CEE
Centre for Environment Education

Towards Green and Socially-Sound Recovery
in Rural and Farm Sector

CASE STUDY OF INLAND FISHERIES IN DIST. VAISHALI AND MUZAFFARPUR, BIHAR

Photo: Vipin Verma

ABOUT US

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INTRODUCTION

The fishery sector is an important sector in the Indian economy. The total quantity of fish production across the world is 178.5 million MT. The total production of fish in India was 14.16 million MT in the year 2019-20 which is around 7.9 per cent of the global production. India has a higher proportion of inland fish production (10.43 million MT, or 73.7%) than marine fish production (3.72 million MT, or 26.3%)(Fisheries Statistics Division, 2020). However, during the COVID-19 induced-lockdown, the whole aquaculture production system was disturbed as consumption decreased resulting in a decrease in demand. As fish is highly perishable, the collapse of the supply chain resulted in the wastage of fish. Fish farming in Bihar is dependent on rainwater so decreasing rainfall has an impact on inland fishery production in the state. Also, during heavy rainfall, the silt flow into lakes and reservoirs causes diseases and fish mortality increases. The change in weather has an impact on physiology, behaviour, distribution and migration patterns, reproductive capacity and mortality (Mohanty et al., 2017). Therefore, this study was conducted to assess the impact of COVID-19 on the fishery sector and to understand the value chains of the inland fishery production system. The aim was also to assess the possibilities of green and socially-sound recovery strategies.

STUDY AREA

The study was conducted in the Saraiya block of Muzaffarpur district and the Jandaha block of Vaishali district in Bihar. Muzaffarpur district is spread over an area of 3,172 sq km and situated on the bank of the *Narayani (Gandak)* river. Muzaffarpur is in the North Alluvial Plain agroclimatic zone of Bihar with an average annual rainfall of 1,040–1,450 mm. Manikpur village in Saraiya block, Muzaffarpur district has a population of 1,196, with 606 males and 590 females (Registrar General of India, 2011).

Vaishali district is spread over a 2,036 sq. km area and ranks tenth in terms of population (27,18,421) and 25th in terms of area (2,036 sq.km.) in the state of Bihar. The district enjoys good rainfall with an annual average rainfall of 1,168 mm. July and August receive heavy rainfall during the year. Rice, maize, and wheat are the main crops in the district. The study was conducted in Pirapur, which is a large village located in the Jandaha Block of Vaishali district with 1,095 families and a population of 5,539, of which 2,906 are males and 2,633 are females (Registrar General of India, 2011).

