FISH PRODUCTION IN HIMACHAL PRADESH
(Economic Analysis of Fish Ponds)

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CONTENTS

EXECUTIVE SUMMARY

Abstract: The State of Himachal Pradesh with its varied topography and diverse climate is endowed with tremendous potential for the development of fisheries with riverine, reservoir and pond resources. The fish industry provides means of livelihood to large number of people in the state, which contributes substantially not only to the state income but also accounts for the export trade of the country. The farmers in the state are adopting this profession as a supplementary enterprise with the agriculture to increase the income to a substantial extent. Himachal Pradesh has also become the first state in the country to introduce trout fish farming in the private sector besides emerging as a number one producer of this specie of fish. The present report examines the costs and returns from pond fish and trout fish rearing and also the problems faced by the fish farmers in the State. The results of the study revealed that overall, the total cost for the production of pond fish was Rs. 19663 per farm. The variable and fixed cost constituted 78.23 and 21.77 per cent of the total cost respectively. Per kg cost of production of pond fish was Rs 21.45. Per farm net income realized by all the sampled pond fish farmers was Rs.18321 and on the whole input output ratio comes out to be 1:1.93. Regarding trout fisheries overall the total cost for the production of trout fish was Rs. 26521 per farm. The variable and fixed cost constituted 85.17 and 14.83 per cent of the total cost respectively. Per farm net income realized by all the sampled trout fish farmers was Rs.180342 and on the whole input output ratio comes out to be Rs.1:1.68. Per kg cost of production of trout fish was Rs 94.87. Problems of pond and trout fish producers related to construction of ponds, fingerlings, fish feed, marketing of fish etc. are also discussed in detail in the report.

Objectives of the Study

i) To analyze the status of fish production in Himachal Pradesh.
ii) To examine the costs and returns from ponds fish and trout fish rearing in Himachal Pradesh.
iii) To examine the problems of pond fish and trout fish farmers in Himachal Pradesh.
iv) To suggest a policy measures for the development of fisheries in Himachal Pradesh.

Methodology

In the present study multistage stratified random sampling technique has been used to finalize the sample of pond fish farmers for detailed study. At the first stage Kangra district was selected purposively on the basis of having largest area under fish ponds. Secondly from selected district six administrative blocks namely Baijnath, Bhawarana, Nagrota Bagwa, Panchrukhi, Kangra and Rait were selected on the basis of highest

area under pond fisheries. A list of pond fish owners in these six blocks was obtained from fish farm of Dr. G.C. Negi, College of Veterinary and Animal Science, CSK, Himachal Pradesh Krishi Vishavidyalaya, Palampur and a sample of 24 pond fish farms (one third of the total pond fish farms) was drawn randomly for detailed study. Similarly, the same technique has been used in the selection of trout fish farms. At the first stage Kullu, Mandi, Shimla and Kinnaur districts were selected purposively on the basis of having largest area under trout fish raceways. Secondly a list of trout fish farms was obtained from the district fisheries office of these districts and twenty trout fish units were selected randomly from the detailed study. The data collected from the sampled pond and trout fish farmers pertain to the agriculture year 2006-07.

MAIN FINDINGS

Fish production in Himachal Pradesh

Since 1976-77 the production of fish from ponds & others in Himachal Pradesh has shown batter performance as compare to riverine and reservoirs. At present maximum fish production comes from riverine followed by ponds & others and reservoirs. District-wise, since 1995 the per year rate of growth of fish production comes out to be maximum (15.12%) in case of Una followed by Hamirpur (8.33%), Solan (6.96%), Mandi (5.76%), Kullu (3.57%) and Kangra (2.13%).

Management of pond for fish

Permanent water supply of required volume and quality is the basic factor for the construction of fish pond. The land must be having the capacity of retaining water. The sides of the ponds should be sloppy and well compacted. The pond should be provided with independent inlets and drainpipe. Liming and manuring of pond is also of utmost importance. Good quality seed and valuable fish species and varieties of fish are also important for successful fish farming.

Socio-economic features of pond fish farmers

The average family size among all the sampled pond fish farmers was 4.37 persons. About 84 percent of the people were found to be literate and out of total persons maximum (25.96%) persons were literate at the Matric level. Agriculture was the main

occupation of the majority (64.91%) of the farmers whereas dairy was the most common subsidiary occupation (66.67%). Land use pattern indicates that maximum (79.74%) area was of cultivated land in all the category of fish farms. In total cropped area, maximum proportion (29.75%) of area was observed in the case of wheat and minimum in the case of barley (0.56%). On an average the number of livestock were 3.23 heads per farm. The proportion of income was observed to be maximum (27.93%) from service sector. In the case of crop highest income was obtained from the vegetable crops.

Cost and returns in pond fish farming

Average cost of construction of fish pond was Rs. 11964 and the source of finance for construction of pond was the own of the majority (45.83%) of the sampled pond fish farmers. The average expenditure on implements and tools was observed to be Rs.1787/farm. Out of the total time spent by pond fish farmers on the various activities of fish production, maximum time goes to the activity of watch and ward followed by feeding of fish, fish catching and maintenance of pond. On an average per farm value of feed for rearing of fish was about Rs.10317 and cake and bran is the major component of feed constituted 80.33 per cent of the total value of feed. Overall, the total cost for the production of pond fish was observed to be Rs.19663 per farm. The variable and fixed cost constituted 78.23 and 21.77 per cent of the total cost respectively. Per farm net income realized by all the sampled pond fish farmers was observed to be Rs.18321 and on an average input out put ratio comes out be to 1:1.93. On the whole, out of total production of fish 95.10 per cent was marketed and contractor was the main functionaries involved in the marketing of pond fish.

Problems faced by the pond fish farmers

The main problems faced by the majority of farmers are lack of finance, shortage of water in summer and winter, non availability of fingerling of required breed, fingerlings not available in required place, lack of knowledge about feed and feed is not available in time. Due to sufficient demand of fish in the producing area marketing is not the major problem of sampled pond fish farmers.

Trout fish production in Himachal Pradesh

In H.P. the total production of trout has increased at the rate of 23.13 per cent per annum during 1996-97 to 2005-06. District wise the annual rate of growth of trout fish production comes out to be maximum (31.43%) in district Mandi followed by Chamba (24.20%), Kinnaur (23.41%) and Kullu (12.38%).

Construction and Management of raceways for trout fish

Adequate quantity and good quality of water is a pre requisite for a trout farm. A single race way of 25x2x1.5-1.8m requires 15 liter of water/second. To maintain the quality of water it is necessary to use of biologically filter for supply of water. The feed given to fish should be fresh and of high quality. Low quality feed causes diseases and mortality. The maintenance of hygiene is important factor in the management of trout farm. All the equipments of the farm should be disinfected. Regular cleaning and checking of tank, raceway and tray is necessary. Monthly grading of fish is also necessary.

Socio-economic features of sampled trout fish farmers

The average family size among all the trout fish farmers was 4.75 persons. About 88 per cent of the people were found to be literate and of total persons maximum (22.89%) persons were literate at the level of Matric. Agriculture was the main occupation of majority (53.12) of the farmers whereas fishery (54.76%) was the most common subsidiary occupation. Land use pattern indicates that maximum (87.55%) area was of cultivated land in all the category of fish farms. In total cropped area, maximum proportion (62.36%) of area was observed in the case of fruits and minimum (0.95%) in the case of pulses. On an average the number of livestock were 2.85 heads per farm. In crops highest income was obtained from fruit crops.

Cost and returns in trout fish rearing

Average cost of construction of raceway was Rs.210215 and the source of finance for construction of raceway was the own and fishery department of the majority (60%) of the sampled trout fish farmers. The average expenditure on implements and tools was observed to be 2681/farm. Out of the total time spent by the trout fish farmers on the

various activities of fish production maximum time goes to the activity of watch and ward and minimum for the maintenance of tank. Overall, the total cost for the production of trout fish was observed to be Rs.265214 per farm. The variable and fixed cost constituted 85.17 and 14.83 per cent of the total cost respectively. Fish feed is the main component of the cost constituted 64.33 per cent of the total cost. Per farm net income realized by all the sampled trout fish farmers was Rs.180342 and on an average input output ratio comes out to be 1:1.68. On the whole, out of total production of fish 95.32 per cent was marketed. Nearly 57 percent of marketed surplus was sold to hotels at Delhi and Shimla, 22 percent was sold to local contractors. The marketing cost incurred by the producers was Rs 70.28/kg at Delhi and Rs 38.85/kg at Shimla. Net price received by the producers was Rs 249.22/kg at Delhi and Rs 221.15/kg at Shimla.

Problems faced in production and marketing of trout fish

Costly feed, lack of availability of feed and not available at desired place is the major problem faced by the majority (90.95%) of the sampled trout fish farmers. Regarding finger lings, costly fingerlings and not available at required place are the main problem faced by 60-65 per cent of the total farmers. No proper market for fish in the area and market is away from producing area are the problems faced by 90 per cent of the trout fish farmers. High cost of construction of pond was also the main problem of majority of the trout fish farmers.

Conclusion and suggestion

Some important recommendations that emerged from the analysis, and need greater policy focus are:

The efforts should be made to establish the feed processing plants in producing areas. The supply of fish feed in remote areas should be ensure through establishing feed distribution centers in the producing areas. Incentives should be provided to marginal and small unit of fish on feed purchased by these. Strengthen and promote institutions such as co-operatives, producers' organizations and contact farming that link producers to markets and reduce marketing and transaction costs. The extension services should be strengthen to disseminate the technical know-how to the small pond fish producers

located in remote areas. It is suggested that the insurance cover of the fish farm should be provided to cover the losses due to damage by natural calamities. The production of fingerling at hatcheries established by the government should be increased and new hatcheries in the producing areas be established to ensure the timely supply of fingerlings to farmers particularly small fish farmers. Adequate financial assistance should also be given to fish farmers for construction of new ponds and rejuvenating old ponds for fish production.

Executive Table

#	Particulars	Pond fish farming	Trout fish farming
1	Total fish production , 2005-06(tonnes)	1807	25
2	Average family size (Persons)	4.37	4.75
3	Literacy %	83.65	87.95
4	Average land holding (ha)	0.64	1.96
5	Annual gross income (Rs)	2,21,240	10,81,426
6	Source wise gross income (%of total income)		
	-Crops	17.65	35.21
	-Livestock	17.25	2.63
	- Fishery	17.17	41.17
	- Service	27.93	8.02
	-Business	13.64	12.97
	-Other	6.36	0
7	Average size of fish pond/raceway	372M^2	152.70 M^3
8	Annual Human labour used (days)	32.30	213
9	Value of fish feed fed (Rs/farm)	10,316	1,70,621
10	Per farm cost of rearing fish	19,663	2,65,214
	-Variable cost	15,383	2.25,870
	-fixed cost	4,280	39,344
11	Per farm annual fish production (kg)	816	1901
12	Fish retained for home consumption (% of total)	2.7	1.63
13	Fish given as gift to relatives/friends (% of total)	2.20	3.05
14	Quantity Marketed (kg)	776	1812
	-sold in the market to wholesalers %	2	1.66
	-sold to retailers	1	-
	-sold to consumers	27	19.18
	-sold to hotels	0	57.25
	-sold to contractors	70	21.91
15	Losses of fish (% of total production)	29.65	0.89
16	Per farm annual gross returns (Rs)	37,984	4,45,556
17	Per farm annual net returns (Rs)	18,321	1,80,342
18	Per kg cost of production	24.10	139.51
19	Per kg value of fish	45.55	234.38
20	Per kg net returns	21.45	94.87
21	Input output ratio	1:1.93	1:1.68

Chapter - 1

INTRODUCTION

1.1 Preamble

Fisheries play an important role in India's economy in augmenting food supply, raising nutritional levels and earning foreign exchange. Fish culture is becoming more and more alluring due to its low capital investment, short gestation period and generation of high profit. Its importance from social and economic point goes to augmentation of nutritional level, employment generation, earning foreign exchange. It is suitable proposition for rural development and to improve the economic conditions of the rural people (Biswas, 2006). Broadly speaking, fishing resources of India are either inland or marine. The principal rivers, canals, ponds, lakes, reservoirs comprise the inland fisheries. The marine resources comprise the two wide arms of Indian Ocean and a large number of gulfs and bays along the coast. India ranks seventh in the world in terms of total fish production and second in inland fish production among the major fish producing countries of the world. At present India's fish production touches 3.8 million tones. Out of the present production about 62 per cent comes from the marine sector and 38 percent from the inland sector while that of the world fish production about 88 per cent and 12 per cent comes from sea and inland sector respectively (Biswas, 2006). Since 1980-81 fisheries production in India has been increasing at a rate of 5.12 per cent per year and the inland has shown better performance with an annual growth rate of 6.22 per cent. Fish contributing 1.4 per cent of GDP and 4.5 per cent of agricultural GDP. Fisheries sector is providing full or part time employment for 6 million people (Pathare et. al., 2005).

In northern part of the country where there is no scope for marine fisheries, the inland fishery alone has to contribute its share to meet the overall requirement of fish in India .Marine fish catch contributes about half of the fish demand of the country. The development of inland fisheries, therefore deserves special attention for investment in greater measures to fully utilize the resources available in this sector so that the

commitment made upon this sector towards the increased fish production could be fully met with.

1.2 Importance of fish in human diet

Fish is an important source of animal protein and other nutrients essential to man and as such has a vital role to play in the improvement of nutritional standard of the people. From the point of view of human nutrition, the fish food is not easily digestible but is also rich in essential amino acids like lysine and methionine. It is unique animal meat that is rich in essential fatty acids. The unique poly unsaturated fatty acid namely eicosapentaenoic acid of fish is known to reduce the cholesterol level of blood and save human beings from coronary diseases. Further, vitamins such as A, B, C, D, B-complex, B 12 and minerals like calcium, phosphorus, iron, sodium, potassium, magnesium and sulphur are also present in good qualities in fish (Santhanam et. al., 1990). The meat of culturable fish as carp, trout, trench, sandu and vendace contain proteins to the extent of 18.0, 20.8, 17.5, 17.7 and 21.2 per cent respectively. The proteinic matter of fresh fish is assimilated two or three times better by man than cattle meat. The meat of fish cultured in ponds contains oil ranging from 0.7 per cent to 15.0 per cent (Martyshev, 1983).

As a supplement diet to bridge the gap between the availability and requirement of food, which is further being accentuated by the fast rising population, the development of fisheries assumes greater importance. Fisheries enterprise provides employment and income not only at production level but its backward and forward linkages are equally important. This would generate employment and income in fish seed farms (hatcheries), breeding and health cover establishments on the input side and in procurement, processing and manufacturing, packaging and marketing for the value added fishery products, (Chauhan, 1995).

1.3 Fisheries in Himachal Pradesh

Himachal Pradesh has a number of streams and rivers which have a vital potential for the production of exotic Brown Trout, and indigenous Asla (snow trout). The state has

also a number of lakes covering about 5000 hectares of area at mid hill and high mountain elevation. The reservoirs created with the construction of multipurpose dams constructed on various rivers and streams have also added to the production potential of inland fish. The state has also two large reservoirs viz. Gobind Sagar and Maharana Partap Sagar. Fish can also be raised in small ponds as well as big ponds, kuhl, channel which are generally found in village and by constructing earlier ponds in agriculture farms or by the construction of exclusive fish farms.

The estimated network of the state fisheries water resources is about 3000 km out of which 600 km. has been classified as trout water's, 2400 km. general waters, 42200 hectares resources including 16000 hectares Gobind Sagar, 24000 hectares Pong, 2000 hectares Chamera, and 200 hectares Pandoh, 1000 hectares ponds and 725 hectares high altitude lakes (The times of India, 2007). During 2005-06 Himachal's fish production is about 7,295 tonnes.

In H.P. fishes suitable for farming are Minor carp/Rohu/Silver carp/Catla/Mirgal etc. for warm districts, trout for cold water districts. These are the best kinds of fish for stocking in ponds/raceways. These all kinds can grow fastly in a pond without competing with each other in consuming food of the pond.

Himachal Pradesh has also become the first state in the country to introduce trout farming in the private sector besides emerging as a number one producer of this specie of fish. The trout produced in the cold water of the state is fast catching fancy of the people especially tourists. At present, trout is considered to be a highly priced fish in the country.

The fish industry provides means of livelihood to large number of people in the state, which contributes substantially not only to the state income but also accounts for the export trade of the country. There was an export of 751.1 tonnes of fish from H.P. during 2002-03. Since the advent of planning era in the country, the Government of India has initiated number of schemes for the development of fisheries in the state. The

State Government is providing technical and financial help to fisherman and rural youth to promote aquaculture that is emerging as a lucrative business in the state.

In the State, Fish Farmers Development Agency was set up during 1982-83 which has rendered a technical and financial assistance for excavating ponds and improving the existing water resources for fish production. It has introduced the fish culture in the state by utilizing the wasteland, swamps and derelict water areas. The farmers in the state are adopting the profession as a supplementary occupation with the agriculture. The neglected ponds have proved to be useful to increase their income and providing gainful employment opportunities in the different parts of the state. In 1988 the Norwegian Government came forward to assist the Himachal Pradesh state government to rehabilitate the exotic trout culture, as well as to commercialize trout production. The project initiated in 1989, was executed in two phases: Transfer of technology and production. Other activities include import of quick growing disease resistant eggs, development of economically viable palletized feed with locally available ingredients, training of local staff and farmers, and production of economically viable fingerlings to encourage the local farmers to adopt trout farming. With the technical support of the state government large number of trout farms has been set up in the private sector in the state.

In the State where the average size of holding is near to one hectare, fisheries enterprise is becoming more and more popular as a supplementary enterprise with agriculture among farmers in the rural areas to increase the income of the farmers to a substantial extent. In one hectare ponds, one can harvest 5000 kg. of fish, proper care, feeding and manuring is timely assured. It can provide fish for the family and extra for the market as cash crop. If there is good source of water, fish pond can be used as reservoir for irrigating agriculture fields. With this background, it was necessary to examine the economic viability of the fish ponds so that the rational to invest the limited resources of the farm could be established.

1.4 Objectives of the study

The specific objectives of the study are:

1. To analyze the status of fish production in Himachal Pradesh.
2. To examine the costs and returns from ponds fish and trout fish rearing in Himachal Pradesh.
3. To examine the problems of pond fish and trout fish farmers in Himachal Pradesh.
4. To suggest a policy measures for the development of fisheries in Himachal Pradesh.

1.5 Plan of the study

The study has been presented in twelve chapters. First chapter introduces the background and the problem and also covered objectives of the study. Second chapter presents the methodology and analytical tools used in the study. Fishery scenario and fish production in Himachal Pradesh are presented in third chapter. Further the study has been divided into two sections. Section- I deals with the with construction and management of fish pond in chapter fourth, socio-economic features of sampled pond fish farms are given in chapter fifth, chapter sixth analyses the cost and returns from pond fish and, problems faced in production and marketing of fish in the state are discussed in chapter seven. Section II deals with trout fish farming and production of trout fish in Himachal Pradesh as given in chapter eighth, chapter ninth presents the construction and management of trout fish raceways, socio-economic features of trout fish farmers are presented in chapter tenth, chapter eleventh analyses the cost and returns from trout fish rearing and chapter twelfth discussed the problems faced by the sampled trout fish farmers. In chapter thirteenth review of fishery development schemes has been presented. Policy issues are presented in the last chapter.

Chapter - 2

RESEARCH METHODOLOGY

This chapter deals with selection of area, sampling design, data collection, reference year and analytical tools used in the study of pond fish and trout fish production in Himachal Pradesh.

2.1 Pond fish

Pond fish is reared in all the districts except Lahaul Spiti but the main producing districts is Kangra having 280 hectares area under fish ponds during 2005-06 (Table 2.1). This district alone accounts for about 47 percent of the total area of 600 hectares under fish ponds in the state. Keeping in view the importance of fishery in the state, Kangra district was selected purposively.

Table- 2.1: District wise area under fish ponds in Himachal Pradesh during 2005-06.

(Area in hectares)

District	Area under Ponds	% of total
Una	106.00	17.65
Chamba	6.20	1.03
Kangra	280.00	46.64
Mandi	47.00	7.83
Hamirpur	10.00	1.67
Sirmour	25.00	4.16
Kullu	3.00	0.50
Solan	60.00	10.00
Bilaspur	36.00	6.00
Kinnaur	2.20	0.37
Shimla	25.00	4.16
L & Spiti	-	-
Total	600.40	100.00

Source: Directorate of Fisheries, Govt. of Himachal Pradesh, Bilaspur.

2..1.1 Sampling Design

Multi stage stratified random sampling technique was used in selection of sample. At the first stage Kangra district was selected purposively on the basis of having largest area under fish ponds. Secondly from selected district six administrative blocks namely Baijnath, Bhawarana, Nagrota Bagwa, Panchrukhi, Kangra and Rait were selected on the basis of highest area under pond fisheries. A list of pond fish owners in these six blocks was obtained from Fish Farm of Dr. G.C. Negi, College of Veterinary and Animal Science, CSK ,Himachal Pradesh Krishi Vishavidyalaya, Palampur and a sample of 24 pond fish farms (one third of the total fish farms) was drawn randomly for detailed study. The selected pond fish owners contacted and the required data was collected on well designed pre-tested schedule through personal interview method.

2.1.2 Pond Owners Classification

The sampled pond farmers were classified into five categories according to their size of ponds i.e. (i) Marginal having pond size below 100 sq. meters, (ii) Small having pond size 100 to below 200 sq. meters, (iii) Medium having pond size 200 to below 300 sq. meters (v) Large pond owner having pond size 300 to 500 sq. meters and, (v) Extra Large having pond size above 500 sq. meters. The details of selected pond fish farms are given in Table 2.2. Thus in sample there were 5 each in both marginal and small pond fish farms, 6 each were in both medium and large pond fish farms and 2 were in extra large pond fish farms.

2.1.3 Reference Year

The data collected from the sampled pond fish farms pertain to the agriculture year 2006-07.

Table- 2.2: Classification of Sampled pond fish Farms.

S.No.	Name of owner	Size in meters	No. of Ponds	Total area in M^2
MARGINAL				
1.	Harnam Dass	4x2.67	1	11
2.	Bichhu	4x7.33	1	30
3.	Subhadra Thakur	5x6.67	1	33
4.	Punni Devi	4x10.67	1	43
5.	Muralidhar	5x10	1	50
SMALL				
1.	Rajender Sood	11.67x8.33	1	100
2.	Roshan Lal	10x10	1	100
3.	Sojee Ram	12x8	1	100
4.	Raghav Parmar	10x10	1	100
5.	Kulbhushan	6x25	1	150
MEDIUM				
1.	Bipat Ram	20x10	1	200
2.	Punia Devi	20x10	1	200
3.	Daler Chand	20x10	1	200
4.	Jagdish chand	20x10	1	200
5.	Kamala Devi	20x10	1	200
6.	Suresh	20x10.5	1	210
LARGE				
1	Kamal Singh	25x12	1	300
2	Kuldeep Singh	25x12	1	300
3	Subhash chand	25x12	1	300
4	Jitender	10x13.33	3	400
5	Ravikant	10x13.33	3	400
6	Milap chand	8.33x15	4	500
EXTRA LARGE				
1	Prem Lal Mahajan	10x160	1	1600
2	Uttam chand	20x20	8	3200

2.2 Trout fish

Trout fish is reared in temperate region of the state. The main trout fish producing districts in the state are Kullu, Mandi, Shimla, Kinnaur, Kangra and Chamba districts. Keeping in view the importance of trout fish production, Kullu, Mandi, Shimla, Kinnaur districts are selected purposively for the present study.

2.2.1 Sampling Design

Multi stage stratified random sampling technique was used in selection of sample of trout fish farms. At the first stage Kullu, Mandi, Shimla and Kinnaur districts were selected purposively on the basis of having largest area under trout fish raceways. Secondly a list of trout fish farms was obtained from the district fishery office of these districts and 20 trout fish units were selected randomly for the detailed study. The selected trout fish farms owners were contacted and the required data was collected on well designed pre-tested schedule through personal interview method.

2.2.3 Trout Fish Owners classification

The sampled trout fish farms were further divided in to three categories according to their raceway size i.e. (i) Small trout farms having water area up to 100 cubic meters, (ii) Medium trout farms having water area 100 to 200 cubic meters and (iii) Large trout farms having water area above 200 cubic meters. Thus in sample there were 10 in small trout farms, 6 were in medium trout farms and 4 were under large trout fish farms. The details about the sampled trout fish farms selected are presented in Table 2.3.

2.2.4 Reference Year

The data collected from the sampled trout fish farms pertain to the agriculture year 2006-07.

Table- 2.3: Classification of Sampled Trout fish Farms.

Sr. No	District	Name of owner	Year of Established	Pond Size (in meters)	No. of Ponds	Water Area in M^3
SMALL FARMS						
1	Kinnaur	Uddam Lal	2002	4x2x1.5	2	24
2.	Kullu	Bhawani Singh	2005	6x2.5x1.25	2	38
3.	Kinnaur	Jaswant	1999	6x2.5x1.25	2	39
4.	Shimla	Bansi Lal	1990	7.5x2.5x1.5	2	56
5.	Kullu	Yudhishter Singh	2006	12x2x1.25	2	60
6.	Kullu	Tek Singh	2003	10x2.5x1.25	2	62
7.	Kullu	Ram Lal	2005	13x2x1.5	2	78
8.	Kullu	Hari Singh	2002	13x2x1.5	2	78
9.	Kinnaur	Birbal	1999	15x2.5x1.15	2	86
10.	Shimla	Narweer Singh	2004	10x2x1.15	4	92
MEDIUM FARMS						
1.	Kullu	Amer Jeet Singh	2002	10x1.5x1.25	6	112
2.	Mandi	Bhupinder Singh	2007	13x2.25x1.5 5x3.25x1.5	2 2	89 49
3.	Kullu	Devi Chand	2002	15x2.25x1.25	3	140
4.	Kullu	Devi Singh Pal	2007	15x2.10x1.5	3	142
5.	Kullu	Mohan Lal	2001	16x2x1.3	4	166
6.	Shimla	Gopal Singh	2006	10x5x2	2	200
LARGE FARMS						
1.	Mandi	N.K. Singlla	2004	20x2x1.25	5	250
2.	Kullu	Vijay Kanwar	2004	15x2.5x1.25	6	281
3.	Mandi	Sanjeev	2002	15x3x1.5	7	472
4.	Kullu	Bhagat Ram	1995	25x2x1.8	6	540

2.3 Analysis of the Data

Simple tabular analysis has been used in drawing the results. However, for detailed analysis of the data some well known statistical tools have been used.

