

AN ECONOMIC ANALYSIS OF PRODUCTION AND MARKETING OF FISH IN WEST BENGAL

Thesis

Submitted to the



**G. B. Pant University of Agriculture & Technology
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By

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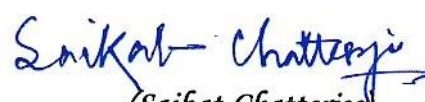
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Pantnagar
October, 2021


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Author

CERTIFICATE - I

This is to certify that the thesis entitled “**AN ECONOMIC ANALYSIS OF PRODUCTION AND MARKETING OF FISH IN WEST BENGAL**” submitted in partial fulfillment of the requirements for the degree of **Master of Science in Agriculture** with major in **Agricultural Economics**, of the College of Post Graduate Studies, G. B. Pant University of Agriculture & Technology, Pantnagar, is a record of bonafide research carried out by **Mr. Saikat Chatterjee, Id. No. 55413** under my supervision and no part of the thesis has been submitted for any other degree or diploma.

The assistance and help received during the course of this investigation have been acknowledged.

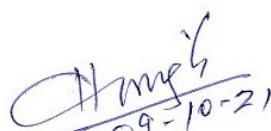
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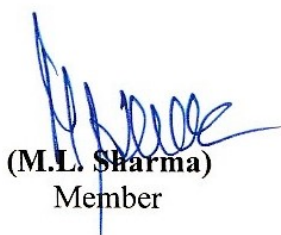
CERTIFICATE - II

We, the undersigned, members of the Advisory Committee of **Mr. Saikat Chatterjee, Id. No. 55413**, a candidate for the degree of **Master of Science in Agriculture** with major in **Agricultural Economics**, agree that the thesis entitled **“AN ECONOMIC ANALYSIS OF PRODUCTION AND MARKETING OF FISH IN WEST BENGAL”** may be submitted in partial fulfillment of the requirements for the degree.



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Member



(Shweta Chaudhary)

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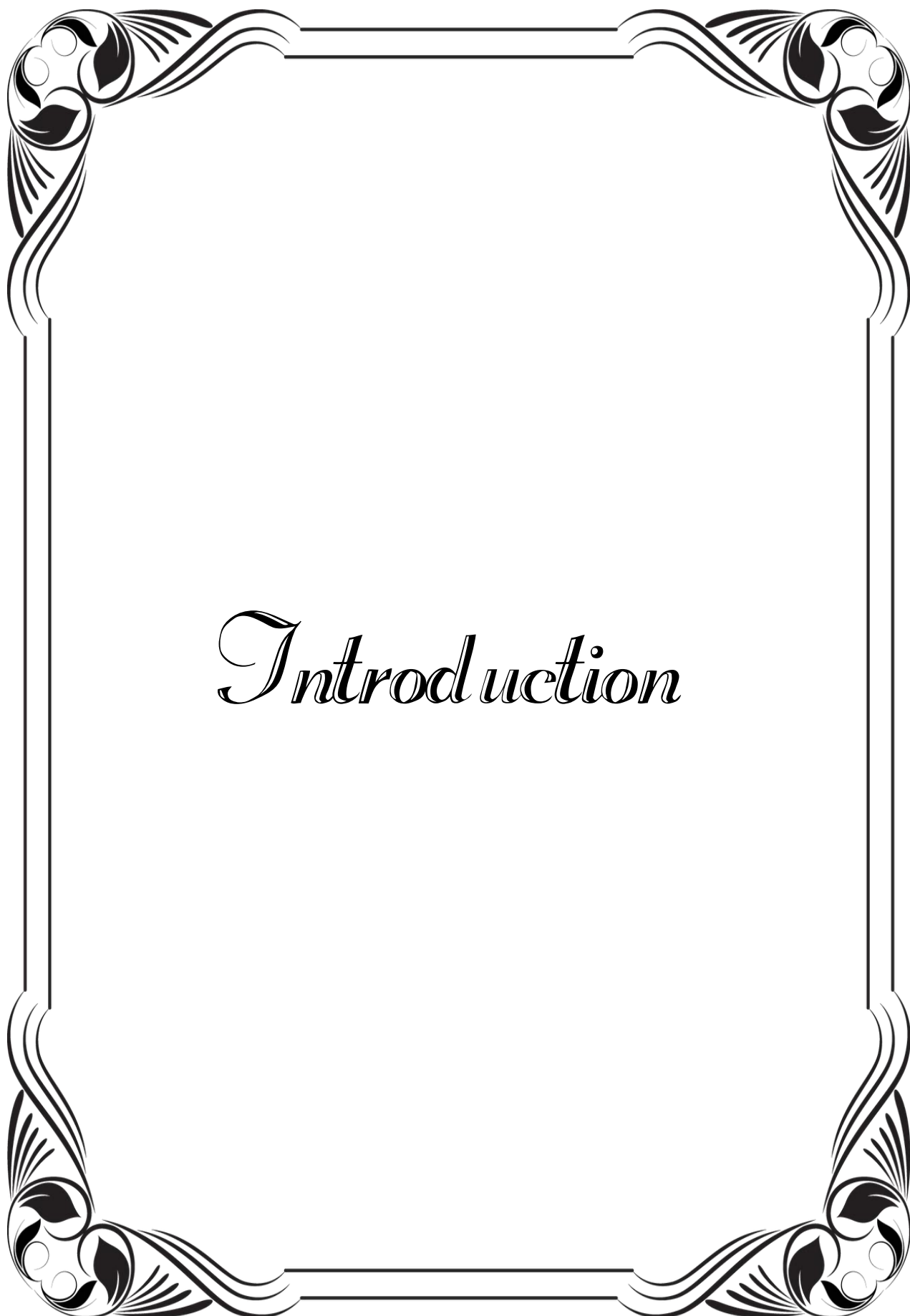
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Introduction

Fish has one of the nature's best nutritional values for human being. It has been identified that the proteins required for sustained human development could be obtained if there are animal proteins in human diet. Fish is a good source of animal protein and has been used as a valuable source of food providing minerals *i.e.*, copper, phosphorous, sulphur, iodine and selenium and small fish that is eaten with bones, are particularly enriched with calcium (**Kaur *et al.* 2014**). Fish has a contribution of 20 per cent of animal protein requirements of around 50 per cent of world's population.

1.1 Background

Fish is enriched with vitamin A, vitamin B and oils containing poly-saturated fatty acids which help to check the cholesterol level of the blood can be taken from fish (**Singh, 1999**) but being a highly perishable commodity there should be a good storage facility of fish, or else it is to be disposed of as early as possible (**Mishra *et al.* 2000**). Therefore, fisheries and aquaculture prove to be a good source of food security and nutrition of human being in the world.

Fishing is one of the oldest occupations of man and it comes much before he could learn something about agriculture. The earliest known references to pond fish culture were from China, 4,000 years ago and from India 2700 years ago. The integration of pond fish culture and rice farming is documented as early as the Mid-Eastern Han Dynasty (AD 25-220) in China. Fish farming was practised during the times of the Roman Empire in the Mediterranean region and later became a part of the food production system of Christian Monasteries in Central Europe (**Ravi kumar, 2005**).

Fisheries sector have been identified as being important in the socio-economic development of the country. It contributes to national income, exports, food and nutritional security and employment generation. For the improvement of fisheries sector in the country, the main challenges are to examine fishery resources and future

fish production, generating advanced techniques for fin and shell fish culture, yield maximizing operations related to harvesting of fish, facilities of landing and berthing for fishing vessels, increment in the export of marine products providing income and employment generation thus improving the standard of living of fishermen as well as their socio-economic status **(Krishan, 2004)**. Entry of WTO as an international regulatory body creates a drastic change in the global trade environment and also had its impact on Indian sea products. Exports of Indian fish and fish products has increased 58.67 per cent in volume from 2010-11 to 2019-20. It has increased from 0.813 Million Tonnes (MT) in volume in 2010-11 to 1.29 MT in volume in 2019-20 **(Handbook on Fisheries Statistics, 2020)**.

There are two main types of fisheries, Inland fisheries and marine fisheries. An Inland fishery deal with the fishery aspects of waters other than marine water. Sources of marine fisheries include 7500 km of coastal line and deep sea beyond it. Inland fisheries are the commercial fishing operations taking place in fresh water. It is performed in brackish coastal areas, irrigation reservoirs, canals, natural, man-made ponds, tanks, cages, pens and lagoons. The fish farming is a performance of cultivation of fish in the controlled environment usually pond and after reaching the desired size, harvesting operation is done. **(Tyler miller, 1994)**. Inland fisheries have a major economic significance to the Indian economy. The main benefits which can be derived from Inland fishery development and associated growth can be categorized under different heads, viz., nutrition and food supply, sources of income, sources of employment, facilitate investments controlling mosquitoes and suitable for scientific research and environmental education **(Chandra et al. 2008)**.

1.2 Production Scenario of Fish

About one billion people rely upon fish as their primary source of animal protein worldwide. Growth of population, urbanization and incremental income would lead to increase in the world fish consumption. Gross Value Added (in constant price 2011-12) by fisheries sector has increased from 68,027.00 crore to 2,12,915.00 crore during the year 2011-12 to 2018-19. In 2014, global fish production reached 167.20 million tonnes (MT) constituting capture fisheries production of 93.40 MT and

aquaculture production of 73.80 MT (**FAO, 2016**) of which almost 30 per cent is contributed by China. Asia is the largest center of aquaculture production, and currently more than 90 percent of the global aquaculture production comes from Asian countries in which our nation is in the third rank after China and Indonesia.

Asia consists of nearly 65.60 MT of aquaculture production which is 89 per cent of world aquaculture fish production. Asia-pacific region consists of 98 per cent of global carp production. Freshwater carps such as Rohu, Catla, Mrigal, Grass carp, Silver carp and Common carp are the widely-cultured species in South Asia consists of more than 80 per cent of the total freshwater aquaculture production (**Siriwardena, 2007**).

Presently, India is the third largest fish producing country in the world. Fish production of the country has increased 240.72 per cent during the year 1991-1992 to 2019-20. It has increased from 4.15 MT (2.44 MT from marine and 1.71 MT from Inland fisheries) in 1991-92 to 14.16MT (3.72MT from marine and 10.43MT from Inland fisheries) in 2019-20. (**Annual Report, Department of Fisheries, 2020**). The contribution of Inland fishery to the total fish production has increased from 29 per cent to 74 per cent from 1970's to 2020; this naturally increases the GDP contribution from the sector (**Handbook on Fisheries Statistics, 2020**).

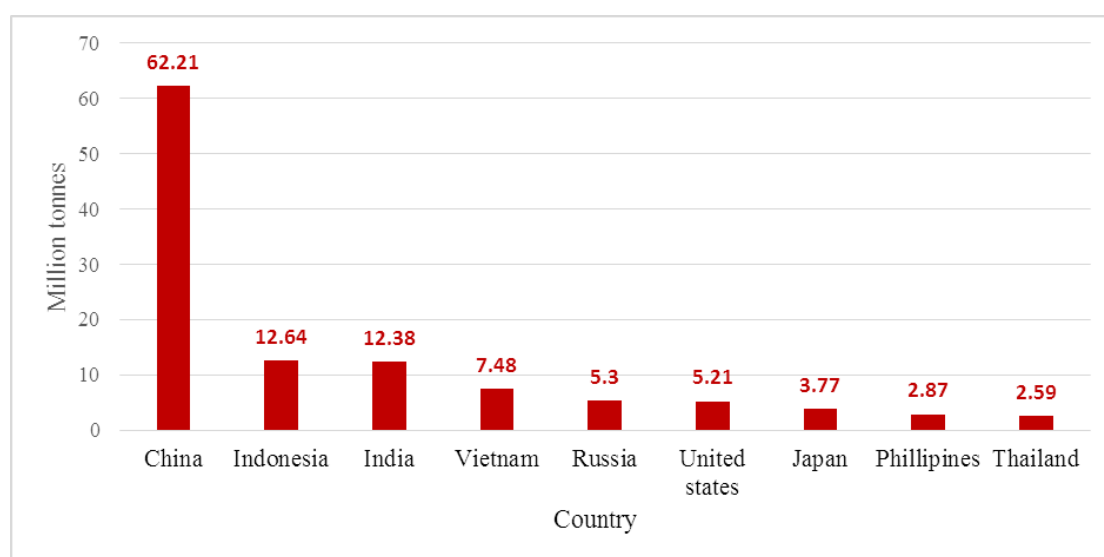


Fig 1: Major Fish producing countries

Source: Source: *SOFIA 2020. – State of Fisheries and Aquaculture in the world*

India is endowed with huge Inland water resources which comprises 2,52,431.48 km of rivers and canals, 10,65,500 hectares of brackish water, 17,76,991 hectares of small reservoirs, 22,54,810 hectares of medium and large reservoirs, 92,00,327 hectares of ponds and tanks and 4,81,455.93 hectares of beels/oxbow lakes/derelict water. Though, the production breaks up of different water bodies is not available, it is examined that ponds and tanks have the major role in aquaculture production, whereas capture fisheries production from rivers and estuaries has only a small share of the total Inland catch. Reservoirs accounted for the major share of Inland capture production, which are managed on the basis of culture-based fisheries or various other forms of enhancement (Ayyapan, *et al.*, 2011).

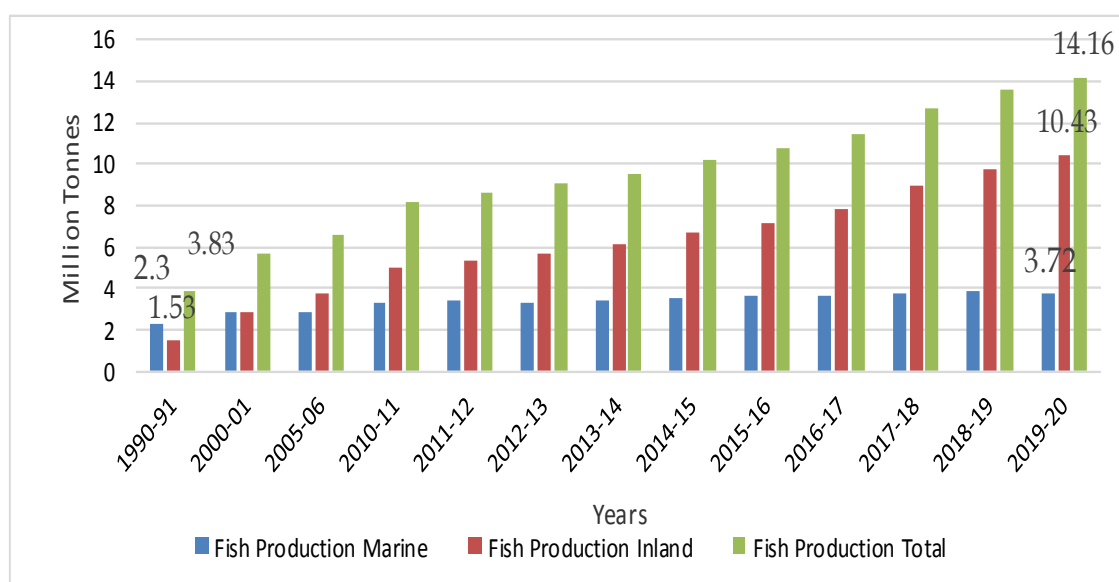


Fig 2: Fish production scenario in India

Source: Handbook on Fisheries Statistics, 2020

The major Inland fish producing states in India are Andhra Pradesh (3.61 MT), West Bengal (1.62), Bihar (0.64), Uttar Pradesh (0.69), Odisha (0.66), Chhattisgarh (0.57), Assam (0.37), Telangana (0.3), Jharkhand (0.22) and Karnataka (0.23 MT) (Handbook on Fisheries Statistics, 2020).

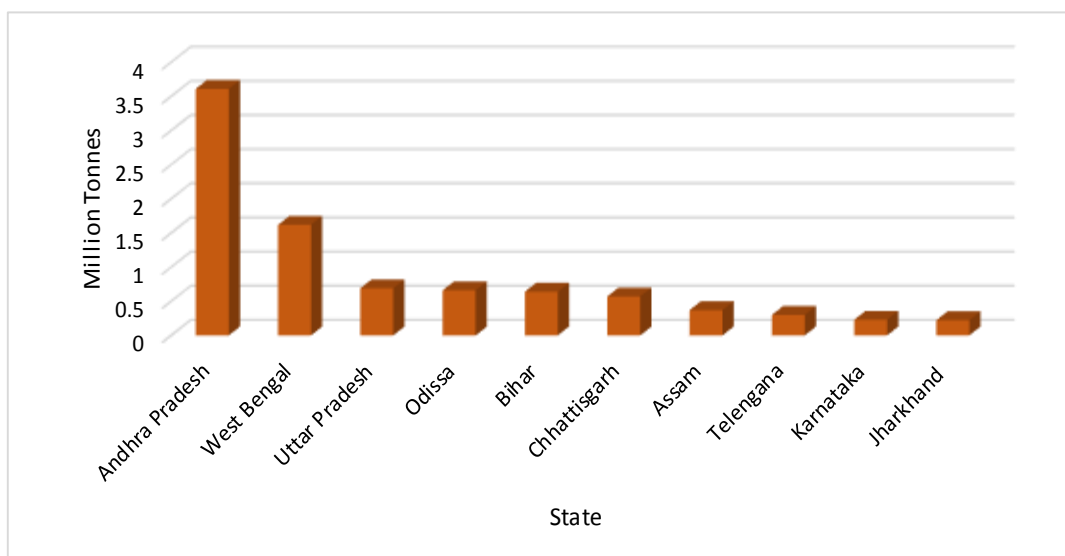


Fig 3: Major Inland Fish producing states

Source: Handbook on Fisheries Statistics, 2020

Roughly 14.50 million people are directly involved in the fishery sector of the country. This sector also generates foreign exchange earnings thus contributing in the country's economy, employment and income generation. Fish products export aggregated to 1.28 MT in volume and valued at Rs. 46,662.85crores (**Annual Report, Dept. of Fisheries, 2020**).

In India, fertilized ponds are the major source of poly culture of Indian Major Carps (IMC) and Chinese carps. The three Indian major carps, namely, Catla, Rohu and Mrigal contribute to the majority of the national carp production. A three-tiered carp culture system is practiced in India, namely, nursery rearing and grow-out production systems (**Nandeesh et al. 2013**). Government of India has established Fish Farmers Development Agencies (FFDA) in almost all districts of every state and provided special support to promote carp farming. West Bengal is in 7th position in marine fish production and 2nd position in Inland fish production in the country. West Bengal is one of the richest states among the Indian states having Inland water resources of various types constituting about 23.09 per cent of Inland water resources of India. These resources have 2,526.00 km of river and canals 28,050.00 hectare of small reservoirs, 2,63,372.00 hectare of ponds and tanks, 2,10,000 hectare of brackish

water 42,082 hectare of beels, 2526 km length of rivers which provide an immense scope of development of Inland fisheries. The production mainly from Inland resources is 1.62 MT. The major Inland fish producing districts of West Bengal are listed in the Appendix IV. In West Bengal highest and lowest number of Inland fish producing districts are North 24 parganas (201955 tonnes) and Darjeeling (1867 tonnes) with average Inland fish production per rural person 46.55 and 1.65 kg, respectively.

1.3 Problem Statement

West Bengal is the sixth largest economy of India and also the second largest fish producing state in the country. During 2019-20, West Bengal produced a total of 1.62 million tonnes of fish (**Annual Report, Department of Fisheries, 2020**). Out of the total aquaculture production, more than 70 percent comes from small-scale farmers, who are also the major contributors of adaptations and small-scale innovations of different aquaculture technologies. Fish farmers of this state have a remarkable interest towards the fish farming. Moreover, the climatic conditions of West Bengal are favourable for the fish production. Although, fish production in West Bengal is increasing over the years but in recent years prices of inputs increases remarkably as well wage rate also that causes declining of income from fish production. Besides these, over fishing, lack of market infrastructure and different socioeconomic and environmental constraints also affecting fish production. Socio economic causes includes high cost of input, capital intensive, poor institutional linkage, poor mass media exposure, lack of quality fish seeds, decline in fish catch, destructive fishing method, habitat degradation due to water pollution, climate change etc. Whereas, bio-physical causes include small pond size, unscientific stocking density and poor water quality (**Biswas *et al.* 2019**). Increasing nuclear family system, rivalry, lack of renovation of existing ponds, pouching, poisoning in the pond has rendered large numbers of water bodies unproductive. Apart from production related problem, inefficient marketing system, exploitation by middleman, unscientific transportation is also impeding the smooth supply, decreasing the producers share in consumers rupee and affecting the timely availability of fish in market (**Rahaman *et***

al. 2013). Marketing of fish is as important as that of production considering the dominance of widely scattered marginal and small fish farmers of West Bengal but over the years this aspect remains neglected and becomes major source of exploitation of the producer in the hands of intermediaries. In the light of above problems, an attempt has been made in the present study to achieve the following objectives.

1.4 Objectives

1. To study the trends in production of Inland fisheries in the state.
2. To work out the cost of and returns from fish farming in the study area.
3. To identify the marketing channels and to work out the efficiency of different channels.
4. To identify the constraints in the production and marketing of fish farming.