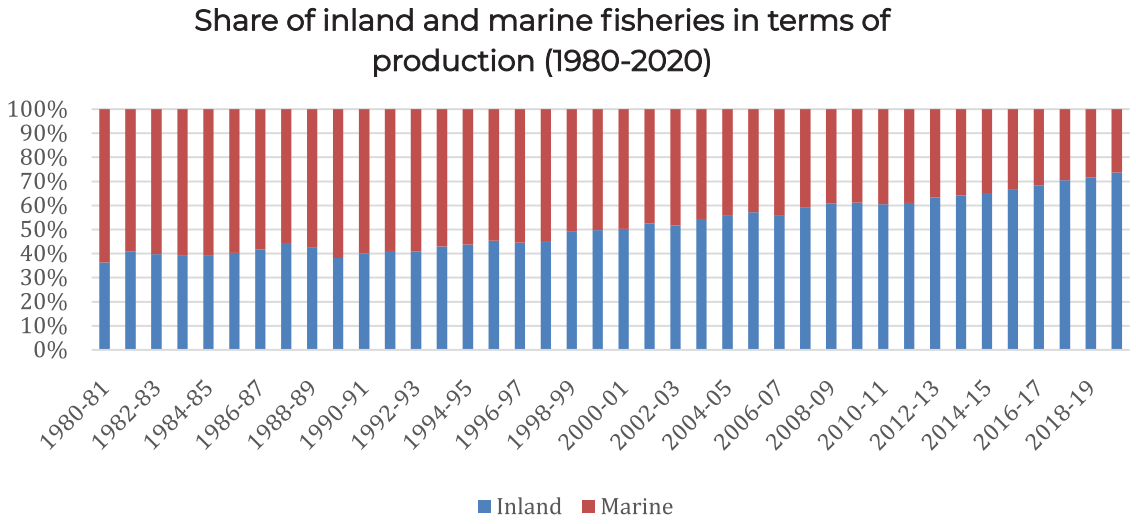

Photo: Satish Awate

APPROACH

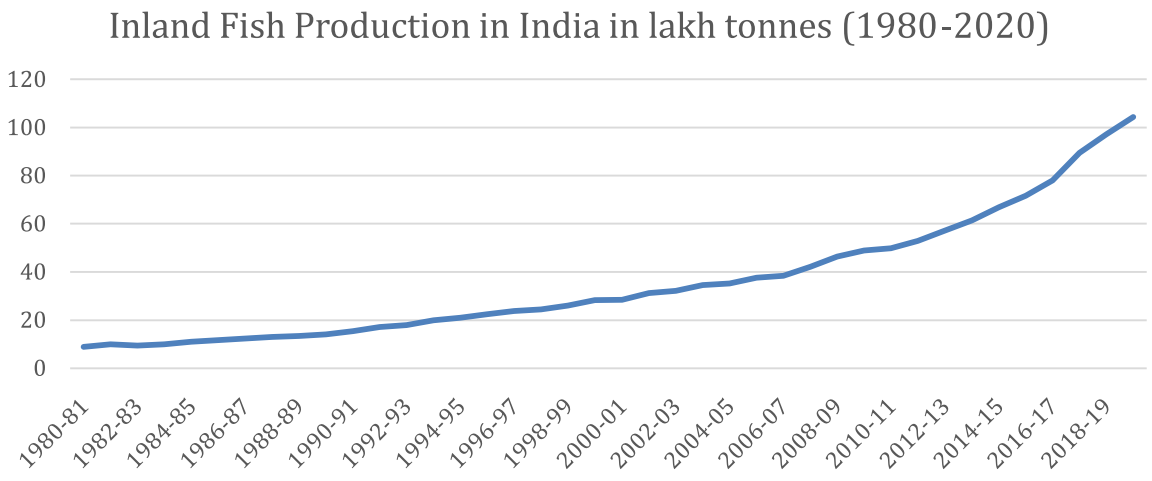
Focussed group discussions (FGDs), in-depth interviews and mapping exercises were conducted with fishers in both villages to understand the fish value chain. Secondary information was collected from various published documents such as the Fish Market Price Information System (FMPIS), Fortnightly Report of the National Fisheries Development Board (NFDB) and Handbook on Fisheries Statistics.

National, state and district scenarios

1. At the global level, the top seven fish-producing countries capture fish accounting for almost 50 per cent of total captures, with China accounting for 15 per cent of the total fish production, followed by Indonesia (7%), Peru (7%), and India (6%). India is the fourth-largest fish-producing and second-largest aquaculture nation in the world after China.
2. There is a definitive shift in production from the marine fisheries sector to the inland fisheries sector as inland fishery production has increased from 8.87 lakh tonnes in the year 1980-81 to 104.37 lakh tonnes in 2019-20 (1076.7%).



Source: Handbook on Fisheries Statistics, 2020



Source: Handbook on Fisheries Statistics, 2020

3. Indian Major Carps (IMC) include commonly-cultivated freshwater carp species such as catla (*Labeo catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*). Disaggregated data for IMC, other local fish, and brackish water shrimps from aquaculture is not available. The major carps such as Catla, Rohu and Mrigal contribute 57 per cent of total fish landings in 2019 followed by exotic carps such as Common, Silver, Grass, Crucian, Tilapia, Tench, Tawes and Gauramy carps. Andhra Pradesh, West Bengal, Uttar Pradesh and Odisha are leading producers of major and exotic carp (Fisheries Statistics Division, 2020).
4. Tripura has the highest consumption of fish at 29.3 kg per capita per year. Kerala, Manipur, Odisha and Assam are other states with comparatively higher per capita consumption of fish.
5. The highest fisher population per district is in the state of Bihar followed by West Bengal and Andhra Pradesh. Bihar has 38 districts in which the fisher population is around 60,27,375 (Fisheries Statistics Division, 2020)
6. The total fish seed production in the year 2019-20 was 5,217.1 crore fry. Fish seed production in India has increased by 52.9 per cent between 2010-11 and 2019-20. West Bengal, Jharkhand and Assam are the top three fish seed-producing states. Bihar is the ninth state in fish seed production and the total production of seeds was 453.9 crore in the year 2019-20 (Fisheries Statistics Division, 2020).
7. Andhra Pradesh, West Bengal and Uttar Pradesh are the top three states in inland fishery production. The state of Bihar was the fifth largest fish-producing state with 6.41 lakh tonnes of production in the year 2019-20. The overall inland fish production in Bihar has been consistently increasing in the last five years (Fisheries Statistics Division, 2020).
8. Fish production in Bihar has been consistently increasing for the last fifteen years. As per the State Fisheries Department, Govt. of Bihar, report, the total fresh water fish production in Bihar in 2004-05 was 2.68 lakh metric tons which has gone up to 6.41 lakh metric tons in 2019-20.