2.3.1 Compound Growth Rate

Before calculating the compound growth rates the whole data was converted into logs form then the following formula of compound growth rate (exponential function was applied):-

$$Y = AB^t$$

Where Y = Production of fisheries

T = Time

If we put log A = a, and log B=b, the equation becomes:

$$\text{Log } Y = a+b^t$$

In log form b was calculated by the formula as:-

$$\text{Log } b = \frac{N \sum t \text{ Log } Y - \sum t \sum \log Y}{N \sum t^2 - (\sum t)^2}$$

(Antilog of b has been taken as B)

$r = (B-1) \times 100$ in percentage.

2.3.2 Cost Concept Used

The standard cost concepts have been used in the study in order to work out the economics of pond/trout fish units. Cost for the year 2006-07 was used for the equipments, machinery, building and depreciation calculated by straight line method.

2.3.3 Prorated Establishment Cost

Prorated establishment cost was computed by using the following formula:

$$PC = P_i/1-(1+I)-n$$

PC = Prorated Establishment cost (Rs./pond/raceway)

P = Initial capital investment (Rs./pond/raceway)

i = Rate of interest (12%)

n = Live span of pond (10 years for pond fisheries and 15 years for trout fisheries.

The prorated establishment cost is charged at 12 per cent and amortized over 10 years for pond fish farms and 15 years for trout fish farms.

Chapter – 3

AN OVERVIEW OF FISHERIES IN HIMACHAL PRADESH

3.1 Development of fisheries in Himachal Pradesh

The Fisheries Department in Himachal Pradesh was created during August 1950 as a wing of Forest Department. The main activities envisaged for the department was conservation of riverine fisheries, production and protection of sport fisheries, issuing of licenses, breeding and production of trout seed, their plantation in rivers and streams for augmentation of riverine stock.

The fisheries department was declared as an independent department in 1966. The thrust was only on sport fisheries. The trout being the focal fish, the seed of brown and rainbow trout used to be produced in three trout farms located at Chirgoan, Mahli/Patlikuhl and Barot. Mirror carp was introduced in the State during 1955. In view of ideal ecological conditions, the introduced fish not only thrived successfully in the new water but also started propagating. The transplantation of mirror carp in fact laid the foundation of fish farming in Himachal Pradesh as earlier to this, the entire fish fauna of the State belonged to rheophylic type and none of the endemic fish was suitable for growing in impounded waters.

With the reorganization of the State during 1966, a large water body viz Gobindsagar got added in to fisheries resources of the State. Later another large water body viz Pong reservoir with water spread of 16000 hectare also got created. These two reservoirs with combined water spread of 40000 hectares unfolded a great challenge in order to harness them for fish production. Seed stocking and fisheries in reservoirs added a new area of activity for the department. This also followed by introduction of Indian Major carps in Himachal Pradesh. During early eighties a Centrally sponsored fish Farmer's Development Agency was also setup in the State.

1976 was a crucial year in the history of Himachal Fisheries when a "Reservoir Development Committee" was constituted and number of decisions were taken for judicious Management of Reservoir Fisheries. As a first step the fishing activities was completely transferred to Cooperative societies. Emphasis was laid on conservation, stocking, enforcement of close-season and initiation of welfare schemes for the fishermen. Meanwhile during 1991, ICAR set up its center for undertaking scientific management on ecology and fisheries of Gobindsagar. This greatly helped in developing commercial fisheries in reservoir, Pong reservoir was also developed on similar lines.

During 1984, a foreign aided project was formulated aimed at commercial farming of trout. After preliminary investigations the Royal Norwegian Government agreed to provide financial and technical support in the implementation of project in Himachal Pradesh. The implementation of this project completely transformed the facet of trout fishery in the State. The commercial trout farming which hitherto was non existent emerged as major prospective activity of the department. With the advent of ninety the department got new impetus. The major thrust areas identified in order of importance were reservoir fisheries, commercial farming of trout, aquaculture and riverine fisheries.

Reservoir Development Policy was redrafted. Reservoir seed stocking programme was regularized and intensified. Strict provisions were incorporated in fisheries Act. And above all series of fishermen welfare schemes were initiated. This all ushered in an era of steep increase in reservoir fish production. The Gobindsagar occupied a status of highest unit area fish production in the country. Similarly the Pong reservoir attained the status of providing highest per Kg. rates of fish being paid to the fishermen in the country.

During ninety a number of Centrally sponsored Scheme were sanctioned to Government of Himachal Pradesh including the 2nd Fish Farmer's Development Agency. The other major schemes are Inland Fish Marketing. Inland Fisheries Statistics, Extension and Training, Model Fishermen Village, Insurance for Fishermen etc.

The plan outlay of the department received a big boost during 10th &11th plan period, commercial trout farming which was a distant dream in early eighties became a reality when the technology was disseminated to the rural youths of Kullu, Mandi, Chamba and Shimla districts. Himachal became the first state to popularize the trout farming in private sector.

During 2006 in order to safeguard the aquatic biodiversity Government of Himachal Pradesh took a historic decision by making release of at least 15% water downstream dams and weirs of Hydro Power Project, besides declaring Tirthan river as free from Hydro Power Projects. Despite of the impact of Hydro power projects on fishery of open waters 6887 M.T of fish has been produced in the state during 2006-07.

3.2 Fisheries Resources

The State of Himachal Pradesh with its varied topography and diverse climate is endowed with tremendous potential for the development of fisheries with 3000 km. of riverine resources and a net work of dams made of multi-purpose power projects like Gobind Sagar and Pong Dam which cover an area of 25000 hectares. Besides this, the area under high altitude lakes is 726 hectares.

3.2.1 Riverine Resources

The perennial rivers of the plain of Punjab viz. Chanab, Ravi, Beas and Sutlej originate from the Himalayan range which borders the State. Ravi, Beas and sutlej rivers with its tributaries are thus the main riverine resources of the Pradesh in the west, while the tributaries of River Yamuna in the district of Sirmour and Shimla are the main contributors to riverine fisheries in the west. The length of riverine resources is estimated at 3,000 km of which about 600 km. length leis in the trout zone and the remaining 2400 km. length in the valley zone. The major fishes available in these streams are Trout, Mahseer, Nemacheilus spp, Barilus sp, Schizothoracids Crossocheitus sp, Glypthorax, etc.

3.2.2 Reservoir Resources

Reservoirs viz. Gobind Sagar and Pong of Himachal Pradesh have come up as a result of high dams across river Beas and sutlej with mean water spread area of 25000 hectares constitute an important fishery resource of the State. The development of fisheries on scientific lines in these reservoirs has shown its tremendous potential for food production and generation of employment. As a result of series of management measures taken by the State Fisheries Department a total of 28207 tones of fish has been harvested from these two reservoirs from 1985-86 to 2006-07. Fish fauna in both these reservoirs differ from each other. While Gobind Sagar is a carp reservoir, Pong dam is cat fish reservoir. Gobind Sagar maintained highest per hectare fish production and Pong Dam fish offers highest per kilorates, thereby enabling good returns to the fisherman. This has also been made possible by strict observation of fisheries rules, initiation of number of welfare scheme like subsidy for purchase of fishing nets, boats, close season assistance etc. Besides many more small reservoirs like Pandoh etc. have also been created from time to time.

3.2.3 Ponds

So far, pond resources are concerned, these are largely scattered and located in the area adjoining the plains. The area under lower altitude ponds is about 600 hectares out of which maximum (280 ha.) area of ponds is in district Kangra, followed by Una (106 ha.), Solan (60 ha.), Bilaspur (36 ha.), Mandi (47 ha.) and Shimla (25 ha.) . Minimum (2.20 ha.) area is observed in district Kinnaur (Table 3.1) Pond fish culture is becoming more and more popular as a supplementary enterprise with agriculture, aims at improving the nutritional standard of people by increasing production and consumption of fish as well as to improve the economic condition of the farmers by providing them with gainful avocation.

Table-3.1: District wise Total Area of Ponds –2005-06

(Ha.)

District	Higher Altitude Lakes	Lower Altitude Ponds
Una	-	106.00
Chamba	73.50	6.20
Kangra	21.40	280.00
Mandi	16.10	47.00
Hamirpur	-	10.00
Sirmour	21.10	25.00
Kullu	118.30	3.00
Solan	-	60.00
Bilaspur	-	36.00
Kinnaur	81.60	2.20
Shimla	50.70	25.00
L & Spiti	343.30	-
Total	726.00	600.40

Source: Directorate of Fisheries, Govt. of Himachal Pradesh, Bilaspur.

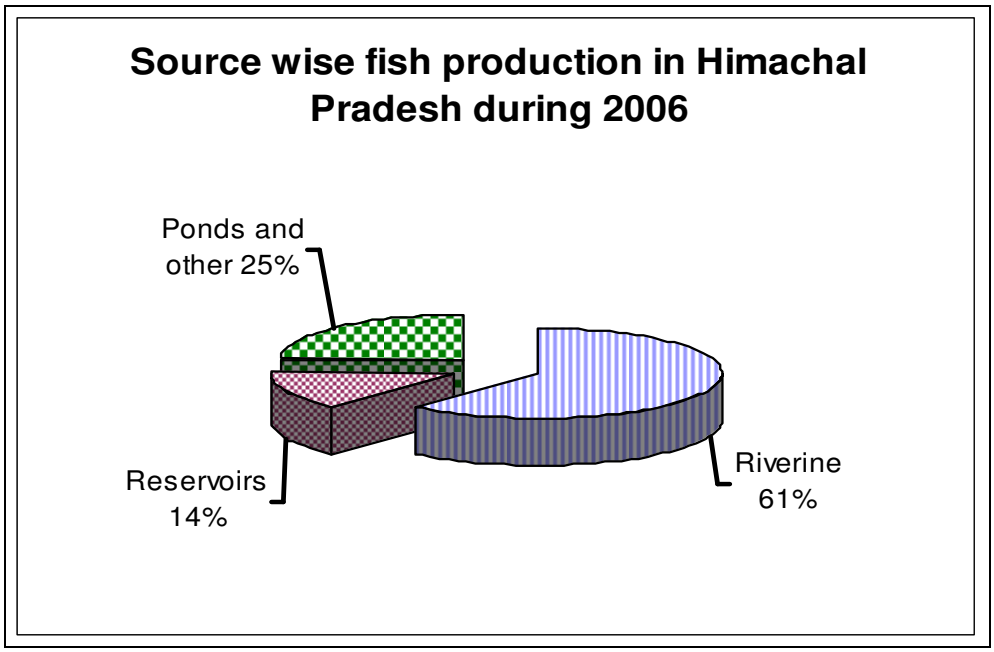
3.3 Fish Production in Himachal Pradesh

The production of fish from riverine, reservoirs and ponds in Himachal Pradesh during the period 1950-51, 1960-61, 1970-71 and 1976-77 to 2005-06 has been presented in Table 3.2. It can be seen from the table that in the year 2005-06 fish production in Himachal Pradesh is 7295 tones. Out of the present production 61.6 percent comes from the riverine resources followed by ponds & others (24.8%) and reservoirs (13.6%). Since 1976-77 fisheries production in the State has been increasing at a rate of 5.77 per cent per annum. The production from ponds & others has shown better performance as compare to riverine and reservoirs with an annual growth rate of 26.63 per cent. The rate of growth from riverine and reservoir resources comes out to be 6.94 and 1.24 per cent per year respectively. In the case of reservoirs during the last three years (2003-2006) the production seems to be continuously decreasing which is mainly due to the decrease in fish production from Gobind Sagar reservoir in district Bilaspur.

Table-3.2: Fish Production in Himachal Pradesh during 1950-51, 1960-61, 1970-71 and 1976-77 to 2005-06.

Year	Production(Tonnes)			
	Riverine	Reservoirs	Ponds and other	Total
1950-51	101	-	-	101
1960-61	224	-	-	224
1970-71	300	-	-	300
1976-77	356	644	-	1000
1977-78	888	972	-	1860
1978-79	909	1291	-	2200
1979-80	938	1312	-	2250
1980-81	1012	1286	2	2300
1981-82	1483	1096	4	2583
1982-83	1797	1061	12	2870
1983-84	1708	895	27	2630
1984-85	1688	984	28	2700
1985-86	1804	1098	48	2950
1986-87	1501	896	63	2460
1987-88	2693	1335	67	4095
1988-89	3045	1260	70	4375
1989-90	2980	1304	336	4620
1990-91	3399	1258	475	5132
1991-92	4212	1340	443	5995
1992-93	4440	1412	538	6390
1993-94	4647	1422	560	6629
1994-95	3234	1499	552	5285
1995-96	4096	1386	520	6002
1996-97	4280	1413	572	6265
1997-98	4476	1550	659	6685
1998-99	4595	1317	874	6786
1999-00	4695	1319	981	6995
2000-01	4234	1510	1276	7020
2001-02	4207	1565	1443	7215
2002-03	4106	1583	1555	7244
2003-04	3746	1251	1468	6465
2004-05	4164	1182	1555	6901
2005-06	4498	990	1807	7295
CGR %	**6.94**	**1.24**	**26.63**	**5.77**

Source: Directorate of Fisheries, Govt. of Himachal Pradesh, Bilaspur.



3.4 District wise Fish Production

3.4.1 Fish Production in District Bilaspur

The production of fish in district Bilaspur during the period 1995 to 2006 is given in Table 3.3. The table reveals that in the year 2006 the total production of fish in Bilaspur is 937.48 metric tones. Out of total production 51.7 per cent comes from reservoir, followed by riverine (28.9%) and ponds (19.4%). Reservoir is the main source of fish production in this district. The total production of fish from all sources was 1120 M.T. in the year 1995 which decreased to 937.48 M.T. in the year 2006 thereby showing decrease of 0.24 per cent per annum. It can also be seen form the table that after the year 2002 the production from reservoir is continuously decreasing. Construction of Kol dam on Sutlej River and fluctuation in reservoir water level reduced value of water in the rivers joining reservoirs, heavy siltation are possibly the causes for the decrease in fish production from Gobind Sagar reservoir.

3.4.2 Fish Production in District Chamba

The production of fish in district Chamba from the year 1995 to 2006 is given in Table 3.4. The table shows that the total fish production in the year 2006 is 257.910 M.T. in this district. Riverine are the main source of fish production and constitute 93.2 per cent of the total fish production. Since 1995 fisheries production in Chamba increased at the rate of 0.43 per cent per year. The production from reservoirs, riverine and ponds increased at the rate of 0.09, 17.38 and 7.91 per cent per annum respectively.

Table- 3.3: Annual Fish Production in district Bilaspur

(Quantity in MT)

Years	Riverine	Reservoirs	Ponds	Others	Total
1995	199.736	873.518	46.746	-	1120.00
1996	199.619	1015.93	20.370	-	1235.91
1997	202.914	1000.546	20.54	-	1224.00
1998	225.363	835.939	12.698	-	1074.00
1999	240.337	865.06	25.184	-	1130.581
2000	210.603	1082.10	100.258	-	1392.961
2001	210.675	1174.10	150.375	-	1535.150
2002	261.500	1202.40	142.400	-	1606.300
2003	219.000	941.80	155.400	-	1316.200
2004	306.00	752.00	144.500	-	1202.500
2005	291.000	681.80	162.000	-	1134.800
2006	271.500	484.480	181.500	-	937.48
CGR %	**3.47**	**-3.57**	**26.68**	**-**	**-0.24**

Source: Office of Assistant Director, Fisheries, District Bilaspur.

Table-3.4: Annual Fish Production in district Chamba.

(Quantity in MT)

Years	Riverine	Reservoirs	Ponds	Others	Total
1995	260.400	-	10.000	-	270.400
1996	216.260	-	4.250	-	220.510
1997	268.790	-	4.750	-	273.540
1998	228.960	-	2.500	-	231.460
1999	195.000	-	4.250	-	199.250
2000	199.000	-	4.750	0.150	203.900
2001	261.170	1.172	5.000	0.200	267.542
2002	258.120	0.850	5.250	0.200	264.420
2003	221.820	0.963	5.450	0.250	228.483
2004	225.500	1.064	5.780	0.200	232.544
2005	253.160	1.626	15.000	0.200	270.036
2006	240.270	2.390	15.000	0.250	257.910
CGR %	**0.09**	**17.38**	**7.91**	**5.63**	**0.43**

Source: Office of Assistant Director, Fisheries, District Chamba.

3.4.3 Fish Production in District Hamirpur

The production of fish in district Hamirpur from the year 1995 to 2007 is given in Table 3.5. It can be seen from the table that the total fish production in the year 2007 is 519 M.T., out of which 61.2 per cent comes from riverine and the rest from the ponds. The rate of growth of fish production comes out to be 8.33 per cent per year. The production from ponds was 9 M.T. in the year 1995 which increased to 201 M.T. in the year 2007 showing an impressive rate of growth of 35.70 per cent per year while the production from riverine has increased at the rate of 4.02 per cent per year.

3.4.4 Fish Production in District Kangra

The data regarding the production of fish in district Kangra is available only for the period 2005-07 and given in Table 3.6. The table reveals that in the year 2007 the total fish production in Kangra is 2171.5 M.T. Out of the present production 67.5 per cent comes from riverine resources and the rest from the ponds. The rate of growth of production comes to be 2.13 percent per annum during 2005-07.

Table-3.5: Annual Fish Production in District Hamirpur.

(Quantity in MT)

Years	Riverine	Reservoirs	Ponds	Others	Total
1995	147.210	-	9.000	-	156.210
1996	257.534	-	16.220	-	273.754
1997	255.852	-	12.440	-	268.292
1998	280.000	-	10.530	-	290.530
1999	290.000	-	11.200	-	381.200
2000	270.000	-	15.350	-	285.350
2001	268.003	-	115.500	-	383.593
2002	258.650	-	188.500	-	447.150
2003	330.000	-	140.00	-	470.00
2004	332.000	-	141.00	-	473.00
2005	333.72	-	140.00	-	473.72
2006	300.00	-	175.4	-	475.40
2007	318.00	-	201.0	-	519.00
CGR %	**4.02**		**35.70**		**8.33**

Source: Office of Assistant Director Fisheries, Palampur Division, Palampur, District Kangra.

Table- 3.6: Annual Fish Production in District Kangra.

(Quantity in MT)

Years	Riverine	Reservoirs	Ponds	Others	Total
2005	1526.0	-	556.0	-	2082.0
2006	1683.6	-	684.5	-	2368.00
2007	1465.0	-	706.5	-	2171.5
CGR %	**-2.02**		**12.72**		**2.13**

Source: Office of Assistant Director Fisheries, Palampur Division, Palampur District Kangra.

3.4.5 Fish Production in District Kullu

The production of fish in district Kullu from the year 1995 to 2006 is given in Table 3.7. It can be seen from the table that in the year 2006 the total fish production in Kullu is 258.155 M.T. Riverine are the main resources of fish production in this district and constitutes 94 per cent of the total fish production. Rest of the production comes from the ponds. The production of fish in this district was 185.082 M.T. in the year 1995 which increased to 258.155 in the year 2006 showing an increase of 3.57 per cent per year. The production from riverine and ponds increased at the rate of 3.09 and 6.90 per cent per annum respectively.

Table-3.7: Annual Fish Production in District Kullu.

(Quantity in MT)

Years	Riverine	Reservoirs	Ponds	Others	Total
1995	169.975	-	15.107	-	185.082
1996	170.150	-	16.189	-	186.339
1997	159.789	-	14.315	-	174.104
1998	185.515	-	13.219	-	198.734
1999	187.360	-	15.398	-	202.798
2000	193.315	-	16.875	-	210.190
2001	185.650	-	13.987	-	199.637
2002	179.797	-	17.650	-	197.447
2003	198.907	-	22.795	-	221.702
2004	215.817	-	45.179	-	260.996
2005	224.619	-	38.750	-	263.369
2006	242.705	-	15.450	-	258.155
CGR %	**3.09**		**6.90**		**3.57**

Source: Deputy Director Fisheries, Trout Farming Project, Patlikuhl, District Kullu.

3.4.6 Fish Production in District Mandi

The production of fish in district Mandi during the year 1995 to 2007 is given in Table 3.8. The table reveals that riverine is the main source of fish production in this district.

Out of total fish production of 718.523 tones in the year 2007, 86 per cent comes from this source. The rate of growth of production from this source comes out to be 5.35 per cent per year during this period.

3.4.7 Fish Production in District Shimla

The production of fish in district Shimla for the year 1995 to 2006 is presented in Table 3.9 wherein it can be seen that in the year 1995 total fish production was 212.608 M.T. which decreased to 175.355 M.T. in the year 2006 thereby showing decrease of 0.46 per cent per annum during this period. Reverine is the main source of fish production in this district and constitute about 96 per cent of the total production in the year 2006. But, the production from this source has decreased at the rate of 1.07 per cent per annum during the study period.

Table-3.8: Annual Fish Production in District Mandi.

(Quantity in MT)

Years	Riverine	Reservoirs	Ponds	Others	Total
1995	380.260	-	15.00	-	395.260
1996	151.329	-	2.50	-	153.829
1997	570.540	-	-	-	570.540
1998	478.431	-	-	-	478.431
1999	443.837	-	-	-	443.837
2000	442.369	-	-	-	442.369
2001	416.824	-	15.52	-	432.344
2002	444.789	-	1.857	-	446.646
2003	444.641	-	8.46	-	453.101
2004	430.744	-	1.840	-	432.584
2005	501.027	-	0.240	-	501.267
2006	663.725	-	9.890	-	673.615
2007	618.023	-	100.5	-	718.523
CGR %	**5.35**		**1.72**		**5.76**

Source: Office of Assistant Director, Fisheries, District Mandi.

Table- 3.9: Annual Fish Production in District Shimla.

(Quantity in MT)

Years	Riverine	Reservoirs	Ponds	Others	Total
1995	212.608	-		-	212.608
1996	288.738	-		-	288.738
1997	328.842	-		-	328.842
1998	269.700	-		-	269.700
1999	345.294	-		-	345.294
2000	288.705	-		-	288.705
2001	311.530	-	7.540	-	319.070
2002	282.672	-	6.150	-	288.822
2003	269.470	-	6.611	-	275.683
2004	292.470	-	-	-	292.470
2005	318.489	-	39.410	-	357.899
2006	167.715	-	7.640	-	175.355
CGR %	**-1.07**		**19.18**	**-**	**-0.46**

Source: Office of Assistant Director, Fisheries, District Shimla.

3.4.8 Fish Production in District Sirmour

The production of fish in district Sirmour from the year 1995 to 2006 is shown in Table 3.10. The table reveals that out of the total fish production of 706 M.T. in the year 2006, 64.3 per cent comes from the riverine resources and the rest 35.7 per cent comes from the ponds. Since 1995 the production of fish has increased at the rate of 0.42 per cent per annum. The production from ponds has shown an increase of 18.02 per cent per year whereas the production has decreased at the rate of 2.72 per cent from riverine resources.

Table-3.10: Annual Fish Production in district Sirmour.

(Quantity in MT)

Years	Riverine	Reservoirs	Ponds	Others	Total
1995	469	-	32.5	-	501.5
1996	615	-	37.3	-	652.3
1997	652	-	45.0	-	697.0
1998	689	-	72.8	-	761.8
1999	736	-	68.0	-	804.0
2000	619	-	51.5	-	670.5
2001	593	-	30.7	-	623.7
2002	469.6	-	40.8	-	510.4
2003	466.5	-	88	-	554.5
2004	460	-	205	-	665
2005	507	-	205	-	712
2006	454	-	252	-	706
CGR	**-2.72**		**18.02**		**0.42**

Source: Senior Fisheries Officer, Nahan, District Sirmour.

3.4.9 Fish Production in District Solan

The production of fish in district Solan from the year 1995 to 2006 is given in Table 3.11. The table reveals that in the year 2006 the total fish production in this district is 333.261 M.T. Riverine constitutes about 55 per cent of the total fish production and the rest 45 per cent comes from the ponds. The rate of growth of the production of fish during the period 1995-2006 comes out to be 6.96 per cent per annum, whereas the production from ponds and riverine increased at the rate of 12 and 1.07 per cent per year respectively.

Table- 3.11: Annual Fish Production in District Solan.

(Quantity in MT)

Years	Riverine	Reservoirs	Ponds	Others	Total
1995	178.18	-	-	-	178.18
1996	156.125	-	45.420	-	201.545
1997	176	-	100	-	276
1998	192.2	-	120	-	312.2
1999	170.59	-	135	-	305.59
2000	178.63	-	180	-	358.63
2001	151.9	-	201	-	352.9
2002	175.6	-	286	-	461.6
2003	213.455	-	285.66	-	499.115
2004	196.623	-	285.5	-	482.123
2005	184.712	-	162.2	-	346.912
2006	183.261	-	150	-	333.261
CGR %	**1.07**		**12.0**		**6.96**

Source: Office of Assistant Director, Fisheries, District Solan.

3.4.10 Fish Production in District Una

The production of fish in district Una from the year 1995 to 2006 is presented in Table 3.12. It can be seen from the table that the total fish production in this district was 106.982 M.T. in the year 1995 which increased to 483.040 M.T. in the year 2006 thereby showing an increase of 15.12 per cent per annum. Ponds are the main source of production of fish in this district and constitute 83.17 per cent of the total fish production in the year 2006. The rate of growth of fish production from this resource comes out to be 22.73 per cent per year during 1995-2006.

Table- 3.12: Annual Fish Production in district Una.

