

# Aquaculture for livelihoods and food security in North-western India

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Above, below: Pangas catfish brood stock and seed produced under agro-climatic conditions of Punjab by GADVASU in 2018.

As per the Department of Economics and Social Affairs (DESA) of the United Nations, the fisheries sector (capture and culture fisheries) has an imperative role to play in feeding the world population, which is estimated will grow to 9.8 billion by 2050 and 11.2 billion by 2100. Aquaculture is one of the fastest growing food production industries, with a striking contribution to livelihoods, employment generation and food/nutritional security across the world. Fish and other aquatic organisms provide at least 15% of average per capita intake of animal protein to more than 4.5 billion people worldwide<sup>1</sup>. However, as per the Food and Agriculture Organization (FAO) of the United Nations, fish provides about 3.0 billion people with almost 20% of their average per capita animal protein intake, while it contributes 15% to animal protein consumed by 4.3 billion people globally. Fish accounts for 30% of animal protein intake in Asia, 20% in Africa and 10% in Latin America<sup>2</sup>, while it constitutes more than 50% in coastal regions, especially in small islands like Andaman and Nicobar.



In 2018, global fish production was 178.5 million metric tons (mmt), including 96.4 mmt from capture and 82.1 mmt from aquaculture sector and about 59.5 million people were engaged in the primary sector of capture fisheries (38.97 million) and aquaculture (20.53 million). With an annual growth rate of 5.3% during the period 2001–2018, aquaculture continues to grow faster than other major food production sectors in the world<sup>3</sup>. Further, the employment opportunities have increased more in aquaculture sector as compared to capture fisheries. Employment in capture fisheries decreased from 83% in 1990 to 65.5% in 2018, while it increased from 17 to 34.5% in the aquaculture sector. According to the employment database of 2018, about 84.66% and 95.54% of the global population employed in the fisheries and aquaculture sectors are in Asia. Over the last two decades, significant employment growth has been witnessed in fisheries and aquaculture in Asia and Africa, with a more pronounced increase in aquaculture sector in special reference to Asia.

For over two decades, Asia has contributed about 89% to world's total aquaculture production<sup>3</sup>. Over the same period, Africa, America, Europe and Oceania also lifted their share. However, the contribution of China, the top fish producing country, to global aquaculture production decreased gradually from 65% in 1995 to 58% in 2018. Among other top producers, India, the second highest aquaculture producer in the world, has strengthened its share in global production from 4.2% in 1997 to about 8.6% in 2018<sup>3,4</sup>.

## Indian fisheries

India's diverse inland aquatic resources, in the form of 195,000 km of rivers and canals, 2.92 million hectares (mha) of reservoirs, 0.79 mha of flood plain lakes and derelict water bodies, 2.43 mha of ponds and tanks, 1.15 mha of brackish water resources<sup>5</sup> and 6.74 mha of inland saline water resources<sup>6</sup>, offer great opportunities for livelihood and employment generation through fisheries, besides steering the national economic prosperity.

Over the last six decades, marine production dominated Indian fisheries sector has transformed and inland fisheries (with 8% compound annual growth rate from 1950-51 to 2016-17) emerged as major contributor to overall fish production. During 2015-16, India produced 10.76 mmt of fish/shellfish, with 7.16 mmt (66.55%) from inland sources and export earnings of ₹ 30,420 crores (Cr.) or USD 4.68 billion<sup>7</sup>, while during 2016-17 total fish/shellfish production increased to 11.41 mmt, with inland sector share of 68.10% (7.77 mmt) and export earnings of ₹ 37871Cr. (USD 5.80 billion). During 2017-18, the total fish/shellfish production of India further

*Pangas catfish culture and overwintering in polyhouse at College of Fisheries, GADVASU, Ludhiana (Punjab).*



**Table 1. World employment of fishers and fish farmers (thousands).<sup>3</sup>**

Year	Asia	Americas	Europe	Africa	Oceania	Total
<b>Fisheries</b>						
2000	28,079	1,982	679	3,247	451	34,439
2018	30,768	2,455	272	5,021	460	38,976
<b>Aquaculture</b>						
2000	12,355	257	104	100	8	12,825
2018	19,617	388	129	386	12	20,533
<b>Total</b>						
2000	40,434	2,239	783	3,348	459	47,263
2018	50,385	2,843	402	5,407	473	59,509

increased to 12.61 mmt<sup>8</sup>, with the inland sector share of about 8.92 mmt (70.73%) and export earnings of over ₹ 45,000 Cr. (USD 7.08 billion). As per the latest estimates, India's total fisheries production increased to 13.75 mmt<sup>9</sup> during 2018-19, with the inland sector share of 9.58 mmt (69.67%) and export earnings of about ₹ 46,589 Cr.