Sr. No.	State	Total inland fish production (lakh tonnes)
1	Andhra Pradesh	36.1
2	West Bengal	16.19
3	Uttar Pradesh	6.99
4	Odisha	6.6
5	Bihar	6.41
6	Chhattisgarh	5.37
7	Assam	3.73
8	Telangana	3
9	Karnataka	2.29
10	Jharkhand	2.23
16	Maharashtra	1.18

Source: Handbook on Fisheries Statistics, 2020

9. The per capita demand for Indian Major Carps like Catla (*Labeo catla*), Rohu (*Labeo rohita*) and Mrigal (*Cirrhinus mrigala*) is high, but production and supply are very limited. The state of Bihar is blessed with potentially rich and varied aquatic resources. The fishery resources of Bihar can be broadly divided into three categories: farm-oriented fishery resources, culture-based capture fishery resources and capture fishery resources. The fishery resources in the state mainly include 65,000 ha of ponds and tanks and nearly 35,000 ha of oxbow lakes and *chaurs* (Chand & Prasad, 2021).
10. The water resources for fisheries in Bihar include rivers and canals of 3,200 km in length and 37 medium and large reservoirs covering an area of 26,304 ha, tanks and ponds covering an area of 93,218 ha and beels/ oxbow lakes of 9,000 ha area (Fisheries Statistics Division, 2020).

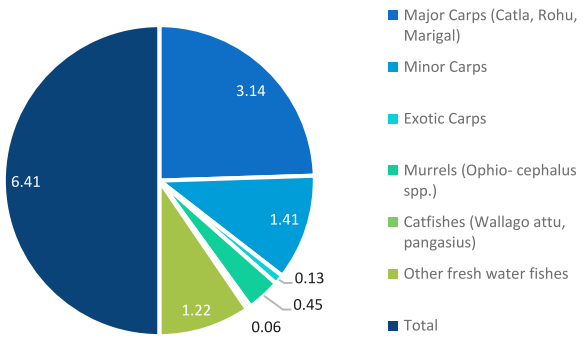
Estimated areas of fisheries resources in Bihar

Sr. No.	Resources	Stretch area (ha)	% Area
1	Rivers	3200	0.52
2	Wetlands	500000	81.01
3	Reservoir	25000	4.05
4	Oxbow lakes	9000	1.46
5	Ponds/tanks	80000	12.96

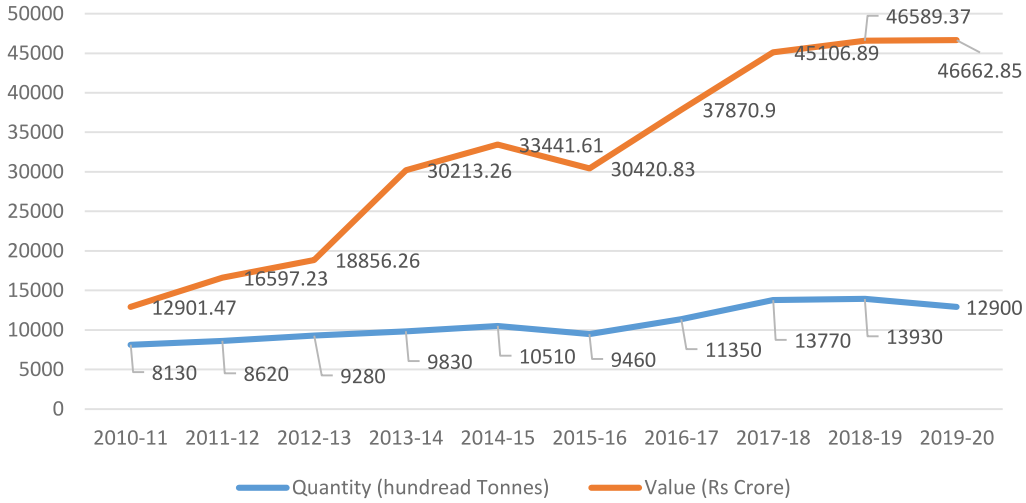
11. Out of the total inland fish landing in Bihar in the year 2019-20, 3.14 lakh tonnes are of major carps, 1.41 lakh tonnes are of minor carps, 0.13 lakh tonnes of exotic carps and 1.73 lakh tonnes of murrels, catfish and other freshwater fish (Fisheries Statistics Division, 2020).

12. Between the years 2010-11 to 2019-20, the quantity of fish products exported has increased from 8.13 lakh tonnes to 12.90 lakh tonnes with an increase of 58.7 per cent. During the same period, the export of fish in terms of value increased from Rs. 12,901.47 crore to Rs. 46,662.85 crore i.e. an increase of 262 per cent. The USA, China, South East Asia, European Union, Japan and the Middle East are the major markets to which fish production is exported. The USA and China are major markets both in terms of value and quantity.