(Quantity in MT)

Years	Riverine	Reservoirs	Ponds	Others	Total
1995	62.576	-	44.406	-	106.982
1996	75.945	-	48.400	-	124.345
1997	73.05	-	47.430	-	120.435
1998	73.80	-	114.72	-	188.520
1999	83.83	-	116.80	-	200.63
2000	105.23	-	151.54	-	256.77
2001	139.268	-	191.810	-	331.078
2002	151.025	-	215.110	-	366.135
2003	130.560	-	259.250	-	389.810
2004	130.063	-	255.350	-	383.413
2005	73.285	-	300.250	-	373.535
2006	81.290	-	401.750	-	483.040
CGR %	**4.10**		**22.73**		**15.12**

Source: Office of Assistant Director, Fisheries, District Una.

3.5 Summing up

It can be concluded from the above discussion that main resources of fisheries production in the State are reverine, reservoirs and ponds. Out of the present production of 1995 tonnes in the year 2005-06, 61.6 percent comes from the reverine resources followed by ponds and others (24.8%) and reservoirs (13.6%). Since 1976-77 fisheries production in the state has been increasing at a rate of 5.77 percent annually whereas the production from ponds & others has shown batter performance as compare to riverine and reservoirs with annual growth rate of 26.63 percent. District-wise, since 1995 the per year rate of growth of fish production comes out to be maximum (15.12%) in case of Una followed by Hamirpur (8.33%), Solan (6.96%), Mandi (5.76%), Kullu (3.57%) and Kangra (2.13%).

SECTION –I

This section deals with construction and management of fish pond, socio-economic features of sampled pond fish farms, cost and returns from pond fish and problems faced in production and marketing of fish in the state.

Chapter - 4

CONSTRUCTION AND MANAGEMENT OF FISH PONDS

Knowledge of the different types of fish ponds is a prerequisite for a profitable fish cultures. A viable fish culture practice primarily depends on the selection of suitable site, which in turn depends upon water retentive quality of the soil and availability of adequate water supply during the culture period (Santhanam et.al., 1990). A rational development of pond fisheries is based on culturing those valuable species and varieties of fish for food, which over a short period, provide a high quality product (Martyshev, 1983). Good quality seed is the primary requirement for successful fish farming.

4.1 Pond Construction

To select a suitable site for the construction of fish farm, the following factors are required to be considered at the site:-

4.1.1 Water Supply

Permanent water supply of required volume and quality is the basic factor to be considered while deciding the suitability of the site for the construction of fish farm. Therefore, the investigations of the available water source at the site should properly be carried out and most important information regarding the said source, such as discharge, yield and floods etc. are taken into consideration before the final decision of the site.

The water source may be river, spring, reservoir, irrigation channel, rainfall run off or dig well. Water from the available source can be supplied to fish farm through open channel or pipe line by gravity or by pumping. The most suitable and economical method is by gravity.

If rainfall run-off water source is to be used, the water is stored in a reservoir or lake to supply the same to fish ponds. The catchments area should be minimum 10-15 times the area of the pond.

If pond is located on suitable soil, the minimum water supply should be 5-6 ltr./sec./ha. of pond area of carp fish culture throughout the year.

4.1.2 Water Quality

Required quality of water is also one of the major factors to be considered when deciding the suitability of the site for construction of fish farm.

Water quality of available water source should be got tested to ensure its suitability by taking a number of water samples for temperature, pH, dissolved oxygen, free oxygen, turbidity, quality and density of plankton and also to know about the present limit of pollutants of agricultural or industrial origin.

For best production results of fish rearing in ponds, the following water quality limits should be preferred:-

PH	7.0 to 9.0
Dissolved oxygen	6.5 to 10.00 ppm
Temperature	5^0C to 30^0C
Free oxygen	up to 70mg/litre
Turbidity	100 to 180 mg/litre

4.1.3 Soil characteristics

Characteristics of a soil are useful in predicting the performance of the soil under load, which depends upon the grain size, shape, surface texture and chemical composition. The property having most influence on the physical characteristics that of particle-size distribution and therefore, it is essential to determine the extent to which each is present.

There is wide variation in the characteristics of different soils and the performance of each individual soil is affected by its moisture content and density. In general, the properties of soils are affected by its moisture content and density. In general, the properties of soil composed largely of coarse materials are primarily controlled by the characteristics of the particle, but for soils composed largely of clays and colloids, the properties are primarily controlled by moisture content. Behavior or soils containing 30 percent of more clay depends solely on the characteristics of the clay.

Before any site for the construction of fish farm is procured, proper investigations to know the surface and sub-surface soil condition should be done as early as possible to decide the suitability of the soil for the construction of fish ponds.

The methods used for soil investigations are visual and laboratory tests. Visual inspection of the site is an important preliminary step to know the basic soil properties. In order to supply data on sub-surface soil, a test pit measuring 1.50x 1.00x 1.50 to 2.00 meter depending on the shape of the land and level of the sub-soil water table, should be dug in the sides and center of the proposed site. Visual examination of the soil can easily be carried out during digging of a test pit. Disturbed and un-disturbed samples of the soil can also be obtained from the different layers below ground level for laboratory analysis to determine the physical and chemical properties of the soil, such as pH value, elasticity of the soil, clay contents, moisture contents, co-efficient of permeability, available nutrients such as potassium, phosphorus, organic carbon and nitrate etc.

In general, dark colours of soil like grey, brown or black indicate organic soil whereas brighter colours are usually found with inorganic soils. Organic soils commonly have a distinctive smell and are undesirable from engineering point of view. Areas having a layer of organic soil more than 0.60 meter in thickness is not fit for the construction of any type of pond because due to high seepage it would be very difficult to maintain water level in the pond.

A clayey loam is the best type of soil for both the construction of ponds and to grow natural food at the bottom of the pond. It consists 20-50% sand, 20-50% silt and 20-30% clay.

4.1.4 Permeability

Permeability of soil is the rate at which water flows through it under the action of hydraulic gradient. The passage of moisture through the interspaces or pores of the soil is called “percolation”. Soils porous enough for percolation to occur are termed “pervious” or “permeable” while those, which do not permit the passage of water are termed “impermeable”. In the majority of materials the rate of flow is directly proportional to the head of water, and the permeability is therefore is constant for the particular material. Permeability is a property of the soil mass and not of individual particles. A knowledge of permeability is required not only for seepage, drainage and ground water problems but also for the rate of settlement of structures on saturated soils. Ground water level depends upon a combination of the permeability of the strata and causing the water to flow.

4.1.5 Seepage Control

Seepage of ponds has been one of the limiting factors in aquaculture. This problem is further stressed when the fish ponds on such soil are located in warm belts where evaporation is very high.

Mainly the seepage losses are liable to occur by under seepage and infiltrations from the ponds and feeding channel. The loss of water into the subsoil can be calculated by the usual methods provided the stratification of any pervious soils. The permeability coefficient “k” there of is determined with the required accuracy. The sediment content of the water feeding the ponds should also be determined to estimate seepage losses over long time ranges. This will indicate whether after some time natural sealing can be anticipated or not. Proper steps accordingly may be taken up to stop the seepage losses.

To control the seepage the method selected should be the cheap combined with its stability. Usefulness and efficiency. Availability of the various materials at work site is also very important factor. Some of the methods to control seepage losses are enumerated below:-

4.1.6 Lining with good Quality Clay

A layer of 3 inches to 6 inches is spread on the bed and sides of the pond. Puddle clay (A mixture of clay and sand 2:1 proportions) lining is quite satisfactory but can only be used if good clay is available. It can reduce seepage by about 70-80 per cent but it is liable to develop cracks on drying.

The alkali soils (having pH 10 or above) are very effective to control seepage losses but expensive when it is to be transported from far off places. The total requirements for 1 ha bed area is 750 tonnes.

4.1.7 Brick Lining

For a successful work it is very essential that the bricks and the brick work must be of the best possible quality.

Brick lining has the advantage that no expansion or construction crack are formed as with concrete lining, repairs can be done easily, at a lower cost than concrete lining. Brick lining gives a saving of about 70-75 per cent in seepage losses. As bricks are porous the lining on the whole is less efficient in controlling the seepage.

4.1.8 Concrete Lining

Concrete lining is generally considered most suitable for controlling the seepage losses. Usual thickness of lining is $2^{1/2}$ ins. to 6 ins according to the design. A thin coat of cement plaster is applied to give smooth surface. The concrete may be reinforced, because it will assist in preventing failure of the lining due to setting of the sub-grade and the spacing of the joints can be increased. Concrete blocks with joints filled with asphalt will probably be better.

4.1.9 Lining with Polyethylene Film

Low Density Polyethylene film is a completely impervious material and used as buried membrane only. The life of the film in buried conditions is the life of the structure itself. The LDPE film in the range of 150-250 Micron in thickness is ideal for use in ponds. After fixing it in the sides and bed of pond as required it should be covered with a soil layer of 30-40 cm.

The use of wide width low Density Polyethylene film is most effective, efficient and economical to control seepage losses.

4.1.10 Treatment by Sodium Carbonate

If good quality of soil/alkali soils are not easily available, the seepage losses could be minimized by using Sodium Carbonate by mixing the chemical @ 750 Kg/ha. at the bottom of the pond. For sides the chemical is applied at the same rates in the shallow channels constructed around the pond and making it seep with water in 2-3 spells to form a sort of impermeable barrier. The life of this process is only three years. After 3 year due to gradual increase in seepage rate it becomes necessary to reapply the above treatment.

4.1.11 Soil Cement Lining

Stabilized soil with 5 percent of cement to be compacted in a 3 inches layer and topped with ½ inches thick cement sand plaster. Proportions of materials for stabilized soil are as under:-

Clay - 8 to 15 percent by weight
Silt - 12 to 25 percent by weight
Sand - 60 to 80 percent by weight

4.1.12 Core Walls in Embankments

The aim of a core wall is to provide barrier to the passage of seepage water from the ponds. A core may be located either in the center of the embankment or on the

upstream side to minimize the seepage losses. A core wall may be of compact clay puddle, brick or cement concrete.

4.2 Ideal Pond Size

Fish culture operations commence with the construction of ponds. Specific types of ponds are required for the culture of particular fish species and their life history stages. Different type of ponds required for fish culture depending upon the life history stage of fish are; nursery, rearing, brooder and stock ponds. The ideal size of different types of ponds are as under:-

(i)	Nursery ponds	0.05 ha.
(ii)	Rearing ponds	0.20 ha.
(iii)	Brooder ponds	0.50 ha.
(iv)	Stock ponds	1.00 ha.

4.2.1 Nursery Ponds

The shape of the nursery pond should be rectangular with leveled bottom and sloped towards out let side for easy drainage of the pond. Each pond should be of 0.01-0.05 ha. area and 0.5-1.20 meter depth provided with a pit near the out let side of the pond for collection of fry. Each nursery pond should have a separate marked in let and out let. The nursery ponds are used for rearing carp spawn up-to fry stage.

4.2.2 Rearing Pond

The rearing pond should be rectangular in shape, drainable with leveled bottom and sloped towards out let side provided with pit near the out let side to collect the fingerlings. Each rearing ponds should have an area of 0.1-03 ha. and 0.9-2 meter depth with separate in let and out let for feeding and drainage of the pond. The rearing ponds are used for rearing of fry to fingerling stage.

4.2.3 Stock and Brood Fish Ponds

They should be rectangular in shape, drainable with leveled bottom and sloped towards out let side, provided with harvesting/collection pit near the out let side wall to collect the fish. Each pond should be of 0.25 – 2.00 ha. area and 1.50 –2.00 meter depth with separate inlet and outlet for feeding and drainage of the pond. The goal of the management of stock ponds is to attain high production of table size fish in the shortest possible time. For complete drainage the bottom of the pond should be sloped towards their out let side. A minimum slope of 0.1 to 0.2 percent is sufficient.

While constructing the fish farm care should be taken for construction of dikes in proper way so during the construction of ponds the side slopes of the embankment should be fixed in accordance with the water depth in the pond, size of the pond and soil conditions. The soil from which the embankment is to be built is another most important factor for the stability of the structure. A soil containing proper proportions of sand, silt and clay will of course from the most stable structure, but such an ideal soil is seldom available. Embankment of homogeneous material throughout should be built as far as possible.

Earthen embankments without any impervious clay core may be built from soils having co-efficient of permeability between K=5x10 6 to 1x10 4 m/sec.

Clay for impervious core should be having:-

Liquid limit	-	80%
Plastic limit	-	20%
Plasticity index	-	30%

In more porous base materials, the width of the core trench at any point should be approximately twice the proposed water depth at that point. The depth of the excavation should be at least 0.9 meter or more into the sub soil.

The following slopes are preferred for the construction of embankments in various soils:-

Type of soil	In side slope	Outside slope
1. Firm clay	1:1	1:1
2. Sandy clay	1:1.5	1:1.5
3. Sandy loam	1:2-1:3	1:1.5-1:2

Slope is defined as the distance in horizontal axis for each foot of height. A 1:1.5 slope means 30.5 cm of height for 45.75 cm of base,. The crest of the embankment should not be less than 90cm wide and if the ponds are built in boggy areas, the crest should be at least 1.20 meter to 1.50 meter wide. All earthen embankments should have some extra height (free board) above water level to prevent waves and flood from over flowing and washing out them. At least there should be 45-60 cm of free board in ponds having an area of 0.3 to 1.00 ha and 90 cm of free board for larger size of ponds. If a pond is located in area of heavy rainfall, a 60 cm free board is necessary for nursery and rearing ponds also, but in areas with a low average rainfall, a 30 cm free board would serve the purpose. At the time of construction, the embankment should be 10-15% higher than required, for the settlement of the earth.

The most important factor to be considered while constructing the embankments is erosion on the up stream side up-to water level by wave action, and down stream side by heavy rains. As soon as an embankment is completed the exposed parts of the embankments such as down streamside, top and up stream side above water level should be protected by sound grass cover against rain erosion. In big ponds up to water level erosion due to waves can be protected by providing brick/cement concrete lining or dry stone pitching.

During construction of fish pond it should be ensured that separate and opposite inlet and outlet must be provided for water supply and drainage of each pond. The inlet

should be at least 150 mm above the full water level of the pond and that should be provided with screen to prevent entry of un-wanted fish and other animals in the pond and better to locate in the center of the short wall of the pond for better water circulation. The outlet should be on the opposite of the inlet side. It is better to provide a harvesting pit near the outlet side for harvesting the pond with netting. Drainability is an essential requirement for fish pond. For quick drainage the pipe should be large enough. Pond having an areas upto 1 ha should have a 153 to 203 mm. diameter drain pipe while for larger ponds 203 to 305 mm. diameter pipe is necessary. Piping should be of solid materials such as asbestos-cement, cast iron, fiberglass and galvanized iron etc. Such pipes should be fixed at the bottom of the pond, so that all the water may be drained out as and when required. The best type of outlet for drainage the pond and controlling water level in the pond is the open sluice monk. The monk consists of a vertical tower with three pairs of grooves for fixing screen and stoplogs at out let side of the pond. The size of inlet and outlet should be designed on the basis of the time required for filling and drainage of the pond respectively.

4.3 Drainability

Drainability is an essential requirement for fish ponds. The possibility of ponds drainage should be carefully examined at the time of site selection. Drainage of the pond by gravity should be ensured. For gravity drainage the bottom of the ponds should be higher than the maximum water table rises during harvesting period. Bottom of the ponds must be sloped towards outlet side and a minimum slope of 0.1-0.2% is sufficient. For gravity drainage of the ponds a drain pipe is highly desirable for efficient pond management. Such pipes should be fixed at the bottom of every pond at out let side, so that all the water may be drained out as and when required. For quick drainage, the pipe should be large enough. Ponds having an areas upto 1 ha should have a 153 to 203 mm diameter drain pipe while for larger ponds 203 to 305 mm diameter drain pipe is necessary. The individually, drinkable ponds are ideal for fish culture. If the gravity drainage is not possible pumps could be used for the complete drainage of the ponds. This drained water can again be used in bigger size fish pond during the scarcity of water.

4.4 Pond Management

4.4.1 Liming of ponds: When the pond is ready it is of utmost importance that harmful insects are eradicated. Pond soil must be tested for its alkalinity. The soil should be slightly alkaline. If the soil is acidic, quick lime is used for eradicating the harmful insects, rendering soil alkaline and providing calcium to the growing fish. Doses of quick lime depends upon the acidity of the soil. Generally 250 kg quick lime/ha is used. If the soil is more acidic the dose of quick lime should be increased to 1500 kg/ha. Half of the dose of quick lime should be broadcast initially and remaining half after about a month. The pond is kept dry for 15 days after the application of lime and then it is filled with water.

4.4.2 Manuring of the Pond: To produce natural food to fish (plankton), ponds are manured with organic and inorganic manures. A mixture of cow dung (550/kg/ha)+ super phosphate (250 kg/ha) and deoiled groundnut cake (250 kg/ha) is broadcast over the surface of pond. This mixture is very useful in producing the phytoplankton and Zooplankton. Manuring is done at least 15 days before stocking by half the manure initially and remaining half in the equal weekly installments. Management of ponds has to be done every year during the month of March-April.

4.4.3 Eradication of Unwanted Fauna and flora: For sustained production of commercial fish, weed fish and weed plants and harmful insects are to be eradicated by means of some suitable chemical control measure or manually.

4.5 Selection of Fish and Stocking of Ponds:

To make fish culture more profitable, it is important that such fish species should be selected which attain maximum weight in minimum time, having good disease resistance and whose seed is easily available and above all should not be predatory in habit. Composite-fish farming is quite profitable, it involves a mixed farming of fish species viz. Common carp, Grass carp and Silver carp and results in an average production of 3000 to 5000 kg/ha/year as compared to 600-2000 kg/ha/year by adopting monoculture of common carp.

The rate of stocking of fish fingerlings should be 10,000 fingerlings/ha and the ratio should be Common carp 3: Grass carp 1 : Silver carp 1. The fingerlings should be stocked in the morning or in the evening. Some pond water should be added in the container to equalize the temperature of the water with that of the pond.

4.6 Supplementary Feeding:

Fishes should be fed with supplementary diet (oil cakes 50%+Wheat 50% bran/rice bran daily at the rate of 2-3% of total fish weight. Feed should be preferably provided in the form of pellets or bowls in fish feeding trays fixed in the ponds in the morning. Grass carps are to be fed with chopped succulent grasses or discarded vegetable leaves. Kitchen refuge can also be used as a supplementary feed for fish culture.

4.7 Harvesting:

Harvesting of table size fish should be done with proper care and crafts such as cast net, drag net, gill net, complete draining of ponds should be avoided.

4.8 Summing up

It can be concluded from the above that permanent water supply of required volume and quality is the basic factor for the construction of fish pond. The land must be having the capacity of retaining water. The sides of the ponds should be sloppy and well compacted. The pond should be provided with independent inlets and drainpipe. Liming and manuring of pond is also of utmost importance. Good quality seed and valuable fish species and varieties of fish are also important for successful fish farming.

Chapter - 5

SOCIO-ECONOMIC CHARACTERISTICS OF POND FISH FARMERS

This chapter deals with the socio-economic characteristics viz. family size, educational status, occupational pattern, land use pattern, cropping pattern, livestock resources etc. of the pond fish farmers.

5.1 Age-wise Number of Persons in the Family

Table 5.1 reveals that maximum persons were in the age-group of 16-60 years in all the category of farmers. The maximum numbers of persons in this age-group were found in the extra large category, followed by medium, small, large and marginal category. Overall, in all the age groups of sampled farmers the total persons were 4.37 where as females were more (2.25) as compare to males (2.12).

5.2 Average Family Size

The average family size among all the sampled pond fish farmers was 4.37 persons whereas it was 3.20, 4.60, 4.66, 4.66, 5.00 persons for marginal, small, medium, large and extra large category respectively (Table 5.2).

5.3 Educational Status of Sampled Pond Fish Farmers

The analysis of Table 5.3 shows that about 84 per cent persons are literate among all the sampled pond fish farmers, whereas males are more (92%) as compare to females (75%). Category wise maximum persons were found to be literate in medium category (96.30%) and minimum in marginal category (56.25%). Out of total persons, maximum persons were literate at the level of matric (25.96%), followed by primary (21.15%) middle (17.31%) and senior secondary (12.50%) where as the graduate, post graduate, technical/professional diploma holders were only 2.88, 0.96 and 2.88 per cent respectively.

Table-5.1 Age wise number of Persons in the Family of Sampled Pond Fish Farmers.

(Number/Family)

Category	Up to 6 years	7-15 years	16-60 years	Above 60 years	Total
Marginal					
M	-	-	1.00	0.40	1.40
F	-	-	1.60	0.20	1.80
T	-	-	2.60	0.60	3.20
Small					
M	-	0.40	1.60	0.20	2.20
F	-	0.40	1.60	0.40	2.40
T	-	0.80	3.20	0.60	4.60
Medium					
M	-	0.66	1.66	0.17	2.49
F	0.17	0.17	1.66	0.17	2.17
T	0.17	0.83	3.32	0.34	4.66
Large					
M	-	0.83	1.33	0.17	2.33
F	-	0.83	1.33	0.17	2.33
T	-	1.66	2.66	0.34	4.66
Extra Large					
M	-	-	2.00	-	2.00
F	-	-	2.50	0.50	3.00
T	-	-	4.50	0.50	5.00
All					
M	-	0.46	1.46	0.21	2.12
F	0.04	0.33	1.62	0.25	2.25
T	0.04	0.79	3.08	0.46	4.37

Table-5.2: Average Family Size of Sampled Pond Fish Farmers.

(Number/Family)

Category	Adult		Children	Total
	Male	Female		
Marginal	1.40	1.80	-	3.20
Small	1.80	2.00	0.80	4.60
Medium	1.83	1.83	1.00	4.66
Large	1.50	1.50	1.66	4.66
Extra Large	-	2.00	3.00	5.00
All	0.83	1.67	1.87	4.37

Table-5.3: Education Status of Sampled Pond Fish Farmers.

(Percentage to total)

Category	Marginal			Small			Medium		
	M	F	T	M	F	T	M	F	T
Illiterate	28.57	55.56	43.75	9.09	33.33	21.74	-	8.33	3.70
Primary	-	44.44	25.00	9.09	16.67	13.04	13.33	33.33	22.22
Middle	42.86	-	18.75	18.18	8.33	13.04	6.67	16.67	11.11
High School	28.57	-	12.50	18.18	25.00	21.74	60.00	25.00	44.45
Senior Secondary	-	-	-	27.27	-	13.04	13.33	16.67	14.82
Graduate	-	-	-	9.09	-	4.35	6.67	-	3.70
Post graduate	-	-	-	-	8.33	4.35	-	-	-
Technical/Professional Diploma	-	-	-	9.09	8.33	8.69	-	-	-
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total Person	7	9	16	11	12	23	15	12	27
Literacy %	71.43	44.44	56.25	90.91	66.67	78.26	100.00	91.67	96.30

Contd..

Table-5.3: Contd……..

(Percentage to total)

Category	Large			Extra Large			All		
	M	F	T	M	F	T	M	F	T
Illiterate	7.14	14.29	10.71	-	16.67	10.00	7.84	24.53	16.35
Primary	21.43	28.57	25.00	-	33.33	20.00	11.76	30.19	21.15
Middle	21.43	35.71	28.57	25.00	-	10.00	19.61	15.09	17.31
High School	35.71	14.29	25.00	25.00	-	10.00	37.25	15.09	25.96
Senior Secondary	14.29	7.14	10.71	25.00	33.33	30.00	15.69	9.43	12.50
Graduate	-	-	-	-	16.67	10.00	3.92	1.89	2.88
Post graduate	-	-	-	-	-	-	-	1.89	0.96
Technical/Professional Diploma	-	-	-	25.00	-	10.00	3.92	1.89	2.88
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total Person	14	14	28	4	6	10	51	53	104
Literacy %	92.86	85.71	89.29	100.00	83.33	90.00	92.16	75.47	83.65

5.4 Occupational Pattern

Main and subsidiary occupation followed by each of the sampled pond fish farmers was also enquired (Table 5.4). Majority (64.91%) of the farmers reported that agriculture was their main occupation, followed by service (22.81%), business (7.02%), dairy (3.51%) and fisheries (1.75%).

The proportion of workers undertaking any subsidiary occupation is given in Table 5.5. Here dairy is the most common subsidiary occupation (66.67%), followed by agriculture (15.15%), fisheries (9.09), labour (6.06%) and business (3.03%). It may also be observed that in subsidiary occupation agriculture, wage labour and business activities undertaken by males only. For females dairy is the most common activity.

5.5 Land Utilization Pattern

Land Use Pattern of the sampled pond fish farmers is presented in Table 5.6. It may be seen from the table that maximum area is of cultivated land (79.74%), followed by grass land (20.26%) in all the sampled pond fish farmers. The same pattern was followed in all the category of fish farms. Out of total land owned by sampled pond fish farmers the proportion of cultivated land was maximum in small category (89.65%) and minimum in extra large category (70.91%).

5.6 Cropping Pattern

The total area devoted to various crops grown by different categories of pond fish farmers is presented in Table 5.7. Maximum area is under wheat (29.75%) followed by vegetables (28.38%), paddy (23.31%), Maize and fruits each (6.06%), Tea (5.87%) and barley (0.56%). Cropping intensity is also given in Table 5.7. Overall, the cropping intensity was observed to be 166 per cent in all the sampled pond fish farmers where as it was found maximum (198%) in marginal category and minimum (129%) in large category.

Table-5.4: Distribution of Workforce According to Main Occupation of Sampled Pond Fish Farmers.