Further, within inland fisheries, a major shift from capture fisheries to aquaculture has been witnessed over the last three decades and the contribution of freshwater aquaculture has increased from 34% in the mid 1980s to 78% in recent years. During 2018-19, fisheries contributed 1.24 % to National Gross Value Added (GVA) and 7.28% to the Agricultural GVA<sup>3,5,10,11</sup>.

So far, about 0.895 million ha (mha) water area has been brought under aquaculture. About 15 million people in India depend on fisheries and aquaculture for their livelihood at the primary level and almost double that number are engaged along the value chain<sup>9</sup>. About 75% of the fishers are engaged in various inland fisheries activities (including aquaculture) and 25% in marine fisheries activities<sup>12</sup>. For every person employed in capture fisheries and aquaculture about three jobs are created in the allied activities, including post-harvest processing.

Under the national 'Blue Revolution' scheme, the total fish production of India was aimed to increase to 15 mmt by 2020, while the Fisheries and Aquaculture Infrastructure Development Fund (FIDF), Department of Fisheries (DOF), Ministry of Agriculture and Farmers Welfare (Now under Ministry of Fisheries, Animal Husbandry and Dairying), Government of India (GOI) targets to augment national fish production further to 20 mmt by 2022-23. With an estimated marine and inland fisheries potential of 5.31 and 17.0 mmt, respectively; the total fish production potential of India has been estimated to be 22.31 mmt<sup>9</sup>. Since, marine resources are already overexploited worldwide and are witnessing ecological imbalances due to pollution and climate change, there is little scope of any remarkable increase in production from the marine sector. Hence, inland resources are anticipated to fill the gap, with the major share coming from aquaculture. The future potential of this sector towards livelihood and employment generation and food/nutritional security depends on its sustainability in ecological, social, and economic contexts.

Realising the socio-economic potential of inland fisheries, a centrally sponsored scheme on 'Development of Inland Fisheries and Aquaculture' was initiated by the Indian Government during the early 70s (1970-74) with following objectives:

- Enhancement of inland fish production and productivity.
- Popularisation of modern fish farming.
- Creation of employment opportunities through fisheries.
- Diversifying aquaculture practices.
- Providing assistance to fish farmers engaged in aquaculture.
- Providing training to fish farmers by 422 (now 429) Fish Farmers Development Agencies (FFDAs) and 39 Brackish Water Fish Farmers Development Agencies (BFDAs).

The major components of the scheme identified following thrust areas for overall development of inland fisheries, with special reference to aquaculture:

- Development of freshwater aquaculture.
- Development of brackish water aquaculture.
- Development of coldwater fisheries and aquaculture.
- Development of waterlogged areas.
- Productive utilisation of inland saline/alkaline soils for aquaculture.
- Integrated development of inland capture resources (reservoirs, rivers, wetlands etc.).
- Innovative projects.

Later on, the Ministry of Agriculture and Farmer's Welfare, Department of Animal Husbandry, Dairying and Fisheries (DAHDF) restructured the scheme to "Development of Inland Fisheries and Aquaculture" by merging all its components under one umbrella called "Blue Revolution", taking care of both culture (freshwater aquaculture, brackish water aquaculture and mari-culture) and capture (inland and marine) fisheries under the National Fisheries Development Board (NFDB), Hyderabad, with a total central outlay of ₹ 3000 Cr. for 5 years (2015-016 to 2019-20). The scheme is described below.

## Blue revolution

### Main objectives

- To increase overall fish production in a sustainable manner for economic prosperity from the available water resources.
- To introduce new technologies in the sector for responsible and sustainable utilisation of resources in an eco-friendly manner.
- To ensure food and nutritional security.
- To generate employment and export earnings.
- To ensure inclusive development and empower fishers (capture sector) and aquaculture farmers (culture sector).