Species-wise fish landing of inland fisheries in Bihar 2019-20



Quantity and value of fish exported in 2019-20



The highest quantity of fish (both marine and inland) has been exported from Pipavav Port in Gujarat, Vizag Port in Andhra Pradesh and Kochi Port in Kerala. In terms of the value of fish exported in the year 2019-20, the percent share of Vizag port is the highest followed by Calcutta port in West Bengal and Krishnapatnam in Andhra Pradesh. Out of the total quantity of fish exported abroad, frozen shrimps are the highest in terms of both quantities as well as value. Compared to the year 2018-19, the export of fish in terms of both value and quantity are increasing in all these markets except South East Asia.

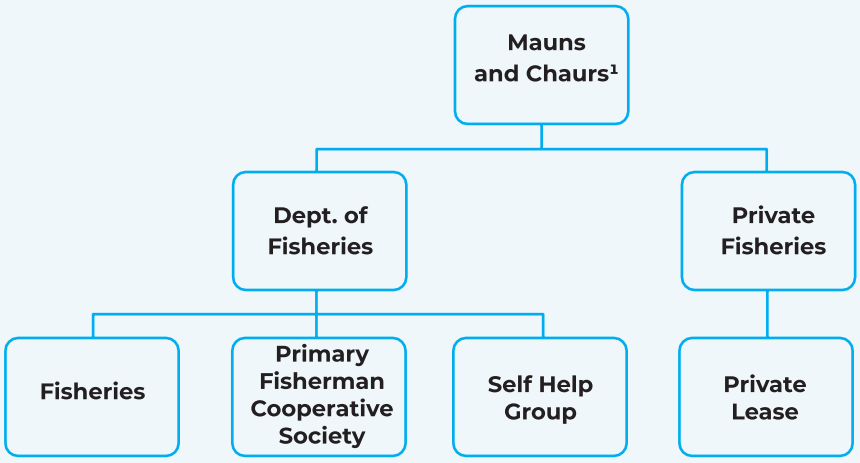
13. In the year 2019-20, out of total fish production (marine and inland) of 121.8 lakh tonnes of fish, 64.94 lakh tonnes (53.3%) were sold fresh in the market, 16.81 lakh tonnes (13.8%) were sold in frozen form, 5.20 lakh tonnes (4.3%) were sold in cured form, 0.36 lakh tonnes (0.3%) in canned form, 3.38 lakh tonnes (2.8%) were reduced to fish oil and other products and 0.08 lakh tonnes (0.07%) were sold in the offal form to be reduced to various fish products.

Study area-specific findings

1. The field study on fish farming in the Jandaha and Saraiya Blocks included a group of seven fish farmers of the *Saraiya Prakhand Matasyajivi Sahyog Samiti Ltd* in Manikpur village in Muzaffarpur district and a group of five fish farmers of Pirapur village of Jandaha Block of Vaishali District. Fish farming practices are almost the same in both Saraiya and Jandaha blocks. Fish farming is dependent on rainfall and deficient rainfall impacts the quantity of fish production.
2. There is only one hatchery in operation for both these blocks which is situated at Jandaha and therefore fish farmers have to transport the fish seeds from a great distance. Fish of local species are in greater demand than major carp and they have special cuisine value in marriage ceremonies as they are more delicious in taste. Therefore, fish farmers catch fish seeds from nearby rivers and grow them in ponds.
3. The fish farmers in these blocks are of the opinion that if proper scientific training on local fish seed production is given and required resources including financial support are provided, this business can earn a greater profit.
4. In between the years 2009-14, the Indian Council of Agricultural Research under its National Agricultural Innovation Project-3 (NAIP-3) initiated work on *chaur* development but could not succeed due to less rainfall. As rainfall was less, fish farmers chose to sow food crops in dried *chaur* areas. If water facilities can be made available, the fish farmers will be able to continue fish farming even when rainfall is deficit.
5. Like deficit rainfall, heavy rainfall also impacts fish production in *chaurs*. The downpour due to heavy rainfall usually carries silt in aquatic resources and causes morbidity and mortality of fish due to various diseases.

Case Study: Saraiya Matasyajivi Sahayog Samiti Ltd

- *Saraiya Matasyajivi Sahayog Samiti Ltd* has 450 members. The committee was registered in 2010 under the district fisheries department of Muzaffarpur. Presently, 80 ponds in this region have been identified by the Department of Fisheries and all of them have been allotted to the *Samiti* for fish production.



- The members of the *Samiti* have to pay annual fees which are paid to the Department of Fisheries as a lease amount. The fish varities of Rohu, Mrigal (Naini), Catla, Grass Carp and Common Carp are produced in these allotted ponds. The following table elaborates the species produced, harvesting time required, the average weight of fully-grown fish, total production per acre of pond and price received in the market.