(Number)

Category	Agri.	Service	Dairy	Fisheries	Labour	Business	Other	Total workers	Total population	Proportion of workers total population
Marginal										
M	5	-	-	1	-	1	-	7	7	100.00
F	7	-	-	-	-	-	-	7	9	77.78
T	12	-	-	1	-	1	-	14	16	87.50
%	85.71	-	-	7.14	-	7.14	-	100.00	-	-
Small										
M	2	2	1	-	-	2	-	7	11	63.64
F	2	3	-	-	-	-	-	5	12	41.67
T	4	5	1	-	-	2	-	12	23	52.17
%	33.33	41.67	8.33	-	-	16.67	-	100.00	-	-
Medium										
M	5	3	-	-	-	1	-	9	15	60.00
F	9	1	-	-	-	-	-	10	13	76.92
T	14	4	-	-	-	1	-	19	28	67.86
%	73.68	21.05	-	-	-	5.26	-	100.00	-	-
Large										
M	3	3	-	-	-	-	-	6	14	42.86
F	3	-	-	-	-	-	-	3	14	21.43
T	6	3	-	-	-	-	-	9	28	32.14
%	66.67	33.33	-	-	-	-	-	100.00	-	-
Extra large										
M	-	1	1	-	-	-	-	2	4	50.00
F	1	-	-	-	-	-	-	1	6	16.67
T	1	1	1	-	-	-	-	3	10	30.00
%	33.33	33.33	33.33	-	-	-	-	100.00	-	-
All										
M	15	9	2	1	-	4	-	31	51	60.78
F	22	4	-	-	-	-	-	26	54	48.15
T	37	13	2	1	-	4	-	57	105	54.28
%	64.91	22.81	3.51	1.75	-	7.02	-	100.00	-	-

Table-5.5: Distribution of Workforce According to Secondary Occupation of Sampled Pond Fish Farmers.

Category	Agri.	Service	Dairy	Fisheries	Labour	Business	Other	Total	Total No. of main workers	% of worker performing secondary occupation
Marginal										
M	-	-	4	1	-	-	-	5	7	71.43
F	-	-	6	1	-	-	-	7	7	100.0
T	-	-	10	2	-	-	-	12	14	85.71
%	-	-	83.33	16.67	-	-	-	100.00	-	-
Small										
M	2	-	1	-	1	-	-	4	7	57.14
F	-	-	-	-	-	-	-	-	5	-
T	2	-	1	-	1	-	-	4	12	33.33
%	50.00	-	25.00	-	25.00	-	-	100.00	-	
Medium										
M	1	-	4	1	-	-	-	6	9	66.67
F	-	-	2	-	-	-	-	2	10	20.00
T	1	-	6	1	-	-	-	8	19	42.10
%	12.50	-	75.00	12.50	-	-	-	100.00	-	-
Large										
M	-	-	4	-	1	1	-	6	6	100.0
F	-	-	-	-	-	-	-	-	3	-
T	-	-	4	-	1	1	-	6	9	66.67
%	-	-	66.67	-	16.66	16.66	-	100.00	-	-
Extra large										
M	2	-	-	-	-	-	-	2	2	100.0
F	-	-	1	-	-	-	-	1	1	100.0
T	2	-	1	-	-	-	-	3	3	100.0
%	66.67	-	33.33	-	-	-	-	100.00	-	-
All										
M	5	-	13	2	2	1	-	23	31	74.19
F	-	-	9	1	-	-	-	10	26	38.46
T	5	-	22	3	2	1	-	33	57	57.89
%	15.15	-	66.67	9.09	6.06	3.03	-	100.00	-	-

Table-5.6: Land Resources per household of Sampled Pond Fish Farmers.

(Area in kanals)

Category	Cultivated land	Grass land	Other land	Total
Marginal				
IR	10.80	-	-	10.80
UIR	-	2.20	-	2.20
Total	10.80	2.20	-	13.00
%	83.08	16.92	-	100.00
Small				
IR	7.30	-	-	7.30
UIR	3.10	1.20	-	4.30
Total	10.40	1.20	-	11.60
%	89.66	10.34	-	100.00
Medium				
IR	6.00	-	-	6.00
UIR	0.83	1.33	-	2.16
Total	6.83	1.33	-	8.16
%	83.70	16.30	-	100.00
Large				
IR	21.00	-	-	21.00
UIR	-	6.83	-	6.83
Total	21.00	6.83	-	27.83
%	75.46	24.54	-	100.00
Extra large				
IR	17.00	-		17.00
UIR	-	6.00	-	6.00
Total	17.00	6.00	-	23.00
%	73.91	26.09	-	100.00
All				
IR	11.94	-	-	11.94
UIR	0.85	3.25	-	4.10
Total	12.79	3.25	-	16.04
%	79.74	20.26	-	100.00

One hectare=25 Kanals

Table-5.7: Cropping Pattern of Sampled Pond Fish Farmers.

(Area in Kanals)

Crops	Marginal		Small		Medium		Large		Extra large		All	
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
Maize	2.40	11.22	-	-	0.17	1.27	-	-	9.00	30.51	1.29	6.06
Paddy	5.00	23.36	6.00	29.41	3.83	28.73	5.67	20.87	3.50	11.86	4.96	23.31
Wheat	7.00	32.71	7.40	36.28	4.00	30.01	5.67	20.87	11.00	37.29	6.33	29.75
Barley	-	-	-	-	-	-	-	-	1.50	5.09	0.12	0.56
Vegetables	7.00	32.71	7.00	34.31	5.00	37.51	7.50	27.60	-	-	6.04	28.38
Fruits	-	-	-	-	0.33	2.48	3.33	12.26	4.50	15.25	1.29	6.06
Tea	-	-	-	-	-	-	5.00	18.40	-	-	1.25	5.87
Total cropped area	21.40	100.00	20.40	100.00	13.33	100.00	27.17	100.00	29.50	100.00	21.28	100.00
Net Area	10.80	-	10.40	-	6.83	-	21.00	-	17.00	-	12.79	-
Cropping intensity percentage	198.15	-	196.15	-	195.17	-	129.38	-	173.53	-	166.38	-

One hectare=25 Kanals

5.7 Livestock Resources

The numbers of various livestock possessed by pond fish farmers are given in Table 5.8 wherein it can be seen that on an average the number of livestock possessed by all the sampled pond fish farmers were 3.33 heads per farm. The number of cows was maximum (1.58/farm) in all the animals possessed. The number of animals was found to be relatively higher (12/farm) in extra large category as compare to other categories.

5.8 Annual Income From Crops

Table 5.9 reveals that per farm annual income was maximum from vegetables (Rs.22970), followed by wheat (Rs.6373) and paddy (Rs.5098). The minimum income was obtained from maize i.e. Rs.1206/farm.

5.9 Gross Annual Income From all Sources

It can be seen from Table 5.10 that out of total income of all sampled pond fish farmers, the proportion of income from service sector was maximum (27.93%) followed by agriculture (17.65%), animal husbandry (17.25%), fisheries (17.17%) and business (13.64%). Category wise it can be seen that in extra large category the proportion of income from fisheries was maximum i.e. 37.74 per cent while in marginal category maximum 46 per cent comes from agriculture sector. In the remaining categories maximum income was obtained from service sector.

5.10 Summing up

From the above analysis it can be concluded that average family size among all the sampled pond fish farmers was 4.37 persons. About 84 percent of the people were found to be literate and out of total persons maximum (25.96%) persons were literate at the level matric. Agriculture was the main occupation of the majority (64.91%) of the farmers whereas dairy was the most common subsidiary occupation (66.67%). Land use pattern indicates that maximum (79.74%) area was of cultivated land in all the category of fish farms. In total cropped area, maximum proportion (29.75%) of area was observed in the case of wheat and minimum in the case of barley (0.56%). On an average the numbers of livestock were 3.23 heads per farm. The proportion of income

was observed to be maximum (27.93%) from service sector. In the case of crop highest income was obtained from the vegetable crops.

Table-5.8: Livestock Resources of Sampled Pond Fish Farmers.

(Number/Farm)

Type of livestock	Marginal	Small	Medium	Large	Extra large	All
1. Cows	0.80	1.80	1.17	0.83	6.50	1.58
C.B.	0.20	-	0.50	-	0.50	0.21
Indigenous	0.60	1.80	0.67	0.83	6.00	1.37
2. Bullocks	0.40	0.80	1.00	1.00	0.50	0.79
3. Youngstock	0.60	0.20	0.33	0.50	4.50	0.75
4. Buffaloes	0.20	-	-	-	0.50	0.08
5. Sheep	-	-	-	-	-	-
6. Goats	-	-	0.17	0.33	-	0.13
7. Horse/Ponies	-	-	-	-	-	-
Total	2.00	2.80	2.67	2.67	12.00	3.33
Poultry	-	400	-	-	1250	187.50
Income (Rs/HH)	14600.00	32320.00	21680.00	29400	187500.00	38170.00

Table-5.9: Annual Income From crops of Sampled Pond Fish Farmers.

(Rs./Farm)

Crops	Marginal	Small	Medium	Large	Extra Large	All
Maize	2140.00	-	125.00	-	8750.00	1206.25
Paddy	3970.00	5570.00	5441.67	5725.00	3825.00	5097.92
Wheat	5950.00	6320.00	4900.00	5616.67	14250.00	6372.92
Barley	-	-	-	-	400.00	33.33
Vegetables	23500.00	15000.00	28000.00	31800.00	-	22970.83
Fruits	-	-	166.67	4166.67	5000.00	1500.00
Tea	-	-	-	7500.00	-	1875.00
Total	35560.00	26890.00	38633.34	54808.34	32225.00	39056.25

Table-5.10: Gross Income from all Sources of Sampled Pond Fish Farmers.

(Rs./Farm)

Source of Income	Marginal	Small	Medium	Large	Extra large	All
Agriculture	35560 (45.49)	26890 (12.42)	38633 (17.75)	54808 (23.57)	32225 (5.74)	39056 (17.65)
Animal husbandry	14600 (18.68)	32320 (14.93)	21680 (9.96)	29400 (12.64)	187500 (33.38)	38170 (17.25)
Wage labour	800 (1.02)	4800 (2.22)	10000 (4.60)	5000 (2.15)	-	4917 (2.22)
Fisheries	9664 (12.36)	13262 (6.13)	23965 (11.01)	40327 (17.34)	212000 (37.74)	37984 (17.17)
Service	-	91200 (42.13)	62000 (28.49)	75000 (32.25)	90000 (16.02)	61792 (27.93)
Business	9600 (12.28)	36000 (16.63)	61333 (28.19)	8000 (3.44)	40000 (7.12)	30167 (13.64)
Pension	7940 (10.16)	12000 (5.54)	-	-	-	4154 (1.88)
Other	-	-	-	20000* (8.60)	-	5000 (2.26)
Total	78164 (100.00)	216472 (100.00)	217611 (100.00)	232535 (100.00)	561725 (100.00)	221240 (100.00)

- Nursery.

Note: Figures in parentheses are the percentages to total.

Chapter - 6

COSTS AND RETURNS FROM POND FISH FARMS

In this chapter, an attempt has been made to work out the costs and returns from pond fisheries on the basis of survey data. The economics of pond fisheries i.e. cost of rearing of fish and net income have been separately worked out for different size groups. Functionaries involved in the marketing of fish are also discussed in this chapter.

6.1 General Features of Sampled Pond Fish Farms

General features of sampled fish ponds are presented in Table 6.1. The number and size of fish ponds depend upon the water resources, variety, size of fish to be cultured and type of management. Out of total sampled fish ponds, 83 per cent ponds were earthen, 13 per cent ponds were made by cement and 4 per cent were mixed (earthen +cement) ponds. The average size of earthen pond was 140.42 sq.mt. while the average size of cement and mixed ponds was 216.67 sq. mt. and 15.04 sq.mt respectively. Most (95.83%) of the ponds were on agricultural land. The main source of water of sampled ponds was kuhl (83.33%), followed by kuhl and pump (12.50%) and pumps (4.17%). The source of finance for construction of pond was the own source of majority (45.83 %) of the pond fish farmers, followed by fisheries department and own & fisheries each (25%).

Table-6.1: General Features of Sampled Pond Fish Farms.

(in Percentage)

Particulars	Marginal	Small	Medium	Large	Extra large	All
1. Average size of pond fish farm (sq.m.)						
Earthen	32.00	80.00	168.33	300.00	-	140.42
Cement	2.20	30.00	33.33	-	-	15.04
Mixed	-	-	-	66.66	2400.00	216.67
2. Ponds on						
Agri.land	100.00	80.00	100.00	100.00	100.00	95.83
Barren land	-	20.00	-	-	-	4.17
3. Source of Water						
Kuhl	100.00	60.00	100.00	83.33	50.00	83.33
Kuhl+Pump	-	20.00	-	16.67	50.00	12.50
Pump	-	20.00	-	-	-	4.17
4. Source of Finance						
Own	40.00	40.00	83.33	16.67	50.00	45.83
Bank	-	-	-	-	-	-
Fisheries Deptt.	20.00	20.00	16.67	50.00	-	25.00
Horti. Deptt.	-	20.00	-	-	-	4.17
Own+Fisheries	40.00	20.00	-	33.33	50.00	25.00

6.2 Average Cost of Construction of Fish Pond

On the whole, the average cost of construction of pond was observed to be Rs.11964 while the average prorated construction cost was Rs.3852 on all the sampled fish ponds (Table 6.2). The cost increases with the increase in the size of fish pond.

Table-6.2: Average Cost of Construction of Sampled Pond Fish Farms.

(Rs./Farm)

Categories	Cost	Prorated construction cost
Marginal	4028	1297
Small	6600	2125
Medium	6916	2227
Large	10416	3354
Extra large	65000	20930
All	11964	3852

6.3 Implements and Tools

The number of implements and tools owned by pond fish farmers are given in Table 6.3 while the per farm value of implements and tools is given in Table 6.4. The implements and tools used in fish catching owned by pond fish farmers are fishing net, basket, kundi dori and pinjara. On an average, the maximum number was of kundi dori (2.88), followed by basket (1.58), fishing net (1.33) and Pinjra (0.96). Overall, the value of all implements owned by sampled pond fish farmers was Rs.1787 which increases with the increase in the size of pond except in the case of large fish ponds.

Table-6.3: Implements and Tools Owned by Sampled Pond Fish Producers.

Type of Pond	Fishing net	Basket	Kundi dori	Pinjra
Marginal	3	5	10	2
Small	5	6	12	2
Medium	6	7	15	4
Large	5	10	12	5
Extra large	8	10	20	10
All	27	38	69	23
Per farm	1.13	1.58	2.88	0.96

Table6.4: Value of Implements and Tools on Sampled Pond Fish Farms.

(Rs/farm)

Type of Pond	Fishing net	Basket	Kundi dori	Pinjra	Total value
Marginal	800	30	12	30	872
Small	1200	36	14	40	1350
Medium	1300	133	15	50	1498
Large	1167	133	14	58	1372
Extra large	6000	800	75	400	7275
All	1533	160	19	75	1787

6.4 Human Labour Used in Production of Pond Fish

Human labour used in feeding of fish, maintenance of pond, fish catching and watch and ward is given in Table 6.5. The table reveals that both males and females are involved in the various activities related to fish production and both family and hired labour is used for this purpose. But the hired labour was only used by large and extra large category of sampled pond fish farmers. On the whole, out of the total time spent by the sampled pond fish farmers the maximum time in the form of days goes to the activity of watch and ward, followed by feeding of fish, fish catching and maintenance of pond. But the pattern of time spent on these activities varies from category to category.

Table-6.5: Annual Human Labour Used in Fish Production on Sampled Fish Farms.

(Days per farm)

Components	Marginal				Small				Medium			
	Family labour		Hired Labour		Family labour		Hired Labour		Family labour		Hired Labour	
	M	F	M	F	M	F	M	F	M	F	M	F
1. Feeding of fish	3	3	-	-	3.2	3.2	-	-	5	5	-	-
2. Maintenance of Pond	0.4	-	-	-	0.4	-	-	-	0.7	-	-	-
3. Fish Catching	0.6	-	-	-	1	-	-	-	1.3	-	-	-
4.Watch & Ward	2	-	-	-	2	-	-	-	2.5	-	-	-
Total	6	3	-	-	6.6	3.2	-	-	9.5	5	-	-

Contd….

Table-6.5: Contd

(Days per farm)

Components	Large				Extra large				All			
	Family labour		Hired Labour		Family labour		Hired Labour		Family labour		Hired Labour	
	M	F	M	F	M	F	M	F	M	F	M	F
1. Feeding of fish	7.5	7.5	-	-	30	30	-	-	6.9	6.9	-	-
2. Maintenance of Pond	-	-	1.3	-	-	-	7	-	0.3	-	0.9	-
3. Fish Catching	-	-	3.8	-	-	-	20	-	0.7	-	2.6	-
4.Watch & Ward	8.3	-	8.3	-	50	-	50	-	7.7	-	6.3	-
Total	15.8	7.5	13.5	-	80	30	77	-	15.6	6.9	9.8	-

6.5 Value of Different Components of Feed

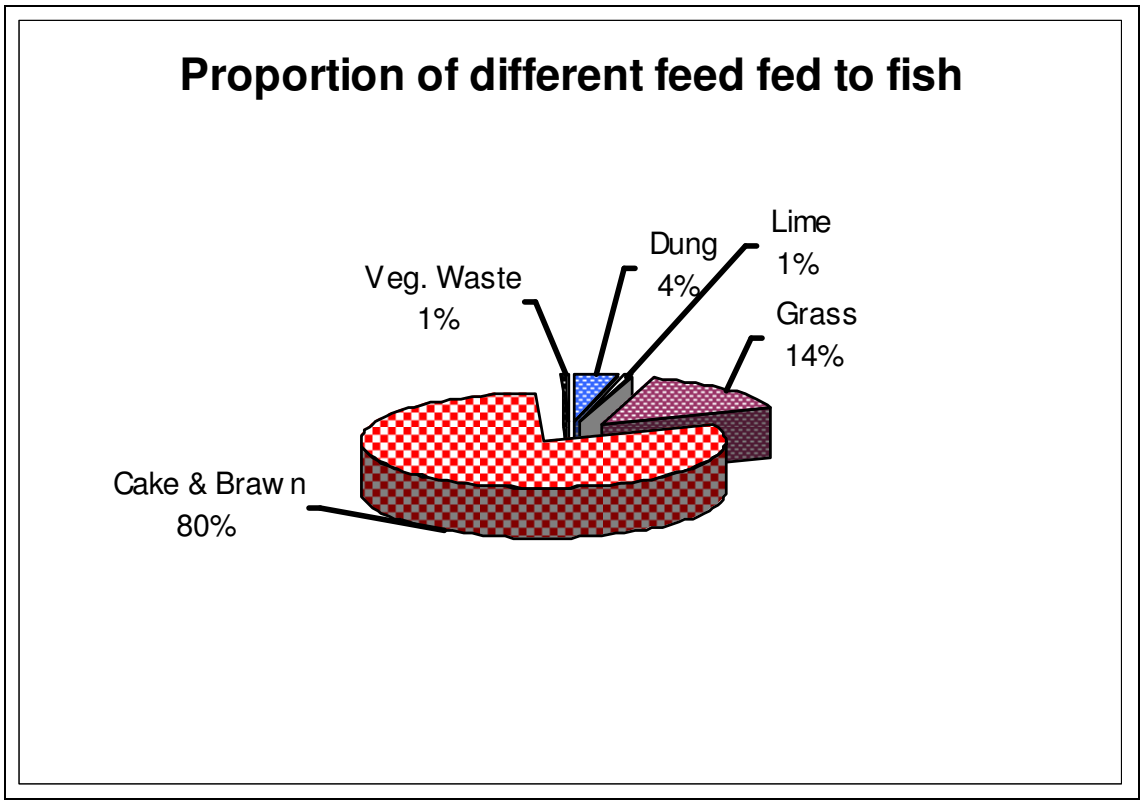
The components of feed for rearing of fish include dung, lime, grass, cake & brawn and vegetable waste. The component wise value of feed is presented in Table 6.6. It may be seen from the table that on an average per farm value of feed for rearing of fish was about Rs.10317, which increases with the increase in the category of fish pond and vary from Rs.1967.60 on marginal category to Rs.59100 on extra large category. Cake and bran is the major component of feed constituted 80.33 per cent of the total value of feed followed by grass (14.34%), dung (3.79%), lime (0.94%) and vegetable waste (0.60%). The same pattern was observed in all the category of fish ponds.

Table-6.6: Value of Different Components of Feed on Sampled Pond Fish Farms.

(Rs./Farm)

Feed Components	Marginal	Small	Medium	Large	Extra large	All
1. Dung	62.60 (3.18)	142.00 (5.08)	91.67 (1.99)	466.67 (3.59)	2500.00 (4.23)	390.54 (3.79)
2. Lime	15.00 (0.76)	13.00 (0.47)	19.17 (0.42)	103.33 (0.80)	725.00 (1.23)	96.88 (0.94)
3. Grass	410.00 (20.84)	600.00 (21.47)	1300.00 (28.30)	1150.00 (8.84)	7875.00 (13.32)	1479.17 (14.34)
4. Cake & Bran	1480.00 (75.22)	2040.00 (72.98)	3183.33 (69.29)	11033.33 (84.85)	48000.00 (81.22)	8287.50 (80.33)
5. Veg. Waste	-	-	-	250.00 (1.92)	-	62.50 (0.60)
Total	1967.60 (100.00)	2795.00 (100.00)	4594.17 (100.00)	13003.33 (100.00)	59100.00 (100.00)	10316.59 (100.00)

Note: Figures in parenthesis denote percentages to total.



6.6 Costs and Returns from Pond Fisheries

The analysis of cost and returns from sampled fish ponds has been shown in Table 6.7. Costs have been grouped into two categories for the purpose of presentation, viz., fixed costs and variable costs. Fixed costs include (a) prorated pond cost, (b) interest on implements and tools, (c) depreciation on implements and tools. The components of variable costs are (a) value of fingerlings, (b) feed cost, (c) value of human labour which includes value of family and hired labour and, (d) interest on working capital. The analysis of Table 6.7 shows that total fixed cost constituted 21.77 per cent of total cost incurred by all the sampled pond fish farmers. The variable cost is 78.23 per cent of the total cost. The main components of cost are feed, prorated pond cost and labour charges which accounted for 52.47, 19.59 and 13.49 per cent of total cost respectively. However the expenses on feed and labour together constitute 65.96 per cent of total cost. Category wise per farm total cost on rearing of fish varies form Rs.4575 in marginal category to Rs.113222 in extra large category and showing increasing trend

with the increase in the size of fish pond. On an average, the total cost incurred by all the sampled pond fish farmers observed to be Rs.19663 per farm. It may also be observed from Table 6.7 that the pond farmers of extra large category realized the higher per farm net income (Rs.98778) and marginal category realized the lowest per farm net income (Rs.5090). On an average, the total per farm net income realized by all the sampled pond fish farmers was observed to be Rs.18,321.

6.7 Costs and returns per kg of fish production

Per kg total costs, gross returns and net returns from pond fish has been analyzed and presented in Table 6.8. On an average, per kg total cost of production of fish ranges between Rs 21.36 on extra large category of farm to Rs 30.90 on marginal category of sampled fish farms. The per kg prices realized by the fish farmers were relatively higher in case of medium category and lesser in case of extra large category of fish farm. The same pattern has been observed in per kg net profit received by the fish producers under study.

6.8 Input output ratio

The output per unit of input has been estimated and presented in Table6.8. The ratio was relatively higher on medium category of fish pond (1:2.59), followed by marginal category (1:2.11), small category (1:2.01), extra large (1:1.87) and large category (1:1.80). On an average, output per rupee of input was Rs 1.93 on all the sampled fish farms. This indicates that the medium category farms are operating efficiently as compared to other fish farms under study.

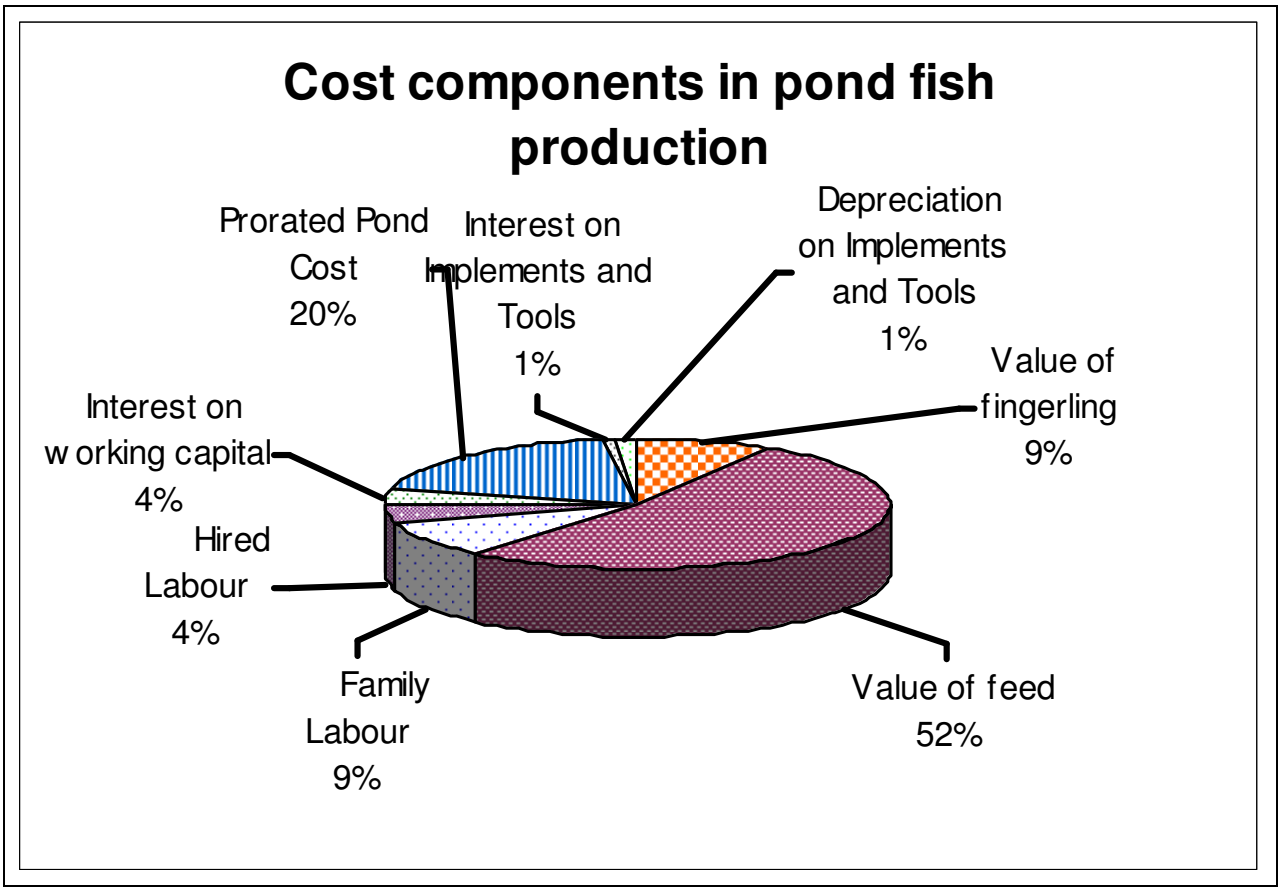

Cost components in pond fish production
Prorated Pond Cost 20%
Interest on Implements and Tools 1%
Depreciation on Implements and Tools 1%
Value of fingerling 9%
Interest on working capital 4%
Hired Labour 4%
Family Labour 9%
Value of feed 52%

Table-6.7: Cost and Returns From Pond Fisheries on Sampled Pond Fish Farms.