### Thrust areas

- Freshwater aquaculture.
- Brackish water aquaculture.
- Coldwater fisheries/aquaculture.
- Saline/alkaline soil aquaculture.
- Wetland aquaculture.
- Inland capture resources (reservoirs, rivers etc).
- Innovative projects.

The COVID-19 pandemic has affected aquaculture activities from seed production to stocking, feeding, harvesting and marketing during 2020, but being a prime food production sector it will continue to feed the human population across the globe. For optimised utilisation of resources to achieve the production targets, there is need to develop a holistic strategic plan involving an ecosystem approach, to meet food and livelihood security requirements at state, regional and national levels.

## Aquaculture development in North-western India

In the north-western states of India, there is great scope for generating substantial livelihood/employment opportunities through following aquaculture activities, which can improve the socio-economic status of the farming community, furnish additional food and nutritional security and boost the national economy as well.

### Freshwater aquaculture

Among different aquaculture sectors (freshwater aquaculture, brackish water aquaculture and mari-culture), freshwater aquaculture is contributing the major share, which is traditionally dominated by extensive/semi-intensive poly culture of carps, including three species of Indian major carps, popularly called Indian major carps (IMCs), *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* and three species of exotic carps *Cyprinus carpio*, *Ctenopharyngodon idella* and *Hypophthalmichthys molitrix*. In North-western India, Punjab and Haryana are two progressive states with highest average annual aquaculture productivity of over 6 t/ha and net profit ranging from ₹ 1.25- 2.50 lakh/ha, depending on the management practices followed by the farmer. The IMCs contribute between 70% and 75% to the total freshwater aquaculture production, while exotic carps, catfish and freshwater prawn ('scampi') make up 25% to 30% of the production<sup>13</sup>, while fresh water aquaculture contributes over 90% to national total aquaculture production. Cold water fisheries are presently contributing a very small share of about 3% to inland fish production, but commercial farming of high value cold water species like rainbow trout (*Oncorhynchus mykiss*) is expanding in medium to high altitudes of Himalayan corridor, including Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, West Bengal and all the northeastern states.

The carp culture industry is well developed across the country, with an effective hatchery network in every state (public/private) to supply seed of all cultivable species; 429 FFDAs and NFDB to provide start up financial impetus (loans/subsidies) to aspiring candidates to take up aquaculture; and well connected technology cum extension backup from ICAR fisheries institutes/directorates/bureaus (7) at national level; and fisheries universities (2)/deemed university (1) and fisheries colleges/institutes (29) in state/central agricultural (SAU/CAU), state veterinary universities (SVUs) or state fisheries universities (SFUs) at regional levels<sup>14,15</sup>. So far, aquaculture has benefitted 1.1 million people across the country and inclusion of aquaculture as an agriculture diversifying component also possesses great scope towards enhancing farmer's income. During 2015-16 and 2016-17, about 14,212 ha area was developed for aquaculture, benefitting 63,372 fish farmers and 799 new fish markets were constructed

including retail/wholesale outlets and kiosks, which reflects employment generating potential of the sector<sup>5</sup>. Rapid growth of freshwater aquaculture sector has generated diverse employment opportunities for professional, skilled, and semi-skilled workers for different support activities (construction and management of farms, hatchery management, seed production/supply, feed mills, netting gears, pharmaceuticals, marketing/trading, processing etc).

### Diversification of carp culture

During the last decade, attempts have been made to diversify low value carp culture with high value species for dual benefit of higher productivity (vertical expansion) and higher income per unit area, making aquaculture even more lucrative as compared to other agricultural/livestock farming systems. Moreover, unlike many coastal states where people relish pond reared freshwater carps having intramuscular spines, the north-western population of India prefers to consume spineless fish (murrels, catfishes etc.). In this context, *Pangasianodon hypophthalmus* (pangas), an exotic catfish without intramuscular spines, has a winning edge towards diversification. Pangas culture is well developed in southern states of the country. The top producer Andhra Pradesh is supplying pangas to almost all parts of India, especially the northern states (covering >2,000 km of distance). About 56,000 mt pangas was produced in India during 2015-16 from 5,743 ha in 7 states (Andhra Pradesh, Maharashtra, West Bengal, Tamil Nadu, Kerala, Karnataka and Odisha), while 4,500 mt was imported from Vietnam during 1st half of 2017 to meet the national demand. Internationally, Vietnam exported 3.30 mmt pangas (92% fillets and 08% frozen) to 40 countries<sup>16</sup>. China alone imported 19,500 mt of pangas during the first half of 2017. Both national and international demand makes pangas a hot candidate for diversification in India, offering additional food/nutritional security and income, without expansion in area under aquaculture (reduced pressure on multiple use land and water resources to meet the production targets). About 400-500 t of additional fish can be produced from every 40 ha of area diversified or used for pangas culture (enhanced food security) supporting about 500 livelihoods including farmers family, farm labour and the linked backward/forward industry; being a potential candidate species for processing, especially filleting.