1.5 Scope of The Study

Scope of the study includes nature, coverage and limitation of the study. With regard to the nature of the study, it is diagnostic in nature and prescribes the costs and returns in fish production, resource adjustment for increasing income level and to find out the efficiency of marketing channels involved in fish sale. The study has been conducted in West Bengal covering 2 districts of the state, namely, Murshidabad and Birbhum. Study is of paramount to examine the trend and cost and return of fish production in fish ponds along with examining the resource use and marketing efficiency of fish. Also, the study looks into the problems faced by the fish producers in both production and marketing.

1.6 Limitation of The Study

The study is particularly focused on economics of pond fish culture. Hence, the policies suggested in the study were narrating to the pond fish culture in the study area. Due to limited time, financial resources and covid-19 situation, the study has been conducted in a limited geographical area. Moreover, farmers do not maintain records of their yield, fertilizer application, plant protection chemicals, and other details, they are expected to recall from their memory. Thus, there may be chances of

some kind of recall biasness. The results of the study are affected by this. However, attempts have been made to reduce this by collection of reliable data through well-structured pre-tested survey schedule.

1.7 Organization of The Thesis:

The thesis has been presented into five chapters. The first chapter deals with Introduction which includes nature and background of the study, statement of the problem, the objectives of the study and also limitations of the study. The second chapter review of literature provides comprehensive review of previous related studies according to the objectives. Profile of the study area has given in the third chapter. Afterwards, the fourth chapter namely research methodology gives sampling design, data collection method, analytical framework of the study and statistical tools used for analysis in the study. The fifth chapter results and discussion show the research findings of the study along with the discussions. Summary of the whole study and conclusions based on the findings have been presented in the section entitled summary and conclusions. At last references have been mentioned under literature cited.

*Review
of
Literature*

Chapter 2

REVIEW OF LITERATURE

A review of the research works done in the field of Inland fisheries are presented in this chapter. A review of past research helps in assessing the conceptual and methodological issues relevant to the study. Researcher has been able to collect relevant data leading to sound reasoning and meaningful interpretation. Keeping in view the objectives of the study, reviews are presented under the following headings.

2.1 Trends in Inland fish production.

2.2 Cost of and returns from fish farming.

2.3 Identification of marketing channels and work out of efficiency of different marketing channels

2.4 Constraints in the production and marketing of fish farming.

2.1 Studies related to trends in Inland fish production

Rao and Raju (1997) studied that practice of fresh water fish culture in Andhra Pradesh was done in reservoirs tanks as well as in agricultural lands by converting them into fish tanks/ponds. About 50 thousand hectares of agricultural land had been converted into fish ponds and the Inland fish production was to the extent of 167 thousand tonnes during 1993-94. There was a boom and recession in the aquaculture industry in Andhra Pradesh in the recent decade. The major cause were fluctuations in export markets, natural calamities, high cost of feed, fuel and seed besides lack of technical knowledge of the farm operators and poor extension services.

Katiha et al. (2005) worked on resource base, yield trends, yield gaps, adoption and impact on fish farmers, economics, returns to inputs, investment needs, and future prospects fish farming. Indian aquaculture is primarily limited to inland sector and carp-oriented; for that reason, this activity received special attention. Freshwater aquaculture observed tremendous growth in the past 15 years, but immense scope still exists for horizontal expansion and increases in productivity

(vertical expansion). Dedicated efforts should be there to achieve the higher demand for quality fish seed and feed which increases 45% in area and more than 50% in productivity.

Mohammad (2007) studied the growth and instability in Inland fish production for two different periods of Sindh province: Period-I (1975-1988) and period-II (1989-2002). The study revealed that in period I, nine districts (out of eleven districts), the growth rate of inland fish production was positive and statistically significant. This means that in the above districts in Sindh province the fishing profession was profitable mainly due to different sources of fish catching, low prices of input, easy availability of formal credit system, better process of issuing license system and better livelihood. The study also confirmed that in period II, the rate of growth of Khairpur, Larkana, Hyderabad, Badin, Thatta and Sindh districts increased positively, while that of Sanghar and Tharparkar decreased. The negative growth may be due to non-profitability of this occupation, poverty, shifting of Inland fish farmers to other profitable enterprises, contract system, non-availability of formal credit system, overall livelihood resource degradation and insufficient sources of catching fish. The increase in the growth rate of 5 districts in period II (especially Badin and Thatta) may be due to; fighting of fishermen against contract system, better availability of formal credit system and better fishing grounds. The results of the study also indicated positive and significant growth rate in all the districts (except Sanghar and Tharparkar) and province in all period.

Narasimha Ramulu (2015) made an attempt to study the fish productivity in certain lakes in Northern Telangana regions during the years 2012 to 2014. In his study the total yield of fish has been estimated for the consecutive years (for a period of two years from 2012-2014). It was observed that the fish production has increased from 1,48,799 tonnes to 1,86,960 tonnes whereas the fresh water prawn production was decreased from 3,229 tonnes to 1,881 tonnes. However, it was observed that in order to increase fish production there has been an increase of pressure on these water bodies which lead to ecological imbalance.

Paul and Basak (2015) studied inland aquaculture in West Bengal. It was revealed that besides agriculture, inland fishing is also another important source of economic development in West Bengal. He also concluded that there are abundant rivers, canals, beels and ponds and a huge demand of fish in this state. The total production of inland fish was 1.53 million tonnes in the year 2012-13. Fishes are exported primarily to Japan followed by Vietnam and China. However, fishery sectors in West Bengal are facing different types of production and marketing related problems. In spite of this, inland fisheries are a sunrise sector of economy as well as rural development of West Bengal.

Sathulingamurthy (2015) studied the growth rates and pattern of the fish production and productivity and the shares of different components in East Coast and West Coast in marine fish sector. The study revealed that the production, exponential growth and instability in marine as well as inland fish production for three different periods for India; period – I as initial phase (1978-87), period – II as growth phase (1988-91) and period – III as saturation (1998-2010) in marine fish production. In overall period the annual rate of growth of fish production in India was 4.20 percent. It was also revealed the elasticity of output with respect to active fishermen and with respect to continental shelf was 0.50 and 0.30 respectively.

Ghosh et al. (2017) made an attempt to analyse fishery resource and production statistics trends of West Bengal a major fish producing state of India with highest per capita consumption. It predicted the following models on sector wise production and fish demand in the state of West Bengal. Prediction Model Inland fish production: $Y_{est} = 8 + 0.467X$, $R^2 = 0.894$. Marine fish production: $Y_{est} = 1.5 + 0.031X$, $R^2 = -1.93$. Total fish production: $Est = 10 + 0.442X$, $R^2 = 0.894$ and Prediction Model total fish demand: $Y(est) = 15 + 0.211X$, $R^2 = 0.996$. The models will help in the planning and development of the sector by identifying and maximizing the use of various resources while taking necessary actions for the state of West Bengal's fisheries growth.

Abishag et al. (2019) revealed that India leads the world in aquaculture production next to China. The current blue revolution aims to triple India's fish

production by 2020, necessitating efficient resource management. A country's aquaculture resources must include not only land and water, but also species diversity, workforce, and infrastructure. Despite the fact that Indian aquaculture has boosted production in recent years, productivity in terms of water and labour resources remains low. Diversification of species is also required for mariculture activities. As a result, this article looks at the state of Indian aquaculture from a worldwide perspective in order to figure out how to boost output.

Khanal *et al.* (2020) studied production, marketing, and strategies for improving production and marketing. Secondary data on production and trade value was gathered from a variety of sources, including organizations, websites, and journals, and analyzed in Microsoft Excel. Rearing of various fish species has become increasingly popular around the world, especially in Nepal. Globally, marine and inland fisheries are becoming profitable markets. Nepal's fish farming is limited to inland water resources due to its landlocked status. As a result, domestic fish production was insufficient to meet national demand. At a national level, fisheries have increased dramatically in recent decades, with overall production, trade, and consumption reaching all-time highs in 2018.

2.2 Studies related to cost and returns from fish farming

Suresh (1996) studied the economic feasibility of composite fish culture in leased-in village tanks of Kanyakumari district. It also revealed that as Kanyakumari district belongs to the high rainfall zone, In the leased-in village tanks, it has resource benefits for composite fish culture. Under the FFDA programme, more than 400 fish farmers are using leased-in tanks to practice composite fish culture. Investment criteria like Pay Back Period (PBP), Simple Rate of Returns (SRR), Net Present Value (NPV) and Benefit Cost Ratio (BCR) were estimated. The village tanks are leased-out to fish farmers under the FFDA programme for 10 years. According to the analysis, there was profitability of composite fish culture in village tanks in the district.

Setty Ajay (2001) assessed the economics of freshwater aquaculture in Thanjavur district, Tamil Nadu. He found that the total cost per ha per crop in carp farming was worked out to Rs. 1,14,620.00 and out of this, the variable costs and

fixed costs were accounted to Rs. 61,820.00 and Rs. 52,800.00, respectively. The total returns and the net return per ha were Rs. 1,47,640.00 and Rs. 33,020.00 respectively. Feed and labour were the major input cost accounting for 24.58 per cent and 11.08 per cent among the items of variable cost. Among the items of fixed cost, lease money/rental value for the land, depreciation, repairs and interest worked out to 3.17, 6.77, 1.62, 6.01 per cent of the total cost, respectively. The input-output ratios on variable cost basis and total cost basis were 2.88 and 1.29, respectively.

Katiha et al. (2005) worked on the resource base, yield trends, yield gaps, adoption and its impact on fish farmers, economics, input returns, investment needs, and future prospects. It further stated that barely one-third of the fish were harvested on average in the farm trials. The difference was primarily due to the fact that on-farm trials used significantly more input. Benefit-cost ratios for different aquaculture systems ranged from 1.22 to 1.86. The return on capital was substantially larger than the return on labour due to the low labour input. The semi-intensive aquaculture system would give the highest return from macrolevel investments, followed by extensive and intense systems.

Jain and Pathak (2006) studied the economics of production and marketing of fish in Raipur district of Chhattisgarh. They found that, the average net income per fish farm estimated was Rs. 33,244 per hectare which indicates that fisheries could be a profitable enterprise for a large number of rural people in Chhattisgarh. The study concluded that with proper fisheries management, technical and financial support, improved marketing and market infrastructure, availability of good quality but cost-effective seeds and extension support the productivity of fisheries could be increased. The benefit cost ratio of 1:0.70 could be further improved upon through credit and support subsidy particularly, for creation of ponds and tank structures in the state of Chhattisgarh.

Sirohi et al. (2007) in their study on economics of milk production variations across productivity levels reported that the average daily maintenance cost ranged from about 62 for crossbred cow of average 7 litres productivity to 97 for high producing animal, yielding nearly 24 litres per day. The feed cost increased from 43

to 79 for corresponding productivity levels of 17 and 24 litres per day, respectively. The net profit margin per cow was estimated to be 9 per cent for milch animals and 35 per cent for the lactating animals. In case of buffaloes, the average daily maintenance cost ranged from Rs. 43.50 for a buffalo producing about 3.6 litres of milk, to 62 for the animal with average daily yield of 11.5 litres. The average daily cost was Rs. 52 over the three productivity ranges and about 7 per cent lower for milch animals.

Gurunathan and Raghuram (2011) studied the profitability of Inland fish farms in Thanjavur district in Tamil Nadu. The study indicated that on an average, the total cost, gross returns, net returns and yield per ha was Rs. 1,30,190, Rs.2,50,300, Rs.1,20,120 and 3,520 kg, respectively. The average variable cost and fixed cost per ha was Rs. 97,000 and Rs. 33,180, respectively. They concluded that fresh water fish farming was a profitable venture for the farmers.

Goswami *et al.* (2013) studied the economics of small-scale pond fish farming in a tribal district of India. The results of the study indicated that the pond fish farming is an economically viable enterprise with the benefit cost-ratio ranging from 2.22 to 4.44. The study also highlighted the major constraints hampering the growth of fish farming in the district. The analysis indicated the necessity of developing infrastructure to realize potential of fish farming and marketing as a premier enterprise in the district.

Kumar *et al.* (2013) analyzed the economics of fish production in Bharatpur district of Rajasthan. Benefit Cost Ratio (BCR) was higher in small owned ponds (2.34) when compared to small leased ponds (2.12). In the case of large sized ponds, it was higher in leased ponds (2.71) against owned ponds (2.00).

Shivakumar *et al.* (2013) made an analysis on the economics of seed rearing and farming of carps. 258 villages of Southern Karnataka were taken for the assessment and found out that in case of fish seed rearing for 50 days, the BC ratio for catla, rohu, common carp and grass carp were 1.59, 2.91, 2.05 and 3.40, respectively. The return on investment (RoI) is high in grass carp (2.61) followed by rohu (2.32), common carp (1.81) and catla (1.52). In fish culture for 10 months' period, the BC ratio in feed-based farming was 1.05, whereas in conventional feed based system and

extensive method it was 0.47 and 0.53, respectively. The RoI was highest in conventional feed-based system (0.86), followed by feed based (0.61) and extensive method (0.29). In second year, the RoI was increased to 2.05, 1.47 and 1.53, respectively. Though the rates of inputs vary from place to place, the study gives the economic trend so that farmers, entrepreneurs can plan their scale of operation based on the resource and capital.

Roy (2013) studied land relations in prawn farming in on the basis of data collected from a household survey in a village in the Sunderban estuarine region in West Bengal. The investigation of the structure of ownership holdings revealed that land distribution in Tentultala village was unequal. The Gini coefficient of ownership holdings distribution was 0.66. Fish farming had resulted in land concentration among Tentultala's large fish growers. In Tentultala, these households controlled over 70% of the whole operated area. The Gini coefficient of operational holdings distribution was 0.93. Small landowners and bargadars' livelihood security has improved as a result of the creation of a land lease market. Unlike in many other parts of India, prawn farming has improved the livelihood security of a group of poor people who own land and have the right to cultivate it.

Bag et al. (2014) worked on economic feasibility of intensive aquaculture integrated with irrigation system. It revealed that different stocking densities viz., 20000 (St. D-2.0), 35000 and 50000 (St. D-5.0) fingerlings ha⁻¹ were used for the culture of the Indian major carps (IMC) *Catla catla*, *Labeo rohita*, and *Cirrhinus mrigala*, for a period of 300 days with suitable management practices. A comparative evaluation of economic feasibility (St. D-3.5) was undertaken between I the actual study carried out within the irrigation system (WIS) and (ii) a hypothetical example of aquaculture carried out alone (OIS). For all three stocking densities, WIS estimated a significantly higher net present value (NPV), internal rate of return (IRR), and shorter payback period than OIS (p0.05).

Anbukkani (2015) conducted study on economic analysis of dairy farming in dry farming areas of Tamil Nadu. The study revealed that farmers received Rs.12 per litre for cow milk by selling milk to private dairy operating in that area. Cost of

production of per litre of milk was estimated and was found to be maximum for large size herds followed by small and medium at Rs. 8.43, 7.13 and 6.13 per litre, respectively.

Chidambaram *et al.* (2016) worked on the techno-economic analysis of carp farming practices in Krishnagiri district of Tamil Nadu. The study revealed that due to lack of scientific knowledge on fish farming, high feed and seed cost and poor technical skills, there was a low income of Rs.23,623.35/ha. Empowering fish farmers on scientific fish farming through training and extending institutional support through supply of quality seed and farm inputs would help the farmers in rational decision of resource use and enhanced income and fish production.

Bhattacharjee *et al.* (2017) studied culture of fish involving various processes like preparation and management of pond, liming, removal of weeds and weedivorous fish, nurturing the desirable species in a scientific manner and harvesting the fish. Profitability depends upon proper management of all the operations involved in the fish cultural activities. It also depends on factors like productivity, cost of production, and market price of the product. Minimization of cost and maximization of productivity help to improve the profitability. The study highlights the production, productivity and profitability of fisheries in and around Burdwan district based on the results of a primary survey conducted among the selected fishermen household units (Samudragarh (23°34'N and 88°32'E); Dhatrigrām (23°27'N and 88°31'E) and Kalna (23°22'N and 88°34'E). It also revealed that, while fish seed production and rearing are viable, the profit margins are razor-thin. Because input and labour expenses are rising rapidly, one must first determine the availability of resources, capital, and predicted profit before embarking on a fish farming venture.

Ray (2017) studied the profitability of selected fishermen from their cultivatable pond in the Shyampur area of the Howrah district, West Bengal, India, as well as their socio-economic pattern, lifestyle, educational background, and family profile. The study's findings demonstrate that educational attainment, land holding size, annual family income from fish culture, and other factors influence the use of pond fish farming. According to the research, each salesman's profit, which accounts

for almost half of all sales, has been steadily increasing. The fisherman should be covered by insurance to protect them from losses caused by natural disasters, and they should be provided with training programmes, input availability, financial facilities, and educational opportunities so that they may be more responsive to their challenges.

Mugaonkar *et al.* (2019) studied the structure of Pangas catfish (*Pangasius pangasius*) (Hamilton, 1822) production in India in order to illustrate the factors of production and estimate costs and returns. Cobb-Douglas production function was estimated for estimating costs and returns and defining factors of production in a farm business study. According to empirical evidence, the *Pangasius* civilization was profitable. Net income across all farms was Rs. 4,37,528.90 /ha, which varied from Rs. 3,97,469.70 on large farms to Rs. 5,88,668.10/ ha on small farms. Coefficients indicates increase in production can be attained by increasing the inputs. The fact that the overall return to scale estimate was more than unity suggests that *Pangasius* production can be boosted through scale economies. Efficient production practices, low-cost inputs, local seed availability, correct resource allocation, and seeking direction through PAD* for sound and competitive culture practice may all contribute to the country's long-term sustainability.

2.3 Studies related to identification of marketing channels and estimation of the efficiency of different marketing channels

Srivastava (1987) had made an attempt to analyse the marketing pattern of fresh water fish. The quantity of fish handled by each channel varied over space and it was found that 30 per cent of the total production was handled by the channel (farmer - commission agent - retailer - consumer) which was considered to be the largest amount among all the channels. The average share of consumer's rupee by the fish farmers in the country worked out to be 81.5 and 61.3 per cent in the case of pond and reservoir fisheries, respectively. In the case of reservoir, the price offered to the fishermen ranged from ` 2 to ` 6 per kg while the price paid by the consumer was very high because the major share of the production from pond and riverine system were sold at production centre and nearby places and also the length of the channel flow through which the highest share of fish farmer flown was smaller than reservoir fish.

Rao and Chowdhury (1988) concluded that, bargaining power of fish producers was low on account of several factors which included irregular fish supplies, elastic demand and perishable nature of the product. The total marketing costs incurred by the middlemen were `0.81 and `7.67 of fish in local and terminal market, respectively. The percentage share of marketing costs in consumer's rupee was `8.74, `9.85 and `12.78 for catla, rohu and mrigal respectively in local market. The same ranged between 46 to 48 per cent in terminal market for rohu and catla varieties. In view of low profit margin and high risks involved in the marketing of catla and terminal market, it was suggested that it should be marketed locally.

Chauhan *et al.* (1989) had studied the role of co-operatives in Himachal Pradesh in fish marketing. It was suggested that the co-operative should be encouraged to supply the fish directly to the retailers to decrease the share of contractor in consumer's rupee. This task should be carried by using refrigerated vans to minimize the spoilage and wastage. This would ensure supply of quality fish in different markets besides providing remunerative prices to the producer wholesaler - retailer and consumer.

Katiha and Chandra (1990) found that the marketing margins monetary terms have shown a wide variation for different size groups for two carp fish species namely *Cirrhinus mrigala* and *Labeo calbaru*. Although it did not vary significantly in percentage terms, considerably good share of retailer price reached the fishermen levels but a small quantity of fish catch nullified its impact on income levels of fishing community. It was found that the fishermen were indebted to the wholesaler and they exploited the fishermen by offering lower prices and at the same time by charging higher rate of interest. There was an immense need for organizing this sector through some active market organization. It was felt necessary to eliminate the role of the intermediaries and provide institutional credit to the fishermen to maximize their returns.

Ramana *et al.* (1990) studied the different marketing channels of fish and also worked out the marketing costs and margins for different varieties of fish of commercial importance. They also worked out the economics of conversion of fresh water fish into dried fish. The fish distribution of fish stocks immediately after the fish is landed from the sea through following three types of fish marketing channels Producer - wholesaler - retailer - consumer (82.5 %), Producer-retailer-consumer (12%), Producer-consumer (5.2%). The marketing costs borne by the producer were nil out of total marketing costs. The margins were shared by different functionaries. The retailer's margin was the highest which varied from 12.32 to 23.40, 11.20 to 20.09, 10.42 to 26.62, 11.86 to 20.18 and 8.25 to 17.60 per cent in two channel studied for royyalu (persons), moyyalu (murelets), morulu (corps), panducrepa (*Latis* sp.) and karyomere (murreis), respectively. The margin of wholesaler succeeded the retailer's margin. The producer received better price and share in channel for all breeds of fish. An additional benefits derived by the producer from the process of conversion of fresh fish into dried fish were 23.56, 19.97 and 17.80 from royyalu, moyyalu and paradicrepa, respectively.