[1]The ox-bow lakes are called *mauns* and tectonic lakes are called as *chaurs* in Bihar

Cost of fingerlings, total production and price received in one acre of fish pond (6-month cycle)

Species	Number of fingerlings per acre	Cost of fingerlings (Rs/acre)	Weight attained (kg)	Total production (quintal)	Price received Rs/kg
Rohu	800	1000	0.85	150	180-200
Mrigal (Naini)	300	350	0.30	25	150-160
Catla	1500	1000	1.00	100	180-200
Grass Carp	800	600	1.00	100	130-150
Common Carp	1300	800	1.00	100	180-200
	Total	**3750**		**475**	

- Apart from the major and minor carp, fish farmers also produce other fish species such as Walking Catfish *(Magur)* and Stinging Catfish *(Singhi)*. For this purpose, they catch the seeds of these species from the river and grow them in ponds.
- One of the major expenses in fishing is fish feed. The following table indicates the various types of fish feed given, quantity required per acre, frequency of feeding and total expenditure per acre. Due to various anthropogenic activities, local aquatic flora is diminishing and therefore fish farmers have to feed the fish externally.

Types of fish feed, expenditure per acre in a year

Fish Feed	Quantity (kg/acre)	Frequency	Cost/Acre (Rs)
Mustard cake	20	After 2 days	12800
Poultry beet	5000	Twice	8500
Cow dung	5000	Once in the whole cycle	6500
Grass/Vegetative plants	Nil	Nil	Nil

- Apart from the expenditure on fish feed, the input cost also includes the cost of various types of fishnets, a boat which is locally called *Dengi* and a transport vehicle. The fishnets used in the cluster are as follows:

Name of Net	Gil Size	No. required per acre	Cost of one unit	Lifespan (year)	Total Cost	Uses
Chat Jal (fine gill size- like mosquito net)	Very Small	5	1250 per 100 sq ft	1	6250	The protective boundary for preventing migration of fish during monsoon flood
Chhanti Jal (selected fish trap)	1'' Gill Size	5	20000 per100 sq ft	2	100000	Used for selected fishing in the big lot
Chhaap Jal (throwing net - fenka jaal)	1'' Gill Size	100	5000 per net	5	500000	Used for selected fishing in small lot
Small boat - dengi	Small Size	10	1700 per dengi	10	17000	For fishing

Case Study: Fish Production – Pirapur Village, Jandaha Block, Vaishali

- The fish production in Pirapur village is also dependent on rainfall in the monsoon season. The fish species of Rohu, Mrigal (Naini), Catla, Grass Carp and Common Carp are produced in these allotted ponds. The following table elaborates the species produced, harvesting time required, the average weight of fully-grown fish, total production per one acre of pond and price received in the market.

Cost of fingerlings, total production and price received in one acre of fish pond (6-month cycle)

Species	Number of fingerlings per acre	Cost of fingerlings (Rs/acre)	Weight attained (kg)	Total production (quintal)	Price received Rs/kg
Rohu	1500	2500	0.85	160	180-200
Mrigal (Naini)	500	650	0.30g	35	150-160
Catla	1500	1800	1.00	120	180-200
Grass Carp	1200	1100	1.00	110	130-150
Common Carp	1500	1200	1.00	140	180-200
	Total	**7250**		**565**	

- The following table indicates the various types of fish feed given, quantity required per acre, frequency of feeding and total expenditure per acre in Pirapur village.

Types of fish feed and expenditure per acre in a year

Fish Feed	Quantity (kg/acre)	Frequency	Cost/acre (Rs)
Mustard cake	20	Twice a month	15000
Poultry beet	5000	Twice in the whole cycle	9500
Cow dung	5000	Once in the whole cycle	6200
Grass/Vegetative plants	Nil	Nil	Nil

- As per the information shared by the fish farmers in Pirapur village, Rs. 50,000-60,000 is incurred on fishnets, boats and vehicles for transport.

Findings from both clusters

1. Fish farming is a labour-intensive business and requires a good number of labourers. In one cycle of six months, two labourers are required which costs around Rs. 60,000. The main functions of these labourers are to protect the fish pond and feed the fish. During the time of harvesting, which is done thrice in six months, around 50 labourers at wages of Rs. 500 each are required. Overall, Rs. 90,000 is spent on harvesting labour. Therefore, the total expenditure on labour for a one-acre area of the pond for one cycle is around Rs. 1,50,000.