Unlike carps, pangas catfish is a cold sensitive species, which restricts its culture to 6-7 months in northern states, where temperature drops below 20°C during winters. Guru Angad Dev Veterinary and Animal Sciences university (GADVASU), Ludhiana in Punjab tested, validated, and demonstrated pangas culture under agro-climatic conditions of the State<sup>17</sup>; with an average productivity of 17.5 tons (t)/ha (three times higher than carps) in six months and corresponding net profit of ₹ 6.25 Lakh (2.5 times higher than carps); clearly indicating its potential in doubling farmers income.

After harvesting pangas (before the onset of winter) in northern states, the emptied pangas ponds can be utilised for rearing carp fingerlings from November to March for additional income. It will support the 'Mission Fingerling' of Blue Revolution, which was envisaged to achieve the target of enhancing national fisheries production to 15 mt by 2020. As per an estimate, total national fish seed requirement for stocking of existing ponds, new ponds and reservoirs ('ranching') is about 60,000 million fry, while 50,252 million fry were produced during 2016-17, leaving a gap of 9,748 million

fry<sup>5</sup>, which decreased to 39,261 million fry in 2017-18, leaving a gap of 20,739 million fry<sup>18</sup>. Hence, innovative initiatives are required to produce surplus quality seed of cultivable species to achieve the projected production targets. In the last two years, pangas culture has been adopted successfully in Haryana state and now fish farmers of Punjab state are also equally motivated to take up pangas fish culture on a larger scale.

### Major concerns

- Presently there is no pangas hatchery in the north-western region of the country. Hence, seed needs to be airlifted from far off coastal states, adding to the seed cost, besides procurement hassles, mortality and delayed stocking.
- Fish mature after four years. Hence, brood stock development is the major bottle neck due to overwintering challenge in the northern states, which causes mortality, besides adding to brood stock and seed production cost.
- Harvesting must be before the onset of winter. Hence, farmers are forced to sell the stock at compromised price, reducing farmers profit margin.
- No cold chain facility and processing industry in the region for preservation, processing/value addition (extend shelf life/availability), leading to post-harvest losses, food safety issues and consequentially economic loss.

### Action plan

- **Cluster pangas farming:** Cluster farming approaches with small scale processing units (filleting) can serve as an effective 'entrepreneurial module' offering ample employment opportunities for rural youth and women folk.
- **National policy:** Since the seed of pangas is to be airlifted from far off hatcheries in southern states; a national policy is required to link non-coastal and coastal states of the country for ensured input (seed and feed) supply and marketing/processing support to non-coastal states.



*Pangas fish from Andhra Pradesh sold in Ludhiana Fish Market of Punjab.*

- **Cold chain facilities** and subsidised refrigerated transport vans are required to minimise post-harvest losses and facilitate direct marketing by the pangas farmers for higher economic returns
- **Research and development programs:** Pangas hatcheries need to be established in the northern states through a strategic R&D program involving brood stock development and breeding of fish under climatic conditions of the region. Most recently for the first time in north-western region, GADVASU achieved the breakthrough of breeding 4 year+ brood stock of pangas catfish (developed in Punjab by overwintering under poly-house conditions from 2015-2018) through induced breeding technology. Hence, there is scope of developing pangas hatcheries (with overwintering facilities) in north-western region to overcome seed availability issues.

Relative economic benefits, in terms of productivity enhancement (additional food/nutritional security) and doubling of farmer income per unit land holding, outcast climatic challenges restricting commercial adoption of pangas culture in northern region. It also offers a potential solution for achieving production targets, in harmony with climate change and depleting multiple use land and water resources. Hence, 'pangas culture cum processing model' can serve as a promising entrepreneurial enterprise for north-western states of the country, where a large quantity of iced pangas fish from coastal states, mainly Andhra Pradesh, is sold throughout the year. Further, Vietnamese pangas fillets are also popular in the supermarkets of the region.