Hussain *et al.* (2003) assessed the market intermediaries and their marketing margins for inland fish in Pakistan's Lahore district. The study identified the market intermediaries involved in inland fish marketing, their marketing margins, and the market pathways via which inland fish reaches the ultimate customers. The study was based on the primary data and simple statistical techniques like averages and percentages were employed to calculate marketing margins. The results of the study indicated that share of market intermediaries in the consumer's rupee was substantial and there was a need to increase the government outlets to reduce the marketing margins and thereby to enhance the producer income.

Nagoor Meeran (2005) conducted a study on marketing behaviour of fish farmers in Thanjavur district. He reported that the farmers used three channels to sell farmed fish. Majority of the respondents (76.67%) marketed their produce through Producer - Consumer channel. About 60% of the respondents had used Producer - Retailer - Consumer channel for marketing carps produced in their farm. The

conventional marketing channel, Producer - Wholesaler -Retailer -Consumer was used by 43.30 per cent of the respondents.

Roy (2008) studied the marketing of fish fingerlings and environmental awareness level of fishermen in Dakshin Dinajpur district of West Bengal. The study had found that over-fishing and lack of production techniques were the main reasons for the decline. The study revealed that the degree of consciousness among respondents about the environment and its impact on fish production and marketing was limited. Infrastructural facilities and information dissemination about marketing were the two very important issues which needed immediate attention. Hence, a collective effort by all concerned should be initiated for eco-friendly and sustainable fish production and marketing under the existing resources, and socio-economic and environmental constraints which, in turn, would upgrade the economic status and quality of lives of fishers in the area.

Anjani (2010) in his study on milk marketing chains in Bihar, traced different milk marketing channels viz, Channel I: producer-consumer, Channel II: producer - dairy co-operatives-processing units-consumers and Channel III: producer-vendors-consumers. The study also revealed that highest quantity of milk was handled by private vendors (38.40 %) whereas 34.80 per cent of milk was disposed through dairy co-operatives and 21.40 per cent of milk was sold to consumers directly.

Kumar et al. (2010) described the Indian Major Carp marketing system and efficiency. The paper analyzed the marketing of Indian Large Carps (IMC) in other major aquaculture states like West Bengal and Orissa, as well as maritime states like Maharashtra and Tamil Nadu, to the highly efficient fish marketing system prevalent in the Kolleru Lake area (KLA). The study revealed that the KLA carp marketing system was extremely effective at sharing advantages with aqua farmers while also providing high-quality fish to consumers at reasonable prices. According to the study, the government should develop with the explicit goal of creating efficient fish marketing in the country, which is critical for fishermen's socio-economic growth as well as providing nutritional security to customers at reasonable costs.

Rahaman et al. (2013) studied problems and constraints in fish production and commercialization. It discovered three key marketing channels with a short lifespan. The price spread is found to be largest in channel III, at Rs. 24.07 per kg of fish, followed by Rs.10.14 in channel II, and lowest in channel I, at Rs. 4.05 per kg of fish, since the farmers sell their catch straight to the consumers. This illustrates a detailed scenario with increased marketing effectiveness. Theft and pilferage, a lack of quality fish seeds, a lack of government support both technically and financially, pond owners' quarrels and litigations, poor adaptability of fish seed in new environments, a lack of government support, a labour shortage, and a high degree of uncertainty are the major constraints in the production and marketing of fish.

Gawa et al. (2017) studied that fish marketing in Srinagar, Jammu and Kashmir, is severely unorganized and lacks basic infrastructure, unlike any other city in India. The market is lacking in species diversity, and locally grown high-value Trout fish have yet to find their way into the local market, where they are sold at farm gate prices. An attempt was made in this study to comprehend the marketing issues in Kashmir. It was discovered that Chattabal has just one wholesale market and only a few retailers that own appropriate marketing retail facilities; the others sell fish on the street at various sites across the city, therefore the author categorizes them as vendors to keep the study simple. Men dominated the wholesale and retail markets, while women dominated the vendors' ranks, and all of the sellers were illiterate. The wholesaler, retailer, and vendor, respectively, invested Rs.36,600.00, Rs.18,573.33, and Rs.2,989.00 in fixed inventories, according to the analysis. Retailers paid the most for marketing, at Rs.10.57/kg, followed by wholesalers and vendors, at Rs.6.76/kg and Rs.5.33/kg, respectively. Salary to permanent labour made for the biggest share of both wholesaler and retailer costs, accounting for 46.12 and 44.28 percent of total costs, respectively, indicating the valley's high cost of human labour. There are three marketing channels available, with channel 3 being the most effective with a marketing efficiency of 36.06, indicating that it was a form of direct marketing. According to the constraints research, the most severe restrictions faced by all intermediaries were a lack of marketing facilities and high transportation costs. To

lower marketing costs, marketing intermediaries must deal in quantity to obtain economies of scale, and a contemporary fish market must be established in the valley, which currently does not exist.

Jadhav *et al.* (2019) studied the marketing system and distribution channels, and constraints/inefficiencies of marine fish in India. The study was based on the secondary information from literature review. The private sector controls practically all aspects of marine fish marketing, and the livelihood and socioeconomic growth of a large number of individuals (directly or indirectly involved) are linked to the efficiency with which fish distribution and marketing systems operate. Local traders, agents/suppliers, wholesalers, and retailers are all part of the market chain that connects producers to consumers. According to the findings of the study, the price of marine fish is influenced by market structure, species quality, demand, and the size and weight of the fish species.

Khanal *et al.* (2020) studied fishery product production, marketing, and ideas for improving production and marketing. Secondary data on production and trade value were gathered and analyzed from various organizations, websites, and journals. Rearing of various fish species has become increasingly popular around the world, especially in Nepal. Globally, marine and inland fisheries are becoming profitable markets. Despite this, numerous obstacles have frequently hampered production and promotion. Climate change, technological limits, disease outbreaks, water temperature fluctuations, high input costs, and marketing obstacles such as uncontrolled distribution networks, a lack of storage facilities, and other factors have slowed the development of the fisheries. With this in mind, this review was conducted in order to provide the fishing sector with relevant production and marketing methods, assisting them in increasing production and achieving a perfect level of distribution. A marketing mix of marketing techniques was created, as well as a SWOT analysis for both production and marketing.

2.4 Studies related to constraints analysis

Verma (2004) studied growth and constraints of fish production in India. This study examined the growth and constraints of fish production in India for the period

1980-81 to 2001-02. The secondary data has been collected from various sources like agricultural statistics at a glance and survey of Indian agriculture, etc. The growth behavior was analyzed with the help of exponential function using least square method. The trend analysis indicates that marine fish production and inland fish production increased at a rate of 0.1148 and 1.0679 million tonnes respectively during period 1980-81 to 2001-02. The compound annual growth rate of marine fish production indicated that fish production during period 1980-81 to 2001-02 was 1.67 per cent per annum which was found positively and statistically significant. However, the sector was beset with the problems like improper storage, preservation and prompt disposal of transport services. This was particularly acute during the monsoon, when up to 30 per cent of the catch would be lost. The study suggested that there is need to improve the accessibility of poor fish farmers to institutions dealing with inputs like fertilizers, supplementary feeds and credit.

Tripathi (2004) studied economic problems of community fish farming system in Jamunapur region of Allahabad (U.P.). Chaka, Jasara and Meja blocks one from each tehsil of Karchana, Bara, Meja of Jamunapur region in Allahabad district were selected purposively for the study. A set of 64 small fish farmers (having above one hectare pond) were selected as respondents from three selected blocks. Most of small ponds were seasonal and medium deep and canal fed whereas large ponds were perennials, deep and groundwater and canal fed. It was observed that the stocking size and stocking density plays an important role in the success of fish farming. The major problems revealed by the fish farmers were nonavailability of credit, lack of knowledge, high cost of inputs, lack of organized markets, etc.

Biradar et al. (2014) explained constraints analysis on fish consumption in Tripura. Considered the growth, popularity and market potential of fish, Tripura had been selected to study the consumer constraints being faced by the fish consumers of the state. The primary cross section data for this study had been collected through survey during February to June, 2010 through stratified multiple random sampling method. Data had been collected covering all the four districts: North, South, West and Dhalia districts of the state. Data from 40 fish consumers households from each

district covering both urban and rural areas were collected. Constraints towards consumption of CFGs (Choice of Groups) were studied using Rank Based Quotient. Seven constraints viz. irregular supply, high price, price fluctuation, lack of fresh fish, non-availability of preferred species, lack of hygiene and nearness to source were identified for ranking through pilot survey.

Debnath *et al.* (2015) studied to examine major constraints of fish consumption for different fish groups in Tripura. It revealed five identified major fish groups in fish market in Tripura viz, Local Carps (Lc), Interstate Carps (IC), Local Non-Carps (LNC), Inter-state Non- Carps (INC) and small weed fish. Rank based quotient analysis of constraints revealed that high price and price fluctuation are the first two major constraints for different fish groups followed by irregular supply and freshness of fish. Non availability of favoured species is another constraint for the consumption of LNC fish. Increase in local fish production is one of the strategies for reducing market price as supply of fish increases in the market.

Mahapatra *et al.* (2015) worked on the pattern of freshwater fish biodiversity in West Bengal. The study revealed that the state of West Bengal has 7.5 percent of the country's water resources, which are becoming scarce due to uncontrolled population growth, irrigation network expansion, and developmental needs. Concerns over diminishing fisheries harvests and a clear reduction in fish biodiversity have prompted a more holistic approach to fisheries management and research.

Purkait *et al.* (2018) studied various indigenous techniques of controlling water pH, white faeces problem in shrimp, mortality, fish-lice and use of natural fish attractant along with the socio-economic background of the involved farmers and fishers in selected blocks of 24 Parganas (South) district, West Bengal. The survey involved 66 farmers from 19 potential fish farming communities in two blocks, and it was conducted using a stratified multiple random sample approach. After scientific refining, this indigenous knowledge, which is eco-friendly, locally available, and cost effective, may be successfully applied as part of current scientific methodologies.

Biswas *et al.* (2019) studied that Purulia district of West Bengal state in India is a water-poor landscape. In the present study, prevailing aquaculture practices in some drought-prone areas of Purulia district had been evaluated based on a multi-layered cross-sectional questionnaire-based survey. The findings of the study revealed that the majority of fish farmers belong to a low-income group (80.50%) and this is a male-dominated occupation (98.30%). Most of the aquaculture farmers have basic literacy (50.50%) and possess medium size family (60.82%). The majority of farmers (44.20 percent) engage in small-scale aquaculture with ponds smaller than 1 ha and single ownership. Traditional extended type farming is practiced by 81.23 percent of farmers, and polyculture is popular. Indian Major Carps (IMCs) and other exotic strains dominate aquaculture in the Purulia district. Aquaculture production is very low, and the market chain is equally underequipped, due to a lack of adoption of scientific management approaches. Water scarcity (78 percent), disease outbreaks (25 percent), poor quality fish seeds (53 percent), lack of extension services and technical expertise (65 percent), social difficulties such as theft (39 percent), and other factors are key concerns. For the sustainable growth of aquaculture in Purulia district, the formation of a local adaptation plan, as well as strong technical, financial, and extension services from government or non-government organizations and research institutions, is required.

Summary comments of studies reviewed

The literature reviewed so far under different headings indicates that number of studies were done related to inland fish production across the India but no separate study was found related to economics of production and marketing of fish farming in West Bengal in recent years. So, the present study made an attempt to look into the trends in inland fish production in west Bengal and India, cost and return analysis of inland fish farming, identification of marketing channel and working out of efficiency of different marketing channels and problems related to production and marketing of Inland fishes with current input pattern, wage rate, price. Thus, this will help researcher in their research work related to this topic in the future.

*Profile of the
Study Area*

Chapter 3 **PROFILE OF THE STUDY AREA**

This chapter provides a general description of the study area where the present research has been conducted. Knowledge about the profile physical and natural characteristics of the study area is of great importance as it helps to dictate a brief overview of the study area. The present study is conducted in West Bengal state. This chapter has been divided into two sections. The first section 3.1 gives a brief description of geographical, demographic and agricultural features of the West Bengal. Section 3.2 describes the geographical, demographic and other important features Birbhum and Murshidabad district.

3.1 General features and geographical structure of West Bengal

Brief description of geographical, demographic and agricultural features of the West Bengal are given below.

3.1.1 Geographical features of West Bengal

West Bengal, state of India, located in the eastern part of the country. It lies between 27°13'15" to 21°25'24" north latitudes and 85°48'20" to 89°53'04" east longitudes. It is bordered on the north by Sikkim and Bhutan, on the northeast by Assam, on the east by Bangladesh, on the south by the Bay of Bengal, on the southwest by Odisha, on the west by Jharkhand and Bihar, and on the northwest by Nepal. West Bengal, which stretches from the Himalayas in the north to the Bay of Bengal in the south, is India's eastern bottleneck. A total area of 88,752 square kilometers is covered by the state (34,267 sq mi). The eastern Himalayan mountain range includes the Darjeeling Himalayan hill region in the state's northernmost corner. Sandakfu, the state's highest mountain at 3,636 meters (11,929 feet), is located in this region. The Terai region divides the hills from the plains of North Bengal, which then transition into the Ganges delta to the south. Between the Ganges delta in the east and the western plateau and highlands lies the Rarh area. In the further south, a little coastline region exists, while the Ganges delta's Sundarbans mangrove forests serve as a geographical feature.

Table 3.1: General features of West Bengal

S. No.	Particulars	Unit	West Bengal
1.	Total geographical area	Sq. Km	88752
2.	Number of Districts	No.	23
3.	Number of Sub divisions	No.	66
4.	Number of Panchayat Samiti	No.	333
5.	Number of Towns	No.	912
6.	Development blocks	No.	341
7.	Gram Panchayat	No.	3347
8.	Villages	No.	40218

Source: State Statistical Hand Book, 2015

3.1.2 Demographic features

Table 3.2 shows the demographic features of West Bengal. In West Bengal, the total population is 912.76 lakh with a rural population of 621.83 lakh and urban population of 290.93 lakh. Out of total population, male and female are 468.09 and 444.67 lakhs, respectively. The average literacy rate was 76.26 per cent and out of which literacy rate for male and female was 81.69 and 70.54 per cent, respectively. Sex ratio in the state is 950 females for per 1000 male.

Table 3.2: Demographic features of West Bengal

S. No.	Particulars	Unit	West Bengal
1.	Area	Sq. Km	88752
2.	Total population	Lakh	912.76
a.	Male	Lakh	468.09
b.	Female	Lakh	444.67
3.	Rural population	Lakh	621.83
4.	Urban population	Lakh	290.93
5.	Sex ratio	Per 1000	950
6.	Literacy rate	Per cent	76.26
a.	Male	Per cent	81.69
b.	Female	Per cent	70.54

Source: Census 2011, Government of India

3.1.3 Land utilization pattern of West Bengal

The land use pattern of West Bengal is represented in table 3.3. Total reported area is 86,84,000 hectares, out of which net sown area is 52,38,000 hectares. In West Bengal 11,74,000 hectare is covered under forest and 3,39,000 is current fallow. Area not available for cultivation and fallow land other than current fallow are 18,55,000 and 78,000 hectares, respectively.

Table 3.3: Land use pattern in West Bengal

(` 000 hectare)

S. No.	Particulars	Area in West Bengal
1.	Total reported area	8684
2.	Area under forest	1174
3.	Current fallow	339
4.	Fallow land other than current fallow	78
5.	Area not available for cultivation	1855
6.	Net area sown	5238

Source: Directorate of Agriculture (Evaluation Wing), Govt. of West Bengal (2015)



Fig 4: Map of West Bengal

3.1.4 Land holding pattern

Table 3.4 presents the distribution of land holdings in West Bengal and India. The table illustrates that 82.81 per cent individuals consist of marginal (0.49 hectare) land holdings followed by small farmers (1.60 hectare) who constitute 13.41 per cent, 3.53 per cent under semi-medium (2.74 hectare), 0.24 per cent under medium (4.81 hectare) and large (361.08 hectare) holding with 0.01 per cent. In India 68.52 per cent individual consists of marginal. Distribution of farmers in small, semi-medium, medium and large categories are 17.69, 9.45, 3.76 and 0.57 per cent, respectively.

Table 3.4: Distribution of farmers and average size and proportion (%) of holding by farm category, West Bengal

West Bengal	Marginal (<1 hectare)	Small (1-2 hectare)	Semi-medium (2-4 hectare)	Medium (4-10 hectare)	Large (>10 hectare)
	0.49 (82.81%)	1.60 (13.41%)	2.74 (3.53%)	4.81 (0.24%)	361.08 (0.01%)
India	0.38 (68.52%)	1.41 (17.69%)	2.70 (9.45%)	5.72 (3.76%)	17.10 (0.57%)

Source: Ministry of Agriculture, Govt. of India, 2015

3.1.5 Percentage of Irrigated Area to Total Area under Principal Crops in West Bengal and India

Percentage of Net Irrigated area to total area under principal crops in West Bengal and India has been shown in table 3.5. Net irrigated area (`000 hectare) of West Bengal and India were 3105 and 67,300, respectively. Percentage of irrigated area to total area in total cereals, total pulses and total oilseeds are 49.70, 15.00 and 79.10 respectively. In West Bengal maximum percentage of irrigated area to total area was in tobacco (99.50) followed by wheat (98.70), Fruits and vegetables (89.50), Rapeseed and mustard (87.80), sugarcane (84.60) cotton (80.00) and gram (18.00) and in India maximum percentage of irrigated area to total area was in wheat (94.20) followed by sugarcane (90.20), Rapeseed and mustard (76.60), Fruits and vegetables

(65.60), Rice (60.10), tobacco (58.80), Gram (38.70), cotton (33.70) and groundnut (26.70).

Table 3.5: Percentage of Irrigated Area to Total Area under Principal Crops in West Bengal

Particulars	West Bengal	India
Rice	46.90	60.10
Wheat	98.70	94.20
Total cereals	49.70	60.10
Total pulses	15.00	19.90
Total Food grains	48.40	53.10
Sugarcane	84.60	90.20
Fruits and Vegetables	89.50	65.60
Total Oilseeds	79.10	27.40
Cotton	80.00	33.70
Gram	18.00	38.60
Groundnut	-	26.70
Rapeseed and Mustard	87.80	76.60
Tobacco	99.50	58.80
Net Irrigated Area (In ` 000 Hectare)	3105	67300

Source: Ministry of Agriculture & Farmers Welfare, Govt. of India, 2015

3.1.6. Classification of workers

Table 3.6 shows that total population of West Bengal is 912.76 lakh. Majority of its population lies in rural areas (621.83 lakh). Its total working population is 347.56 lakh with majority of workers are from rural areas (240.82 lakh) and rest in urban areas (106.73). Total non-workers in West Bengal are 565.19 lakh out of which

381 lakh workers resides in rural areas and rest workers resides in urban areas (184.19). Total male working population of the state is 267.16 lakh (29.28% rural and 29.23 % urban) which is higher than female working population of the state which is 80.40 lakh (48.82 % rural and 48.56 % urban).

Table 3. 6: Classification of workers in West Bengal and India

(in lakhs)

Sl. No.	Particulars	West Bengal			India		
		Total	Rural	Urban	Total	Rural	Urban
1.	Total population	912.76 (100.00)	621.83 (100.00)	290.93 (100.00)	12108.54 (100.00)	8337.48 (100.00)	3771.06 (100.00)
2.	Total working population	347.56 (38.07)	240.82 (38.72)	106.73 (36.68)	4818.88 (39.79)	3487.43 (41.82)	1331.45 (35.30)
3.	Total main workers	256.86 (28.14)	164.89 (26.51)	91.97 (31.61)	3624.55 (29.93)	2458.68 (29.48)	1166.97 (30.94)
4.	Total marginal workers	90.69 (9.93)	75.92 (12.11)	14.76 (4.07)	1193.23 (9.85)	1028.74 (12.33)	164.48 (4.36)
5.	Total non-workers	565.19 (61.92)	381.00 (61.27)	184.19 (63.31)	7289.66 (60.20)	4850.05 (58.17)	2439.60 (64.69)
6.	Male population	468.09 (51.28)	318.44 (51.21)	149.64 (51.43)	6232.70 (51.47)	4277.81 (51.30)	1954.89 (51.83)
7.	Male working population	267.16 (29.26)	182.11 (29.28)	85.04 (29.23)	3319.39 (27.41)	2268.37 (27.20)	1051.02 (27.87)
8.	Male main workers	216.78 (23.74)	140.19 (22.54)	76.58 (26.32)	2732.09 (22.56)	1780.95 (21.36)	951.14 (25.22)
9.	Female population	444.67 (48.71)	303.38 (48.82)	141.28 (48.56)	5875.84 (48.52)	4059.67 (48.69)	1816.16 (48.16)
10.	Female working population	80.40 (8.80)	58.71 (9.44)	21.69 (7.45)	1499.48 (12.38)	1219.06 (14.62)	280.42 (7.43)
11.	Female main workers	40.08 (4.39)	24.69 (3.97)	15.38 (5.28)	893.55 (7.37)	677.73 (8.12)	215.82 (5.72)

Source: Agricultural Statistics at a glance, 2019

3.1.7 Cropping pattern

Area under different crops in West Bengal is shown in table 3.7. Table revealed that wheat and paddy were the most important crops occupying 3,35,000 and 55,27,000 hectare area, respectively. Maize was the third major crop occupying 1,52,000 hectare area. Total area under food grains were 62,76,000 hectare where area under cereals and pulses were 60,27,000 and 2,49,000 hectare respectively. Total area under non-food grains were 20,00,000 hectare which includes 7,61,000 hectare under oilseeds, 5,78,000 hectare under fibre, 1,40,000 hectare under plantation crops, 77,000 hectare under spices and 4,44,000 hectare under vegetables and miscellaneous crop.