Photo: Satish Awate

2. There are market constraints and currently retailers and wholesalers buy fish at a very low price and take it to the market and sell it at a higher price. The nearest big fish market to the clusters is Musallahpur Haat in Patna which is at a distance of 80 km from Jandaha and around 90 km from Saraiya. The bargaining power of fish farmers is low as the shelf life of harvested dead fish is low and cold storage and transport are not available to the fish farmers.


Photo: Subodh Kumar

3. Selling live fish can be an alternative but the technology and live fish transport setup are not accessible and affordable to fish farmers. Therefore, fish farmers have made temporary water tanks using tarpaulin sheets and carry live fish in these temporary tanks. As the roads are not good, the fish often die en route to the market, especially during harsh weather, and thus the farmers incur a loss.
4. Apart from all these expenses, the fish farmers have to pay 6 per cent tax at the time of selling their produce in the market.

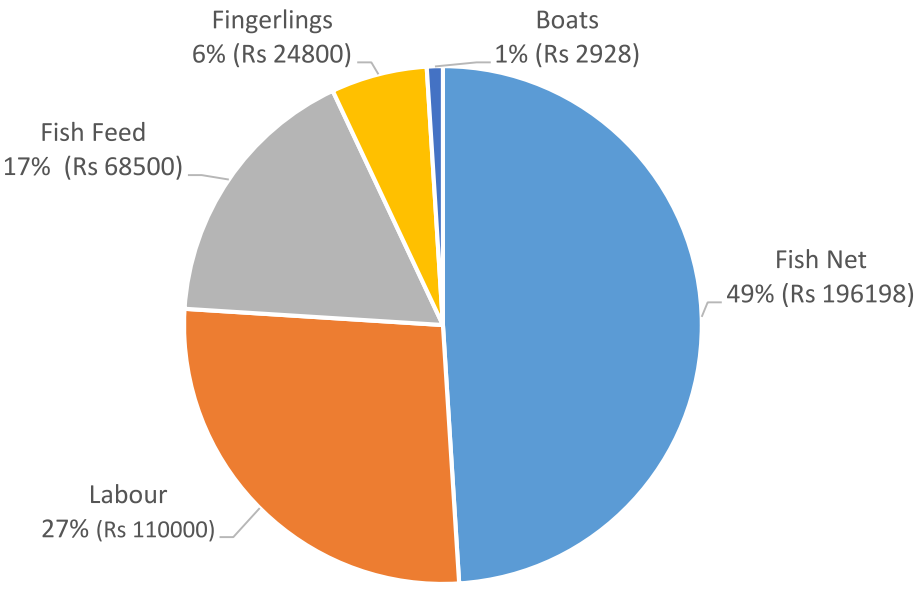
COST OF PRODUCTION

The distribution of annual cost per acre in fisheries is as follows. The total cost of fishing is Rs. 4,02,464 per acre and within that, the major costs are fishnet (49%), the cost of labour (27%), and the cost of fish feed (17%).

Cost of production of fisheries per acre

Heads of expenditure	Type	Total cost	Lifespan	Total yearly payable (Rs)
Fish nets	Chhanti	100000	2 years	56484
	Chaap	500000	5 years	133464
	Chat	6250	NA	6250
Boat	Dengi	17000	10	2928
Fingerlings	Rohu	6000	NA	6000
	Mrigal	3200	NA	3200
	Catla	6000	NA	6000
	Common Carp	4800	NA	4800
	Grass Carp	4800	NA	4800
Fish feed	Mustard cake	54000	NA	54000
	Poultry beet	8000	NA	8000
	Cow dung	6500	NA	6500
Labour	Managerial	60000	NA	60000
	Harvesting	25000	NA	50000
			Total	402426

Distribution of annual input cost per acre in fisheries



Total quantity of fish harvested and average income per acre per year

Species	Weight attained (kg)	Total production in a cycle of 6 months (quintal)	Price received (Rs/quintal)	Total amount received in the market
Rohu	0.85	7	13000	91000
Mrigal (Naini)	0.30	8	13000	104000
Catla	1.00	10	13000	130000
Grass Carp	1.00	8	13000	104000
Common Carp	1.00	10	13000	130000
		43		559000