### Aquaculture in village/community ponds

Village/community ponds, an important and integral part of rural India, represent an underutilised aquatic resource with prodigious potential for developing aquaculture. India has more than 600,000 villages, hosting a massive aquatic resource in the form of village or community ponds that could be used for aquaculture development, which holds more relevance in reference to depleting aquatic resources and hence, need to be utilised through an ecosystem approach for human as well as environmental wellbeing. The role of village ponds in aquaculture development can be estimated from the database available in respect to some states of the country. In Punjab, out of total 11,268 aquaculture ponds (16,226 ha)<sup>19</sup>, about 78% are village ponds (8,794), while private ponds are 2,474 constituting only 22%. However, only 60% of the existing village ponds in Punjab have been brought under aquaculture so far. In Haryana, 10,000 farmers are engaged in aquaculture covering 18,975 ha area (18,000 units), where more than 80% (15,550) of existing village ponds has been utilised<sup>20</sup>, while number of private ponds is only 2,500. However, aquaculture development in village or community ponds has not been promoted to its actual potential due to various social and political issues.

### Major concerns

- Food safety concerns due to the presence of potential contaminants (pollutants) in village ponds such as domestic sewage discharge, visiting cattle and pesticide entry with runoff from catchment areas, including agriculture fields.

- Low aquaculture productivity due to poor water quality, with special reference to organic pollution/load, biological oxygen demand, pH, dissolved oxygen and ammonia levels.
- Culture of hardy banned exotic fish, Thai magur (*Clarias gariepinus*) in polluted village ponds, owing to non-suitability for carp culture practices.
- Thai magur has not only spread its tentacles in the village ponds, but it has also escaped into the rivers, posing serious ecological threats to the indigenous aquatic biodiversity. In Uttar Pradesh and Uttrakhand, *C. gariepinus* has been reported to have invaded into the Ganga, Yamuna, Ramgamaga, Gomti, Sai, Tamsa, Sone, Baigul, Nakatia, Hindon, Kali, Gerua, Sharda and Dewa rivers by National Bureau of Fish Genetic Resources, Lucknow<sup>21,22</sup>. It is also seen as a big ecological threat for the native fish species inhabiting natural waters of Punjab and Haryana. Most recently, about 700 kg of Thai magur seed consignment to Punjab State from Kolkata (West Bengal) was seized and destroyed in the month of March, 2019 by the State Fisheries Department in district Patiala. As per various scientific reports, Thai magur has been reported in rivers of Punjab as well<sup>23,24,25</sup>. It indicates that the problem is already deep rooted and hence, need to be addressed in a 'mission mode'.

### Action plan

- **Database generation:** Documentation of village ponds in each state, including number, area, utility status, water quality in respect to potential contaminants (physical, chemical and biological) and biosafety for designing village pond development plans.
- **Rural aquaculture development program:** To promote aquaculture in village/community ponds, with a 'triple mission':
  - **Resource conservation and optimised utilisation:** For economic gains through aquaculture (pollution control and reuse).
  - **Employment:** Generation of livelihoods.
  - **Food security and safety.**
- **Utility Services:** Water testing, bioremediation model development, consultancy/ technical guidance and capacity building (training/skill development) programs for farmers/youth/entrepreneurs/officials/scientists/gram panchayats for promoting healthy aquaculture practices in village ponds.
- **National surveillance program:** For monitoring pollution levels and aquaculture activities in village ponds.

Aquaculture in village ponds through scientific management will also help in expansion of the sector without exerting any additional pressure on depleting multiple use land and water resources. The said mission will not only improve water quality of village ponds (enhanced aquaculture productivity and food safety), but also make them suitable for carp/pangas catfish culture and check proliferation of Thai magur, besides generating livelihood/employment opportunities for the

Polluted village ponds in Punjab, India.



Thai magur, *Clarias gariepinus*.

rural youth and communities. An energy saving eco-friendly 'bio-remediation technology' can enhance productivity of village ponds by 2-3 t/ha/yr. A duckweed based bioremediation ("phytoremediation") model is available, which has been tested successfully by GADVASU with dual benefit of wastewater remediation for 'reuse' or 'recycling' and nutrient rich 'duckweed biomass' production (feed resource) for feeding animals, including fish, duck, chicken, pigs, goats etc. For this purpose, the village ponds need to be transformed from a waste dumping site to a potential aquaculture resource.

