, total 96 Aqua One Centres were established in 14 states (NFDB).

Harnessing the potential of women

Rural women are involved in aquaculture production activities including composite carp culture, seed rearing and integrated fish farming for their socio-economic improvement and self-employment. However, a lack of focus coupled with cultural and social constraints limit the participation of women in training and empowerment. The role of women is mainly confined to subsistence aquaculture in India, taking care of fish after stocking. Aquaculture, as a tool for empowering women is increasingly being recognised for its noteworthy contribution even in the most difficult areas. The initiatives of the government as well as non-government actors have also helped in bringing them closer to government establishments and banks. Office bearers of self-help groups have to deal with the management and financial aspects of pond management viz., purchase of inputs - fingerling, lime, feed, fertilisers and so on - and selling table fish. The additional income generated from fish culture has improved the socio-economic status of women. Appropriate methods of aquaculture extension and customised technologies can draw more rural women towards aquaculture.

Farming as business - the era of producer companies

Farmer producer organisations (FPOs) are registered bodies with farmers and producers as shareholders in the organisation. They deal with business activities related to the farm produce and it works for the benefit of the member producers, focusing on enhancement of farmer's capacity through advanced agricultural practices to increase productivity. FPOs facilitate access to fair and remunerative markets including linking of producer groups to marketing opportunities through market aggregators. They undertake many activities starting from the procurement of inputs to the disposal of produce and acts as a bridge between production and marketing. The Government of India is promoting FPOs by mobilising the farmers and helping them in registering as companies through the Small Farmers' Agribusiness Consortium, National Bank for Agriculture and Rural Development and National Cooperative Development Corporation. Presently, around 7,374 FPOs are registered in the country. Though fisheries FPOs are a small number at the moment, their numbers are steadily growing.

Seed rearing in backyard ponds is a profitable business.

Conclusion

Small scale aquaculture has undergone considerable changes over the years. These include aqua farmers turning into aqua entrepreneurs; farmer-to-farmer dissemination of technologies through aquaculture field schools; gender mainstreaming taking centre stage; producer companies being formed for fish farmers; and a new market-orientation to fish farming. The Union Government has recently launched Pradhan Mantri Matsya Sampada Yojana to turn India into a hotspot for fisheries and aquaculture products through appropriate policy, marketing and infrastructure support. The Government of India aims for national production to reach 20 million tonnes of fish by the year 2022-23. It has also set a target of forming 10,000 FPOs in agriculture with 500 FPOs in the fisheries sector. It would be desirable to think beyond production and lay an adequate emphasis on input supply, advisory services, and the entire fisheries value chain. With the government extending enormous support for fisheries sector development, the onus is now on the farmers and entrepreneurs to take up the latest techniques in fish farming and realise the true potentials of the blue economy.

Acknowledgements

The authors are indebted to the Director, ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar, Odisha for providing facilities to carry out the work.

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