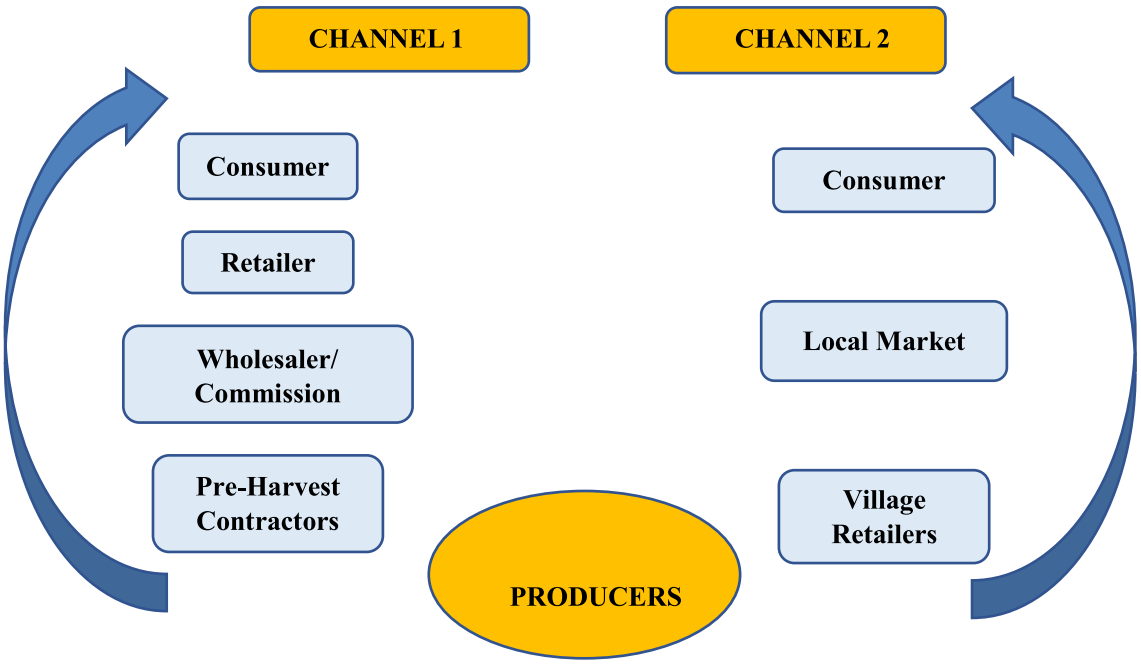
Net profit of fish farmers per acre pond area

Expenditure Head and Income	Rupees
Non-Recurring Expenditure of One Acre Natural Pond (Rs)	192876
Recurring Expenditure of One Acre Natural Pond (Rs)	209550
Total Harvest (quintal)	43
Gross Income	559000
Average profit = (Gross Income) - (Recurring + Non-Recurring cost)	156574

VALUE CHAIN OF INLAND FISHERIES

1. The value chain has been mapped with the fish farmers. It consists of input suppliers of spawn/ fingerlings, fish feed, farmers, and pre-harvest contractors. The pre-harvest contractors visit the fish farms before the harvest season and bid on the price to the fish farmers. If the price is agreed, the farmer harvests the fish from the pond and sells it to wholesalers in Hajipur, Muzaffarpur and Patna.
2. There are two main fish supply chains in the cluster villages viz. through pre-harvest contractors and village retailers. The most preferred channel is through pre-harvest contractors and commission agents from Hajipur, Muzaffarpur and Patna. During the glut period, farmers also prefer to sell their produce to local retailers at Muzaffarpur and Vaishali to recover at least the cost of production.
3. Small fish farmers also sell parts of their produce directly to consumers at roadside markets and local haats. This satisfies the immediate cash requirement of small farmers. The overall value chain is depicted in the figure ahead:

Fisheries value chain in the study area



GHG EMISSION AND IMPACT OF CLIMATE CHANGE

Carp-based fisheries have been a very traditional industry, with little technology and making use of the local resources for feed. It has the potential for CO_2 sequestration through phytoplankton growth. The study revealed that water refilling and transportation is based on diesel-operated water pump sets and diesel-operated vehicles and are the major source of GHG emissions in the sector. The post-harvest processing activities, distribution, and trade are heavily dependent on fossil fuels and responsible for GHG emissions (Das & Sharma, 2010). For inland waters, projected changes in surface water availability are the most obvious threat to fishery production. There is a close relationship between floodplain area, river flow, wetland surface area and total fish production. Therefore, the decline in surface water availability in many parts of the country is predicted to be a threat to inland fish production, so to the study area. Simultaneously an increase in temperature has been witnessed during the winter months of January and February. This increase in temperature is not linear and sudden increases in temperature result in detrimental impacts on the fish production system. Farmers have reported the increased mortality of their fish during extreme weather events.