(Rs./Farm)

Cost Components	Marginal		Small		Medium		Large		Extra large		All	
	Rs.	%	Rs.	%	Rs.	%	Rs.	%	Rs.	%	Rs.	%
A. Variable Cost												
1. Value of fingerling	228	4.99	325	4.95	567	6.13	1783	7.97	11750	10.38	1682	8.55
2. Value of feed	1968	43.03	2795	42.57	4594	49.66	13003	58.09	59100	52.20	10317	52.47
3. Value of human labour												
Family Labour	732	16.00	804	12.25	1187	12.83	1867	8.34	8800	7.77	1817	9.24
Hired Labour	-	-	-	-	-	-	1157	5.17	6560	5.79	836	4.25
4. Interest on working capital	146	3.19	196	2.99	317	3.43	890	3.97	4310	3.81	732	3.72
Total Variable Cost	3074	67.21	4120	62.76	6665	72.05	18700	83.54	90520	79.95	15383	78.23
B. Fixed Cost												
1. Prorated Pond Cost	1297	28.35	2125	32.37	2227	24.08	3354	14.98	20930	18.49	3852	19.59
2. Interest on Implements and Tools	87	1.90	135	2.05	149	1.61	137	0.61	727	0.64	178	0.91
3. Depreciation on Implements and Tools	116	2.54	185	2.82	209	2.26	194	0.87	1045	0.92	250	1.27
Total Fixed Cost	1500	32.79	2445	37.24	2585	27.95	3685	16.46	22702	20.05	4280	21.77
Total Cost (A+B)	4574	100.0	6565	100.0	9250	100.0	22385	100.0	113222	100.0	19663	100.0
Total Production (Qtls.)	1.48		2.40		3.58		8.17		53.00		8.16	
Value of total Production	9664		13262		23965		40327		212000		37984	
Net Returns	5090		6697		14715		17942		98778		18321	

Table-6.8: Annual total costs, gross returns, net returns and input output ratio.

Category of pond	Per pond fish farm (Rs)			Per kilogram (Rs)			Input output ratio
	Total costs	Gross returns	Net returns	Total costs	Gross returns	Net returns	
Marginal	4574	9664	5090	30.90	62.30	31.40	1:2.11
Small	6585	13262	6697	27.35	55.26	27.91	1:2.01
Medium	9250	23965	14715	25.84	66.91	41.07	1:2.59
Large	22385	40327	17942	27.40	49.36	21.96	1:1.80
Extra Large	113222	212000	98778	21.36	40.00	18.64	1:1.87
Overall	19663	37984	18321	24.10	45.55	21.45	1:1.93

6.9 Production and Utilization of Pond Fish

The production and utilization of fish by the pond fish farmers is given in Table 6.9. On an average, total production of fish was 8.16 qtls per farm by all the sampled pond fish farmers. Farm size wise production of fish varied from 1.48 qtls./farm on marginal farm to 53 qtls./farm on extra large farms. On an average, proportion of fish sold by all the sampled pond fish farmers constitutes 95.10 per cent of the total fish production, 2.70 per cent fish is retained for home consumption and 2.20 per cent is given as gift to others. According to the category of pond fish farmers the proportion of fish sold was maximum (98.76%) in the case of extra large category and minimum (80.45%) in the case of medium category. The pattern of utilization of fish is almost same in all the categories of pond fish farmers.

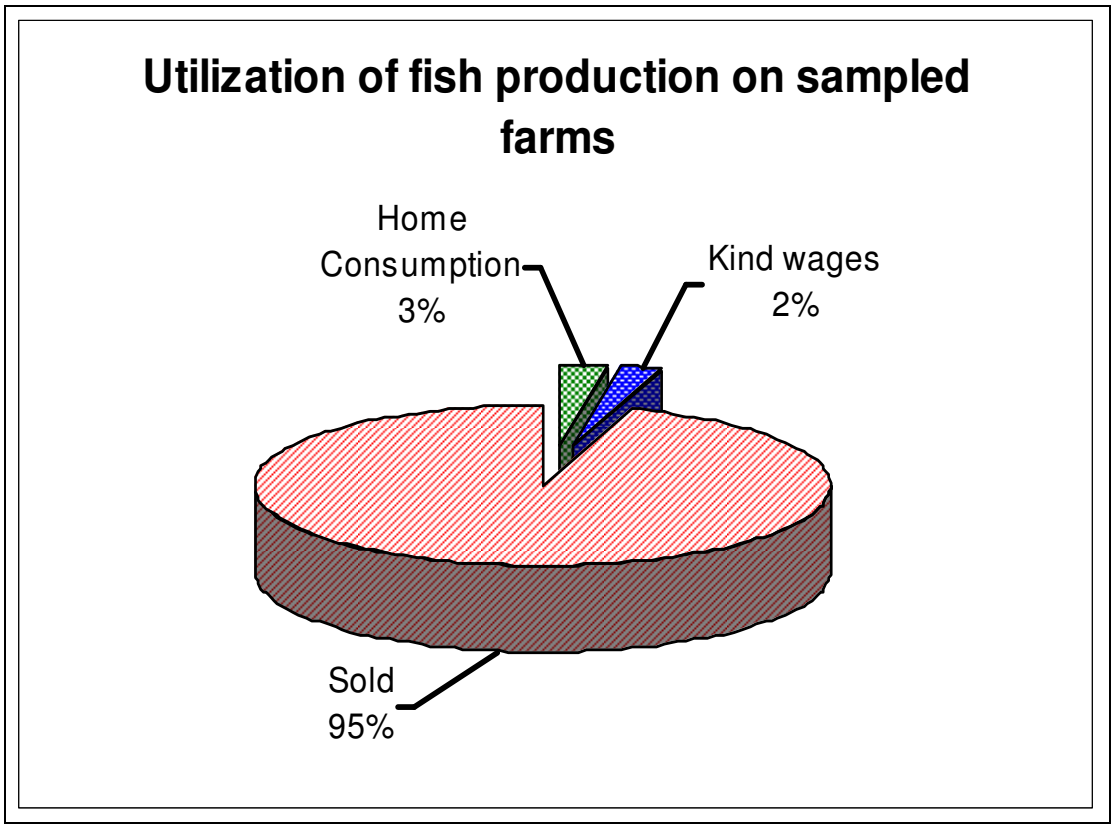


Table6.9: Production and Utilization of Fish by Sampled Pond Fish Farmers.

(Qtls./Farm)

Particulars	Marginal	Small	Medium	Large	Extra Large	All
Home Consumption	0.17 (11.49)	0.08 (3.33)	0.38 (10.61)	0.19 (2.33)	0.33 (0.62)	0.22 (2.70)
Kind wages	-	-	-	-	-	
Gifted	0.01 (0.67)	0.09 (3.75)	0.32 (8.94)	0.21 (2.57)	0.33 (0.62)	0.18 (2.20)
Sold	1.30 (87.84)	2.23 (92.92)	2.88 (80.45)	7.77 (95.10)	52.34 (98.76)	7.76 (95.10)
Total Production	1.48 (100.0)	2.40 (100.0)	3.58 (100.0)	8.17 (100.0)	53.00 (100.0)	8.16 (100.0)

Note: Figures in parenthesis denote percentage to total.

6.10 Losses of Fingerlings and its Value

The losses of fingerlings on sampled pond fish farmers are given in Table 6.10. Farmers reported that loss occurs due to mortality and also due to snakes and birds and some times due to poison given by others. Out of total losses of 344 fingerling/farm by all sampled pond fish farmers the proportion of losses by birds is maximum (34.6%) ,followed by losses due to mortality (32.3%) and losses by snakes (30.8%). In terms of value losses were observed to be of Rs.1363/farm by all the sampled pond fish farmers. Losses were maximum (Rs.10400/farm) in the case of extra large category and minimum (Rs.155 /farm) in the case of small category.

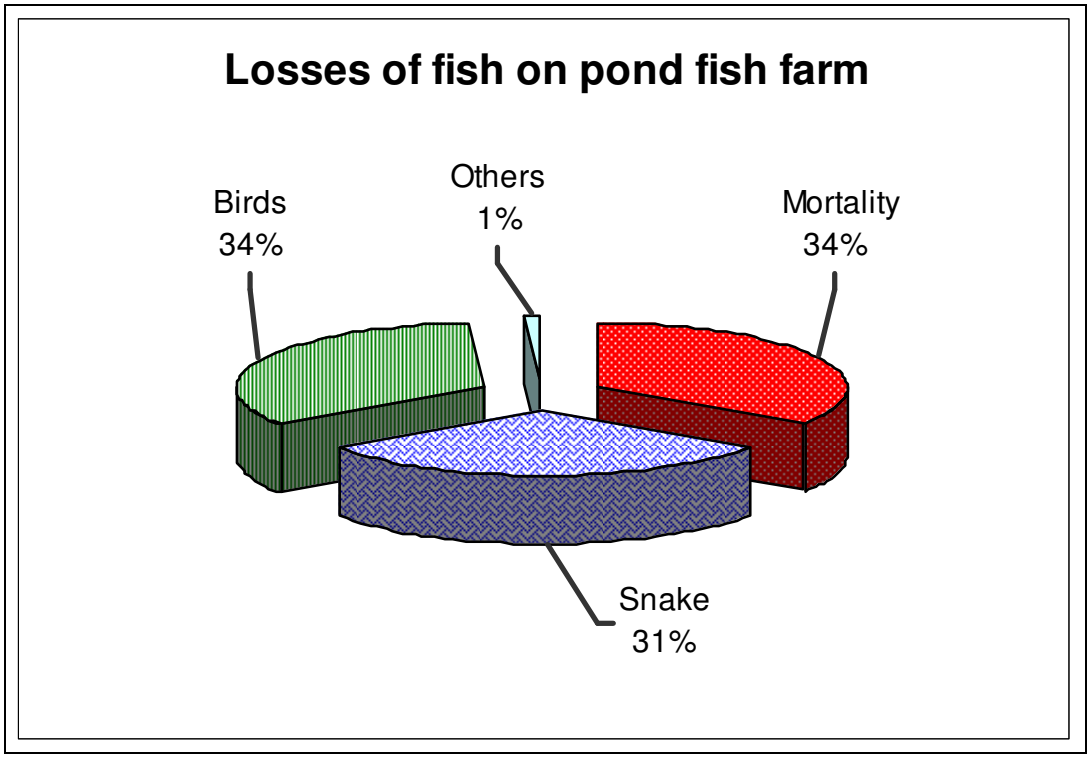


Table-6.10: Per Farm Losses of Fingerlings and its Value on Sampled Fish Ponds.

(Value in Rs.)

Losses due to	Marginal	Small	Medium	Large	Extra large	All
1. Mortality						
No.	8	20	14	40	1100	111
Value	18.00	20.00	28.00	125.00	5100.00	471.00
2. Snake						
No.	24	11	133	93	500	106
Value	80.00	55.00	411.00	317.00	2500.00	418.00
3. Birds						
No.	19	16	148	98	600	119
Value	65.00	80.00	475.00	365.00	2600.00	457.00
4. Theft						
No.	-	-	-	-	-	-
Value	-	-	-	-		-
5. Others	-	-	-	-	-	-
No.	-	-	-	-	100	8
Value	-	-	-	-	200.00	17.00
Total						
No.	51	47	295	231	2300	344
Value	163.00	155.00	914.00	807.00	10400.00	1363.00

6.11 Marketing Channels used in Pond Fish Marketing

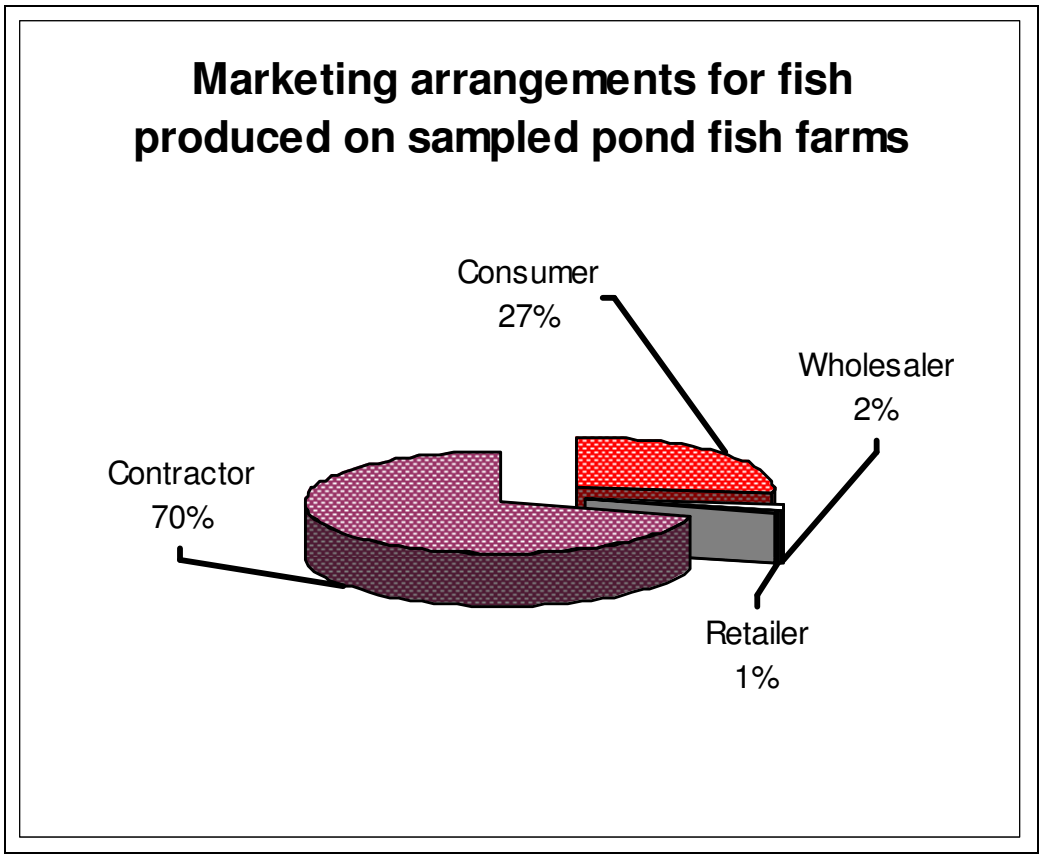
Four marketing channels prevailing in pond fish marketing are:

1. Producer – Consumer
2. Producer – wholesaler – retailer – consumer
3. Producer – retailer – consumer
4. Producer – contractor – wholesaler – retailer – consumer

6.12 Functionaries Involved in Fish Marketing

The quantity of pond fish marketed by different functionaries is given in Table 6.11. It can be seen from the table that in the case of marginal and medium category entire

marketed surplus of fish directly goes to consumers. In the case of small category out of total fish marketed of 2.23 qtls/farm, 58.30 per cent directly goes to consumer while 30.04 and 11.66 per cent sold to wholesalers and retailers respectively. Large category of pond fish farmers sold 41.57 per cent of the total marketed surplus directly to consumers and 58.43 per cent through contractors while extra large category sold entire fish through contractor. On the whole it can be seen that contractor is the main functionaries involved in the marketing of pond fish followed by consumer, wholesaler and retailer.



6.13 Summing up

It can be concluded from the above analysis that average cost of construction of fish pond was Rs. 11964 and the source of finance for construction of pond was the own of the majority (45.83%) of the sampled pond fish farmers. The average expenditure on implements and tools was observed to be Rs.1787/farm. Out of the total time spent by pond fish farmers on the various activities of fish production, maximum time goes to the activity of watch and ward followed by feeding of fish, fish catching and maintenance of pond. On an average per farm value of feed for rearing of fish was about Rs.10317 and cake and bran is the major component of feed constituted 80.33 per cent of the total value of feed. Overall, the total cost for the production of pond fish was observed to be Rs.19663 per farm. The variable and fixed cost constituted 78.23 and 21.77 per cent of the total cost respectively. Per farm net income realized by all the sampled pond fish farmers was observed to be Rs.18321 and on an average input out put ratio comes out be to 1:1.93. On the whole, out of total production of fish 95.10 per cent was marketed and contractor was the main functionaries involved in the marketing of pond fish.

Table-6.11: Quantity of Fish Marketed by Different Functionaries on sampled Pond Fish Farms.

(Qtls./Farm)

Category of Pond	Total Production	Marketed		Consumer	Wholesaler	Retailer	Contractor
		Qty.	% of total production				
Marginal	1.48	1.30 (100.0)	87.84	1.30 (100.0)	-	-	-
Small	2.40	2.23 (100.0)	92.92	1.30 (58.30)	0.67 (30.04)	0.26 (11.66)	
Medium	3.58	2.88 (100.0)	80.45	2.88 (100.0)	-	-	-
Large	8.17	7.77 (100.0)	95.10	3.23 (41.57)	-	-	4.54 (58.43)
Extra large	53.00	52.34 (100.0)	98.76	-	-	-	52.34 (100.0)
All	8.16	7.76 (100.0)	95.10	2.07 (26.68)	0.14 (1.80)	0.05 (0.64)	5.50 (70.88)

Note: Figures in parentheses are the percentages to total.

Chapter - 7

PROBLEMS FACED BY FISH FARMERS

The various problems related to pond fisheries faced by the sampled pond fish farmers are discussed in this chapter. The problems revealed are multiple in response as shown in Tables 7.1 to 7.5. .

7.1 Problems Related to Construction of Ponds

Selection of suitable site along with water parameters, soil characteristics and construction aspects are the prime consideration for the success of pond fisheries. The sampled pond fish farmers were asked about the problems which they were facing regarding construction of ponds (Table 7.1). Majority (62.50%) of pond fish farmers reported the problem of shortage of water in summer and winter. Fifty eight percent farmers reported the problem of suitable site while 54 per cent stated the problem of lack of finance and high interest rate. About 13 per cent stated about the problem of lack of knowledge about establishing of fish pond.

Table-7.1: Problems Related to Construction of Pond faced by Sampled Pond Fish Farmers.

(Multiple Response)

Problems		Marginal	Small	Medium	Large	Extra large	All
1. Lack of knowledge about establishing of Pond	No %	1 20.00	1 20.00	- 	1 16.67	- 	3 12.50
2. Lack of Finance & High Interest rate	No %	3 60.00	2 40.00	3 50.00	3 50.00	2 100.0	13 54.17
3. Location of Pond is away from house	No %	2 40.00	3 60.00	4 66.67	3 50.00	2 100.0	14 58.33
4.Shortage of Water in Summer & Winter	No %	3 60.00	3 60.00	4 66.67	4 66.67	1 50.00	15 62.50
Sample Size	No %	5 100.0	5 100.0	6 100.0	6 100.0	2 100.0	24 100.0

7.2 Problems Related to Fingerlings

The sampled pond fish farmers were also asked about the problems related to fingerlings and their responses are given in Table 7.2. About 46 per cent farmers reported that fingerlings of required breed are not available and about 38 per cent farmers were of the view that the fingerlings are not available in time. Only 4 per cent stated that fingerlings are costly. Majority (58%) of fish farmers reported that fingerlings are not available in required place.

Table-7.2: Problems Related to availability of Fingerlings faced by Sampled Pond Fish Farmers.

(Multiple Response)

Problems		Marginal	Small	Medium	Large	Extra large	All
1. Fingerlings of required breed are not available	No %	3 60.00	2 40.00	3 50.00	2 33.33	1 50.00	11 45.83
2. Fingerlings are not available in time	No %	2 40.00	2 40.00	2 33.33	2 33.33	1 50.00	9 37.50
3. Fingerlings are costly	No %	1 20.00	-	-	-	-	1 4.17
4.Fingerlings are not available in required place	No %	2 40.00	3 60.00	3 50.00	4 66.67	2 100.0	14 58.33
Sample Size	No %	5 100.0	5 100.0	6 100.0	6 100.0	2 100.0	24 100.0

7.3 Problems Related to Fish Feed

Feed is one of the important component of cost and constitutes 52.47 per cent of total cost in pond fish rearing. Majority (70.83) pond fish farmers reported that required feed is not available and fifty eight percent stated that they have lack of knowledge about feed. Only four and eight per cent reported that feed is costly and not available in time respectively (Table 7.3).

Table-7.3: Problems Related to Fish feed faced by Sampled Pond Fish Farmers.

(Multiple Response)

Problems		Marginal	Small	Medium	Large	Extra large	All
1. Lack of knowledge about feed	No	3	3	3	4	1	14
	%	60.00	60.00	50.00	66.67	50.00	58.33
2. Required feed is not available	No	4	3	4	4	2	17
	%	80.00	60.00	66.67	66.67	100.0	70.83
3. Feed is costly	No	-	1	-	-	-	1
	%		20.00				4.17
4. Feed is not available in time	No	1	-	1	-	-	2
	%	20.00		16.67			8.33
5. Credit is not available for feed	No	2	2	3	3	1	11
	%	40.00	40.00	50.00	50.00	50.00	45.83
Sample Size	No	5	5	6	6	2	24
	%	100.0	100.0	100.0	100.0	100.0	100.0

7.4 Problems Related to Marketing of Fish

Marketing of pond fish is not the major problem of pond fish farmers. Only about 17 per cent farmers stated the problem of small quantity of marketed surplus and 4 per cent reported the problem of lack of market intelligence (Table 7.4).

Table-7.4: Problems Related to Marketing of Fish faced by Sampled Pond Fish Farmers.

(Multiple Response)

Problems		Marginal	Small	Medium	Large	Extra large	All
1. Small Quantity of Marketed Surplus	No	2	2	-	-	-	4
	%	40.00	40.00				16.67
2. Lack of Market Intelligence	No	-	-	-	-	1	1
	%					50.00	4.17
Sample Size	No	5	5	6	6	2	24
	%	100.0	100.0	100.0	100.0	100.0	100.0

7.5 Other Problems

Other problems are related to losses due to theft, snake, birds, poison etc. Fifty four percent pond fish farmers reported that loss occurs due to snakes and 50 per cent and 29 per cent were of the view that birds and theft cause losses of fingerlings (Table 7.5).

Table-7.5: Problems Related to theft, and other faced by Sampled Pond Fish Farmers.

(Multiple Response)

Problems		Marginal	Small	Medium	Large	Extra large	All
1. Theft	No	1	1	2	1	2	7
	%	20.00	20.00	33.33	16.67	100.0	29.17
2. Snake	No	2	3	3	3	2	13
	%	40.00	60.00	50.00	50.00	100.0	54.17
3. Birds	No	2	2	3	3	2	12
	%	40.00	40.00	50.00	50.00	100.0	50.00
4. Poison	No	-	-	-	1	-	1
	%				16.67		4.17
Sample Size	No	5	5	6	6	2	24
	%	100.0	100.0	100.0	100.0	100.0	100.0

7.6 Summing up

It can be concluded from the above analysis that marketing is not the major problem of sampled pond fish farmers. The main problems faced by the majority of farmers are lack of finance, shortage of water in summer and winter, non availability of fingerling of required breed, fingerlings not available in required place, lack of knowledge about feed and required feed is not available.

Raceway for trout fish in the village in Kullu district

SECTION II

This section deals with trout fish farming in Himachal Pradesh, production of trout fish, construction and management of trout fish raceways, socio-economic features of trout fish farmers, cost and returns from trout fish rearing and problems faced by the sampled trout fish farmers

Raceway for trout fish in the village in Kullu district

Chapter – 8

TROUT FISH FARMING IN HIMACHAL PRADESH

The trout culture has a very recent origin. Among European Salmonids, brown trout is the first fish to be artificially reproduced and reared. However, a greater focus is being given now-a-days on rainbow trout farming. It is the only species among the cold water fishes being cultured commercially in the U.S.A. The trout industry in U.S.A. has grown phenomenally with production level of 15000 mt. of trout during 1975.

Rainbow trout are the native of Sacrament river region, while the brown trout are indigenous to mountain waters of Central and Western Europe. Zoologically, both these species belong to the family Salmonidae order Isospondyli. Brown trout varies in colour form. The two differentiating features of brown trout are (i) red orange spots on the body; (ii) edge of the adipose fin is tipped with red. The skin of rainbow trout is covered with small black star shaped spots. The adults have an iridescent reflecting rose-coloured band on their flanks which is particularly apparent at the time of reproduction. Rainbow trout are best suited for farming as they accept artificial feed easily. They are eurythermal and can withstand higher temperature fluctuations, their incubation is shorter and growth faster, and they are more resistant to certain diseases.

8.1 History of Introduction

The first attempt to introduce trouts in Himalayan waters dates back to 1899, when Mitchell succeeded in bringing live eyed-eggs of brown trout from England and hatched them successfully in a hatchery in Harwan, Kashmir. The 'eyed-eggs' of this transplanted exotic brown trout were later brought to Kangra and Kullu valley of Himachal Pradesh. These transplanted eggs were also hatched successfully in Mahili hatchery Katrain in 1909 and hatchings produced were stocked in the streams of Kullu valley. Later a consignment of 5000 eggs of rainbow trout 'eyed ova' was brought from Kashmir. The progeny on attaining maturity were spawned and the fry produced were

stocked in the streams of Chamba, Mandi, Shimla and Kinnaur districts. The well oxygenated icy cold water as well as rich benthic fauna of Himachal streams offered congenial conditions not only for establishment of these world-known game fishes, but also facilitated their breeding and propagation in the streams. In subsequent years, excellent catches of trout were reported by the anglers from the different streams of the state. The state government set up number of trout farms viz Barot, Patlikuhl , Chirgaon and Sangla in different regions of the state for augmentation of stocks in the streams and promotion of recreation fishery.