Table 3.7: Area under different crops in West Bengal

S. No.	Crops	Area (000, hectare)
I. Food grains:		
A.	Cereals	
1.	Rice	5527.00
a.	Aus (March/June- July/Nov)	228.00
b.	Aman (April/June- Nov/Dec)	4009.00
c.	Boro (Oct/Feb- April/May)	1290.00
2.	Wheat	335.00
3.	Barley	2.00
4.	Maize	152.00
5.	Ragi	10.00
6.	Small Millets	1.00
7.	Other Cereals	0.18
Total Cereals		6027.00
B.	Pulses:	
1.	Gram	26.00
2.	Arhar (Tur)	2.00
3.	Mung	32.00
4.	Musur	66.00

5.	Khesari	33.00
6.	Other Pulses	90.00
Total Pulses		249.00
Total Foodgrains		6276.00
II Non-Food grains		
A.	<i>Oilseeds</i>	
1.	Rapeseed & Mustard	449.00
2.	Linseed	5.00
3.	Sesame (Til)	224.00
4.	Other Oilseeds	83.00
Total Oilseeds		761.00
B.	<i>Fibres:</i>	
1.	Jute	567.00
2.	Mesta	9.00
3.	Other Fibres	2.00
Total Fibre		578.00
C.	<i>Plantation Crops:</i>	
1.	Tea	140.00
D.	<i>Spices</i>	
1.	Dry Chillies	65.00
2.	Ginger (Dry)	12.00
Total Spices		77.00
E.	<i>Vegetables & Misc. Crops:</i>	
1.	Potato	412.00
2.	Sugarcane	18.00
3.	Tobacco	14.00
Total Vegetables & Misc. Crops:		444.00
Total Non-Food grains		2000.00

Source: State Statistical Hand Book, 2015

3.1.8 Livestock and poultry in West Bengal

Table 3.8 presents livestock and poultry in West Bengal. Total of 76,08,29,000 poultry birds were there which includes 6,41,40,000 fowls and 1,26,89,000 ducks. Total number of livestock was 3,74,26,600 where cattle was the highest in number 1,90,21,500 followed by goat (1,62,79,340), sheep (9,52,890), buffalo (6,30,920), pig (5,40,360) and horses and ponies (1,590).

Table 3.8: Livestock and poultry in West Bengal

('000)

No.	Particulars	2019
1.	Cattle	19021.50
2.	Buffalo	630.92
3.	Others	17774.18
a.	Sheep	952.89
b.	Goat	16279.34
c.	Horses and Ponies	1.59
d.	Pigs	540.36
	Total livestock	37426.60
	Birds	
a.	Fowl	64140.00
b.	Duck	12689.00
	Total Poultry	76829.00

Source: 20th Livestock Census, 2019, Department of Animal Husbandry and Dairying

3.1.9. Production of Fish and Fish seed in West Bengal

In West Bengal total production of fish was 1.782 MT constituting 1.619 MT of Inland and 0.163 MT of Marine. The total production of fish seed was 12455 million in the state.

Table 3.9: Production of Fish and Fish seed in West Bengal

No.	Particulars	Production (Million tonnes)
1.	Inland	1.619
2.	Marine	0.163
Total		1.782
	Production of Fish seed (number in million)	12455

Source: Directorate of Fisheries Government of West Bengal, 2020

3.2 General features and geographical structure of West Bengal

Brief description of geographical, demographic and agricultural features of the Birbhum and Murshidabad districts are given below.

3.2.1 Geographical features of Birbhum and Murshidabad districts

The geographical features of Birbhum and Murshidabad districts is shown in table 3.10. Total geographical area of Birbhum and Murshidabad were 4545 Sq km and 5324 Sq km, and total number of sub divisions, panchayat samiti and towns in Birbhum were 3, 19 and 20, respectively whereas in Murshidabad were 5, 26 and 72, respectively. The total number of blocks, gram panchayat and villages in above districts were 19, 26; 2458, 2167 and 2458, 2167; respectively.

Table 3.10: General features of Birbhum and Murshidabad District

S. No.	Particulars	Unit	Birbhum	Murshidabad
1.	Total geographical area	Sq. Km	4545	5324
2.	Number of Sub divisions	No.	3	5
3.	Number of Panchayat Samiti	No.	19	26
5.	Number of Towns	No.	20	72
6.	Development blocks	No.	19	26
7.	Gram Panchayats	No.	167	254
8.	Villages	No.	2458	2167

Source: State Statistical Hand Book, 2015

3.2.2 Demographic features of Birbhum and Murshidabad District

Demographic features of Birbhum and Murshidabad is shown in table 3.11. Total population of Birbhum and Murshidabad were 35.02 lakh and 71.03 lakh, respectively. Male and female population in Birbhum were 17.90 lakh and 17.11 lakh, and in Murshidabad 36.27 lakh and 34.76 lakh, respectively. There was slightly higher literacy rate in Birbhum (70.68 %) than the Murshidabad (66.59%) whereas in sex ratio Murshidabad (958) was slightly higher than Birbhum (956).

Table 3.11: Demographic features of Birbhum and Murshidabad District

S. No.	Particulars	Unit	Birbhum	Murshidabad
1.	Area	Sq. Km	4545	5324
2.	Total population	Lakh	35.02	71.03
a.	Male	Lakh	17.90	36.27
b.	Female	Lakh	17.11	34.76
3.	Rural population	Lakh	30.52	57.03
4.	Urban population	Lakh	4.49	1.40
5.	Sex ratio	Per 1000	956	958
6.	Literacy rate	Per cent	70.68	66.59
a.	Male	Per cent	76.92	69.95
b.	Female	Per cent	64.14	63.09

Source: State Statistical Hand Book, 2015

3.2.3 Land utilization pattern of Birbhum and Murshidabad District

The land use pattern of Birbhum and Murshidabad district hectares been shown in table 3.12. Total reported area (000, hectare) was 451.11 and 532.49 hectares, respectively. However, 15,853 hectares area in Birbhum and 771 hectares in

Murshidabad district were covered under forest. Area under current fallow and not available for cultivation in Birbhum and Murshidabad were 3590, 1,01,450 and 830, 1,32,860 hectares; respectively. The net sown area was 3,27,010 and 3,95,970 hectares, respectively in above districts.

Table 3.12: Land use pattern in Birbhum and Murshidabad district

(000, hectare)

S. No.	Particulars	Birbhum	Murshidabad
1.	Total reported area	451.11	532.49
2.	Area under forest	15.853	0.771
3.	Current fallow	3.59	0.83
4.	Fallow land other than current fallow	3.20	2.05
5.	Area not available for cultivation	101.45	132.86
6.	Net area sown	327.01	395.97

Source: Directorate of Agriculture (Evaluation Wing), Govt. of West Bengal (2015)

3.2.4 Cropping pattern of Birbhum and Murshidabad district

Area under different crops in Birbhum and Murshidabad district are shown in table 3.13. Table revealed that wheat and paddy were the most important crops occupying 33,500 hectare and 3,84,700 hectares respectively in Birbhum and 1,04,900 hectare and 3,67,500 hectares area in Murshidabad districts, respectively. Under total food grains, number of cereals, and pulses in Birbhum were 4,18,600 and 16,200 hectares and in Murshidabad were 4,80,200 and 53,700 hectares. Total non-food grains in Birbhum and Murshidabad were 58,300 and 2,77,100 hectares, respectively.

Table 3.13: Area under different crops in Birbhum and Murshidabad districts.

Crops	Area (000, hectare)	
	Birbhum	Murshidabad
Rice	384.70	367.50
Wheat	33.50	104.90
Other Cereals	0.40	7.80
Total Cereals	418.60	480.20
Pulses	16.20	53.70
Total Foodgrains	434.80	533.90
Oilseeds	40.00	110.10
Jute (C)	0.30	154.80
Potato	18.00	12.20
Total Non-Foodgrains	58.30	277.10

Source: State Statistical Hand Book, 2015

3.2.5 Annual Rainfall in Birbhum and Murshidabad district

Annual rainfall of Birbhum and Murshidabad districts shown in table 3.14. In 2019 annual rainfall in Birbhum and Murshidabad were 1201.1 mm and 1130.6 mm, respectively. Maximum annual rainfall in Birbhum and Murshidabad were occur in the year of 2015(1627 and 1046.20 mm) and minimum rainfall occur in the year 2018(904.40 and 815.40 mm).

Table 3.14 : Annual Rainfall in Birbhum and Murshidabad district

in millimeter (mm)

No.	District	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
1.	Birbhum	985.00	1482.00	976.00	1319.00	1130.00	1627.00	1295.70	1468.90	904.40	1201.10
2.	Murshidabad	989.00	1526.00	1001.00	1143.00	1126.00	1600.00	1046.20	1187.00	815.40	1130.60

Source: State Statistical hand Book 2015

3.2.6 Distribution of Milch animals in Birbhum and Murshidabad District

Table 3.15 presents the distribution pattern of milch animal as per 1000 rural person in Birbhum and Murshidabad which were found to be 19.16 and 23.87 in number, respectively.

Table 3.15: Distribution of Milch animals in Birbhum and Murshidabad District

No.	District	Milch animals per 1000 rural persons (Nos)
1.	Birbhum	19.16
2.	Murshidabad	23.87

Source: NFDB, 2018

3.2.7 Distribution of inland fish production in Birbhum and Murshidabad district.

Annual Inland fish production per rural person in Birbhum and Murshidabad were 22.80 kg and 20.50 kg respectively. Average area under ponds and tanks in the above districts were 17,903 and 20,599 hectares. Total Inland fish production in Birbhum and Murshidabad were 71,855 and 1,20,794 million tonnes, respectively.

Table 3.16: Production of inland fishes in Birbhum and Murshidabad

No.	District	Annual inland fish production per rural person (kgs)	Area under ponds and tanks (hectare)	Inland fish production (MT)
1.	Birbhum	22.80	17903	71855
2.	Murshidabad	20.50	20599	120794

Source : NFDB, 2018



Methodology

This chapter presents the methodological details to be employed to achieve the objectives set for the study. The chapter has been divided into two sections. Section 4.1 provides a brief description of the research plan followed in the study and in section 4.2 the analytical procedure applied for analyzing data to arrive at relevant conclusion is described. Thus, this chapter provides information about the conceptual framework of the research design.

4.1 Research plan of the study

The design of the study and data collection for the present study include four components viz., selection of the area, types of data and their sources, method of data collection, and sampling technique.

4.1.1 Selection of the area

The present study was conducted in West Bengal state.

4.1.2 Nature and sources of data

To meet the objectives of the present study, both primary as well as secondary data were collected.

4.1.2.1 Primary data

To fulfil the objectives of the study, necessary data relating to fish production was obtained from the selected farmers with the help of pre-tested well-structured schedule. The farmers were personally interviewed and the information related to land holdings, asset position, farmer's age and educational level, details on input use and output obtained etc. were collected. Further, the data on the quantity of produce sold, the price of inputs and outputs etc., were collected from the sample farmers. Information about marketing cost and margins were collected from intermediaries with a well-structured survey schedule. The opinion about the fish production and the problems faced by fish farmer were recorded. Every effort was made to elicit accurate

information from the sample farmers. However, data of previous years was collected from the respondents on recall basis, because they were not maintaining any record of farming operations.

4.1.2.2 Secondary data

Secondary data were collected from various published and unpublished sources such as Department of Fisheries, Govt. of India and Govt. of West Bengal, National Fisheries Development Board (NFDB) etc.

4.1.3 Method of data collection

The primary data were collected by sample farmers by survey method through personal interview using pre-tested survey schedule. However, data of previous years were collected from the respondents on recall basis, because they were not maintaining any record related to farming operations. Effort was made to collect data as reliable as possible from selected farmers pertaining to the year 2020-21.

4.1.4 Sampling design

In the proposed study multi-stage sampling was used. West Bengal has 23 districts out of which 12 districts have major contribution in the Inland fish production in the state. Considering the Covid-19 situation, out of these 12 districts, 2 districts were selected randomly namely Murshidabad and Birbhum. Murshidabad and Birbhum comprised of 26 and 19 blocks out of which 2 blocks from Murshidabad (Jalangi) and Birbhum (Mayureswar I) were selected randomly. Thereafter, 3 villages from Jalangi (Sagarpara, Raghunathpur and Debipur) and Mayureswar I (Mallarpur, Hazipur and Birchandrapur) were selected randomly and then from each village 10 fish farmers were chosen randomly. The total sample size of the proposed study was 60 fish farmers. These respondents were divided into three categories according to the size of their land holdings, viz., marginal (<1 ha), small (1-2 ha) and semi-medium (>2 ha). For the study of marketing cost, marketing margins and price spread, two market intermediaries each (wholesaler and retailer) was taken into the sample from the main fish market of the area after identification of prevailing marketing channels.

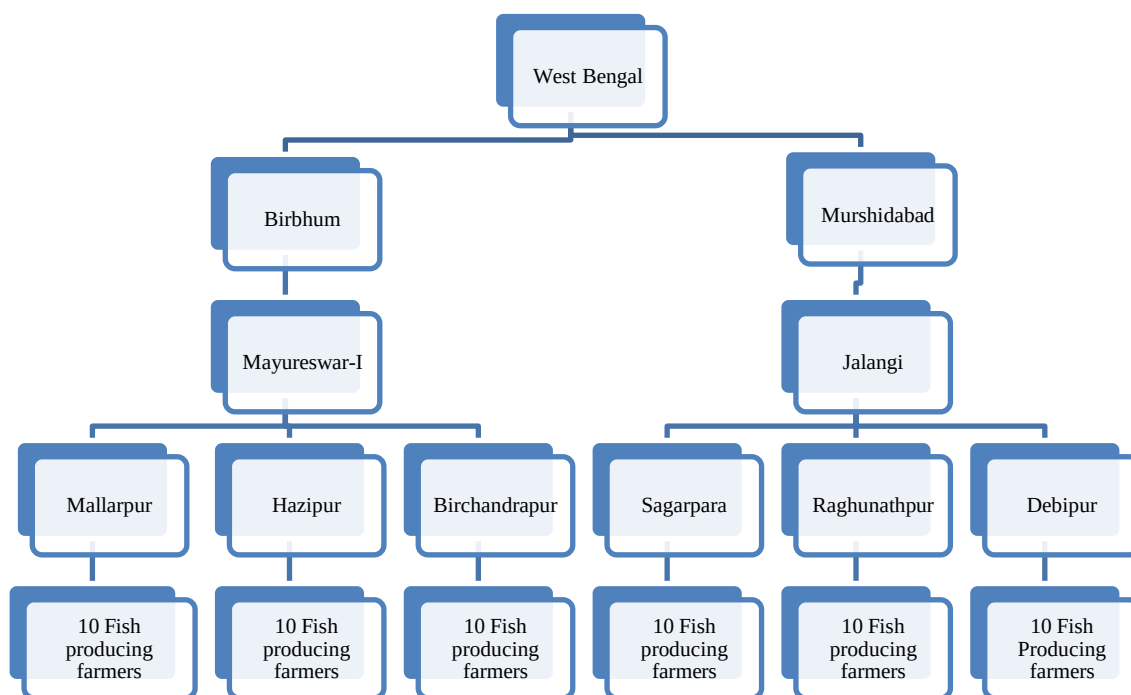


Fig 5 : Sampling Design

4.2 Analytical Framework

The analytical techniques used to evaluate the objectives of the present study are summarized below.

4.2.1 To analyze the socioeconomic status of sample fish producing farmers

To analyze data on various socio-economic variables of the sample fish producing farmers like family size and composition, level of education, pond area, number of livestock, use and distribution of farm machinery and implements etc. were collected. Simple descriptive statistics like average, percent, etc. was used to analyze data. Detailed procedures using different aspects of socio-economic characteristics was analyzed like classifying farmers in different farm category, age group, consideration of literacy, land holding etc.

4.2.2 To study the trends in production of Inland fisheries

To obtain this objective the growth in production of fish in the country and the state as well were estimated for the different periods. The simple growth rate showing the absolute change in growth per unit of time can be written mathematically as:

$$dY_t/dt.$$

Compound Annual Growth Rate can be mathematically written as:

$$CAGR = [(1/Y_t) \cdot (dY_t / dt)] = [(Y_{t-1} - Y_t) / Y_t]$$

It is rate of change of Y_t per unit of change in time 't' expressed as a fraction of the magnitude of Y_t itself.

The CAGR will be estimated using the exponential function of the following form:

$$Y_t = Ae^{bt}$$

The log transformation of this function is as follows:

$$\text{Log}_e Y_t = \text{Log}_e A + bt$$

Through regression analysis we will find the values of 'A' and 'b'

The log form of function represents a constant growth rate over time. The formula for calculating CAGR from the log liner can be derived as follows:

Let ' Y_0 ' be the value of the variables under study in the base period ' Y_t ' be the value of the variable in the time 't' and 'r' be the value of CAGR (compound annual growth rate).

Using compound annual growth formula we get,

$$Y_t = Y_0 (1 + r)^t$$

Log transformation of the above is

$$\text{Log } Y_t = \text{log } Y_0 + t \text{ log } (1 + r)$$

Assuming $\text{log } Y_0 = \text{log } A$ and $\text{log } (1 + r) = b$, the same expression can be put as :

$$\text{Log } Y_t = \text{log } A + bt$$

The estimate of 'b' here is in log-linear form. Therefore, to convert it into original form of Y_t , following transformation is done,

$$\text{Since } b = \log(1 + r)$$

$$\text{Antilog}(b) = 1 + r$$

$$\text{Therefore: CAGR}(r) = (\text{Antilog } b) - 1$$

$$\text{CAGR in percentage terms} = [(\text{Antilog } b) - 1] * 100$$

4.2.3 To work out the cost of and returns from fish farming in the study area.

Costs and returns analysis of fish production in ponds were estimated for the year 2020-21. Net return per rupee investment made was also calculated by dividing the net return by total cost. Depreciation cost was worked out for investment made in establishing fish ponds and capital assets and included in the total costs.

Fixed cost: It includes the depreciation cost and interest on fixed capital.

Variable cost: Variable cost used in the study includes cost of labour, cost of material inputs i.e., seed, feed, fertilizer, lime, manures, cost of disease and predatory control measure, maintenance cost, interest on working capital (7% per annum) etc.

Returns:

Gross return = Total production (in kg.) * price per kg.

Net return (Rs.) = Gross return – Total cost

4.2.3.1 Resource use efficiency

Resource use efficiency in the fish production was worked out by fitting the Cob- Douglas type of production function to the farm level data per hectare.

The specification of the equation was as follows,

$$Y = a X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} \dots \dots \dots (1)$$

Where,

Y =Returns (Rs. /ha)

X_1 = Labour cost (Rs. /ha)

X_2 = Feed cost (Rs. /ha)

X_3 = Fertilizer cost (Rs. /ha)

X_4 = Lime cost (Rs. /ha)

X_5 = Manure-mix cost (Rs. /ha)

X_6 = Seed cost (Rs. /ha)

a =Constant

b_1 to b_6 are elasticity coefficients of respective inputs. The equation (1) was converted into the logarithmic form; it assumed a log linear equation as under.

$$\log Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + u$$

Where, u stands for error term.

4.2.3.2 Labour man days

Human labour utilized in various activities was calculated in terms of man days per ha and is estimated in terms of eight hours of man days' work per day.

The specification of the formula was as follows,

Labour man days = (No of working days X No of working hours per days X No of labour working per day)/ 8 hrs.

4.2.4 Identification of marketing channels and estimation of the efficiency of different marketing channels.

The cost of moving goods from the producer to the consumer and the number of services given are both directly tied to marketing efficiency. It will be efficient marketing if the cost is less than the value of the services provided. The improvement

in marketing efficiency means the reduction of marketing cost without reducing quantum of services offered to the consumer.

The following marketing efficiency measures were used in the study to assess the efficiency of existing fish marketing system.

4.2.5.1. Shepherd's method

4.2.5.2. Acharya and Agarwal's method

4.2.5.3. Conventional method

4.2.4.1. Shepherd's Method

Shepherd has suggested that the ratio of total value of goods sold in the market and the total marketing cost is to be used as a measure for estimating marketing efficiency. According to him, the greater the ratio, the higher the efficiency and vice versa. Shepherd's formula for marketing efficiency is as follows

$$ME = \frac{V}{I} - 1$$

Where,

ME = Marketing efficiency

V = Value of fish sold or consumer price

I = Total marketing cost

4.2.4.2. Acharya and Agarwal's method

According to Acharya and Agarwal's method for estimating marketing efficiency, the higher value of the 'E' denotes higher level of efficiency and vice versa. The formula for computing efficiency is as follows,

$$E = \frac{\text{Net price received by the farmer}}{\text{Marketing cost} + \text{Marketing margin}}$$

4.2.4.3. Conventional method

As per this method, efficiency is calculated with following formula.

$$ME = \frac{\text{Gross Marketing margin}}{\text{Marketing cost}}$$

Where,

ME = Marketing efficiency

Market is said to be efficient, if the total marketing margin is reduced for a given marketing cost. In other words, among the marketing margins of the different channels, that with lowest value is considered as efficient channel.