Photo: Subodh Kumar

CONSTRAINTS IN FISH FARMING

1. Inland fisheries are subjected to a range of challenges, including flow alterations, invasive species, sedimentation, low rainfall and drought, and pollution in the form of runoff from the nearby settlements and agricultural fields.
2. Some of the limiting factors for fisher folk are a lack of knowledge about monitoring soil and water parameters, feed composition and its nutritional value and different packages of practices such as pond preparation, fertilization, stocking, feeding, and health care.
3. Property regimes, input supply, harvesting, output disposal, high interest rates for credit, poaching, technology adoption etc. also are major constraints limiting the realization of fishing potential.
4. Most of the ponds are village/government ponds and small numbers are privately owned. These water resources have open access with multiple uses for drinking water, agriculture, and allied activities and water for day-to-day requirements. This affects the full adaptation of the package of best practices adversely.
5. The states have different policies in terms of lease amount, lease period and selection of lessee. For example, in Bihar, the ponds are leased out to a small group of fishers for one year. Such policies restrict the adoption of scientific practices and pond restorations and security structures. As the benefits of these practices are realized only over a longer period, farmers are unwilling to invest in sustainable pond restoration practices.
6. The fisher lessees are mostly very poor and cannot follow the scientific package of practices. The process requires support systems for effective collectivization, credit, technological access, supervision, monitoring and fish catch and marketing.
7. Given the remote locations, fish farmers' biggest challenge is reaching the market with live fish harvest intact. Currently, farmers are using pickup vehicles lined with plastic sheets to transport fish harvests to the market. Sometimes nearly half of their fish die due to harsh weather conditions, lack of oxygen, and delays due to traffic jams on the way to the market. Once the fish is dead, it reduces the price to half. Hence fish producers generally avoid transporting the harvest to the markets on their own and instead rely on pre-harvest contractors. Middlemen and pre-harvest contractors have ability to invest in transportation systems and consequently corner a big share of the profit for themselves.

RECOMMENDATIONS

The fisheries sector is important for food and nutritional security and has a high potential for driving rural development, employment generation, gender mainstreaming as well as export earnings. Despite having vast fishery resources, Bihar lags in fish production and needs focussed programmes to improve the production and strengthen the livelihoods of the *Mallah, Kewat, Bind, Nishad, Dhimar, Karabak,* and *Sahani* communities, often referred to collectively as *Nishad,* who form a significant population in the state and whose traditional livelihoods centre around water bodies.

1. Promotion of sustainable fishery practices: There is an urgent need to promote conservation and eco-restoration of freshwater bodies. Some of the key aspects of eco-restoration are the eradication of invasive weeds and exotic fish species, scientific de-silting, replenishing aquatic flora and native fish species and reducing the use of pesticides and runoffs from nearby agricultural fields. Existing frameworks such as the Biological Diversity Act, 2002, Mahatma Gandhi National Rural Employment Guarantee Act, 2005, and Forests Rights Act, 2006 provide scope for local management and eco-restoration of freshwater bodies.

2. Protective water supply: The fisheries in Bihar are based on the monsoon rains. The rainwater that fills in the lakes, ponds, *chaurs* and *mauns* is used for fisheries purposes for only one cycle of 6-8 months. Most of the fish production ponds dry up in April-May-June. Fish farmers try to harvest their stock till March or up to mid-April. A special plan for creating a secured water supply to cope with uncertain rainfall is needed, with provision for solar-based pump sets to replace existing systems of largely diesel genset-based pump sets.
3. Access to quality fish seed/spawn and fingerlings: The present government schemes support the establishment of hatcheries at the district level towards strengthening spawn supply from within the state. This programme should be extended with support for the construction of low-cost and bamboo-based cage and pen structures towards the production of fingerlings from spawn. A unit of cage and pen with the capacity to rear 1,00,000 spawn costs around Rs. 1,00,000, with bamboo cost being the key variable. Other bit expensive but durable alternatives too can be considered as options. This will enable the production and supply of quality spawn at low cost, reduce the mortalities and enable the production of native fish seeds.
4. Live fish marketing: The study revealed that fishers get a small share in the price paid by final consumers. The technological input and collectivization of fishers can help fishers reduce the cost of inputs, sell fish directly to the consumer and increase their share in the value chain. The technologies like oxygen-equipped fish transport EVs to supply live fish to distant markets can help fishers nearly double their earnings.
5. Other aquatic livelihood sources: There is huge potential for other freshwater-based livelihoods such as *Singhada* (water chestnut or trapa), *Makhana,* and lotus root as vegetables, which have good market value and add extra income to the fishers.
6. Strengthening of fishery cooperatives in Bihar: Presently, the fishery cooperative structure is limited in its role in terms of securing a 5-year lease from the state-level authorities and sub-letting waterbodies among its members. The following action points are recommended for the effective performance of the cooperative system
    a. Capacity building in eco-restoration, better production system practices, and marketing.
    b. Developing a network of hatcheries and cage-pen culture across the state. Low-cost options can be explored towards this infrastructure creation, especially with ownership by trained women groups on the lines of the experiences of the *Dhiwar* community in Vidarbh region of Maharashtra.
    c. Live fish transportation and cold-chain development.
    d. Business plan-based investments in fishery development including retail marketing systems. A block-level pilot is recommended in this regard before up-scaling.

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