8.2 Culture

The credit for initiating trout culture in uplands of India also goes to Mitchell who established the first trout hatchery at Harwar Kashmir during 1905. Mahili hatchery at Katrain in Himachal Pradesh was the next to be built in the year 1909.

Both the species of trout not only attained maturity in Himalayan waters but also bred successfully and thrived in the streams.

During initial years the artificial propagation of trout was undertaken to meet the stocking requirements of rivers streams. Till early fifties, trout was considered only a game fish and hardly any interest was evinced in its culture or large scale farming. This is mainly attributed to the absence of any technology in the country on trout raising. The farms were plagued with poor growth rate, large scale mortality and heavy infestation of diseases. The concept of commercial farming of trout got a boost with the appearance of dry trout feed in the European markets. This revolutionized trout culture in North America, Denmark and Japan.

In India, the trout farms usually sub-serve the need of the anglers. They have been established primarily for raising the stocking material and later their transplantation in the streams. All the 12 trout farms of the country, 3 in Kashmir, 5 in Himachal Pradesh and one each in Uttar Pradesh, Kerala, Arunachal Pradesh and Tamil Nadu have been set up for raising the stocking material and their release in the streams. Barring

Achabal and Patlikuhl, all these farms are out-dated, primitive in facilities and afflicted with qualitative and quantitative problems of water. The survival rate from 'eyed' ova to fingerling stage is exceeding low compared to European farms and ranges from nil to 10%.

During 1982, the European Economic Commission (E.E.C.) project on commercial farming of rainbow trout was initiated in Kashmir. The project helped in the remodeling of Achabal trout farm, demonstration of farming technology and production of large scale table-sized fish. Later during 1988, a Norwegian aided project was initiated in the State of Himachal Pradesh, with three main objectives viz (i) Setting up of a model trout farm with latest hatchery techniques; (ii) Formulation of pelleted trout feed and (iii) Demonstration of large scale table-size trout farming technology.

Both these foreign aided projects contributed significantly not only in setting up latest trout farms in the country, but also giving a new orientation in the trout farming technology in the country. The projects also helped in circumventing the major impediments confronting the commercial trout farming in the country.

8.3 Trout Fish Production in Himachal Pradesh

The river length for trout fisheries in Himachal Pradesh is 600 km. which can be judiciously trapped for trout culture. The State has some of the finest trout streams in the north. The Pabbar in the Rohru Valley, the Baspa in the Sangla Valley, the Uhl in the Barot Valley and river Beas and its tributaries in the Kullu Valley. The State has taken a major leap in production of Indigenous Schizothoracids, exotic salmonids such as Rainbow and Brown trout. Keeping in view the vast potential of trout in the perennial rivers, Himachal has become the first state in the country to introduce trout farming in the private sector besides emerging as a number one producer of this specie of fish.

In 1988 the Norwegian Government came forward to assist the Himachal Pradesh state government to rehabilitate the exotic trout culture, as well as to commercialize trout production. The project, initiated in 1989 and was split into two phases viz. (i) transfer

of technology and (ii) production phase. Import of quick growing disease resistant eggs, development of economical and viable palletized feed with locally available ingredients, training of local staff and farmers, production of economically viable fingerlings with the aim to enable the local farmers to adopt trout farming were the other aspects of this project.

The total production of trout in H.P. was 0.54 tones in the year 1996-97 which increased to 25 tones in the year 2005-06 thereby showing an increasing rate of growth of 23.13 per cent per year during the study period. During the year 2003-04 a sharp decline was observed in the production of trout which was due to attack of the disease on trout (Table 8.1).

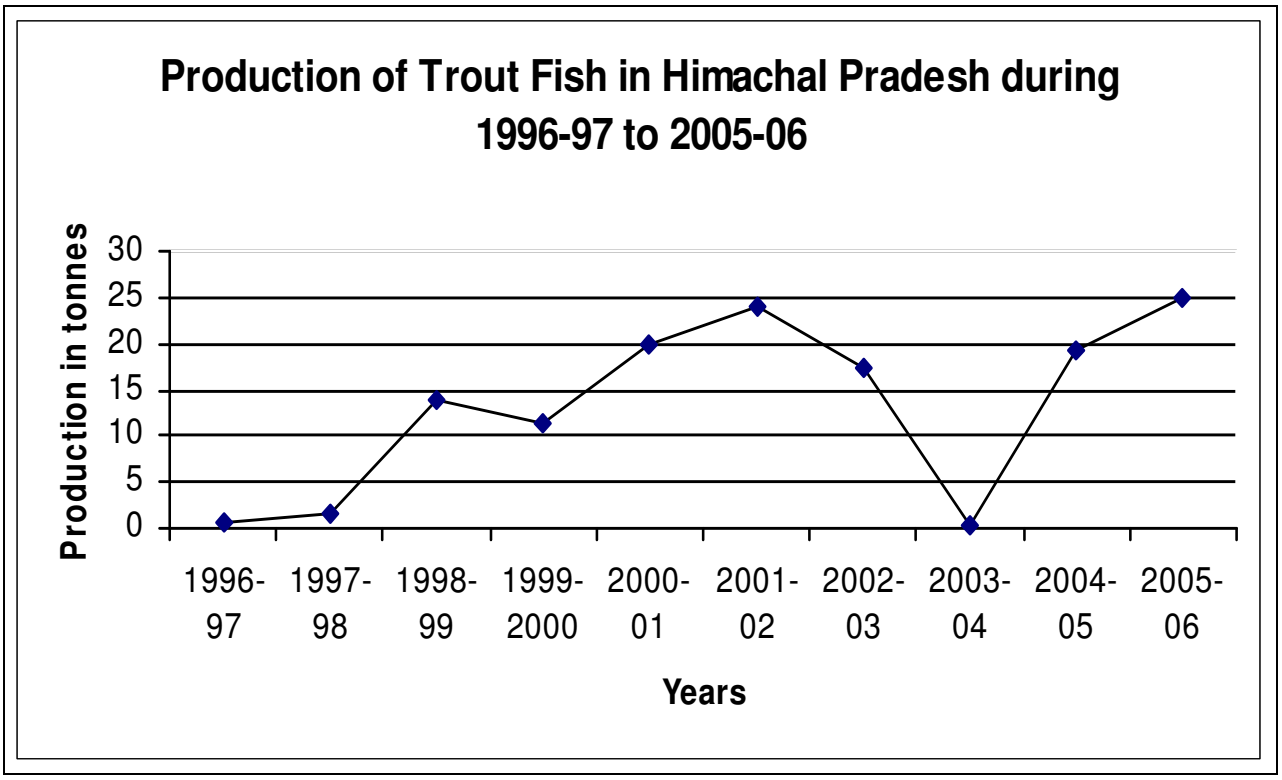


Table-8.1: Production of Trout in Himachal Pradesh during 1996-97 to 2005-06

(Tonnes)

Years	Production
1996-97	0.54
1997-98	1.62
1998-99	13.90
1999-2000	11.29
2000-01	19.89
2001-02	24.02
2002-03	17.33
2003-04	0.31
2004-05	19.34
2005-06	25.00
CGR %	**23.13**

Source: Directorate of Fisheries, Govt. of Himachal Pradesh, Bilaspur.

8.4 District wise Trout Fish Production

8.4.1 Trout Fish Production in District Chamba

The production of trout in district Chamba during the year 2001 to 2007 is given in Table 8.2 wherein it can be seen that the production of trout was 0.200 M.T. in the year 2001 which increased to 1.20 M.T. in the year 2007 showing an increasing rate of growth of 24.20 per cent per annum. In terms of value the rate of growth comes out to be 32.39 per cent per year.

Table-8.2: Annual Trout Fish Production in District Chamba

Years	Quantity (MT)	Value in Rs.
1995	-	-
1996	-	-
1997	-	-
1998	-	-
1999	-	-
2000	-	-
2001	0.200	30000.00
2002	0.150	22500.00
2003	1.200	180000.00
2004	0.100	16000.00
2005	0.150	24000.00
2006	0.600	120000.00
2007	1.200	264000.00
CGR %	**24.20**	**32.39**

Source: Office of Assistant Director, Fisheries, District Chamba.

8.4.2 Trout Fish Production in District Kinnaur

In district Kinnaur the river Baspa in the Sangala Valley is known for trout fishing. Baspa makes a series of rapids and has many nice ponds for trout. The production of trout in district Kinnaur from the year 1995 to 2007 is given in Table 8.3. The table shows that the production of trout was 67.340 kgs. in the year 1995 which increased to 378.150 kgs in the year 2007 showing an increasing rate of growth of 23.41 per cent per annum. In terms of value the rate of growth comes out to be 37 per cent per annum.

Table-8.3: Annual Trout Fish Production in District Kinnaur.

Years	Quantity (kgs.)	Value in Rs.
1995	67.340	4714.00
1996	58.900	7068.00
1997	81.320	11995.00
1998	37.710	4627.00
1999	322.970	42902.00
2000	72.210	75610.00
2001	647.500	97125.00
2002	786.000	109604.00
2003	-	-
2004	-	-
2005	261.650	41864.00
2006	421.100	84220.00-
2007	378.150	76946.00
CGR %	**23.41**	**37.00**

Source: Office of Assistant Director, Fisheries, District Shimla.

8.4.3 Trout Fish Production in District Kullu

Kullu Valley offers some ideal opportunities for trout fishing in the river Beas, which meanders through it, and in its larger tributaries like Sarveri, Parbati, Sajoin and Phojal. The Sajoin and Tirthan rivers which form a trijunction with a Beas are also trout streams. The main Kullu valley right from Manali to Bhuntar provides some excellent pools for fishing especially at Patlikuhl, Katrain and Raison. The production of trout in Kullu district from the year 1995 to 2007 is given in Table 8.4. The table shows that the production of trout in this district was 5.712 M.T. in the year 1995, which increased to 16 M.T. in the year 2007 thereby showing an increasing rate of growth of 12.38 per cent per year. In terms of value the rate of growth comes out to be 21.71 per cent per year during the study period.

Table-8.4: Annual Trout Fish Production in District Kullu.

Years	Quantity (MT)	Value in Rs. (Lacs.)
1995	5.712	5.71
1996	4.795	4.79
1997	6.319	8.21
1998	7.535	11.30
1999	9.879	14.81
2000	13.587	27.17
2001	15.787	31.57
2002	13.598	31.27
2003	2.312	5.31
2004	14.397	33.10
2005	19.300	38.60
2006	34.780	79.99
CGR %	**12.38**	**21.71**

Source: Office of Assistant Director, Fisheries, District Kullu.

8.4.4 Trout Fish Production in District Kangra

There is only one trout fish pond in district Kangra and during 2006-07, the trout fish production from this pond is recorded to be one metric tone valued of Rs.2,2000.

8.4.5 Trout Fish Production in District Mandi

Barot (Mandi) is known not only for its picturesque water reservoir and scenic beauty but for trout fishing also which abounds in the Uhl river, a tributary of river Beas. Besides Barot the entire reservoir from Pandoh Dam to Aut is also considered good for trout fishing. The production of trout in district Mandi from the year 1994-95 to 2006-07 is given in Table 8.5. It can be seen from the table that the production of trout in this district was 127.4 kg in 1994-95 which increased to 1332.4 kg in the year 2006-07 thereby showing an increasing rate of growth of 31.43 per cent per annum. In terms of value the rate of growth is observed to be 42.31 per cent per year. During the year 2003-04 the whole stock of the production was disposed off due to virus attack.

Table-8.5: Annual Trout Fish Production in district Mandi (Govt. farm)

Years	Quantity (Kg.)	Value in Rs.
1994-95	127.4	8918
1995-96	47.9	3353
1996-97	36.5	4380
1997-98	104.8	14954
1998-99	99.050	11886
1999-2000	450.95	65735
2000-2001	529.88	79483
2001-2002	395.716	58939
2002-2003	719.250	103874
2003-2004	Stock Disposed off, due to virus attack	
2004-2005	249.155	42617
2005-2006	765.775	130202
2006-2007	1332.4	266480
CGR %	**31.43**	**42.31**

Source: Office of Assistant Director, Fisheries, District Mandi.

8.4.6 Trout Fish Production in District Shimla

Pabbar in Rohru Valley is an important fishing center for trout fishing. Chirgaon is another fishing center known for providing good fishing opportunities. In Shimla district, during the year 2007 the total fish production was recorded to be 3 tones valued of Rs. 6,00,000 (Table 8.6).

Table-8.6: Annual Trout Fish Production in District Shimla.

Years	Quantity (tonnes)	Value in Rs.
1995	-	-
1996	-	-
1997	-	-
1998	-	-
1999	-	-
2000	-	-
2001	-	-
2002	-	-
2003	1.00	2,00,000.00
2004	-	-
2005	-	-
2006	-	-
2007	3.00	6,00,000.00

Source: Office of Assistant Director, Fisheries, District Shimla.

8.5 Fish Production in Indo-Norwegian Trout Farming Project Patlikuhl

During the year 2006-07, 14.62 tones trout fish and 3.26 lakhs seed has been produced at Patlikuhl farm. During 1999-2007 trout fish at this farm has increased at the rate of 5.37 per cent per year while the rate of growth of the production of fish seed during this period comes out to be 0.75 per cent per year (Table 8.7)

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Table-8.7: Fish production in Indo-Norwegian Trout Farming Project Patlikuhl

Years	Fish (tonnes)	Fish seed (Nos. lakh)
1999-2000	8.56	2.69279
2000-2001	12.3	2.25631
2001-2002	13.977	2.19762
2002-2003	11.3	2.25201
2003-2004	Disease affected year	
2004-2005	12.07	1.78
2005-2006	12.34	2.09
2006-2007	14.62	3.26
CGR %	**5.37**	**0.75**

Source: Office of Deputy Director, in Indo-Norwegian Trout Farming Project Patlikuhl

8.6 Fish Feed Production in Indo-Norwegian Trout Farming Project Patlikuhl

During the year 2006-07, the total fish feed production was 64.3 tones and out of this 58 per cent was fed at farm, 13 per cent transferred and 27 per cent was sold. Since 1999-2000, total fish feed production has increased at the rate of 11.93 per cent per annum where as the fish feed sold is concerned it has shown an impressive rate of growth of 23.02 per cent per year (Table 8.8).

Table-8.8: Fish feed production in Indo-Norwegian Trout Farming Project Patlikuhl

(Qty in tonnes)

Years	Total production	Fed at farm	Transferred	Sold
1999-2000	23.25	15.4	4.6	3.77
2000-2001	32.4	20.2	6.4	5.6
2001-2002	45.2	33.5	6.2	5.7
2002-2003	19.2	11.8	0.9	6.2
2003-2004	Disease affected year			
2004-2005	34.99	26.64	6.64	5.16
2005-2006	38.8	21.98	5.66	10.48
2006-2007	64.3	37.45	8.30	17.74
CGR %	**11.93**	**9.75**	**5.86**	**23.02**

Source: Source: Office of Deputy Director, in Indo-Norwegian Trout Farming Project, Patlikuhl, district Kullu.

8.7 Income from Indo-Norwegian Trout Farming Project Patlikuhl

During the year 2006, the total income from Patlikuhl farm was Rs.46.2 lakhs, out of which 21.62 per cent consists of income from fish sale and 78.35 per cent from the sale of fish seed. Since, 1999, 2000, the income from this farm has increased at the rate of 14.53 per cent per year, while the rate of growth of income from fish sale and the sale of fish seed comes out to be 29.30 and 13.43 per cent per annum respectively (Table 8.9).

8.8 Summing up

From the above analysis it can be concluded that in H.P. the total production of trout has increased at the rate of 23.13 per cent per annum during 1996-97 to 2005-06. District wise the annual rate of growth of trout fish production comes out to be maximum (31.43%) in district Mandi followed by Chamba (24.20%), Kinnaur (23.41%) and Kullu (12.38%). During the year 2006-07, 14.62 tonnes trout fish, 3.26 lakh seed and 64.3 tonnes fish feed has been produced at Patlikuhl farm. Out of total fish feed production 58 percent was fed at farm, 13 percent transferred and 27 percent was sold. Out of the total income of Rs 46.2 lakh from Patlikuhl farm, 21.62 percent consists of income from fish sale and 78.35 percent from the sale of fish seed.

Table- 8.9: Income from Indo-Norwegian Trout Farming Project Patlikuhl

(Rs in lakh)

Years	Fish sale	Fish seed and sale	Total
1999-2000	1.65537	14.81721	17.48805
2000-2001	2.53503	18.49176	22.03297
2001-2002	2.56138	21.61626	24.57001
2002-2003	2.01220	17.89532	19.90752
2003-2004	Disease affected year		
2004-2005	2.77	24.43	27.2
2005-2006	6.0	26.60	32.6
2006-2007	9.99	36.2	46.2
CGR %	**29.30**	**13.43**	**14.53**

Source: Source: Office of Deputy Director, in Indo-Norwegian Trout Farming Project Patlikuhl

Chapter -9

CONSTRUCTION AND MANAGEMENT OF TROUT FISH RACEWAYS

9.1 Requisite of a Trout Farm

Of paramount importance for a model trout farm is the water and source of its water supply. It is essential that there should be abundant, clear fresh water always renewable and protected against heating in the summer season in order to ensure a sufficient dissolved oxygen content. This crucial hydrological condition obviously limits the number of sites where a farm could be established. Acceptable sources of water supply for a trout farm are springs or fast flowing snow fed streams. Water from the sluggish streams, swamps, bogs and wells are often low in dissolved oxygen as such water from the spring is always considered ideal provided it is abundant and its temperature does not exceed 15^0C. The river water is also desirable provided it remain clear free from silt during maximum days in the year. No farm should be established in a site where the water supply can fail. Even a periodical deficiency or cut off water supply can decimate the entire stock.

It may be emphasized that quantity of water available decides the number of ponds or other breeding activities in the farm. Besides abundant flow of water, the quality of water is also very important. The water should be as clear as possible. One needs to keep in mind that trout is a feeder by sight and water with suspended particles of silt or silica affect type fish in locating feed.

A number of workers have calculated suitable flow rate for fish culture. It has been estimated that 1000 m^3 per day (10 lit/sec) is needed for production of one tone of trout. These are conservative estimates and as such, a flow rate higher than this is always desirable.

A neutral or lightly alkaline pH is best. While pH value ranging from 7-8 is desired, water with less than 6 pH must be avoided. The mineral content of naturally occurring fresh water varies according to the terrain though which it has passed and the material it has dissolved from the environment. Frost and brown state that trout thrives well in 150 ppm calcium carbonate but below that the growth is impeded. BOD is one commonly used parameter of water quality. It is the quality of dissolved Oxygen in mg/lit required during stabilization of the decomposable organic matter in the water by aerobic biochemical action and it provide an assessment of the quantity of organic matter present in the water. Trout eggs are susceptible to 0.1 mg/lit of Chlorine and adult rainbows to 0.3 mg/lit. Trout eggs are also susceptible to zinc concentrations of 0.4 ppm.

9.2 Physical Qualities of Water

As stated earlier, the spring water is particular suitable for hatcheries. The preferential for growing trout ranges from 10^0-12^0C. The temperature limit exceeding 18^0C even for short stretch of time may cause distress and eventual mortality to the fishes. Growth of trout more or less stops at temperature less than 4^0C.

Besides direct influence water temperature play a significant role on the capacity of water to hold oxygen. The Oxygen content of the water is directly proportional to the temperature of the water. The saturation level of oxygen of water is also affected by altitude, less oxygen being present in the water at saturation level at high Altitude.

Apart form its direct influence, water temperature has a very important effect on its capacity to hold oxygen. Water containing as much oxygen it can hold is said to be fully saturated. As the temperature increases, the quantity of oxygen that can be dissolved in water decreases so that while fully saturated water at 4^0C, it will contain only 9.0 ppm.

Both rainbow and brown trout require a minimum saturation level of 6 ppm, but to allow to drop to that level is undesirable. They should always be held in fully saturated water.

The hydrogen concentration of water is an important environmental parameter, the variations of which, among other causes are linked with density and life processes of animals and plant life, the pH of water is defined as the logarithm of the reciprocal of hydrogen ion concentration. It may be expressed mathematically as

$$Ph = (H^{-1})$$

Increase in concentration of H^+ ions result in lower pH values, solutions are acidic in pH values below 7 and alkaline in values above 7 pH is not affected by neutral salts which are the salts of strong acids and strong bases but is determined by the absorbed Carbon dioxide. In a buffering system, the pH is determined by the relationship between CO_2 and bicarbonates or more precisely by H_+ ions arising from the dissociation of H_2CO_3 and of the H_+ from the hydrolysis of bicarbonates.

Waters having pH ranging from 7.0-8.0 are most suitable for trout culture and those having pH value of over 9.0 are unsuitable. Fish dies at about 10. Acidic water reduces the appetite of the fish, their growth and tolerance to toxic substance.

The turbidity of water in trout water is mainly due to silt, mica or clay. It is important limiting factor primarily for two reasons.

Firstly as the trouts are know to be feeder by sight as such the turbidity directly affect the feed intake and resultant growth, secondly it affects the natural production of water in terms of reduced planktonic or entomofauna growth. Turbidity caused by colloidal particles is likely to affect the temperature condition of water mass by restricting the penetration of sun-light and scattering it. However, except stoppage of feed, no behavioural reaction has been reported unless and until the value crosses 1000 ppm.

The total alkalinity of water is mainly caused by the cations Ca, Mg, Na, K., NH_4 and Fe either as carbonate, bicarbonates or hydroxides. A mixture of bicarbonates and carbonates alkalinity is generally encountered in water of pH ranging between 8.4-10.5.

In trout farming the total alkalinity range ought to be between 50-150 ppm. Water of hill streams sandy, rocky areas usually have low total alkalinity values.

After ascertaining a good supply of water, the land adjacent to it on both sides be studied. Taking production target of 10 tonnes of table-size trout annually, 2000 m^2 of land would be quite sufficient. This would enable the culturists to allocate 25% land for raceways, 10% for hatchery, 25% for office and staff quarters and remaining 40% as open space. From the intake the water has to be conveyed to the farm by gravity. This can be achieved by two ways viz. through close conduits/pipes or by means of open channel.

Although conveyance of water through closed HDP pipes is the safest both from the point of view of breaches/contamination, but avowedly, a costly method for small farmers. The conveyance of water through lined or unlined channel is the most convenient and economical method for water alignment. It may be emphasized that water supply line is the life line of a trout farm. Its disruption even for few hours would not exterminate the entire stock, but also the entire efforts.

9.3 Water Movement

The most reliable and cheapest way to get the water at the farm's site is by gravity. For this, there must be sufficient drop in ground level from intake to final outflow. To the intake of water feeding channel of the farm is at lower level than farm's site, then pumping of large quantity of water regularly would be necessary and this would add to the capital and running costs of the project.

9.4 Components of a Trout Farm

The main components of a trout farm are: (i) A dependable water supply channel; (ii) Series of Raceways; (iii) A Hatchery and (iv) Office and residential quarters.

It hardly needs to be emphasized that an uninterrupted dependable water supply is the lifeline of the project. One needs to give full consideration in the construction of water

supply line alignment. Floods during rainy season often vitiate the water supply channel. As such construction of feeder channel should be such that there is no disruption to the water supply. Similarly, during the peak summer months the supply should not recede to dangerous limit. And once regular and plentiful supply of water in the farm is assured, one can hopefully look forward the maximum returns from the farm.

9.5 Raceways

Raceway is the term used for flow-through ponds generally built for raising of salmon or trout for raising fingerlings to table-size. In these rectangular ponds the water is rushed through at a certain velocity depending upon the total biomass raised and the dissolved oxygen contents of the water, through out the rearing period of the fish and hence the name raceway.

As far as the construction and dimensioning of raceways are concerned these may be of three types:-

- Made of RCC or Cement mortar;
- Made of stone pitched sloping sides with cement mortar pointing;
- Mud ponds.

The raceways varies in size from 15-30 m in length, 2-3 m wide and 0.8 to 1.3 m deep. While the RCC raceways are generally costly, the mud raceways are not durable and easily get eroded with the constant scouring movement of the flowing water. This leaves us with the third type of raceways i.e. 'Semi Pucca' in this case, a ditch with sloping slides (1:1 to 1:2) is dug into the ground and then lined with stone pitching in cement mortar of 1:3. The inlet and outlet of raceways are however constructed with stone masonry with cement mortar.

The basic requisite to be kept in mind while construction of these raceways are as under:-

- It must be sturdy enough to last several fish rearing seasons;
- It must retain a minimum water level of one metre or so;
- Inlet and outlet arrangement of water should have well fitted screens;

- It must be provided with free board of at least 50 cm above maximum water level;
- Its top should be above ground level so that the possibility of ground water finding passage into raceways and polluting it ruled out;
- It should be easily manageable and drained, cleaned and filled quickly;

The ideal size of the raceways is 15x2x1.1 m, as suggested by various European experts.

9.6 Hatchery

A hatchery is an important component of a trout farm. The space requirement of this building depends upon the production levels of the farm especially number of eggs to be hatched and fry produced. Unlike carp, hatching process in trout is quite long and ranges from 60-75 days from 'green egg' stage to early 'hatchling' and yolk sac absorption. The hatchlings are fed in the indoor for a month or so. While construction of a hatchery, future farm projection should also be taken into consideration and for a farm with production capacity of 10 tonnes of trout the recommended hatchery size is 100-120 m^2 in area.

Fry up to one gram are raised in the indoor hatchery in a phased manner. While the two stages of 'green egg' to early hatching are completed in longitudinal troughs, the raising of hatching to swim-up fry to one gm is done in start feed tanks.