4.2.5. Constraints in the production and marketing of fish farming

Garrett's ranking technique:

$$\text{Percentage position} = 100 (R_{ij} - 0.50) / N_j$$

Where,

R_{ij} = Rank given for the i th item by the j th individual

N_j = Number of items ranked by the j th individual.

Results
and
Discussion

In this chapter findings related to the different objectives of the study as mentioned in the chapter-1 are presented. The chapter is divided into six sections. Section 5.1 deals with the findings of the socio-economic status of the fish producing farmers in West Bengal state. The second section 5.2 represents the trends in production of inland fisheries in West Bengal and India. The third section 5.3 deals with the major findings on costs and returns obtained in the inland fish production in the targeted area. The fourth section 5.4 illustrates resource use efficiency in inland fish production. In section 5.5 examines various marketing channels and their associated costs and margins and describe the major findings of it. And lastly, section 5.6 deals with various problems associated with the production and marketing of fish in the study area. The collected data have been processed, tabulated and analyzed using tabular methods and appropriate statistical tools.

5.1 Socioeconomic features of fish producing farmers in the study area

In this sub-section we will deal with various findings related to the socioeconomic status of the sampled fish producing farmers such as age-wise distribution, family composition, education level, cropping pattern, use and distribution of farm machinery and implements, distribution of land holdings, livestock and area under inland fisheries. Sample fish producing farmers are the farmers who do crop farming as well as fish production. Fish producing farmers are categorized according to classification of farm categories given by the Department of Agriculture, Govt of West Bengal. They are categorized as marginal (<1 ha), small (1-2 ha) and semi-medium (2-4 ha). The socioeconomic status affects the decisions in various aspects such as choice of crop, etc. These variables play an important role to have the general overview of the fish producing farmers.

5.1.1 Age-wise distribution of household head of sample fish producing farmers

Table 5.1 shows the average age of household head of sample fish producing farmers which is considered as one of the most important constituents of

socioeconomic status of producers. It is depicted from the table that 21.66, 48.33 and 30.00 percent household heads are belonging between 25-35, 36-50 and greater than 50 years of age, respectively. Both in case of marginal and small farm category, majority of the household head were aged between 36 to 50 years which accounted for 50.00 and 51.61 per cent, respectively. In marginal category 33.33 per cent of producers were aged 25-35 and 16.66 per cent of producers were aged greater than 50 years. Whereas in small category, 22.58 per cent of producers were aged between 25-35 years and 25.80 percent of producers were aged greater than 50 years. However, in case of semi- medium category, 36.36 per cent of the producers were aged between 36-50 years, 63.63 percent lied greater than 50 years of age. The overall average age of sampled fish producing farmer was 47.87 years. While the average age of household head of marginal, small and semi-medium farm category was 43.85, 48.32 and 53.20 years, respectively.

Table 5.1 Age-wise distribution of fish producing farmers(head) in the study area

Age group(Years)	Farm category of fish producing farmers*			Total number of fish producing farmer
	Marginal (<1 ha)	Small (1-2 ha)	Semi-medium (2-4 ha)	
25-35	6 (33.33)	7 (22.58)	0 (0.00)	13 (21.66)
36-50	9 (50.00)	16 (51.61)	4 (36.36)	29 (48.33)
>50	3 (16.66)	8 (25.80)	7 (63.63)	18 (30.00)
Total	18 (100.00)	31 (100.00)	11 (100.00)	60 (100.00)
Average age	43.85	48.32	53.20	47.87

*Categories of farmers who involved in fishery production on their farms

Note: Figures in parentheses indicates percentage of respective values

5.1.2 Educational status of household head of sample fish producing farmers

Education is the key element for the development of an individual, society and nation as a whole. The educational profile of household head of fish producing farmers is summarized in table 5.2 from which it can be concluded that on an overall basis, 8.33 per cent of the household head of fish producing farmers have educated up to higher secondary level followed by 15 per cent of producers who have studied up to secondary level and about 53.33 percent educated up to primary level. On an average 23.33 per cent fish producing farmers were illiterate. In marginal, small and semi medium farm categories of fish producing farmers, majority of fish producers educated up to primary level with 50.00, 51.61 and 63.63 per cent, respectively. In case of marginal, small and semi-medium farm category, 16.66, 12.90 and 18.18 per cent of fish producing farmers studied up to secondary level. On an average 5.55, 6.45 and 18.18 per cent of fish producing farmers of marginal, small and semi-medium category farm studied up to higher secondary level. And the rest 27.77 and 29.03 per cent producers of marginal and small categories of farm were illiterate.

Table 5.2: Educational status of household head of sample fish producing farmers

(Numbers)

Educational level	Farm category of fish producing farmers			Total
	Marginal (<1 ha)	Small (1-2 ha)	Semi-medium (2-4 ha)	
Illiterate	5.00 (27.77)	9.00 (29.03)	0.00 (0.00)	14.00 (23.33)
Primary	9.00 (50.00)	16.00 (51.61)	7.00 (63.63)	32.00 (53.33)
Secondary	3.00 (16.66)	4.00 (12.90)	2.00 (18.18)	9.00 (15.00)
Higher secondary	1.00 (5.55)	2.00 (6.45)	2.00 (18.18)	5.00 (8.33)
Total	18.00 (100.00)	31.00 (100.00)	11.00 (100.00)	60.00 (100.00)

Note: Figures in parentheses indicates percentage of respective values

5.1.3 Family composition of household head of sample fish producing farmers

Table 5.3 shows that average family size of the household head of sample producing farmers is 5.63. The table shows that average family size of sample fish producing farmer is 5.34, 5.68 and 6.02 members for marginal, small and semi-medium farm categories, respectively. It can be concluded from the table that average family size has a positive relation with size of farm. On an overall basis there are 3.40 male and 2.23 female with overall family size of 5.63. In all three farm categories of fish producing farmers, males are higher than females with average of 3.21, 3.44 and 3.63 as compared to 2.13, 2.24 and 2.39 females, respectively.

5.3 Family composition of household head of sample fish producing farmers

(Numbers)

Farm categories	Number of selected farmers	Male	Female	Average family size (Nos)
Marginal (<1 ha)	18 (30.00)	3.21	2.13	5.34
Small (1-2 ha)	31 (51.67))	3.44	2.24	5.68
Semi-medium (2-4 ha)	11 (18.33)	3.63	2.39	6.02
Overall average	60 (100.00)	3.40	2.23	5.63

Note: Figures in parentheses indicates percentage of respective values

5.1.4 Land holding details of fish producing farmers in the study area

The distribution of average land holding of the sample farm is given in table 5.4. It is found from the table that the average size of land holding for the sample fish producing farmers is about 1.29 ha in the study area. Average land holding in marginal, small and semi-medium farm were 0.69, 1.39 and 2.00 hectare, respectively. The main sources of irrigation for the sampled farms were rivers, canals

and beels and in small and semi-medium categories of farm there were submersible pump for irrigation system. It was observed that in case of marginal and small farm, out of the total land holding 60.86 per cent and 61.87 per cent of land was under irrigated area where as in case of medium farm the figure was increased to 63.50 per cent and the rest were un-irrigated land. On an overall basis, it was observed that 62.01 per cent of the area was irrigated out of the total land holding.

Table 5.4. Land holding details of sample fish producing farmers (ha)

Particulars	Farm category of fish producing farmers			Overall
	Marginal (<1 ha)	Small (1-2 ha)	Semi-medium (2-4 ha)	
Number of farmers surveyed	18.00 (30.00)	31.00 (51.66)	11.00 (18.33)	60 (100.00)
Average land holding	0.69 (100.00)	1.39 (100.00)	2.00 (100.00)	1.29 (100.00)
Irrigated area	0.42 (60.86)	0.86 (61.87)	1.27 (63.50)	0.80 (62.01)
Un-irrigated area	0.27 (39.13)	0.53 (38.12)	0.73 (36.50)	0.48 (37.20)
Sources of irrigation	Rivers, canals, beels	Rivers, canals, beels, submersible pump	Rivers, canals, beels, submersible pump	

Note: Figures in parentheses indicates percentage of respective values

5.1.5 Average area of pond (hectare) of sample fish producer's farm

The distribution of average area of pond (hectare) in sample fish producers farm has been presented in Table 5.5. The table shows that average size of pond of marginal farm category fish producers are 0.35 hectare. In case of small and semi-medium farm category average size of inland fisheries were 0.76 and 1.32 hectare, respectively. Overall average area of pond in sample fish producers farm was 0.73 hectare.

Table 5.5. Average area of pond in sample fish producer's farm

Sl. No.	Farm categories	No. of farmers	Average size of pond (ha)
1	Marginal (<1 ha)	18.00 (30.00)	0.35
2	Small (1-2 ha)	31.00 (51.67)	0.76
3	Semi-medium (2-4 ha)	11.00 (18.33)	1.32
Average area of pond			0.73

Note: Figures in parentheses indicates percentage of respective values

5.1.6 Cropping Pattern on sample farm

Table 5.6 shows cropping pattern of fish producers farm in study area. Table indicates that the major crops in surveyed area were rice, wheat, potato, tomato, cabbage, cauliflower, brinjal, jute etc. In kharif season rice is the major crop which accounted for 81.15, 81.29 and 83.00 per cent area to total area by marginal, small and semi-medium farm categories, respectively. Other important crops in the kharif season were okra, bottle gourd, early cauliflower and brinjal etc. but allocated area was meager and mostly for home consumption. In rabi season boro rice was the major crop planted by the farmers in study area. The share of area under boro rice was 78.00, 79.13, and 78.00 per cent to total area planted in rabi season on marginal, small and semi-medium category of farms, respectively. Apart from boro rice, the other crops such as potato, wheat, cabbage, cauliflower, tomato were cultivated by the fish producing farmers depending on their necessity and availability of resources. In pre-kharif season land is mostly left fallow since there was no irrigation facility in the summer season but in some portion of area was planted jute that depend on the access of irrigation facility. Average area under jute cultivation on small and semi-medium farm category were 0.19 and 0.25 ha, respectively. Cropping intensity in marginal, small and semi-medium farm categories were found to be 189.85, 207.19 and 208.50 per cent, respectively.

Table5.6: Cropping pattern on sample farm**(hectare)**

Crops	Farm categories		
	Marginal (<1 ha)	Small (1-2 ha)	Semi-medium (2-4 ha)
Kharif			
Rice (aman)	0.56 (81.15)	1.13 (81.29)	1.66 (83.00)
Okra	0.04 (5.79)	0.06 (4.31)	0.10 (5.00)
Bottle gourd	-	0.03 (2.15)	0.05 (2.50)
Early Cauliflower	0.02 (2.89)	0.03 (2.15)	0.04 (2.00)
Brinjal	0.03 (4.34)	0.09 (6.47)	0.11 (5.50)
Others including fallow	0.04 (5.79)	0.05 (3.59)	0.04 (2.00)
Sub Total	0.69 (100.00)	1.39 (100.00)	2.00 (100.00)
Rabi			
Rice (boro)	0.53 (78.00)	1.10 (79.13)	1.56 (78.00)
Potato	0.04 (7.00)	0.10 (7.19)	0.13 (6.50)
Wheat	0.06 (8.10)	0.09 (6.47)	0.14 (7.00)
Cabbage	0.02 (2.89)	0.02 (1.43)	0.03 (1.50)
Cauliflower	0.01 (1.44)	0.03 (2.15)	0.04 (2.00)
Tomato	-	0.01 (0.71)	0.02 (1.00)
Others including fallow	0.03 (4.34)	0.04 (2.87)	0.04 (2.00)
Sub total	0.69 (100.00)	1.39 (100.00)	2.00 (100.00)
Pre-kharif			
Jute	-	0.19 (13.66)	0.25 (12.50)
Others including fallow	0.69 (100.00)	1.20 (86.33)	1.75 (87.50)
Sub total	0.69 (100.00)	1.39 (100.00)	2.00 (100.00)
Grand total	1.31	2.88	4.17
Net cropping intensity (%)	189.85	207.19	208.50

Note: Figures in parentheses indicates percentage of respective values

5.1.7: Distribution of farm machinery and implements in the study area

Table 5.7 shows the distribution of farm machinery and implements in the study area. Major farm machinery and implements were tractor with an average number per respondents was 0.16 followed by power tiller (0.35), desi plough (1.36), M.B. Plough (0.51), disc plough (0.50), disc harrow (0.51), rotavator (0.16), seed-cum-fertilizer drill (0.58), spade (3.66), khurpi (4.33), sickle (5.16), wheel hoe (0.58), dry land peg weeder (0.56), knapsack sprayer (2.33), combine harvester (0.25) and multi-crop thresher (0.33).

Table 5.7: Distribution of farm machinery and implements (Numbers)

No.	Farm machinery and implements	Total number of sample fish producing farmers = 60	
		Total number of farm machinery and implements	Average number/farm
1	Tractor	10.00	0.16
2.	Power tiller	21.00	0.35
3.	Desi plough	82.00	1.36
4.	M.B Plough	31.00	0.51
5.	Disc plough	30.00	0.50
6.	Disc harrow	31.00	0.51
7.	Rotavator	10.00	0.16
8.	Seed-cum-fertilizer drill	35.00	0.58
9.	Spade	220.00	3.66
10.	Khurpi	260.00	4.33
11.	Sickle	310.00	5.16
12.	Wheel hoe	35.00	0.58
13.	Dry land peg weeder	34.00	0.56
14.	Knapsack sprayer	140.00	2.33
15.	Combine harvester	15.00	0.25
16.	Multi-crop thresher	20.00	0.33

5.1.8: Distribution of livestock population on sample farm

It can be seen from the table 5.9 that average number of livestock across different categories of farms was 10.13 with an average number of cow (2.11), buffalo (0.53), bullock (2.21), goat (2.62), pig (0.45) and sheep (1.82) per farm. Average number of birds in the sampled area was 10.41 with an average of poultry (5.15), and ducks (5.25). The average numbers of livestock and birds were highest in case of small farms with the average of 12.35 and 11.37 followed by semi-medium farm with an average number of 11.76 and 10.43 and marginal farm with an average number of 5.34 and 8.75, respectively.

Table 5.8: Distribution of livestock population on sampled farm

(Average number. /farm)

Particular	Category of farm			Overall
	Marginal	Small	Semi-medium	
a. Livestock				
Cow	1.20 (22.47)	2.60 (21.05)	2.24 (19.04)	2.11 (20.82)
Buffalo	0.20 (3.74)	0.70 (5.66)	0.60 (5.10)	0.53 (5.23)
Bullock	1.55 (29.02)	2.75 (22.26)	1.80 (15.30)	2.21 (21.81)
Goat	1.54 (28.83)	3.20 (25.91)	2.77 (23.55)	2.62 (25.86)
Pigs	-	0.80 (6.47)	0.25 (2.12)	0.45 (4.44)
Sheep	0.85 (15.91)	2.30 (18.62)	2.10 (17.85)	1.82 (17.96)
Overall	5.34 (100.00)	12.35 (100.00)	11.76 (100.00)	10.13 (100.00)
b. Birds				
Poultry	4.33 (49.98)	5.65 (49.69)	5.10 (48.89)	5.15 (49.47)
Ducks	4.42 (50.51)	5.72 (50.30)	5.33 (51.10)	5.25 (50.43)
Overall	8.75 (100.00)	11.37 (100.00)	10.43 (100.00)	10.41 (100.65)

Note: Figures in parentheses indicates percentage of respective values

5.1.9. Sources of annual income of sample fish producing farmers

The annual income of farmers was Rs. 8,51,670.73/- from both farm and non-farm sources is shown in the table 5.9. The distribution of gross income from crop production and livestock are presented in the appendix III. Table 5.9 indicates that fisheries production seems to be major source of income as it was contributed Rs. 5,70,817.93/- (67.02%) per annum followed by crop production Rs. 2,08,175.50/- (24.44%) , livestock Rs.19977.30/- (2.34%) to total annual income. The other sources of income of fish producers were Govt. and private job which contributes Rs. 20,200.00/- (2.37%), business Rs.20,000.00/- (2.34%) and remittance Rs. 12,500.00/- (1.46%) in target area. Analysis revealed that fisheries are the major economic activity of farmers in the study area.

Table 5.9: Sources of annual income of sample fish producing farmers

S. No.	Source of income	Overall average	Percentage
A.	Farm income		
	Crop production	2,08,175.50/-	24.44
	Livestock	19,977.30/-	2.34
	Fisheries	5,70,817.93/-	67.02
B.	Non-farm income		
	Govt/Private job	20,200.00/-	2.37
	Business	20,000.00/-	2.34
	Remittance	12,500.00/-	1.46
	Total	8,51,670.73/-	100.00

5.2 Trend of Inland fish production in West Bengal and India

The production trend of Inland fisheries in West Bengal and India during the period from 2001 to 2020 is presented in Table 5.10 and growth rate figures are depicted in figure 6. The table reveals that in India, Inland fish production has

increased from 2.84 million tonnes (MT) in 2001 to 10.43 MT in 2020. The growth rate indicates that it has increased by 6.84 per cent per annum. In West Bengal, Inland fish production was around 0.87 MT in 2001 and it increased to 1.62 MT in 2020. Fish production during 2001 to 2020 in West Bengal was increased by 3.24 per cent per annum.

Table 5.10 Inland fish production trends in India, West Bengal (2001-2020)

(MT)

Years	West Bengal	India
2001	0.87	2.84
2002	0.91	3.12
2003	0.93	3.21
2004	0.98	3.45
2005	1.03	3.52
2006	1.09	3.75
2007	1.18	3.84
2008	1.26	4.20
2009	1.29	4.63
2010	1.33	4.89
2011	1.24	4.98
2012	1.29	5.29
2013	1.33	5.71
2014	1.39	6.13
2015	1.43	6.69
2016	1.49	7.16
2017	1.52	7.80
2018	1.55	8.90
2019	1.61	9.72
2020	1.62	10.43
CAGR	3.24	6.84

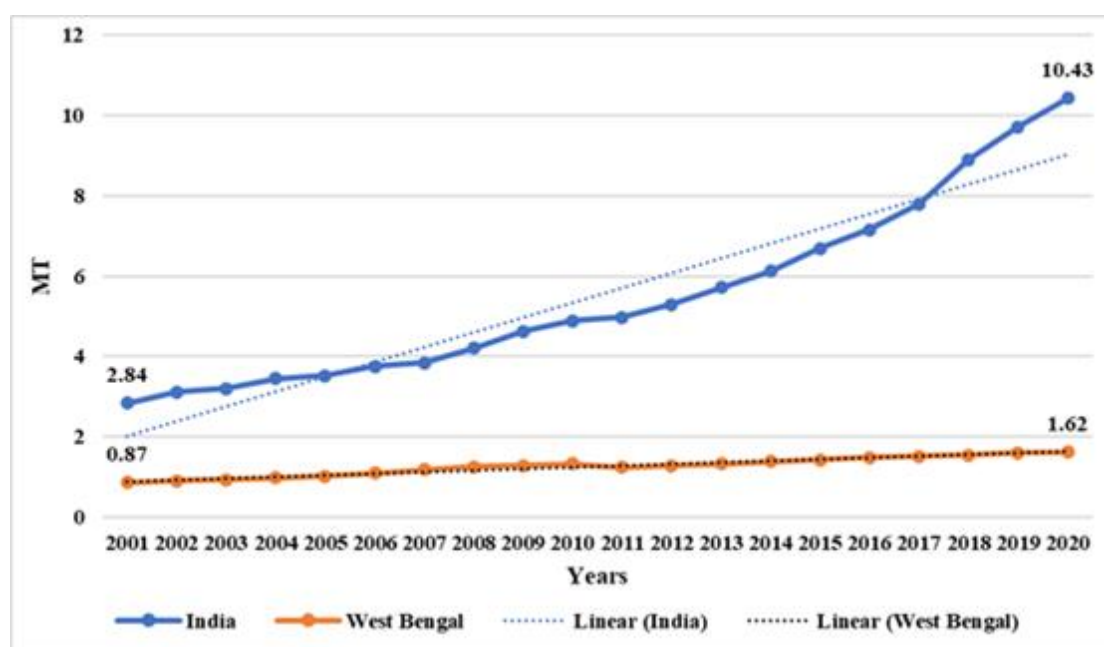


Fig 6: Growth rate of inland fish production from 2001 to 2020.

5.3. Cost and returns of inland fish farming in study area.

The detailed analysis of cost and returns of fish production in study area is given below.