### **Inland saline water aquaculture**

Inland saline water aquaculture in non-coastal northern states holds gigantic potential towards reclamation of salt affected, poor/zero earning waste lands, besides creating livelihood/employment opportunities and revenue generation through export earnings. Over 1,300 million hectare (mha) area across the world has been documented to be salt affected<sup>26</sup>, which has hit agricultural output and consequentially the rural economy of many developing countries, including India. Out of total 6.74 mha salt affected areas (including coastal saline soils) in India distributed in 15 states and 13 agro-climatic regions<sup>27,28,29</sup>, about 1.20 mha is present in non-coastal Indo-Gangetic plains (northern India) covering seven states, including Punjab (151,000 ha), Haryana (232,000 ha), Rajasthan (375,000 ha), Bihar (153,000 ha), Uttar Pradesh (137,000 ha), Madhya Pradesh (139,000 ha) and Jammu and Kashmir (17,000 ha). As per an estimate by ICAR-Central Soil Saline Research Institute, Karnal (Haryana), the salt affected area in India is expected to expand from 6.74 mha to 16.25 mha by 2050, which need to be managed scientifically for its optimised utilisation for food production and livelihood security.

Owing to R&D initiatives by GADVASU in Punjab and Regional Center of Central Institute of Fisheries Education (CIFE), ICAR in Haryana, inland saline water aquaculture technologies have been tested, validated, demonstrated, and adopted successfully in both the states<sup>30,31,32,33,34,35</sup>, under the Blue Revolution promotional schemes implemented by the state governments/state fisheries departments. In 2014, three farmers in Haryana started farming vannamei shrimp (*Litopenaeus vannamei*) successfully in 5 ha of salt affected area<sup>19</sup>, which increased to 30 ha in 2015, 128 ha in 2017 and crossed 160 ha mark in 2018. About 250 ha salt affected waterlogged lands in southwest Punjab have also been converted into aquaculture farms in last five years, including fresh water carp culture in low saline areas ( $\leq 5$  parts per thousand or ppt or g/l) and vannamei shrimp culture in medium to high saline areas (10-25 ppt). In Punjab, after the first pilot project on vannamei shrimp culture (0.4 ha) in 2014, area under shrimp farming increased to 15 ha in 2017, 92 ha in 2018, 140 ha in 2019<sup>36</sup>. Further, inspired by the success stories of Punjab and Haryana states, Rajasthan state is also following the footsteps, where area under shrimp farming increased from 3.5 ha in 2017 to 6 ha in 2018 and over 20 ha in 2019 (survey data, unpublished). During 2020, the COVID pandemic affected shrimp farming across the country due to its major dependence on USA and China for import of brood stock and marketing (export) of shrimp.

Owing to aquaculture development in inland salt affected areas, resource deficient farmers are now earning net profits of ₹ 1.0-1.25 lakh/ha/year through freshwater carp polyculture (catla, rohu, mrigal and common carp) and ₹

800,000-1,000,000 /ha/crop of just four months through vannamei shrimp farming in their erstwhile zero earning waste lands. It has not only opened the much-needed window for self-employment/employment but has also increased the value of salt affected lands due to increased demand among progressive entrepreneurs/agencies for developing commercial shrimp industry in these states.

Shrimp farming is a well-developed industry in southern coastal states, where frozen shrimp accounts for 68.46% and 41.10% of total exports from India, in terms of value and quantity, respectively<sup>37</sup>. In the last five years, shrimp farming has also converted inland salt affected degraded lands of non-coastal states into an economic resource beyond imagination. Although, the winter period (November/December to February/March) restricts the shrimp culture period in northern region to 7-8 months, but still two crops of shrimp can be harvested between April to November (before the onset of winters), making it highly remunerative as compared to any other agriculture and livestock enterprise. However, for long term sustainable development of shrimp farming in inland saline areas, it is recommended to adopt a single crop concept (100-140 days) to facilitate complete drying of pond for its preparation for the next crop, without/minimised effluent/sludge disposal issues. As compared to carp farming, a low cost low risk crop, shrimp farming as a high cost high risk crop needs a very high capital investment, which limits its adoption to only big farmers possessing higher investment and risk-taking capacity. However, small farmers can also establish shrimp farms with one time start up financial assistance from state/central government. Income from the first crop will be sufficient to generate a revolving fund for the subsequent crop, ultimately transforming the small farmers into bigger progressive farmers with every crop they harvest.