The hatching troughs are usually made up of plastic or fiber glass or aluminium or even wood. An average-size trough is 3.0 mx0.5x0.2 m though sizes vary. The troughs are provided with screens both at the inlet and outlet to prevent entry of unwanted material and escape of fry or alevins respectively. To minimize space the hatching troughs are installed in 2 or 3 level above each other.

Egg baskets ranging 5 to 7 are fitted in each trough. The mesh aperture of basket is elongated or oval of such a size that it retains the spherical eggs but allows the thin alevins to fall through the water beneath. It is necessary for water to be forced upward

through the mesh in order to provide adequate aeration for the eggs. In some cases however the baskets are designed with a downward projecting baffle on their down stream end, which forces the water backward. The recommended size of tray is 0.35x-.30x0.09 m.

In view of limited space and higher production target, several culturists prefer battery incubators. They consist essentially of vertically stocked plastic drawers, each drawer corresponding to a small trough and containing an egg basket and a cover. They are so designed that each drawer can be pulled out for inspection. A common arrangement is for the water flow to pass downward through stacked vertical tray filtering from each one from top to bottom. One of the advantage of these incubators is that installations can be equipped with recalculation system in which the water can be heated or cooled and thus regulate the rate of development of eggs. However, the incubators could not gain popularity in Indian trout farm as space is never a limiting factor in the country's trout farms.

9.6.1 Water Supply to the Hatchery The most essential pre-requisite in a trout hatchery is its water supply alignment, while clean silt-free water is important in all phases of trout raising, it is especially so in the hatchery. Water entering the hatchery must be free from any sediments, detritus, silt or twings, leaves etc. Since river water generally bring lot of silt as such, spring water is always preferred in hatcheries. The construction of sedimentation tank or filtration unit often suggested are hardly a practical solution to the problem in view of voluminous requirement of water. The water supply to the hatchery must be installed in a manner that the water flows by gravity to the troughs and start feed tanks. The main water supply may flow directly into the hatchery, though the rate of flow must be adequately controlled. This will be easier if initial intake passes into a header tank. Water to the trough and tanks may be supplied by way of closed pipes with valved outlet. The outlet may be in the form of a adjustable elbow pipes which have their offices above the level of water in the channel, thus cutting off the supply to the trough.

Though the requisite water flow to be passed through, the troughs would depend on the density of eggs stocked vis-à-vis water temperature, but in general the water flow of 8 lit/sec (10^{o}C) would be required for raising 2-3 lakhs eggs. However, the flow can be regulated with experience and it is always better to have at least double the quantity of water in hand for safety. Eggs consume increasing amount of oxygen as they develop and should the temperature increase the oxygen requirement would also increase.

9.6.2 Breeding of Trout

Trouts are simplest to breed, the principal method being stripping either dry or wet. Majority of workers prefer 'day' stripping mainly due to the reason that fertilization rate is high.

All the species of trout show sexual dimorphism, but the relevant character get more pronounced when the sexes attain maturity. The sexual dimorphism exhibited by brown and rainbow trout is as in Table 9. 1

Table-9.1: Sexual dimorphism as exhibited by brown and rainbow.

Characters	Brown		Rainbow	
	Male	Female	Male	Female
Shape of the body	Laterally compressed during breeding season	Rounded and distended in ripe specimens	Normal	Normal
Snout and lower jay	Lower jaw hooked, hook more prominent in mature specimens	Lower jaw not hooked	Lower jaw hooked in older specimens hooked jaw very conspicuous	Lower jaw not hooked
Body colouration	In ripe specimens a white stripe at the outer margin of the anal fin present	White stripe absent	Vivid red stripes on lateral side increase in number during breeding season	Vivid red stripes do not show any increase in number
Genital papilla	Absent	Present in fully ripe specimens	Absent	Present in fully ripe specimens

Prior to commencing egg-taking operation, two large tubs of fresh water one each for female and male are placed along side the pond and stripping container is placed nearby in shade. Passing a small sieve net through the pond, the broodfish are drawn to the surface. If on applying gentle pressure milt or roe oozes freely, the brood fish may be considered ready for spawntaking. A healthy female weighing about 1.0 kg. gives an average of 1200 eggs. Fewer males than females are necessary; half or even one third is sufficient. In effect in the course of reproduction period, the male can give milt several times, between three to four times provided the successive spawning are separated by fortnight or so. Often the milt of two males is used to fertilize the eggs of four females.

Trout eggs are spherical with a thin porous translucent elastic shell allowing the embryo within to be seen. Inside the shell is the yolk sac, which encloses the yolk on which the developing embryo feed. The shell of the newly emerged trout egg is soft and sticky. As it absorbs water, it swells and in a little while gets hard. Expansion of eggs takes about 20 minutes and starts immediately it contacts water. Dead eggs are opaque because they contain precipitated globulin. They need to be removed as otherwise they would be attacked by the fungus saprolegniaceae and contaminate the healthy eggs. Removal may be done either with forceps or pipette of desired diameters.

There are three phases from 'green egg' to yolk absorption stage:-

1st phase:- From fertilization till appearance of 'eye' (eyed egg stage);
2nd phase:- From 'eyed' stage till hatching;
3rd phase:- From hatching till absorption of yolk sac.

The incubation period of trout eggs varies considerably. Table 9.2 indicate number of days normally taken in hatching vis-à-vis temperature for rainbow and brown trout:-

Table-9.2: Number of days taken in hatching and temperature for rainbow and brown trout

Water temperature	No. of days to hatch	
	Rainbow	Brown
4.5^0C	80	97
7.0^0C	49	61
10.0^0 C	31	41

After hatching, the alevins (yolk sac fry) settle at the base of basket. Once in water, the alevins continue to feed on their yolk sac for sometime usually 2-6 weeks, depending on the temperature. They do not need much attention though the trough or trays should be siphoned and all screens must be kept meticulously clean. As the yolk sac is absorbed, the fry become more active and seen to converge and swim toward the corners and as such called 'swimup' fry.

This is critical period in the life of the fish, because if feeding is not commenced immediately, they would lose the urge to feed and consequently die. It is best to offer little food, dribbling it gently on the water surface. Feeding is generally recommended from 8-10 time a day.

The rearing of fry is carried out in hatching troughs from which the hatching baskets have been removed or in 'start feed' tanks. The most difficult problem in raising fry is to get them used to feeding. Feeding in troughs results in rapid growth. After 3 to 4 weeks the fry are liberated into rearing pond or open water. They attain average size of 5 gm and can withstand the current velocity or prediction.

9.7 Raising of Table-sized Fish

Once the fry have grown to fingerling size, they are transferred to raceways or circular ponds. Raceways intended for intensive rearing generally range from 30 to 100 m^2. These are stocked with 30-50 fingerlings/m^2. Fry are intensively fed on artificial feed. Rainbow trout reach marketable size in a period of 16-20 months at temperature ranging from 10-15^0C. The basic requirement during this rearing period is the regular

flow of abundant and silt-free cold water in the raceway. Feeding also warrant full attention of the culturist. If these preconditions are met, the losses in terms of mortality hardly exceed 5-10% in raceways.

9.8 Feeds and Feeding

Feed constitutes an important component in trout rearing operations. Artificial dry feed are getting increasingly popular in view of their better conversion, easy handling, storage and transportation. The main ingredients used in feed formulation are fish meal, soabean, bone meal, whole wheat, yeast, linseed oil, Methionine, chlorine chloride and Sodium alginate. The crude protein value of such a feed is kept at 40-50% level. The composition of the constituents vary in case of different type of feeds, viz. larval feed, grow-out feed and brooder's feed. Similarly the pellet size of the feed varies for different stages of trout. The stability ratio is an important aspect in trout feed. Feeds which tend to sink soon after their dispersal are normally not preferred. Feed constitutes 60-70% cost in trout rearing. Any compromise made with the quality or quantity of feed directly affects the growth and survival rate.

9.9 Trout Diseases

A wide variety of disease are known to afflict the trout at different stages of its life. Most of these diseases are attributable to viral, bacterial, fungal or nutritional. A trout culturist has to constantly observe the infestation of any disease and take immediate remedial measures. The details of major symptoms etiology, therapy and prophylactic measures have been given by various workers and couple of good books are available on this aspect.

9.10 Trout Fishery

Brown trout (Salmo trutta fario) and rainbow trout (Onchorynchus mykiss) are the two species among salmonids, which constitute trout fishery of the streams, lakes and reservoirs in the Indian uplands. Of late the population is showing a declining trend caused mainly by disturbances along the catchments. In the high Garhwal Himalayas, the Dodital Lake supports a significant population of brown trout. At such altitudes the

fish breeds in the adjacent stream and migrates back to the lake. In the reservoirs of Kerala and Tamil Nadu, sizeable catches of rainbow trout are recorded. The catch structure of two species indicated small sized population, in case of brown trout in Himalayan region the size range being 265 to 455 g/rod/d. Contrary to this, the average weight of rainbow trout in the Deccan Plateau range between 150 and 210 g/rod/d.

Trout is now being cultured in Jammu and Kashmir, Himachal Pradesh and Uttranchal in public and private sectors. This is a good augury not only for domestic consumers but more so for the tourists who are now able to obtain their choicest dishes in the hotels in the metros. Increased production of fry and fingerlings is being used for ranching and reestablishing the denuded stocks in streams best known for angling in the past. Given proper and adequate attention and technical and financial support by the government extension agencies and the banks, the face of the hills and the industry is going to change soon as we are now in the take-off stage. The rainbow trout (O. mykiss) has been raised for first time at Katarian Trout Farm in Kullu District of Himachal Pradesh in 1964 but to produce quality and quantity of trout this farm is equipped with modern technology in 1991 with the help of Norwegian government and sold to the local public in 2001 and extend this technology to the local farmers for the commercialization of trout culture.

9.11 Essential requirement of trout farm

There are three main requirement of trout farm.

9.11.1 Quantity and quality of water supply A single race way of 25x2x1.5-1.8 m requires 15 liter of water/second. A standard race way is of 12x2 x2m. Good circulation and flushing rates are the important components of the fry rearing. Phase Flow should not create excessive exercise, but sufficient velocity should be present to keep the fish adequately exercised for physical conditioning before release. Water flow entering the pond should provide flushing rates that replace the volume twice in an hour. Flow distribution has to be uniform as well to assure that no waste or dissolved solids are concentrated and fish should not congregate at one place. Thus the volume of water

required for total fish biomass is related with the size of fish and its oxygen requirement at SET. To maintain the quality water supply it is necessary to use biological filter for supply of water. However, if supply is directly from spring then use of filter may not be obligatory. If the quality and quantity of water is adequate the trout culture is possible at lower altitude i.e. up to 1200 msl.

9.11.2 Quality and Quantity of Feed The first consideration for formulation and production of successful diets is the quality of the feed ingredients. Diets produced with poor quality raw materials and under adverse processing conditions have inferior nutritive value and adverse effects on fish health. Quality criteria for the ingredients must be respected to insure that the final product is of consistent quality and that deleterious effects are avoided. The chemical composition (nutrient, energy, antinutrients, and contaminants) of the ingredient obviously plays a determinant role for the quality. However, biological aspects, such as digestibility and utilization of nutrients are most important and often overlooked. The loss of indigestible matter from the diet as feces is the primary reason for variation in the nutritional of feed ingredients. Measurement of digestibility provides, in general, a good indication of the availability of energy and nutrients, thus providing a rational basis upon which diets can be formulated to meet specific standards of available nutrient levels. Further, the quantity of feed is related with the size of fish, stocking density and water temperature. The optimal dietary protein requirement of very young trout is 45-50% of diet (starter diet), while juvenile trout require 40% (production diets), and older trout 35% (maintenance diets) dietary crude protein. The gross protein requirements, as a percent) diet, are highest in initial feeding fry and decrease as size increases.

9.11.3 Hygiene

The maintenance of hygiene is another important factor in the management of trout farm. Nets and farm gadgets generally used on the farm premises should not be used in the hatchery and vice versa. All the equipments of farm should be disinfected with formal in (4%) KmnO4 (5ppm) before using them repeatedly. Due precautions have to be taken in case there is any sign of disease on the farm, hand should be thoroughly

washed in a mild disinfectant before touching any thing. The eggs are treated with disinfectant i.e. buffodine at the @ 10ml/l it of water for 10 minutes or 9g NaCI/llt of water for 5 to 10 minutes. If the eggs develop a soft and sticky consistency and tend to clump together, it is better to increase water flow and water temperature should not be more than 13^{o}C. The eyed ova should be disinfected before releasing in hatching tray. During incubation period the eggs are treated with malachite solution (10 g/1 of water) at the rate of 67 ml in each tray containing water flow 41/ minute. The different concentration of formalin is used to treat different size of fishes for example small fish (below 5 g) should be treated with 1:12000 solution of formalin, the fishes of 5-50 size with 1:8000 formalin and of more than 50g with 1:6000 formalin solution. When fish attain a size of 10 to 15 g the first vaccination is done by giving the bath in the solution @ the rate 21 Vaccine/4 Kg fish for 30 second. It is advisable not to disturb the fish 14 days before vaccination and weeks after vaccination. Regular cleaning of tank, raceway and tray is necessary and before transferring the stock the tanks and raceways have to be disinfected with formalin (4%), KmnO4 (5ppm) and lime. To avoid cannibalism monthly grading of fish is also necessary. Regular checking of tank, raceway and tray is necessary and before transferring the stock the tanks and raceways have to be disinfected with formalin (4%), KmnO4 (5ppm) and lime. To avoid cannibalism monthly grading of fish is also necessary. Regular checking of health of fish and water analysis is necessary to avoid diseases and environmental stress. Feed quantity is readily reduced in turbid water as well as cloudy day and dissolved oxygen level of the water should be checked frequently for daily variation and at intervals following feeding and this information should be checked frequently for daily variation and at intervals following feeding and this information should be used in establishing the time, amount and frequency of feeding. The change from feed size to the next larger size should be made gradually by mixing the two feeds in various proportions for a few days before the complete change over. It is necessary to clean the tank every day and remove dead fish, pin head fry, white colour fry and blue sac fry to avoid diseases.

9.12 Summing up

It can be concluded from the above that adequate quantity and good quality of water is a pre requisite for a trout farm. A single race way of 25x2x1.5-1.8m requires 15 liter of water/second. To maintain the quality of water it is necessary to use of biologically filter for supply of water. The feed given to fish should be fresh and of high quality. Low quality feed causes diseases and mortality. The maintenance of hygiene is important factor in the management of trout farm. All the equipments of the farm should be disinfected. Regular cleaning and checking of tank, raceway and tray is necessary. Monthly grading of fish is also necessary.

Chapter – 10

SOCIO-ECONOMIC CHARACTERISTICS OF SAMPLED TROUT FISH FARMERS

This chapter deals with the socio-economic characteristics viz. family size, educational status, occupational pattern, land use pattern, cropping pattern, livestock resources and income pattern etc. of the sampled trout fish farmers. .

10.1 Age-wise Number of Persons in the Family

Table 10.1reveals that maximum persons were in the age-group of 16-60 years in all the category of households. The maximum number of persons in this age group are in the medium category (4.34) followed by large category (3.50) and small category (3.30). Overall, in 16-60 years age group the total persons were 3.65 whereas males were more (2.05) as compare to females (1.60).

Table-10.1: Age wise Composition of Family.

(Number)

Category of Tank	Up to 6 years	7-15 years	16-60 years	Above 60 years	Total
Small					
M	0.10	0.20	2.00	0.10	2.40
F	0.20	0.30	1.30	0.30	2.10
T	0.30	0.50	3.30	0.40	4.50
Medium					
M	0.50	-	2.17	0.17	2.84
F	0.33	-	2.17	0.50	3.00
T	0.83	-	4.34	0.67	5.84
Large					
M	0.25	-	2.00	-	2.25
F	-	-	1.50	-	1.50
T	0.25	-	3.50	-	3.75
Overall					
M	0.25	0.10	2.05	0.10	2.50
F	0.20	0.15	1.60	0.30	2.25
T	0.45	0.25	3.65	0.40	4.75

10.2 Average Family Size

The average family size among all the sampled trout fish farmers was 4.75 persons whereas it was 4.50, 5.83 and 3.75 persons for small, medium and large categories respectively (Table 10.2).

Table-10.2: Size and Composition of Family.

(Number)

Tank size	Adult		Children	Total
	M	F		
Small	2.10	1.60	0.80	4.50
Medium	2.33	2.67	0.83	5.83
Large	2.00	1.50	0.25	3.75
All	2.15	1.90	0.70	4.75

10.3 Educational Status of Sampled Trout Fish Farmers

The proportion of literates among people is an important indicator of its quality. According to Table 10.3 about 88 per cent of the people are literate among all the sampled farmers whereas males are more (97.67%) compare to females (77.50%). As far as category wise literacy is concerned, hundred per cent literacy was found in large category followed by medium (92.86) and small category (78.57%). The literacy percentage is better among males as compared to females in all the categories. Out of total persons, maximum were literate at the level of matric (22.89%) followed by middle (16.87%), senior secondary (15.66%), primary (12.05%), graduate (10.84%), technical diploma/degree (7.23%) and post graduate (2.41%).

Table-10.3: Education Status of Sample Households.

(Percentage to total)

Particulars	Small			Medium			Large			All		
	M	F	T	M	F	T	M	F	T	M	F	T
Illiterate	4.54	40.00	21.43	-	7.14	3.70	-	-	-	2.33	22.50	12.05
Primary	18.18	15.00	16.67	7.69	7.14	7.41	-	16.67	7.14	11.63	12.50	12.05
Middle	18.18	15.00	16.67	7.69	21.43	14.81	12.50	33.33	21.43	13.95	20.00	16.87
High School	22.73	25.00	23.81	7.69	7.14	7.41	62.50	33.33	50.00	25.58	20.00	22.89
Senior Sec.	22.73	-	11.90	23.08	28.57	25.93	12.50	-	7.14	20.93	10.00	15.66
Graduate	9.09	5.00	7.14	23.08	21.43	22.22	-	-	-	11.63	10.00	10.84
Postgraduate	4.55	-	2.38	7.69	-	3.70	-	-	-	4.65	-	2.41
Technical diploma/degree	-	-	-	23.08	7.14	14.81	12.50	16.67	14.29	9.30	5.00	7.23
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total person	22	20	42	13	14	27	8	6	14	43	40	83
Literacy %	95.45	60.00	78.57	100.0	92.86	96.30	100.0	100.0	100.0	97.67	77.50	87.95

10.4 Occupational Pattern

Main and subsidiary occupation followed by each of the sampled trout fish farmers was also enquired. Majority (53.12%) of the sampled trout fish farmers reported that agriculture was their main occupation (Table 10.4). In agriculture the proportion of female workers was higher as compared to male workers. Out of total workers 15.63 per cent reported that service was their main occupation, while 15.62 per cent business, 10.94 per cent fisheries and 4.69 persons reported wage labour as their main occupation. Category wise in small and medium category majority of the farmers stated that agriculture is their main occupation while in large category fishery is the main occupation of majority of the farmers.

The proportion of workers undertaking any subsidiary occupation is given in Table 10.5. Here fisheries is the most common subsidiary occupation (54.76%) followed by dairy (23.81%), agriculture (16.67%) and business (4.76%). From the sex wise figures it may be observed that in subsidiary occupation agriculture and business are the activities undertaken by males only whereas in fisheries the proportion of males is more as compare to females and in dairy females are greater than males.

10.5 Land Utilization Pattern

Land Utilization pattern of the sampled trout fish farmers is presented in Table 9.6. It may be observed from the table that 87.55 per cent of the area is under cultivated land followed by grass land (10.20%) and other land (2.25%) in all the sampled trout fish farmers. The same pattern was followed in all the category of sampled households. Out of total land the proportion of cultivated land was more in medium category (96.51%) followed by small (88.72%) and large category (78.38%). Average land holding of sampled trout fish farms was 1.96 hectares.

Table-10.4: Distribution of Work force According to Main Occupation.

Category of Household	Agri.	Service	Dairy	Fisheries	Labour	Business	Other	Total worker	Total popu.	Proportion of workers to total population
Small										
M	10	2	-	-	3	2	-	17	24	70.83
F	12	-	-	1	-	-	-	13	21	61.90
T	22	2	-	1	3	2	-	30	45	66.67
%	73.33	6.67	-	3.33	10.00	6.67	-	(100.0)		
Medium										
M	2	4	-	1	-	5	-	12	17	70.59
F	7	1	-	-	-	1	-	9	18	50.00
T	9	5	-	1	-	6	-	21	35	60.00
%	42.86	23.81	-	4.76	-	28.57	-	(100.0)		
Large										
M	1	3	-	3	-	1	-	8	9	88.89
F	2	-	-	2	-	1	-	5	6	83.33
T	3	3	-	5	-	2	-	13	15	86.66
%	(23.08)	(23.08)	-	(38.46)	-	(15.38)	-	(100.0)		
Total										
M	13	9	-	4	3	8	-	37	50	74.00
F	21	1	-	3	-	2	-	27	45	60.00
T	34	10	-	7	3	10	-	64	95	67.37
%	(53.12)	(15.63)	-	(10.94)	(4.69)	(15.62)	-	(100.0)		

Note: Figures in parenthesis denote percentages to total.

Table- 10.5: Distribution of Work force According to Secondary Occupation.

Category of Household	Agri.	Service	Dairy	Fisheries	Labour	Business	Other	Total	Total No. of main worker	% worker performing secondary occup.
Small										
M	2	-	1	10	-	-	-	13	17	76.47
F	-	-	6	1	-	-	-	7	13	53.85
T	2	-	7	11	-	-	-	20	30	66.67
%	10.00	-	35.00	55.00	-	-	-	(100.0)		
Medium										
M	2	-	-	8	-	1	-	11	12	91.67
F	-	-	2	1	-	-	-	3	9	33.33
T	2	-	2	9	-	1	-	14	21	66.67
%	14.29	-	14.29	64.28	-	7.14	-	(100.0)		
Large										
M	3	-	1	2	-	1	-	7	8	87.50
F	-	-	-	1	-	-	-	1	5	20.00
T	3	-	1	3	-	1	-	8	13	61.54
%	37.50	-	12.50	37.50	-	12.50	-	(100.0)		
Total										
M	7	-	2	20	-	2	-	31	37	83.78
F	-	-	8	3	-	-	-	11	27	40.74
T	7	-	10	23	-	2	-	42	64	65.62
%	16.67	-	23.81	54.76	-	4.76	-	(100.0)		

Table-10.6: Land Resources per household.

(In Bigha)

Size of Trout farm	Cultivated land	Grass land	Other land	Total
Small				
IR	9.10	-	-	9.10
UIR	2.70	1.50	-	4.20
Total	11.80	1.50	-	13.30
%	88.72	11.28	-	100.0
Medium				
IR	27.17	-	-	27.17
UIR	0.50	0.83	0.17	1.50
Total	27.67	0.83	0.17	28.67
%	96.51	2.90	0.59	100.0
Large				
IR	30.00	-	2.50	32.50
UIR	6.25	7.50	-	13.75
Total	36.25	7.50	2.50	46.25
%	78.38	16.22	5.40	100.0
Overall				
IR	18.70	-	0.50	19.20
UIR	2.75	2.50	0.05	5.30
Total	21.45	2.50	0.55	24.50
%	87.55	10.20	2.25	100.0

One hectare=12.50 bighas

10.6 Cropping Pattern

A study of cropping pattern would reveal the proportion of area under different crops. The total area devoted to various crops grown by different categories of farmers is presented in Table 10.7. It can be seen from the table that maximum area is under fruits (62.36%) followed by wheat (13.88%), paddy (8.37%), maize (6.46%), vegetables (4.94%), others (1.90%), barley (1.14%) and minimum area was found in the case of pulses (0.95%). Further it may be observed that fruits are the most popular crop in all the three categories. Cropping intensity is one of the important indicators of production efficiency. Cropping intensity in all the three categories under study is also given in Table 10.7. It may be seen from the table that cropping intensity was higher in small category (131.35%) followed by large (131.03%) and medium category (108.99%).

Table-10.7: Cropping Pattern per Trout Farm.

(Area in bighas)

Particulars	Small		Medium		Large		Overall	
	Area	%	Area	%	Area	%	Area	%
Maize	1.70	10.97	2.00	6.63	1.25	2.63	1.70	6.46
Paddy	0.20	1.29	0.33	1.09	10.00	21.05	2.20	8.37
Wheat	2.10	13.55	1.17	3.88	11.25	23.69	3.65	13.88
Barley	0.40	2.58	0.33	1.09	-	-	0.30	1.14
Pulses	-	-	0.83	2.75	-	-	0.25	0.95
Vegetables	2.60	16.77	-	-	-	-	1.30	4.94
Other	1.00	6.45	-	-	-	-	0.50	1.90
Fruits	7.50	48.39	25.50	84.55	25.00	52.63	16.40	62.36
Total cropped area	15.50	100.00	30.16	100.00	47.50	100.0	26.30	100.0
Net area	11.80	-	27.67	-	36.25	-	21.45	-
Cropping intensity percentage	131.35	-	108.99	-	131.03	-	122.61	-

One hectare=12.50 bighas

10.7 Livestock Resources

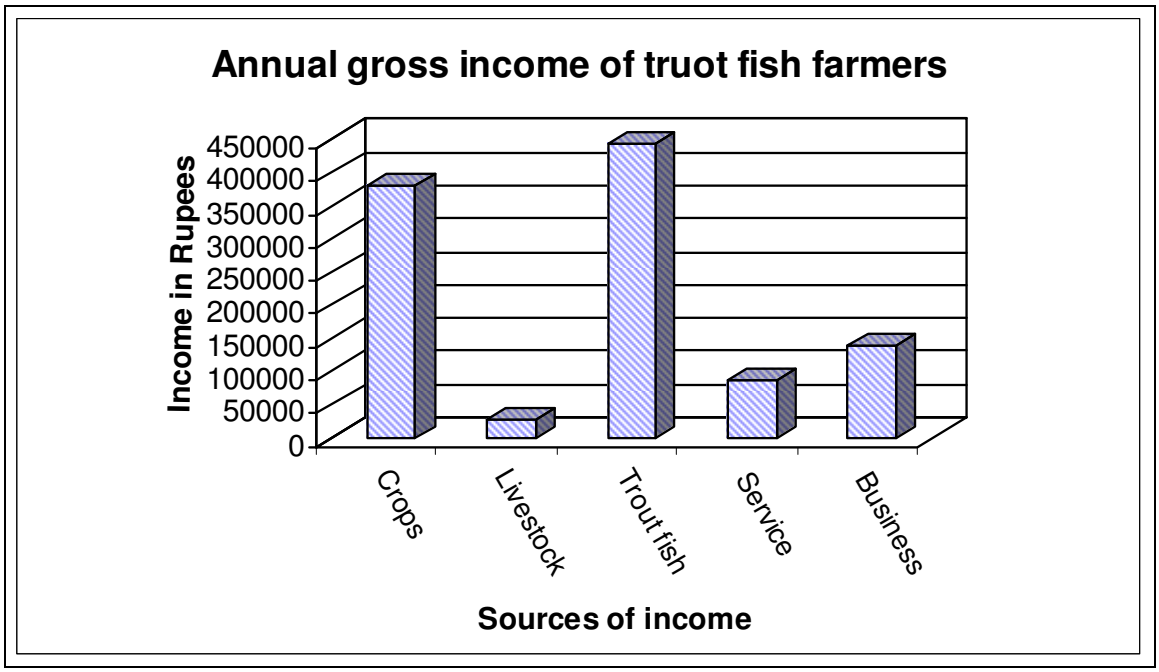
Livestock rearing is also important sector providing employment and income to the farmers family. The number of various livestock possessed by sampled trout fish farmers are given in Table 10.8. It may be seen from the table that the number of livestock per farm was relatively higher in medium category (3.51heads) followed by small category (2.90 heads) and large category (1.75 heads).