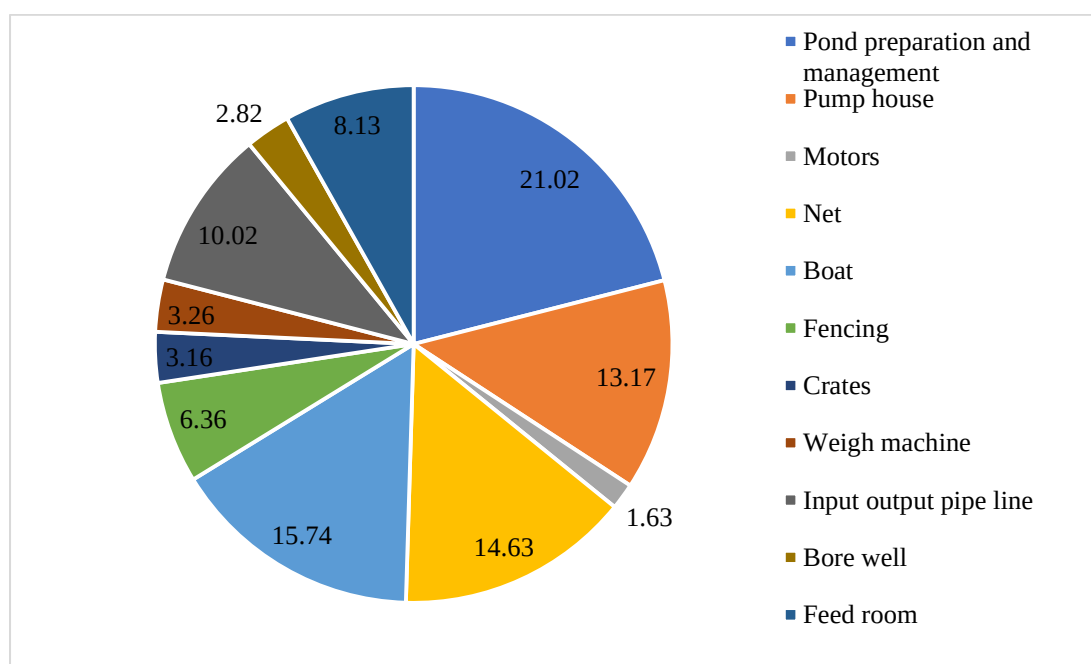
5.3.1 Fixed cost involved in inland fish production.

The fixed cost required for fish farming on per hectare basis is presented in the table 5.11. The total investment required for establishing fish pond was estimated to be Rs.1,92,168.00/-. Among the establishment cost the major item of investment was towards renovation and maintenance of pond and pump house construction which was Rs.65,738/- and accounts for 34.19 per cent of the total investment cost. The investment on other items such as submersible pump (Rs. 3134.00/-), cast net (Rs.28118.00/-), boat (Rs.30255.00/-), fencing (Rs.12241.00/-), plastic crates (Rs.6084.00/-), weighing machine (Rs.6273.00/-), input-output pipe line (Rs.19266.00/-), bore well (Rs.5435.00/-) and feed room (Rs.15624.00/-), which is necessary in establishing of inland fish production and the proportion altogether 65.75 per cent in the total investment. The share of different items in total investment is also presented in the pie chart in Fig 7.

Table 5.11 Fixed cost of fish farming in study area**(Rs. / ha)**

Sl. No.	Particular	Fixed cost	Percentage
1	Renovation and maintenance of pond*	40412.00/-	21.02
2	Pump house	25326.00/-	13.17
3	Motors/Pump	3134.00/-	1.63
4	Net	28118.00/-	14.63
5	Boat	30255.00/-	15.74
6	Fencing	12241.00/-	6.36
7	Crates	6084.00/-	3.16
8	Weighing machine	6273.00/-	3.26
9	Input-output pipe line	19266.00/-	10.02
10	Bore well	5435.00/-	2.82
11	Feed room	15624.00/-	8.13
	Total	192168.00/-	100.00

*Ponds are quite old even it is two to three generations older in West Bengal. Fish farming is an integral part of farming system of majority of the farmer in the state.

**Fig 7: Share of different items of fixed cost in fish farming.**

5.3.2. Input and output analysis of inland fish production.

Table 5.12 shows input use pattern in inland fish production in the study area. The average quantity of fertilizer, lime, manures, fingerlings and feed were accounted 191.70, 272.80, 5000.00, 480.00 and 3809.22 kg per hectare, respectively. Rate of fertilizer in the targeted area was Rs. 51.12/kg followed by lime (Rs.25.00/-), manure (Rs.1.00/-), fingerlings (Rs.200.00/-) and feed (Rs.52.11/-) on sample farms. Average labour man days in the study area was 304-man days per hectare where rate of labour man days was Rs. 250.00/man/ day. In pre-stocking, stocking and post-stocking management activities, the average number of labour engaged were 125.00, 63.00 and 116.00, respectively.

Table 5.12 Input use pattern in inland fish production on sample farms.

No	Particular of input	Quantity/ number used per ha	Rate (Rs. /kg or man days)
a. Material			
1.	Fertilizer (kg/ha)	191.70	51.12/-
2.	Lime (kg/ha)	272.80	25.00/-
3.	Manure (kg/ha)	5000.00	1.00/-
4.	Fingerlings (kg/ha)	480.00	200.00/-
5.	Feed (kg/ha)	3809.22	52.11/-
b. Labour use (man days/ha) by activity			
1.	Pre-stocking	125.00 (41.00)	250.00/-
2.	Stocking	63.00 (21.00)	250.00/-
3.	Post-stocking	116.00 (38.00)	250.00/-
	Total	304.00 (100.00)	

Note: Figures in parentheses indicate percentage of respective values

Level of fish production in the targeted area is shown in table 5.13. It represents that average number of productions of rohu, catla and mrigal are 1227.00, 2786.00 and 1071.00 per hectare, respectively. The average weights of above fishes were 1.10, 1.40 and 0.70 kg/fish, respectively. Analysis also revealed that the average production of composite fish culture in inland fisheries was 6000.00 kg/ha whereas average production of rohu, catla and mrigal were 1350.00, 3900.00 and 750 kg/ha, respectively. The sale price (farm- gate) of rohu, catla and mrigal were Rs.170.00/-, Rs. 180.00/- and Rs.130.00/kg in surveyed area.

Table 5.13 Levels of output in inland fish(composite) production.

Fish breed	Average number of fish/ha	Average weight of fish (kg)	Average production (kg/ha)	Average rate of sale (Rs. /kg)
Rohu	1227.00	1.10	1350.00	170.00/-
Catla	2786.00	1.40	3900.00	180.00/-
Mrigal	1071.00	0.70	750.00	130.00/-

5.3.2.1 Cost and return analysis:

The different cost components of inland fish production are presented in the Table 5.14. The cost and return of inland fish is presented on per hectare (ha) basis. The total cost incurred by fish producers for rearing fish in inland was about Rs.4,58,182.07/- per hectare. The variable cost accounted for 95.07 per cent (Rs. 4,35,618.40/-) and fixed cost accounted for 4.92 per cent (Rs22,563.67/-) in the total cost. Under variable costs, the expenditure on feed items was the major item of expenditure and worked out to be Rs. 1,98,500.00/- accounting to 43.32 per cent of the total cost. This was followed by seed/fingerlings cost of Rs. 96,000.00/-(20.95%), maintenance charges of Rs. 10,000.00/- (2.18%) on sample farms. The labour cost accounted for Rs.76,000.00/ which consist of 16.58 per cent of the total cost. The cost on manure, fertilizer and lime constituted only 1.09 (Rs.5000.00/-), 2.13 (Rs 9800.00/-) and 1.48 per cent (Rs.6820.00/-) of the total cost, respectively. Medicinal expenses per hectare was Rs.5000.00/-(1.09%). The interest on working capital is also

included in total variable cost of fish production which was 6.21 per cent (Rs.28498.40/-) of the total cost.

The returns obtained from fish production are presented in the table 5.14. The return realized by the producers was worked out by multiplying average productivity with the average price realized by the producers. The average productivity along with their average price is mentioned in table 5.13. The gross return from Inland fish production was realized Rs. 10,29,000.00/- per ha on sample farm. Whereas, the corresponding figures from Rohu, Catla and Mrigal were Rs. 2,29,500.00/-, (22.30 %), Rs. 7,02,000.00/- (68.22%) and Rs. 97,500.00/- (9.47%), respectively in surveyed area. The net return of Rs 5,70,817.93/ ha was realized over total cost of fish production. Cost of production per kg of fish was worked out to be around Rs.76.36. Every rupee invested in the inland fish production earned Rs.1.24 in net return ensuring that the fish production is an economically feasible enterprise. Different cost components and returns are presented through bar diagram in Fig. 8.

Table 5.14 Cost and return analysis of Inland fish production on surveyed farms

Sl. No.	Particular/Items	Cost (Rs. /ha)	Percentage
A.	Variable costs		
1.	Labour charges	76000.00/-	16.58
2.	Material cost		
	a. Seed	96000.00/-	20.95
	b. Feed	198500.00/-	43.32
	c. Manures	5000.00/-	1.09
	d. Fertilizer	9800.00/-	2.13
	e. Lime	6820.00/-	1.48
3.	Maintenance	10000.00/-	2.18
4.	Medicine	5000.00/-	1.09
5.	Interest on working capital (@7%)	28498.40/-	6.21
	Sub Total	435618.40/-	95.07

B.	Fixed cost		
1.	Depreciation (@5%)	5268.55/-	1.14
2.	Interest on fixed cost (@9%)	17295.12/-	3.77
C.	Sub total	22563.67/-	4.92
D.	Total cost	458182.07/-	100
	Analysis of returns		
	Average production/ha6000.00 kg		
1.	Rohu	229500.00/-	22.30
2.	Catla	702000.00/-	68.22
3.	Mrigal	97500.00/-	9.47
E.	Gross Return	1029000.00/-	100.00
F.	Net return	570817.93/-	
	Net return per rupees invested	1.24	
	Cost of production (Rs/kg)	76.36	
	Cost of production over variable cost (Rs/kg)	72.60	

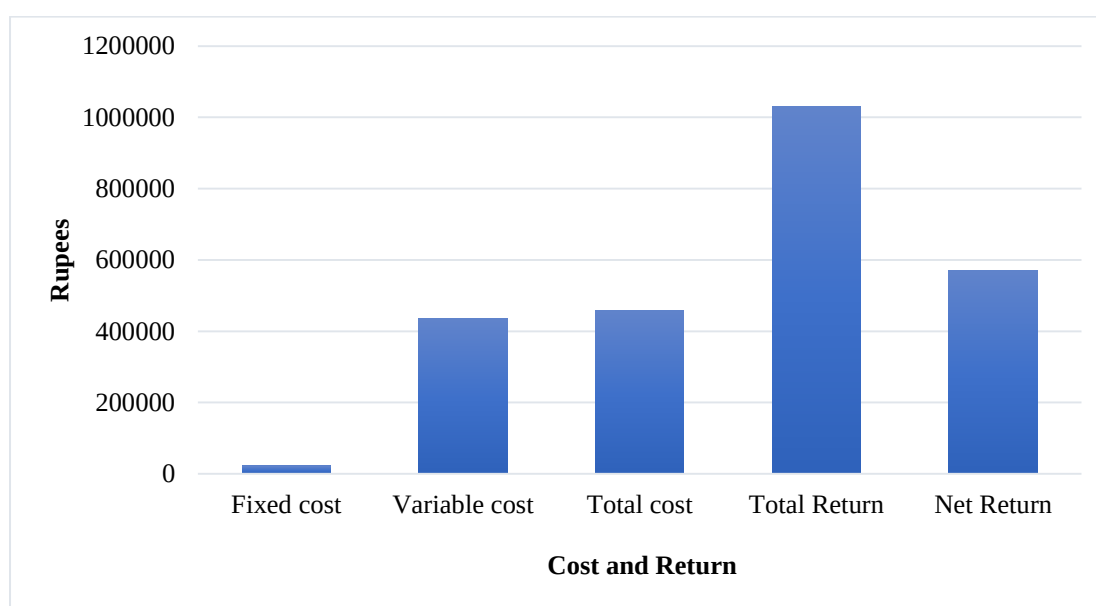


Fig 8: Different cost components and returns

5.3.3 Resource use efficiency of Inland fish production.

The main objectives of any production unit are better co-ordination and utilization of various resources to realize greater returns. In this section, an attempt is made to analyse the productivity of various resources used in the fish production. The analysis was done for the study under fish production in order to determine whether or not the factors of production were used optimally.

5.3.3.1 Estimated production function of inland fish production in the study area

The Cobb Douglas production function was used to study resource use efficiency in fish production on per hectare basis which is presented in Table 5.15. The coefficient of multiple determination (R^2) was 71.00 percent implied that the 71 per cent variations in returns was explained by the different independent variables included in the model in Inland fish production in the target area. The regression coefficient of human labour (0.28) and feed (0.27) were found positive and significant at 5 per cent probability level and manures (0.11) was at 1 per cent level of significance. This implies that one percent increase in expenditure of human labour, feed and manure, there will be probability to increase in gross return by 0.28, 0.27 and 0.11 per cent, respectively.

Table 5.15 shows the analysis of marginal value product and marginal input cost of resources used in inland fish production. The marginal physical productivity, marginal value product and profitability ratio (MVP/MIC) were calculated at the geometric mean level of various production inputs and output levels. It is evident from the Table 5.16 that MVP to MFC ratio for all the inputs viz., labour (0.32), fertilizer (0.22), lime (-0.13), manure (0.19), seed (0.76) and feed (0.38) were found to be less than 1 and indicated excess use of these inputs.

Table 5.15 Estimated production function and MVP/MIC ratios of resources in inland fish production

No.	Variable	Regression coefficient	Standard Error	MVP	MIC	MVP/MIC
1.	Intercept	0.32	3.893	-	-	-
2.	Human labour (Rs./ha)	0.28**	0.105	0.32	1	0.32
3.	Fertilizer (Rs.)	0.14	0.120	0.22	1	-
4.	Lime (Rs.)	-0.05	0.045	-0.13	1	-
5.	Manure (Rs.)	0.11*	0.019	0.19	1	0.19
6.	Seed/fingerling (Rs.)	0.63	0.492	0.76	1	-
7.	Feed (Rs.)	0.27**	0.103	0.38	1	0.82
8.	R ²	0.71		-	-	-

*, ** indicates significant at 1% and 5 % probability level, respectively.

5.4 Identification of marketing channels and efficiency of different marketing channels.

The selection of marketing channels becomes imperative for the producers since the real benefit accrued to them is mainly depend upon the choice of agency and channel for disposal of their produce. The channels selected by them must account for minimum marketing cost and ensure higher share of consumer's rupee.

In the study area, following three important channels were identified in marketing of inland fish.

Channel-I: Producer → Consumer

Channel-II: Producer → Retailer → Consumer

Channel-III: Producer → Wholesaler → Retailer → Consumer

Some of the major fish markets in Murshidabad and Birbhum were selected for the study. The channels identified in the study area have been illustrated in the

Table 5.16. The findings revealed that channel-III is the crucial channel for the disposal of fishes. The 46.66 per cent of the fish producers marketed their fish in the channel-III (Producer - Wholesaler - Retailer – Consumer). Only 23.33 per cent of the producers used channel-I, i.e., they have sold the produce to the consumers directly and rest 30.00 per cent of the producers followed channel-II for marketing of the produce.

Table 5.16 Identification of fish marketing channels in the study area.

Sl. No	Marketing channel	Number of producers	Percentage (%)
1.	Channel I (Producer – consumer)	14.00	23.33
2.	Channel II (Producer- retailer – consumer)	18.00	30.00
3.	Channel III (Producer – wholesaler -retailer – consumer)	28.00	46.66
	Total	60.00	100.00

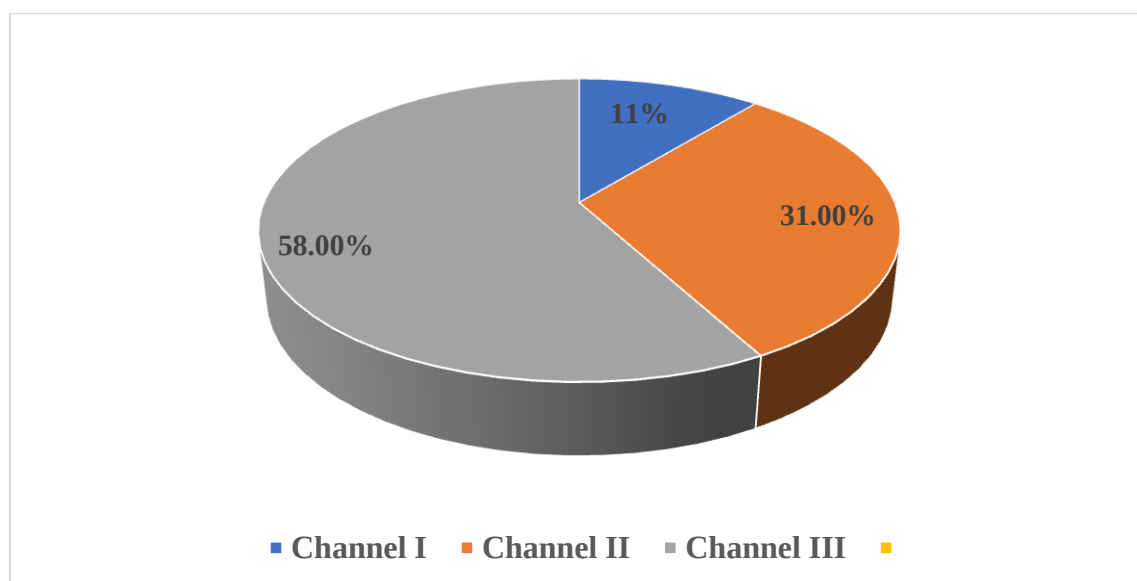
5.4.1 Quantity of fish sold in different marketing channel

The quantity of fish sold to intermediaries in different channels is illustrated in Table 5.17 and it is clear that the major portion of around 58.00 per cent of the total produce produced by the fish producers in the study area is sold in channel-III followed by channel II (31.00 %) and channel I (11.00 %). Fish is a perishable product and producers had a little amenity to store fish for future consumption, thus, only 50.00 kg (0.83) fish retains for home consumption. Channel I is the shortest marketing channel as the harvested fish from the fish producer moved directly to the ultimate consumer. The quantity of fish sold in channel I (660.00 kg) was comparatively less than channel II (1840.00 kg) and III (3450.00 kg) which is depicted in fig 9.

Table 5.17 Average quantity of fish sold in different channels of marketing

Sl. No	Marketing channels	Quantity (Kg)	Percentage (%)
1.	Channel I	660.00	11.00
2.	Channel II	1840.00	31.00
3.	Channel III	3450.00	58.00
	Total sale	5950.00	100.00

Note: Fish producers uses about 50 kg fish for their family consumption.



. Fig 9: Proportion of produce disposal in different marketing channels.

5.4.2 Marketing cost incurred by intermediaries

The Table 5.18 shows marketing cost incurred by the different intermediaries in the fish market. The total marketing costs incurred were Rs.4.24, Rs.5.16 and Rs.6.97 by producer, retailer and wholesaler, respectively, for marketing of a kilogram of fish (per kg). The producer has incurred maximum cost on transportation (37.73%) followed by labour (33.96%), ice (15.33%) and packing (12.97%). Retailers incurred maximum cost towards ice (36.24%) followed by transportation (19.37%),

marketing fee (18.79%), rent (15.50%), packaging (5.62%) and electricity (4.45%) in the total marketing cost. Similar to producer, transportation cost was maximum for the wholesaler (41.46%) followed by labour (17.64%), ice (15.78%), rent (11.04%), electricity (8.03%), packing (3.58%) and marketing (2.43%) costs respectively. The highest cost incurred by wholesaler followed by retailer in the marketing of fish.

Table 5.18 Marketing cost incurred by intermediaries

(Rs./kg)

Sl. No	Particular	Producer	Retailer	Wholesaler
1.	Ice	0.65 (15.33%)	1.87 (36.24%)	1.10 (15.78%)
2.	Transportation	1.6 (37.73%)	1.00 (19.37%)	2.89 (41.46%)
3.	Packing	0.55 (12.97%)	0.29 (5.62%)	0.25 (3.58%)
4.	Market fee	-	0.97 (18.79%)	0.17 (2.43%)
5.	Labour	1.44 (33.96%)	-	1.23 (17.64%)
6.	Rent	-	0.80 (15.50%)	0.77 (11.04%)
7.	Electricity	-	0.23 (4.45%)	0.56 (8.03%)
	Total	4.24 (100.00)	5.16 (100.00)	6.97 (100.00)

Note: Figures in parentheses indicates percentage of respective values

5.4.3 Price spread in marketing of Rohu fish

Price spread is one of the important measures of marketing efficiency. It is the difference between price paid by the ultimate consumer and price received by the producer for an equivalent quantity of farm produce. The spread includes marketing cost incurred by the intermediaries as well as their margin accrued. The price spread has been computed for different breeds of fish sold by the sample producers separately. The gross and net price received along with the marketing cost incurred by

each intermediary under different channels. The price spread has been computed for rohu fish by the sample producers' indifferent channels identified. The price spread was higher when the marketing channel is longer and lesser in shorter channel. The price spread of rohu fish is presented in the table 5.20 which reveals that in channel-I, the producer share in consumer rupee was 97.50 per cent and had no price spread. In channel-II, the producer share in consumer rupee was 81.87 per cent. Whereas, in channel-III producer share was 81.31 per cent in consumer rupee and having highest price spread (Rs.35.50/-) followed by channel II (Rs. 30.20/-).