Shrimp, being an export commodity, can play a significant role in revenue and employment generation. Shrimp farming in 40 ha of salt affected areas in northern India will produce about 400 t of shrimp (1 crop/yr, with average productivity of 10 t/ha) worth ₹ 10-16 Cr., depending on the market value (₹250-400/kg). In shrimp farming, backward (consultants, hatcheries, feed mills, pharmaceuticals etc.) and forward (processors, traders, exporters etc.) linkages have been estimated to create 4 jobs/t of shrimp produced<sup>4</sup>, which means every 40 ha (400 t) of shrimp farms can support over 1,600 livelihoods. Presently, approximately 60,000 shrimp farmers are producing about 500,000 t of shrimp (tiger and vannamei shrimp) from 120,000 ha brackish water ponds in coastal states, where each farm employs 2-3 labourers during crop period, supporting the livelihood of 120,000-180,000 skilled/unskilled workers directly and holding a potential of providing jobs to at least 2,200,000 workers in the shrimp industry, through backward and forward linkages. Likewise, utilisation of only 1% of existing salt affected lands in Punjab (1,510 ha), Haryana (2,320 ha) and Rajasthan (3,750 ha) for shrimp farming can produce about 75,000 t of shrimp (average productivity 10t/ha) and support about 300,000 livelihoods.

### **Major concerns**

- Vannamei shrimp culture is a high-cost high risk intensive technology, hence, highly skilled manpower, stringent monitoring and high level bio-security is required.

- SPF (specific pathogen free) shrimp seed is to be air lifted from registered hatcheries located in far off coastal states, adding to seed cost, besides transportation hassles, mortality and delayed stocking.
- No cold chain facility and processing industry in the northern region, contributing to post-harvest losses and quality issues.
- No shrimp feed industry in northern region; transportation adds extra cost to an already high feed cost.
- International dependence for marketing (export) and no backup domestic market, leading to a marketing crisis, as recently witnessed in the case of COVID-19 international lock down and restrictions.

*Conversion of inland salt affected waterlogged lands into aquaculture ponds by GADVASU Team.*





- Unlike sea water, the salinity and composition of inland saline water varies with location, even within the same district. A requisite database is lacking for development of region-specific aquaculture practices in respect to species selection and water quality management.
- Effluent/sludge disposal issues causes social conflicts and environmental impact.
- Salinisation of soil/ underground water resources. In special reference to those areas where underground saline water available below the freshwater aquifer is extracted for shrimp farming activities.

## Action plan

### Recommendations

- **Cluster shrimp farming:** Cluster farming approaches under self help groups (SHGs), fish farmers producers originations (FFPOs), co-operatives or contractual farming are required to address the listed concerns.
- **Biosecurity and disease surveillance:** Shrimp farming needs to be promoted under strict biosecurity and surveillance (monitoring and reporting) to prevent any unforeseen loss due to disease outbreak.
- **Single crop concept:** For maintaining healthy pond conditions and optimised shrimp production levels, the concept of a single crop (100-140 days) per year is desired to be adopted to facilitate complete drying of pond till cracking of bottom soil (oxidation) and preparation of pond (ploughing, levelling and dyke strengthening) for the next crop, so that environmental issues in respect to effluent/sludge disposal could also be addressed.
- **Food safety and quality assurance:** Farmer-level awareness and abidance to guidelines/best management practices (BMPs) is required for export quality shrimp production and sustained profitability.
- **Introduction of alternate species:** Some potential low-cost low-risk brackish water species need to be introduced in the region for sustainable development of inland saline water aquaculture, in special reference to small and marginal farmers.

### Policies

- **Regional research cum training centers (RRTCs):** State level RRTCs are required for sustainable development of inland saline water aquaculture in each non-coastal/ northern state, after complete ecological mapping of salt affected areas (salinity and composition), through:
  - **R&D:** Development and dissemination of region-specific aquaculture technologies for marginal. small, medium and large farmers/entrepreneurs.
  - **Capacity building:** Training/skill development/experiential learning.
  - **Utility services:** Consultancy, technical hand holding, water testing, seed testing, disease diagnosis/health management, processing etc.