Table 5.19. Price spread of Rohu fish market

(Rs /kg)

Sl. No	Particular	Channel I		Channel II		Channel III	
		Rs.	% consumer price	Rs.	% consumer price	Rs.	% consumer price
I	PRODUCER						
1	Producer sale price	170.00	100.00	159.80	84.10	154.50	81.31
A	Market cost	4.24	2.49	4.24	2.23	-	-
B	Net price realized	165.76	97.50	155.56	81.87	154.50	81.31
II	WHOLESALE						
1	Purchase price					154.50	81.31
A	Marketing cost					6.97	3.66
B	Marketing margin					9.88	5.20
C	Sale price					171.35	90.18
III	RETAILER						
	Purchase price			159.80	84.10	171.35	90.18
	Marketing cost			5.16	2.71	5.16	2.71
	Marketing margin			25.04	13.17	13.49	7.10
	Sale price			190.00	100.00	190.00	100.00
	Consumer purchase price	170.00	100.00	190.00	100.00	190.00	100.00
	Price spread	-		30.20		35.50	
	Producer share in consumer rupee	165.76	97.50	155.56	81.87	154.50	81.31

5.4.4 Price spread in marketing of Catla fish

The price spread of catla fish is presented in the Table 5.20. The findings reveal that in channel-I, the producer share in consumer rupee was 97.64 per cent. In channel-II, producer share in consumer rupee was 83.19 per cent. In channel-III, producer share was 81.82 per cent in consumer rupee and having highest price spread (Rs.38.17/-) followed by in channel II (Rs. 35.29 /-)

Table 5.20 Price spread of Catla fish market

(Rs /kg)

Sl. No	Particular	Channel I		Channel II		Channel III	
		Rs.	% consumer price	Rs.	% consumer price	Rs.	% consumer price
I	PRODUCER						
1	Producer sale price	180.00	100.00	178.95	85.21	171.83	81.82
A	Market cost	4.24	3.81	4.24	2.01	-	-
B	Net price realized	175.76	96.82	174.71	83.19	171.83	81.82
II	WHOLESALER						
1	Purchase price					171.83	81.82
A	Marketing cost					6.97	3.31
B	Marketing margin					11.13	5.30
C	Sale price					189.93	90.44
III	RETAILER						
	Purchase price			178.95	85.21	189.93	90.44
	Marketing cost			5.16	2.45	5.16	2.45
	Marketing margin			25.89	12.32	14.91	7.10
	Sale price			210.00	100.00	210.00	100.00
	Consumer purchase price	180.00	100.00	210.00	100.00	210.00	100.00
	Price spread	-		35.29		38.17	
	Producer share in consumer rupee	175.76	97.64	174.71	83.19	171.83	81.82

5.4.5 Price spread in marketing of Mrigal fish

The price spread of Mrigal fish is presented in the Table 5.22 reveals that in channel I the producer share in consumer rupee was 96.73 per cent and price spread is nil. In channel II, the producer share in consumer rupee was 82.83 per cent whereas, in channel III producer share is 80.61 per cent in consumer rupee and having highest price spread (Rs. 29.08/-) followed by in channel II (Rs.25.75/-).

Table 5.21 Price spread of Mrigal fish market

(Rs /kg)

Sl. No	Particular	Channel I		Channel II		Channel III	
		Rs.	% consumer price	Rs.	% consumer price	Rs.	% consumer price
I	PRODUCER						
1	Producer sale price	130.00	100.00	128.49	85.66	120.92	80.61
A	Market cost	4.24	3.26	4.24	2.82	-	-
B	Net price realized	125.76	96.73	124.25	82.83	120.92	80.61
II	WHOLESALE						
1	Purchase price					120.92	80.61
A	Marketing cost					6.97	4.64
B	Marketing margin					7.35	4.90
C	Sale price					135.24	90.16
III	RETAILER						
	Purchase price			128.49	85.66	135.24	90.16
	Marketing cost			5.16	3.44	5.16	3.44
	Marketing margin			16.35	10.90	9.60	6.40
	Sale price			150.00	100.00	150.00	100.00
	Consumer purchase price	130.00	100.00	150.00	100.00	150.00	100.00
	Price spread	-		25.75		29.08	
	Producer share in consumer rupee	125.76	96.73	124.25	82.83	120.92	80.61

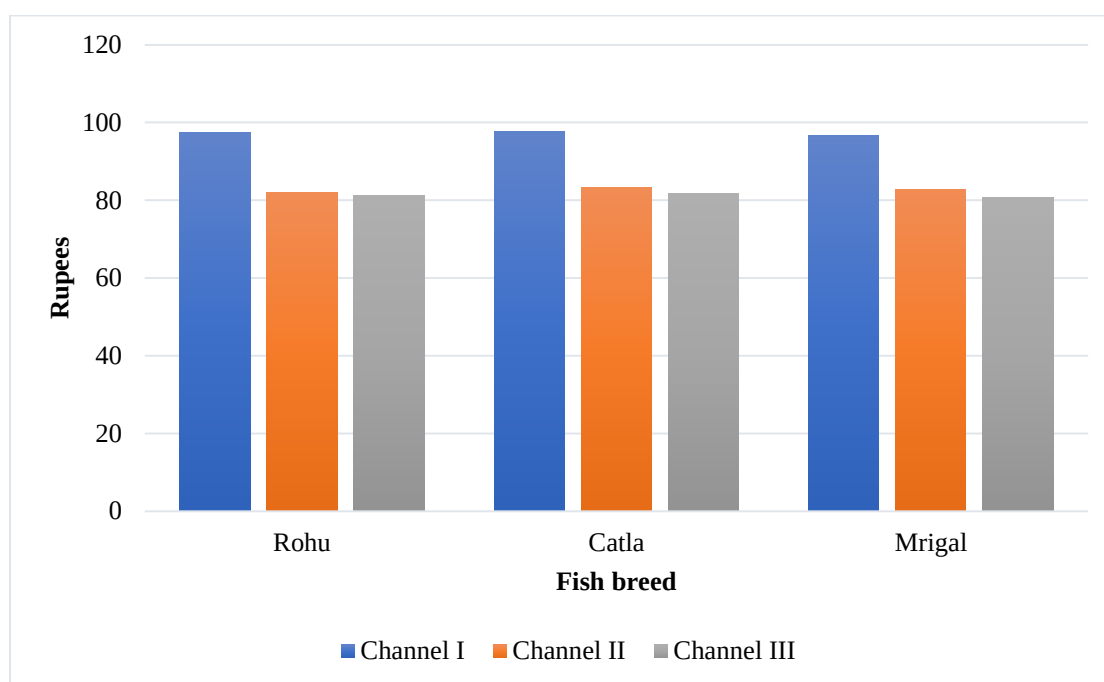


Fig 10: Producer shares in consumers rupee in three different channels

5.4.6 Marketing efficiency of Catla, Rohu and Mrigal fishes

Marketing efficiency is directly related to the cost involved in moving goods from producer to the consumer and the quantity of services offered. If the cost incurred by marketing intermediaries is lower when compared to services involved, and then it will be called as efficient marketing system. The improvement in marketing efficiency means the reduction in marketing cost without reducing quantum of services of the consumer.

In the present study shepherd's method of marketing efficiency is used, which suggests that the ratio of total value of goods sold in the market and the total marketing cost is to be used as a measure for marketing efficiency. According to him, the greater the ratio higher the efficiency and vice versa.

Table 5.22 shows that the marketing efficiency by shepherd method of rohu, catla and mrigal in channel I, channel II and channel III. It represents that for rohu marketing efficiency in channel I (39.09) was greater than channel II (19.21) and channel III (14.66). For catla marketing efficiency in channel I (41.45) was greater

than channel II (21.34) and channel III (16.31) and for mrigal marketing efficiency in channel I (29.66) was greater than channel II (14.95) and channel III (11.36).

It is quite noticeable that the marketing efficiency estimated by shepherd methods was in descending order in three channels for rohu, catla and mrigal fishes. It may be inferred that due to less no of intermediaries, marketing cost and marketing margin was low in channel I, thus channel I was more efficient than channel II. And in the same way due to high marketing cost and marketing margin, channel III is less efficient than channel II.

Table 5.22 Marketing efficiency of Rohu, Catla and Mrigal fishes

Sl. No	Fish breeds	Channel I		Channel II		Channel III	
		Shepherd method	Marketing efficiency	Price	Marketing efficiency	Price	Marketing efficiency
1.	Rohu	(170/4.24)-1	39.09	(190/9.4)-1	19.21	(190/12.13)-1	14.66
2.	Catla	(180/4.24)-1	41.45	(210/9.4)-1	21.34	(210/12.13)-1	16.31
3.	Mrigal	(130/4.24)-1	29.66	(150/9.4)-1	14.95	(150/12.13)-1	11.36

5.5. Constraints faced by the fish producers.

An attempt was made to the study the various problems related with the fish farming in the study area. The problems faced by fish producers were categorized in two subgroups viz., production related problems and marketing related problems. Various problems are enlisted in the table as per the interview done with the fish producers. Further to rank the constraints, Garrett's ranking technique was used. With the help of Garrett's ranking table average score were given and then constraints were ranked accordingly.

5.5.1 Production related problems faced by the fish producers in the study area

It is necessary to identify the important constraints faced by the fish producers' in fish production. Therefore, scheduled survey was carried out to elicit the perception of producers on problem faced in fish production.

The problems faced by the producers in production were collected and presented in table 5.23. The major problem faced by the producers was loss of produce due to its perishable nature with an average score of 74.13 followed by lack of sufficient water during summer with an average score of 63.66. Another major problem was non-availability of labour in time for various activities(62.73).The other major problems faced by the producers in order of importance were loss due to predators(57.53), non-availability of fingerlings at required place (50.03), lack of knowledge about source of feed and feeding practices(43.80), heavy investment(41.00) and non-availability of quality seeds(39.60).Producers reported that fish production in inlands required heavy investment thus lack of capital is one of the major problems in the study area with an average score of 39.60. The other problems reported by the producers in fish production were non availability of required breeds of fingerlings (34.70) and non-availability of fingerlings in time (25.70).

Table 5.23 Problems faced by fish producers in the study area

Sl. No.	Problem	Avg. score	Rank
1	Loss of produce due to perishability	74.13	I
2	Shortage of water during summer	63.66	II
3	Non availability of labour in time	62.73	III
4	Loss of produce due to Predators	57.53	IV
5	Non availability of fingerlings at required place	50.03	V
6	Lack of knowledge about source of feed and feeding procedure	43.80	VI
7	Requires heavy investment	41.00	VII
8	Non availability of quality seeds	39.60	VIII
9	Non availability of required breed of fingerlings	34.70	IX
10	Non availability of fingerlings in time	25.70	X

5.5.2 Marketing related problems faced by the fish producers

Marketing constraints as presented in Table 5.24 were collected through the sample producers and enlisted down in which it was found that high marketing cost with an average score of 54.70 was the most severe problem faced by the fish producers. The problem of lack of organized market prevails in the area followed by non-availability of cold storage with score of 50.38 and 43.50, respectively. Even the produce is taken too far off markets but still there is problem some time exists for transportation as the wholesalers and commission agents arrange these facilities for the fish producers.

Table 5.24: Constraints faced by sample fish producers in marketing of fish

Sl. No.	Constraints	Avg. score	Rank
1	High marketing cost	54.70	I
2	Lack of organized marketing system	50.38	II
3	Non availability of cold storage	43.50	III
4	More number of middlemen	35.19	IV
5	Market very far off	23.21	V
6	Problem in transportation of produce	20.06	VI

*Summary
and
Conclusion*

Fisheries sector have been identified as one of the most important sectors of agriculture. The sector contributes about 1.07 percent to the overall GDP and 4.85 percent of the agricultural GDP. It contributes to national income, exports, food and nutritional security and employment generation. Fish has one of the nature's best nutritional values for human being. Fish is enriched with vitamin A, vitamin B and oils containing poly-saturated fatty acids which help to check the cholesterol level of the blood can be taken from fish. There are two main types of fisheries: Inland fisheries and marine fisheries. Inland fisheries include vast swamps, low-line accumulation of water, tanks, ponds, embankments etc. which act as breeding ground for mosquitoes and other aquatic animals. Production and farming of fishes are there in inland fisheries only, whereas in marine fisheries catching or collecting of fish from deep sea is done. Sources of marine fisheries include 7500 km of coastal line and deep sea beyond it.

Asia is the largest center of aquaculture production, and currently more than 90 percent of the global aquaculture production comes from Asian countries. Presently, India is the third largest fish producing country in the world with total production of 14.164 million tonnes (MT) (3.727MT from marine and 10.437MT from inland fisheries) in the year 2019-20. The contribution of Inland fishery to the total fish production has increased from 29 per cent to 74 per cent from 1970's to 2020; this naturally increases the GDP contribution from the sector. The three Indian major carps, namely, Catla, Rohu and Mrigal contribute to the majority of the national carp production.

West Bengal is the sixth largest economy of India and also one of the richest states among the Indian states having Inland water resources of various types constituting about 23.09 per cent of inland water resources of India. West Bengal (1.62 million tonnes) ranks second in inland fish production after Andhra Pradesh (3.61 million tonnes). More than 70% of total aquaculture production comes from small-scale farmers, who are also the major contributor to aquaculture technology

adaptations and small-scale innovations. Fish farmers of this state have a remarkable interest towards the fish farming. Furthermore, West Bengal's climatic conditions are favourable for fish farming. However, in recent years, input prices have risen rapidly, as has the wage rate, resulting in a decrease in income from fish production. Besides above, other factors impacting fish output include overfishing, shortage of high-quality fish seeds, a lack of market infrastructure, and various socioeconomic and environmental constraints. Socioeconomic causes include high cost of inputs, poor institutional linkages, poor mass media exposure, pouching and poisoning in the pond etc. Biophysical causes include small pond size, unscientific stocking, poor water quality, unscientific transportation of fingerlings etc. Apart from production related problem, due to inefficient marketing system fish producers are not getting genuine price and are highly exploited by intermediaries resulted in to lower profitability of fish farming. Inefficient marketing system is also impeding the smooth supply and timely availability of fish in market. Since the producers are confined to a particular location and the consumers are dispersed across the country, developing an effective domestic marketing strategy is important. In the light of above problems, an attempt has been made in the present study to achieve the following objectives.

1. To study the trends in production of Inland fisheries.
2. To work out the cost of and returns from fish farming in the study area.
3. To identify the marketing channels and work out the efficiency of different channels.
4. To identify the constraints in the production and marketing of fish farming.

Methodology

The present study was conducted in Birbhum and Murshidabad district of West Bengal as these districts have high Inland fish production across the districts. In the proposed study multi-stage sampling was used. West Bengal has 23 districts out of which 12 districts have major contribution in the Inland fish production in the state. Considering the Covid-19 situation, out of these 10 districts, 2 districts were chosen randomly namely Murshidabad and Birbhum. Murshidabad and Birbhum comprised

of 26 and 19 blocks out of which 2 blocks from Murshidabad (Jalangi) and Birbhum (Mayureswar I) were selected randomly. Thereafter, 3 villages from Jalangi (Sagarpara, Raghunathpur and Debipur) and Mayureswar I (Mallarpur, Hazipur and Birchandrampur) were selected randomly. And then from each village 10 fish farmers were chosen randomly. The total sample size of the proposed study was 60 fish farmers. These respondents were divided into three categories according to the size of their land holdings, viz., marginal (<1 ha), small (1-2 ha) and semi-medium (>2 ha). For the study of marketing cost, marketing margins and price spread, two market intermediaries each (wholesaler and retailer) was taken into the sample from the main fish market of the area after identification of prevailing marketing channels.

The required primary data for the study was collected from the fish producing farmers by personal interview method, using pre-tested well-structured survey schedule pertaining to the year 2020-21. However, data of previous years was collected from the respondents on recall basis, because they were not maintaining any record of farming operations.

To obtain the first objective, Compound annual growth rate (CAGR) analysis was done. To obtain the second objective, average annual cost and returns of inland fish farming were calculated and Cobb-Douglas production function was used to study the effects of various inputs on fish production. To attain the third objective, marketing cost, marketing margins, and marketing efficiency were calculated using required formulae. To obtain the fourth objective, Garrett's ranking technique was used to rank the various constraints faced by the fish producers.

Major findings of the study:

- The average age of household head in the study area was 47.87 years. In case of marginal, small and semi-medium category farmers, the average age was found to be 43.85, 48.32 and 53.20 years, respectively.
- Out of total, 53.33 per cent of fish producing farmers were educated up to primary level followed by illiterate (23.33 %), secondary (15.00 %) and higher secondary education (8.33 %). Majority of fish producing farmers were

illiterate under marginal farm category and small and semi- medium farmers were educated up to primary level.

- The average family size was 5.63 members with the composition of 3.40 males, 2.23 females. The overall family size has a positive relation with the size of farm. Average family size of fish producing farmers in marginal, small and semi-medium farm was 5.34, 5.68 and 6.02 members, respectively.
- The average land holding of the sampled farms was 1.29 hectare. Average land holding of marginal, small and semi-medium farms were 0.69, 1.39 and 2.00 ha, respectively. On an overall basis the irrigated area in the study area was about 62.01 per cent of the total land holding.
- The major crops in surveyed area were rice, wheat, potato, tomato, cabbage, cauliflower, brinjal, jute etc. In kharif season rice is the major crop which accounted for 81.15, 81.29 and 83.00 per cent area to total area by marginal, small and semi-medium farm categories, respectively. Other important crops in the kharif season were okra, bottle gourd, early cauliflower and brinjal etc. but allocated area was meagre. In rabi season boro rice was the major crop planted by the farmers and its share was 78.00, 79.13, and 78.00 per cent to total cropped area in rabi season on marginal, small and semi-medium farms, respectively. In pre- kharif season land is mostly left fallow since there was no irrigation facility in the summer season but in some portion of area was planted jute that depend on the access of irrigation facility. Cropping intensity in marginal, small and semi-medium farms were found to be 189.85, 207.19 and 208.50 per cent, respectively.
- Average area of pond in sample fish producers farm were 0.73 ha where average area in marginal, small and semi-medium farm 0.35, 0.76 and 1.32 hectare, respectively.
- In distribution of farm machinery and implements, spade, khurpi and sickle were mostly available in the study area where average number per farm were

3.66, 4.33, 5.16, respectively and tractor was least available with average number of 0.16 per farm.

- The average numbers of livestock in the sample farm were 10.13 on overall basis. For marginal, small and medium farmers the total number of livestock was 5.34, 12.35 and 11.76, respectively. Average number of birds in the sample farm were 10.41 and for marginal, small and semi-medium were 8.75, 11.37 and 10.43, respectively.
- In the study area, fisheries production seems to be major source of income as it contributed Rs. 5,70,817.93/- (67.02%) per annum followed by crop production Rs. 2,08,175.50/- (24.44%), livestock Rs. 19,977.30/- (2.34%). The other sources of income of fish producers were Govt. and private job Rs. 20,200.00/- (2.37%), business Rs. 20,000.00/- (2.34%) and remittance Rs. 12,500.00/- (1.46%).
- In India, inland fish production has increased from 2.84 Million Tonnes (MT) in 2001 to 10.43 MT in 2020 with growth rate of 6.84 per cent per annum and in West Bengal, inland fish production was around 0.87 MT in 2001 and it increased to 1.62 MT in 2020 with growth rate of 3.24 per cent per annum.
- The total investment for establishing one hectare of fish pond in the study area was worked out to be around Rs. 1,92,168.00/- per hectare. With regard to total cost of production was Rs. 458,182.07/- per hectare. Variable cost (Rs. 435,618.40/-) constituted about 95.07 per cent of the total cost. Feed cost was the major item of variable cost which constituted 43.32 per cent of the total cost (1,98,500.00/-) followed by seed cost, Rs. 96,000.00/- (20.95%), labour charges, Rs. 76,000.00/- (16.58 %), manure cost, Rs. 5,000.00/- (1.09 %), fertilizer cost, Rs. 9,800.00/- (2.13%), lime cost, Rs. 6,820.00/- (1.48 %), maintenance cost, Rs. 10,000/- (2.18 %) and medicinal cost, Rs. 5,000.00/- (1.09 %). The cost of production was Rs. 76.36/- and Rs. 72.60/- per kg over total cost and variable costs, respectively. On an average, 6,000.00 kg of fish was produced in one hectare of pond.

- The gross and net return from fish production was Rs. 10,29,000.00/- and Rs.5,70,817.93/- per hectare, respectively. The net return per rupee investment in the study area was around Rs.1.24 /-.
- The average quantity of fertilizer, lime, manures, fingerlings and feed were accounted 191.70, 272.80, 5000.00, 480.00 and 3809.22 kg per hectare, respectively. Rate of fertilizer in the targeted area was Rs. 51.12/kg followed by lime (Rs.25.00/-), manure (Rs.1.00/-), fingerlings (Rs.200.00/-) and feed (Rs.52.11/-) on sample farms. Average labour man days in the study area were 304-man days per hectare. The labour, fertilizer, lime, manure, seed and feed were overused and were allocative inefficient.
- A majority of over 46.66 per cent of the sample farmers marketed their produce through channel III followed by channel II (30.00 %) and channel I (23.33 %). 57.50 per cent of the total produce was sold in the channel III, followed by channel II (30.66 %) and channel (11.00%).
- Marketing cost for producer, retailer and wholesaler was Rs.4.24/-, Rs.5.16/- and Rs.6.97/- per kg, respectively. Maximum cost incurred by producers (37.73 %) and wholesalers (41.96%) were in transportation, and maximum cost incurred by retailers (36.24%) was icing.
- There was no intermediaries in channel I thus producers share in consumer rupee and marketing efficiency was highest in channel I followed by channel II and III in all the three breeds (catla, rohu and mrigal) of fish showing that direct transaction between the farmer and consumer is profitable for the farmers.
- Out of all the constraints faced in production of fish, loss of produce due to perishability, shortage of water during summer, non-availability of labour in time was the major problems as reported by the fish producers. Apart from these problems, loss of produce due to predators, non-availability of fingerlings at required place, lack of knowledge about source of feed and feeding procedure, heavy investment, non-availability of quality seeds, non-

availability of required breed of fingerlings, non-availability of fingerlings in time were the other problems faced by the fish producers in the surveyed area.

- Out of all the constraints faced in marketing of fish, high marketing cost, lack of organized marketing system, non-availability of cold storage was the major problems as reported by the fish producers. Apart from these problems, more number of middlemen, market very far off, problem in transportation of produce were the other problems faced by the fish producers in the surveyed area.

Conclusion and policy implication:

- Fish production in the surveyed area are major economic activity of the farmers because it contributed about 70% income to total annual income of the farmers. The capital investment on establishing production of fish in the study area is very high. Therefore, Govt should provide subsidy to fish farmers: marginal and small for purchase of capital assets (boat, cast net and preparation of pump house), feed and fingerling which constitutes major proportion of variable cost.
- Since, fish market is located far away than the place of production, thus, high transportation cost is incurred by producers for selling the fish in the market. Hence, a organized marketing structure is recommended near the place of production to decrease the marketing cost which increases the net income of the producers.
- Resources like human labour, feed and manure were underutilized even though they have contributed positively. The farmers also had lack of knowledge about availability of quality and proper feeding practices. Hence, appropriate and adequate training or extension programme need to be tailored through the line departments and relevant agencies on production technology, input and output marketing and post-harvest management.
- As per farmers perception major problem prevalent in the study area are nature of perishability of fish and lack of storage facilities. Thus, facilities like proper storage structure and cold chain may be developed to overcome the problem of perishability.

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Appendices

Appendix-I

Management practices of inland fish production in West Bengal

Composite carp farming is a poly-species pond culture system in which three Indian major carps (IMC), catla (*Labeo catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*) are stocked. This system is a practical modification of the IMC polyculture so as to fill the vacant niches in a pond ecosystem for optimizing internal resource utilization and thereby a means of increasing productivity. The principle behind the scientific fish culture is to produce maximum quantity of fish per unit area from a scientifically managed water body by stocking fast growing, economically important, compatible species having shortest food chain utilizing the all-ecological niches of the water body. Catla is surface feeder and feeds on zooplankton and it has ecological and socio-economic potential advantages with having a strong impact on the pond ecology because it is a fast growing and very efficient filter-feeder. Mrigal is bottom feeder and considered to monitor culture and health status in farm condition. Catla is stocked in upper layer, rohu in column layer and mrigal in bottom layer to minimize overlap. Common carp has more rapid growth and known as bioturbator.

Management protocols adopted in composite fish culture can be divided into pre-stocking management, stock management and post-stocking management.

Pre-stocking management	
Aquatic weed and weed fish control	Aquatic weeds hamper primary productivity creating obstruction in movement of fishes and in netting operations etc. Removal of unwanted and predatory fishes and other animals is done by repeated netting.
Liming	Application of lime is done not only for fertilizing the pond but also as a remedial measure necessary in acidic pond.
Fertilization and manuring	Fertilization keeps the metabolic cycle in operation, increases natural productivity.

Stock management	
Species composition	Selection of species plays an important role for any culture practices.
Stocking density and ratio	A pond having average water depth of 6-9feet may be stocked at the rate of 6,000 -12000 fingerlings per ha. Production level decline as the depth of the pond increase above 5.00 to 9.00 feet.
Post-stocking management	
Feeding of fishes	Commonly available agricultural by-products such as rice bran and mustard oil cake are used as supplementary feed at 2 to 5 per cent of the body based on natural productivity of fishpond.
Fertilization and liming	cow dung @ 5000 kg per ha can be applied near the dyke of the pond. Organic fertilizer like urea and SSP can be applied @ 20-25 kg per ha per month. liming with quick lime @ 250-300 kg per ha for regulating pH of pond water
Health care and hygiene	Before releasing the fingerlings, a dip treatment with 3% KMnO ₄ for 1 minute should be given. Alternatively, 2% to 3% common salt solution may also be used.
Harvesting and yield	Harvesting is generally done at the end of first year, when the fishes attain average weight of 800 g to 1.25 kg. Average body weight of seedlings is 80 gm. More than 6 tonnes per ha per year fish production is achieved from the average pond size of 0.6 to 1 ha. The most favourable stocking time is between may 15th May to June 15th.

Appendix II

Use of farm machinery and implements in the study area

Operations	Farm category		
	Marginal	Small	Semi-medium
Tillage operations	Desi Plough	Disc Plough, M.B plough, Tractor	Disc Plough, M.B plough, Disc harrow, Rotavator, Power tiller, Tractor
Sowing and fertilizer application	-	Seed-cum-fertilizer drill	Seed-cum-fertilizer drill
Interculture operation	Spade, Khurpi, Sickle	Spade, Khurpi, Sickle, Wheel hoe, Dryland peg weeder	Spade, Khurpi, Sickle, Wheel hoe, Dryland peg weeder
Plant protection equipment	Knapsack sprayer	Knapsack sprayer	Knapsack sprayer
Harvesting equipment	Sickle	Combine harvester	Combine harvester
Threshing	-	Multi-crop thresher	Multi-crop thresher

Appendix III

Source of Gross annual income in the study area

Crops	Average (area or number)	Production (ha or number or liter or kg)	Gross return
Kharif			
Rice (aman)	1.06	2650.00	66000.00/-
Okra	0.06	360.00	8000.00/-
Bottle gourd	0.02	220.00	3080.00
Early Cauliflower	0.03	450.00	8500.00/-
Brinjal	0.07	910.00	31000.00/-
Others including fallow	0.04	-	
Sub Total	1.29	4590.00	116580.00/-
Rabi			
Rice (boro)	1.02	3060.00	73000.00
Potato	0.08	2080.00	29120.00/-
Wheat	0.09	243.00	4200.00/-
Cabbage	0.03	720.00	16000.00/-
Cauliflower	0.03	650.00	13000.00/-
Tomato	0.01	150.00	2850.00/-
Others including fallow	0.03	-	
Sub total	1.29	6903.00	138170.00/-
Pre-kharif			
Jute	0.52	1456.00	65520.00/-
Others including fallow	0.02	-	-
Sub total	0.54	1456.00	65520.00/-
Total Crop production	-		3,20,270.00/-
Livestock			
Egg	5.41	200	2164.00/-
Milk	2.11	500	26,375.00/-
Total livestock			28,539.00/-
Fisheries			10,29,000.00/-
Grand total			13,77,809.00/-

Appendix IV

Major Inland Fish producing districts of West Bengal

No	District	Inland Fish Production (Tonnes)	Annual Inland Fish Production per Rural Person (Kg)
1.	Darjeeling	1867	1.65
2.	Jalpaiguri	12765	4.53
3.	Purulia	49977	18.86
4.	South 24 Parganas	186870	30.37
5.	Cooch Behar	21918	8.36
6.	Uttar Dinajpur	29450	10.41
7.	Paschim Medinipur	68880	12.76
8.	Dakshin Dinajpur	53586	16.10
9.	Maldah	62581	17.47
10.	Purba Medinipur	164731	35.40
11.	Murshidabad	120794	20.50
12.	Bankura	50109	14.69
13.	Hoogly	100988	29.69
14.	Birbhum	71855	22.80
15.	Howrah	39947	23.65
16.	Nadia	100880	26.83
17.	North 24 Parganas	201955	46.55
18.	Bardhaman	146253	30.91

Source: NFDB, 2018

Appendix V

Factors affecting fish production (Zero order correlation matrix)

	Yield	Labour	Fertilizer	Lime	Manure	Seed	Feed
Yield	1						
Labour	0.560999	1					
Fertilizer	0.503194	0.362384	1				
Lime	-0.0586	-0.07841	0.088635	1			
Manure	0.648085	0.173617	0.309799	0.061861	1		
Seed	0.534306	0.660209	0.5695	-0.03482	0.169096	1	
Feed	0.571527	0.356182	0.348264	0.049686	0.371692	0.333125	1

Appendix VI

Survey Schedule

Name of the Investigator:

Schedule No.

Date:

Village:

Block:

District:

General Information

1. Name of the respondent:

2. Age (Years):

3. Mobile No:

4. Education: Illiterate/Primary/Secondary/Higher secondary

5. Family type: Joint/Nuclear

6. Family size:

Total:

Male:

Female:

Educated:

No. of persons working in farm:

7. Occupations: Main:

Subsidiary:

8. Income: Farm Income:

Non-farm Income:

Size of land holding

IR/UIR	Area(ha)		
Irrigated			Total
Un-irrigated			
Total			
Source of irrigation			

Cropping Pattern

Season	Crop	Variety	Area	Irrigated/Un-irrigated	Output
Kharif					
Rabi					
Pre-kharif					

Livestock

S. No.	Types	Number
1.	Cow	
2.	Buffalo	
3.	Bullock	
4.	Goat	
5.	Pig	
6.	Sheep	
7.	Poultry	
8.	Ducks	

Income sources other than fisheries

S. No.	Particular sources	Income
1.	Crop Production	
2.	Livestock and poultry	
3.	If other source of income specify,	

General structure of fish farming

1.Size of pond:

2.Breeds of fishes:

3.input use pattern:

No	Particular of input	Quantity/ number used per ha	Rate (Rs. /kg or man days)
a. Material			
1.			
2.			
3.			
4.			
5.			
b. Labour use (man days/ha) by activity			
1.	Pre-stocking		
2.	Stocking		
3.	Post-stocking		
	Total		

4. Levels of output in inland fish(composite) production:

Fish breed	Average number of fish/ha	Average weight of fish (kg)	Average production (kg/ha)	Average rate of sale (Rs. /kg)

5. Fixed cost of fish farming in study area

Sl. No.	Particular	Fixed cost	Percentage
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
	Total		

6. Cost and return analysis of Inland fish production on surveyed farms

Sl. No.	Particular/Items	Cost (Rs. /ha)	Percentage
A.	Variable costs		
1.	Labour charges		
2.	Material cost		
	a.		
	b.		
	c.		
	d.		
	e.		

3.	Maintenance		
4.	Medicine		
5.	Interest on working capital (@7%)		
	Sub Total		
B.	Fixed cost		
1.	Depreciation (@5%)		
2.	Interest on fixed cost (@9%)		
C.	Sub total		
D.	Total cost		
	Analysis of returns		
1.			
2.			
3.			
E.	Gross Return		
F.	Net return		
	Net return per rupees invested		
	Cost of production (Rs/kg)		
	Cost of production over variable cost (Rs/kg)		

7. Sale pattern and marketing channel of producer

Particulars	Quantity	Price	Value
Direct sale of consumer			
To contractor			
To wholesaler			
To retailer			
To any agency			

8. Production constraints:

S. No.	Problems	Rank	Suggestions
1.	Loss of produce due to perishability		
2.	Shortage of water during summer		
3.	Loss of produce due to Predators		
4.	Lack of knowledge about source of feed and feeding procedure		
5.	Requires heavy investment		
6.	Non availability of quality seeds		
7.			
8.			
9.			

9. Marketing constraints:

S. No.	Problems	Rank	Suggestions
1.	High marketing cost		
2.	Lack of organized marketing system		
3.	Non availability of cold storage		
4.	Market very far off		
5.			
6.			
7.			
8.			
9.			

10. Market functionaries

Commission agent/Wholesaler/Retailer:

Name of the respondent:

Age:

Place:

Block:

District:

Annual Income:

- a. How long you are in this business?
- b. Do you know the arrival price of fishes prevailing in the market?
- c. On what basis you fix prices?
- d. What facilities do you provide to the producers who bring produces for sale?

11. Marketing cost

A. Do you have shop owned/rented

1. If rented, what is the rent per year,

2. License fee:

3. Maintenance cost:

4. Tax paid

B. Other marketing cost:

1.Mode of transport:

2.Distance travelled:

3.Total quantity transported:

4. Transportation charges:

5.Cost incurred in loading/unloading:

6.Commission paid:

7.Labour charges:

Opinion of market functionaries:

A. Did you face any transport problem? Yes/No'

If yes then specify

B. What is your suggestion to solve them?

C. Are you satisfied with the present marketing channels?

If not, what part of marketing channels you are not satisfied? Why

D. Are you satisfied with the price received for your crop? If not what price you want and why could not get that price?

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S. No.	Examination Passed	Institution	Year	Percentage/ CGPA
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2.	B.Sc. (Agriculture)	Palli Siksha Bhavana (Institute of agriculture), Visva-bharati, Santiniketan, West Bengal	2019	7.93
3.	Intermediate	Kandi Raj High School, Kandi, West Bengal	2015	90.00%
4.	High School	Kandi Raj High School, Kandi, West Bengal	2013	85.57%

- **Specialization:** Major: Agricultural Economics Minor: NIL
- **Trainings Attended:** “Analytical Technique for Social Science Research” March, 3rd-4th, 2021, organized by the Department of Agricultural economics, GBPUA&T, Pantnagar
- **Software Skills:** MS Word, MS Excel, PowerPoint, Adobe Photoshop
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Place: Pantnagar

Date: October, 2021

Saikat Chatterjee
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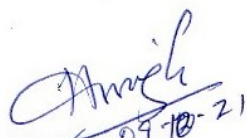
Name	: Saikat Chatterjee	Id. No.	: 55413
Semester & Year of Admission	: 1st Semester, 2019-20	Degree	: M.Sc. (Ag.)
Department	: Agricultural Economics		
Major	: Agricultural Economics	Minor	: Nil
Thesis Title	: “AN ECONOMIC ANALYSIS OF PRODUCTION AND MARKETING OF FISH IN WEST BENGAL”		
No. of pages	: 84	Advisor	: Dr. H. N. Singh

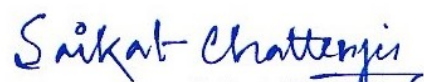
ABSTRACT

Fisheries sector have been identified as one of the most important sectors of agriculture. Fish is a valuable source of food enriched with animal protein. Asia is the largest center of aquaculture production, and currently more than 90 percent of the global aquaculture production comes from Asian countries. Presently, India is the third largest fish producing country in the world with total production of 14.164 million tonnes followed by China and Indonesia. West Bengal is the sixth largest economy of India and constituting about 23.09 per cent of Inland water resources of India. West Bengal (1.62 million tonnes) ranks second in Inland fish production after Andhra Pradesh.

The present study was conducted in West Bengal to study the trends in production of Inland fisheries in the state, to work out the cost of and returns from fish farming in the study area, to identify the marketing channels and to work out the efficiency of different channels, to identify the constraints in the production and marketing of fish farming. Fish producing farmers have been found middle aged group (36-50), mostly educated up to primary with average land and pond holding of 1.29 and 0.73 hectare, respectively. The total investment for establishing fish pond in the study area was worked out to be around Rs. 192168.00/- per hectare. The total cost of production was Rs. 4,58,182.07/- per hectare. Variable cost constituted about 95.07 per cent of the total cost of Rs. 435618.40/- and fixed cost about 4.92 per cent of the total cost (Rs. 22,563.67/-). The gross and net return from fish production was Rs. 10,29,000.00/- and Rs.5,70,817.93/- per hectare, respectively. The return per rupee investment in the study area was around Rs.1.24 /-. The resource use efficiency revealed that the resources are not optimally utilized in the fish production. Majority of the fish producers marketed their fish in channel III followed by channel II and channel I. Producers share in consumer rupee and marketing efficiency was highest in channel I followed by channel II and III for all the three breeds (catla, rohu and mrigal) of fish.

It was observed that majority of the fish producers expressed the problem on loss of produce due to perishability, shortage of water during summer and non-availability of labour in time. Marketing problem associated with fish producers were high marketing cost, lack of organized marketing system and non-availability of cold storage.


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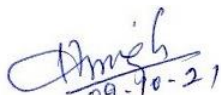
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सत्र एवं प्रवेश वर्ष	: प्रथम, 2019-20	उपाधि	: स्नातकोत्तर (कृषि)
बिभाग	: कृषि अर्थशास्त्र		
मुख्य विषय	: कृषि अर्थशास्त्र	गौण विषय	: शुन्य
शोध शीर्षक	: “पश्चिम बंगाल में मछली के उत्पादन और विपणन का एक आर्थिक विश्लेषण”		
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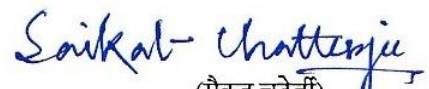
सारांश

मत्स्य पालन क्षेत्र को कृषि के सबसे महत्वपूर्ण क्षेत्रों में से एक के रूप में पहचाना गया है। मछली पशु प्रोटीन से समृद्ध भोजन का एक मूल्यवान स्रोत है। एशिया जलीय कृषि उत्पादन का सबसे बड़ा केंद्र है, और वर्तमान में वैश्विक जलीय कृषि उत्पादन का 90 प्रतिशत से अधिक एशियाई देशों से आता है। वर्तमान में, भारत 14.164 मिलियन टन के कुल उत्पादन के साथ दुनिया का तीसरा सबसे बड़ा मछली उत्पादक देश है, जिसके बाद चीन और इंडोनेशिया हैं। पश्चिम बंगाल भारत की छठी सबसे बड़ी अर्थव्यवस्था है और भारत के अंतर्देशीय जल संसाधनों का लगभग 23.09 प्रतिशत है। पश्चिम बंगाल (1.62 मिलियन टन) आंध्र प्रदेश के बाद अंतर्देशीय मछली उत्पादन में दूसरे स्थान पर है।

वर्तमान अध्ययन पश्चिम बंगाल में राज्य में अंतर्देशीय मत्स्य पालन के उत्पादन में प्रवृत्तियों का अध्ययन करने, अध्ययन क्षेत्र में मछली पालन की लागत और रिटर्न की गणना करने, विपणन चैनलों की पहचान करने और विभिन्न की दक्षता का पता लगाने के लिए आयोजित किया गया था। चैनल, मछली पालन के उत्पादन और विपणन में बाधाओं की पहचान करने के लिए। मछली उत्पादक किसान मध्यम आयु वर्ग (36-50) पाए गए हैं, जो ज्यादातर प्राथमिक तक शिक्षित हैं, जिनकी औसत भूमि और तालाब क्रमशः 1.29 और 0.73 हेक्टेयर हैं। अध्ययन क्षेत्र में मछली तालाब की स्थापना के लिए कुल निवेश लगभग ₹. 192168.00/- प्रति हेक्टेयर। उत्पादन की कुल लागत ₹. 4,58,182.07/- प्रति हेक्टेयर। परिवर्तनीय लागत रुपये की कुल लागत का लगभग 95.07 प्रतिशत है। 435618.40/- और स्थिर लागत कुल लागत का लगभग 4.92 प्रतिशत (₹. 22, 563.67/-)। मछली उत्पादन से सकल और शुद्ध लाभ ₹. क्रमशः 10,29,000.00/- और 5,70,817.93/- प्रति हेक्टेयर। अध्ययन क्षेत्र में प्रति रुपये निवेश का प्रतिफल लगभग ₹. १.२४/- था। संसाधन उपयोग दक्षता से पता चला कि मछली उत्पादन में संसाधनों का इष्टतम उपयोग नहीं किया जाता है। अधिकांश मछली उत्पादकों ने चैनल III के बाद चैनल II और चैनल I में अपनी मछली का विपणन किया। उपभोक्ता रुपये में उत्पादकों की हिस्सेदारी और विपणन दक्षता चैनल I में सबसे अधिक थी, इसके बाद चैनल II और III तीनों नस्लों (कटला, रोहू और मृगल) के लिए थी।

यह देखा गया कि अधिकांश मछली उत्पादकों ने खराब होने, गर्मी के दौरान पानी की कमी और समय पर श्रम की अनुपलब्धता के कारण उपज के नुकसान पर समस्या व्यक्त की। मछली उत्पादकों से जुड़ी विपणन समस्या उच्च विपणन लागत, संगठित विपणन प्रणाली की कमी और कोल्ड स्टोरेज की अनुपलब्धता थी।


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