*Freshwater carps harvested from low salinity (<5 ppt) ponds in Shajrana Village, Fazilka District, Punjab.*



- **Regulatory governance:** Like coastal states, inland saline water aquaculture also needs to be regulated on the lines of the Coastal Aquaculture Authority of India, including registration and insurance of shrimp/aquaculture farms; biosecurity standards; BMPs; effluent/sludge disposal standards; impact assessment etc.

Shrimp farming in Punjab.



- **National aquaculture policy:** Public-private-community partnerships (PPCPs) involving shrimp farmers producers organisations are required to develop effective working linkages between coastal and non-coastal states under a national aquaculture policy, for ensured input supply (seed and feed) and marketing/processing/export support to northern states, subsequently leading to optimised utilisation of resources across regional borders.
- **Cold chain facilities and subsidised refrigerated transport vans:** Self-marketing support for domestic marketing, necessitates provision of cold chain facilities and refrigerated transport vehicles to shrimp farmers, to help them preserve and sell their produce at competitive rates for higher returns.

- **Processing cum export hub:** A regional 'processing cum export hub' is required to promote export industry for enhanced marketing/trading efficiency within the north-western region.

## Development Initiatives

Recognising the socio-economic impacts of fisheries and its contribution in national economy, the Department of Animal Husbandry, Dairying and Fisheries under the Ministry of Agriculture and Farmers Welfare, was bifurcated to create a separate Department of Fisheries in 2019, as an impetus measure to drive the nation towards a sustainable 'Blue Revolution' plateau.

To evolve an integrated and comprehensive approach towards sustainable development of inland fisheries and aquaculture, that caters the needs of the states and national priorities, the Department of Fisheries proposed the National Inland Fisheries and Aquaculture Policy with the following vision and mission:

### Vision

*"Ecologically healthy, economically viable and socially inclusive, inland fisheries and aquaculture that generates gainful employment and economic prosperity."*

### Mission

*"Inland fisheries and aquaculture resources are developed, managed, conserved and sustainably utilised for improving livelihoods, generating gainful employment, food and nutritional security, economic prosperity and wellbeing through appropriate strategies, and legislations, stakeholder's participation, public private and community partnership, market support, and strengthening research, extension and their linkages"*

Further, a separate Fisheries and Aquaculture Infrastructure Development Fund (FIDF) was created, with an aim to boost fish production from both inland and marine fisheries sectors in India, so as to achieve the production target of 20 mt by 2022-23, at a sustainable growth rate of 8-9%, besides generating 950,000 lakh employment opportunities as per FIDF guidelines<sup>8</sup>.

Most recently in May 2020, the Indian Government approved the scheme "Pradhan Mantri Matsya Sampada Yojana" under DOF to accelerate Blue Revolution through sustainable and responsible development of the fisheries sector in India, with an estimated investment of over ₹ 20,000 Cr. for a period of 5 year (2020-21 to 2024-25) in all states /union territories of the country, with following vision and objectives:

### Vision

*"Ecologically healthy, economically viable and socially inclusive fisheries sector that contributes towards economic prosperity and well-being of fishers and fish farmers and other stakeholders, food and nutritional security of the country in a sustainable and responsible manner."*

## Aim and objectives

- Harnessing of fisheries potential in a sustainable, responsible, inclusive and equitable manner.
- Enhancing fish production and productivity through expansion, intensification, diversification and productive utilisation of land and water.
- Modernisation and strengthening of value chain, post harvest management and quality improvement.
- Doubling of fisher and farmer incomes and generation of employment.
- Enhancing contribution to agricultural GVA and exports.
- Social, physical and economic security for fishers and fish farmers.
- Robust fisheries management and regulatory framework.

*Shrimp farming in Rajasthan.*



*Shrimp farming in Haryana.*



## Conclusion

For overall development of aquaculture in north-western India, a holistic approach for its horizontal and vertical expansion in fresh water and inland saline resources needs to be taken up under a strategic plan. In this context, the listed issues need to be addressed at national level (beyond inter-state boundaries) under a national aquaculture network, for optimised utilisation of available resources/opportunities in every state to enhance food/nutritional security, employment/livelihood opportunities and revenue generation, consequentially leading to national socio-economic opulence.

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