10.8 Annual Income from Crops

Table 10.9 reveals that per farm annual income was maximum from fruits (Rs.3,62,235), followed by vegetables (Rs.6250), Wheat (Rs.5132),Paddy (Rs.3135) and maize (Rs.2522). Minimum income was obtained from pulses.

10.9 Income from different sources

Annual gross income from different sources on sampled trout farms has been estimated and presented in Table 10.10. It may be observed from the table that trout fish rearing was the main source of income of sampled farms, followed by value of crops (fruit, vegetables and cereal crops), business and services in public and private sector. It is important to mention here that the area under study is the commercial belt of the state where horticulture and tourism are the main activities of the households. It was also observed during the field survey that in general trout fish farms were established by the economical rich people in the area. Hence, annual income of the sampled trout fish farmers is much higher than other farm households in the state. Annual per household income from all sources ranges between Rs 5,06,898 on small category of farms to Rs 21,00,882 on large trout farms. On an average, per farm annual income from all sources was Rs 10,81,426. Out of total income, 41 percent is the value of trout fish produced and 35 percent is the value of crops produced on farm. Business, service and livestock rearing contributed 13 percent, 8 percent and 3 percent in total annual income of sampled households under study.



10.10 Summing up

It can be concluded from the above analysis that average family size among all the trout fish farmers was 4.75 persons. About 88 per cent percent of the people were found to be literate and of total persons maximum (22.89%) persons were literate at the level of Matric. Agriculture was the main occupation of majority (53.12) of the farmers whereas fisheries (54.76%) was the most common subsidiary occupation. Land use pattern indicates that maximum (87.55%) area was of cultivated land in all the category of fish farms. In total cropped area, maximum proportion (62.36%) of area was observed in the case of fruits and minimum (0.95%) in the case of pulses. On an average the numbers of livestock were 2.85 heads per farm. In crops highest income was obtained from fruit crops. Annual per household income from all sources ranges between Rs 5,06,898 on small category of farms to Rs 21,00,882 on large trout farms. On an average, per farm annual income from all sources was Rs 10,81,426.

Table-10.8: Livestock Resources per trout Farm.

(Number)

Type of livestock	Small	Medium	Large	Overall
1. Cows	1.30	1.34	1.50	1.35
C.B.	0.90	1.17	1.50	1.10
Indigenous	0.40	0.17	-	0.25
2. Bullocks	0.80	0.67	-	0.60
3. Young stock	0.20	0.67	0.25	0.35
4. Buffaloes	0.10	-	-	0.05
5. Sheep	0.50	0.83	-	0.50
6. Goat	-	-	-	-
7. Horse/Ponnies	-	-	-	-
Total	2.90	3.51	1.75	2.85
Poultry	7.00	-	-	3.50

Table-10.9: Income From Crops per Trout Farm.

(Rs/farm)

Crops/Fruits	Small	Medium	Large	All
Maize	2530.00	3175.00	1525.00	2522.50
Paddy	230.00	633.33	14150.00	3135.00
Wheat	2930.00	1841.67	15575.00	5132.50
Barley	335.00	275.00	-	250.00
Pulses	-	250.00	-	75.00
Vegetable	10500.00	3333.33	-	6250.00
Other	2310.00	-	-	1155.00
Fruits	178970.00	359166.67	8325000.00	362235.00
Total	197805.00	368675.00	8356250.00	380755.00

Table-10.10: Per farm Annual gross Income From different sources on sampled Trout Farms.

(Rs/Farm)

Source of income	Small	Medium	Large	All
Crops	1,97,805 (39.02)	3,68,675 (27.12)	8,56,250 (40.76)	3,80,755 (35.21)
Livestock	20,700 (4.08)	30,333 (2.23)	45,000 (2.14)	28,450 (2.63)
Trout fish	1,86,893 (36.87)	6,10,661 (44.93)	8,43,132 (40.13)	4,45,271 (41.17)
Service	42,600 (8.40)	1,22,000 (8.97)	1,44,000 (6.85)	86,700 (8.02)
Business	58,900 (11.63)	2,27,667 (16.75)	2,12,500 (10.12)	1,40,250 (12.97)
Total	5,06,898 (100.00)	13,59,336 (100.00)	21,00,882 (100.00)	10,81,426 (100.00)

Note: Figures in parenthesis denote percentages to total.

Chapter – 11

COSTS AND RETURNS FROM TROUT FISH FARMS

In this chapter, an attempt has been made to work out the cost and returns from trout fish farms on the basis of survey data. The economics of trout fish farm i.e. cost of rearing of fish and net income have been separately worked out for different size groups.

11.1 Type of Land Used and Sources of Water for Raceway

The type of land used and sources of water for trout fish farm is given in Table 11.1. The average size of raceway was 152.70 M^3 of all the sampled trout fish farms. Majority (90%) raceway were on agricultural land whereas 5 per cent each on barren and other land. The source of water for raceway is only the kuhl on all the sampled trout farms.

Table-11.1: Type of land used and sources of water for raceway on sampled trout fish farmers.

Particulars	Small	Medium	Large	All
Average size M^3	61.3	149.67	385.75	152.70
% Raceway on				
Agriculture Land	90.00	83.33	100.00	90.00
Barren land	10.00	-		5.00
Other land	-	16.67	-	5.00
Source of Water				
Kuhl	100.00	100.00	100.00	100.00

11.2 Source of Finance

Various sources like own, bank and State Fisheries Department exist to finance for the construction of raceway (Table 11.2). The source of finance for construction of raceway was the own source for most (65%) of the trout farms, followed by own & Fishery

Department (30%) and Fisheries Department (5%). Category wise, in the large category the source of finance for the construction of raceway is only the own source and in medium category also own source is the main source while in small category majority (60%) of the raceway were financed by own & Fishery Department.

Table-11.2: Sources of finance for construction of raceway on sampled trout fish farms..

Particulars	Small	Medium	Large	All
Average size of pond in Cubic meters	61.3	149.67	385.75	152.70
Source of Finance				
% household				
1. Own	40.00	83.33	100.00	65.00
2. Own+Fishery deptt	60.00	-		30.00
3. Bank				
4. Bank+ Fishery deptt..	-	16.67	-	
5. Fisheries deptt. only				5.00
6. Total	100.00	100.00	100.00	100.00

11.3 Average Cost of Construction

On the whole, the average cost of construction of raceway was observed to be Rs.210215 on all the sampled trout fish farm. The cost increases with the increases in the size of trout farm (Table 11.3)

Table-11.3: Average cost of construction of raceway on different size of trout fish farms.

Categories	Cost Rs.
Small	81200
Medium	274633
Large	436125
All	210215

11.4 Expenditure on Implements and Tools

The average expenditure on implements and tools was observed to be Rs.2681/farm on all the sampled trout farms. Category wise per farm total expenditure on implements and tools was Rs.1074, Rs.3222 and Rs.5897 for small, medium and large category respectively which means that expenditure increases with the increase in the size of trout farm (Table 11.4). List of implements and tools owned by the farmers is given in tables 11.5 and 11.6.

Table-11.4: Per farm Average expenditure on implements and tools per raceway on different size of trout fish farms.

Categories	Total expenditure (Rs)
Small	1074
Medium	3222
Large	5897
All	2681

Table-11.5: Price per unit of different implements & tools and their uses.

Implements & tools	Price per unit (Rs)	Use of the implement
Hand net	228	To catch the fish
Basket	95	To carry the feeds fish
Weighing machine	857	To weighing the fishes
Drum	300	To store the feed
Tub	607	For washing and treatment of fish
Hand Gloves	50	To protect the hands from infection disease etc.
Thermometer	50	To see the water temperature
Gum boot pair	175	To protect the fact from infection of disease etc.
Brush	109	To clean the raceway
Net	667	To protect the fish from birds
Pipe	220	To supply the water
Tray	200	To carry the fingerlings at hatchery
Ice box	347	To carry the fish to market
Water tank	3000	To store the water
Feed container	150	To store the fish feed
Grinder	800	To grind and mix the fish feed

Table-11.6: Per farm number of implements and tools owned by the different size of sampled trout farmers and No. of household owning them.

Implements & tools	Small		Medium		Large		Overall	
	No.of Implement per farm	No.of household owning	No.of Implement per farm	No.of household owning	No.of Implement per farm	No.of household owning	No.of Implement per farm	No.of household owning
Sample size		10		6		4		20
Hand net	1.60	10	3.16	6	3.00	4	2.35	20
Basket	1.30	6	2.67	5	5.50	4	2.55	15
Weighing machine	0.10	1	0.50	3	0.75	3	0.35	7
Drum	0.10	1	0.33	1	-	-	0.15	2
Tub	0.60	4	1.50	4	2.00	3	1.15	11
Hand gloves	0.20	1	-	-	0.50	1	0.02	2
Thermometer	-	-	0.17	1	-	-	0.05	1
Gum boot pair	0.10	1	-	-	0.25	1	0.10	2
Brush	0.20	1	0.33	1	7.50	2	1.70	4
Net	0.90	3	2	2	-	-	1.05	5
Pipe	-	-	1.67	1	-	-	0.50	1
Tray	-	-	0.33	1	-	-	0.01	1
Ice box	-	-	1.16	1	2.50	1	0.85	2
Water tank	-	-	-	-	0.25	1	0.05	1
Feed container	-	-	-	-	1.00	1	0.20	1
Grinder	-	-	-	-	0.25	1	0.05	1

11.5 Production and Utilization of Trout Fish

The production and utilization of trout fish by the trout fish farmers is given in Table 11.7. On an average, total production of fish was 19.01 qtls. per farm by all the sampled trout fish farmers. Farm size wise, per farm total production of trout was observed to be 8.99, 25.54 and 34.25 qtls. for small, medium and large category respectively. On an average, out of total production, 95 per cent was observed to be sold in the market, 3.05 per cent given as gift to relatives and friends and 1.63 percent was retained for home consumption by all the sampled trout fish farmers. The pattern of utilization of trout fish is same in all the categories also.

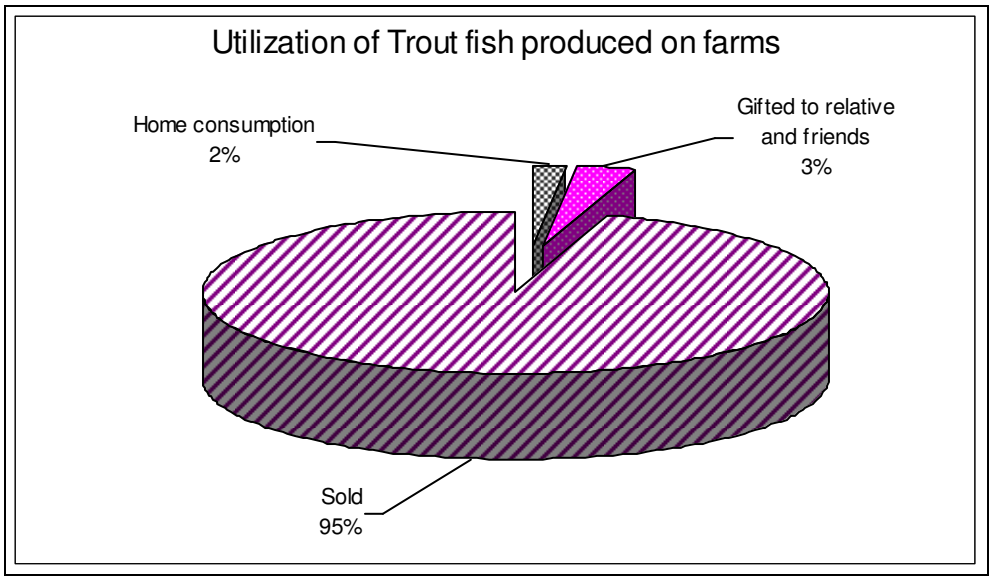


Table-11.7: Annual Production and Utilization of fish on sampled trout fish farms.

(Quantity in qtls/farm)

Particulars	Small	Medium	Large	All
Home consumption	0.17 (1.89)	0.53 (2.08)	0.32 (0.93)	0.31 (1.63)
Kind wage	-	-	-	-
Gifted to relative and friends	0.33 (3.67)	0.93 (3.64)	0.68 (1.99)	0.58 (3.05)
Sold	8.49 (94.44)	24.08 (94.28)	33.25 (97.08)	18.12 (95.32)
Total production	8.99 (100.00)	25.54 (100.00)	34.25 (100.00)	19.01 (100.00)

Note: Figures in parenthesis denote percentages to total.

11.6 Marketing system of trout fish

Fish marketing involves activities like catching, dressing, packing, transportation etc. After attaining the weight of 250 – 350 grammes the fishes are picked up by hand net and kept in water tub. Before packing the fishes are dressed and the intestine and other unwanted parts are removed by hand. After dressing the fish are packed in thermo cool box. The ice is also put in the box for protecting the fish for maintaining proper temperature. Then the boxes are carried from farm to road head manually or by pick up van. From road head fishes are generally transported by bus up to market. The box is transported by bus roof and a person travel in bus for sale in the market.

11.7 Marketing season of trout fish

Trout fish are sold throughout the year however; main supply season of fish is September to April. Demand for fish in the consuming markets is higher in winter season**.** The producer supplies the fish to consumers particularly to hotels as per demand which is depends on the types of tourists stay in the hotels.

11.8 Marketing channels

The following supply chains through which the fish is marketed by the producers**.**

1. Producer→ Consumer
2. Producer → local hotels
3. Producer → hotels at Delhi/Shimla
4. Producer → Local traders → hotels at Delhi/Shimla

Among the supply channels listed above Channel 3 is the main channel through which major marketed surplus is sold by the producers.

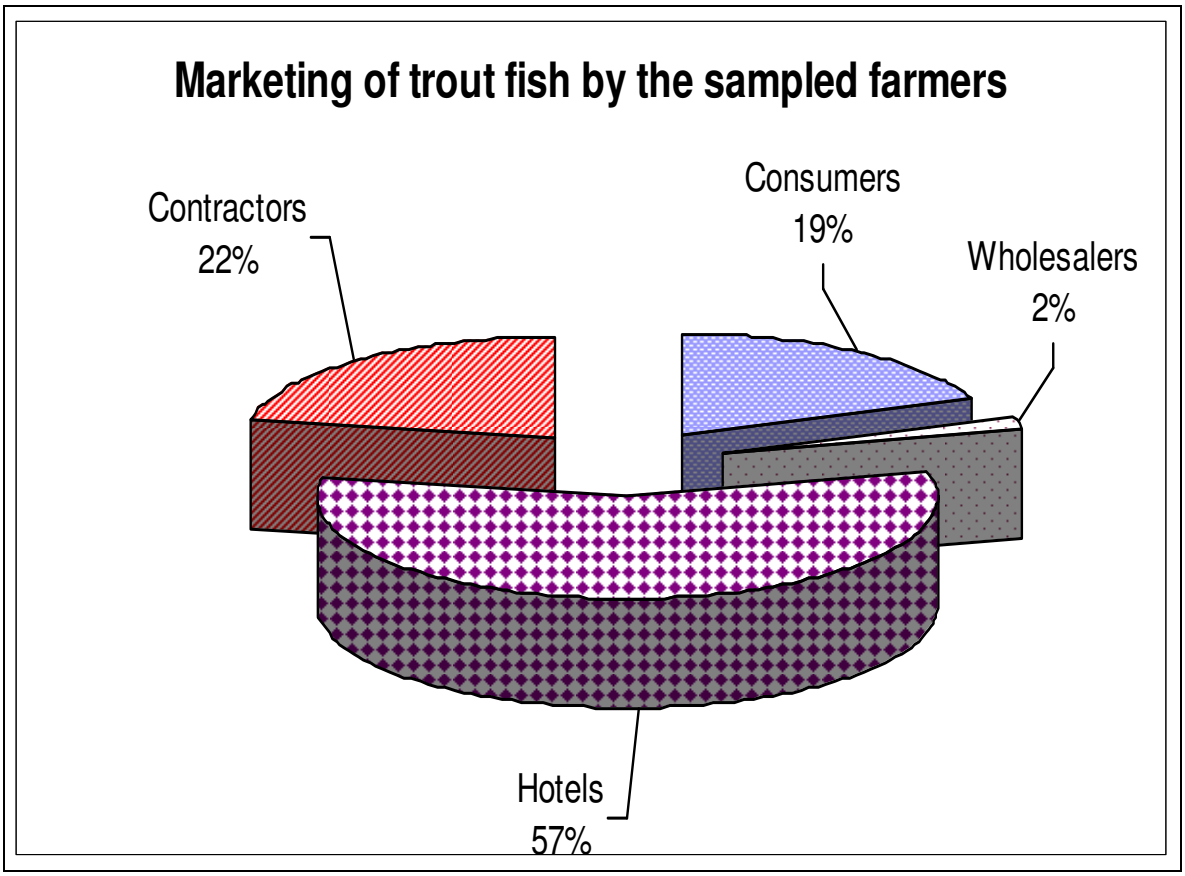
Marketing arrangements made by the producers are presented in Table 11.8. It may be seen from the table that major quantity of marketed surplus (57.25%) was sold to hotels at Delhi and in the state. Nearly 22 percent of marketed surplus was sold to local contractors. The fish sold to consumers directly constituted about 19 percent of marketed surplus. The sale to wholesaler at Delhi was 1.66 percent of the marketed surplus of trout fish produced by the farmers.

Table-11.8 : Marketing arrangements for trout fish produced on sampled farms.

(Quantity in kg/farm)

Category	Marketed surplus	Marketing arrangements			
		Consumers	wholesalers	Hotels	Contractors
Small	899 (100.00)	202 (24.14)	59 (7.06)	210 (24.75)	375 (44.05)
Medium	2554 (100.00)	66 (2.76)	- (-)	1642 (68.18)	700 (29.06)
Large	3425 (100.00)	1125 (33.83)	- (-)	2200 (66.17)	- (-)
Over all	1901 (100.00)	348 (19.18)	30 (1.66)	1037 (57.25)	397 (21.91)

Note: Figures in parenthesis denote percentages to total.



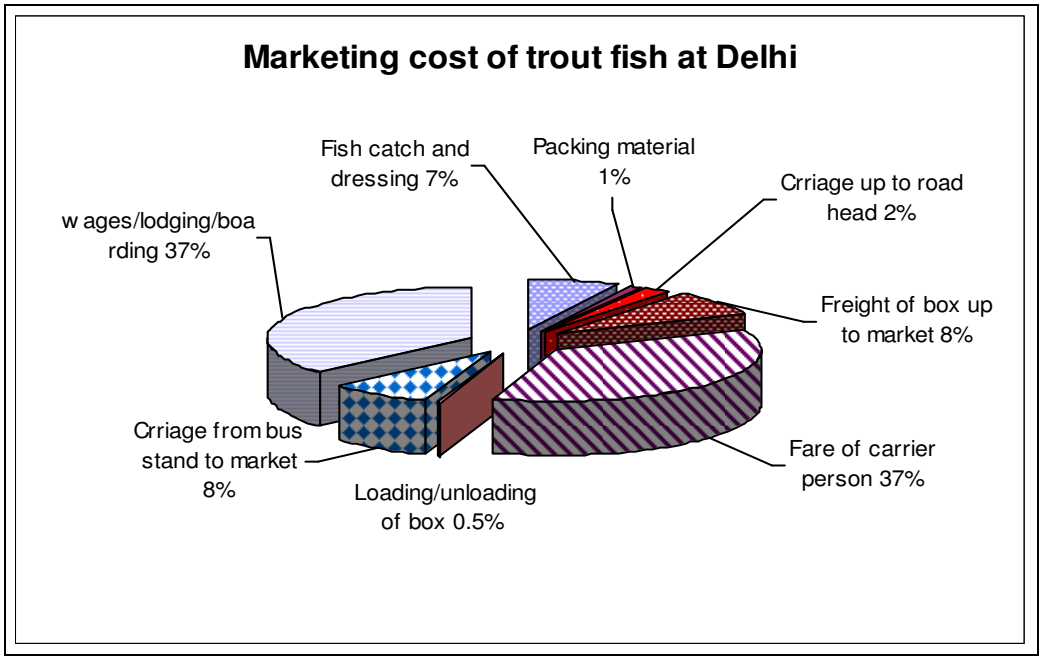
11.9 Marketing Cost of trout fish:

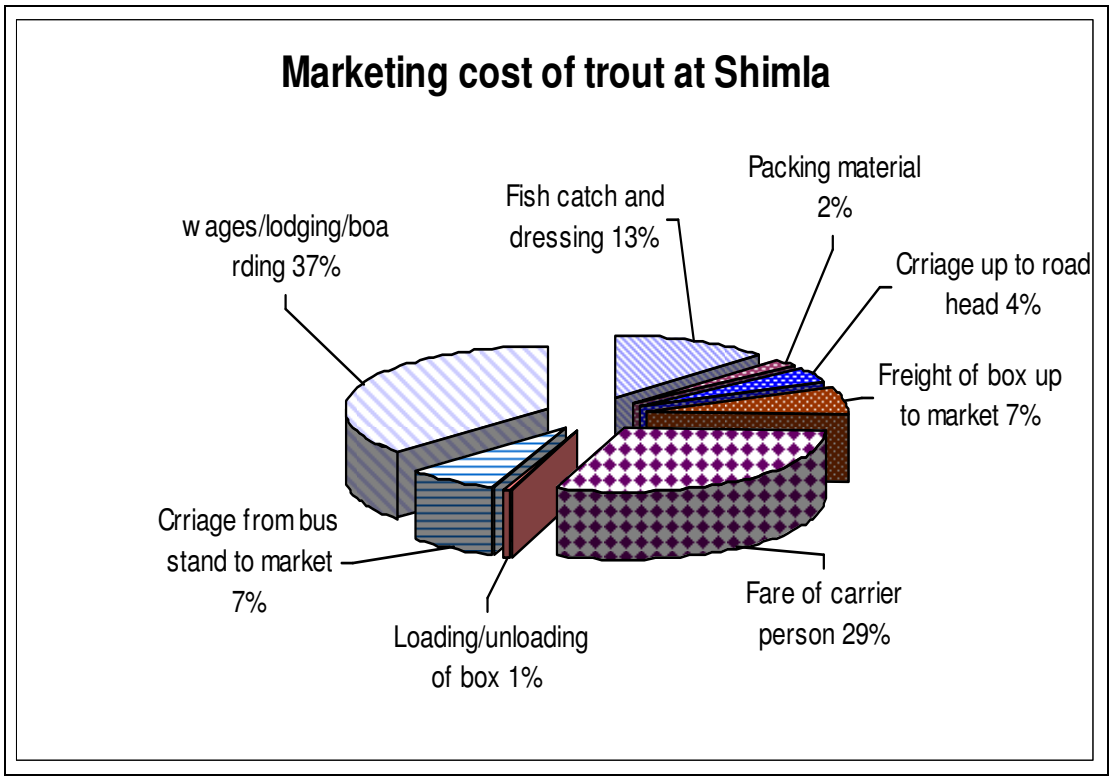
The analysis revealed that the marketing costs per box of 35 kg incurred by the producers were higher in Delhi as compared to Shimla. On an average, marketing costs were Rs 2460 when the trout fish sold at Delhi and Rs 1360 per box at Shimla (Table-11.9). The break up of marketing costs incurred by the producers revealed that transportation (including expenditure on carrier person) constituted the major share and ranged between 91 percent in Delhi and 85 percent in Shimla market. Dressing of fish, packing material and loading/unloading are the other cost components, which are 11 percent at Delhi and 15 percent at Shimla market. Net price received by the producers was Rs 8740.20 per box in case of Delhi market and Rs 7740.25 per box in case of fish markets at Shimla. On average, net price received by the producers in marketing of trout marketed at Delhi was Rs 249.72 and Rs221.15 at Shimla.

Table-11.9 : Marketing costs of trout fish in Delhi and Shimla.

(Per box of 35 kg)

#	Cost items	Delhi Market		Shimla market	
		In Rs	%	In Rs	%
1	Fish catch and dressing	175.00	7.11	175.00	12.87
2	Packing material				
	-Thermo cool box	5.00	0.20	5.00	0.37
	- Value of Ice	20.00	0.81	20.00	1.47
3	Carriage from farm to road head	50.00	2.03	50.00	3.68
4	Freight/fare from road head to market				
	-box	200.00	8.13	100.00	7.35
	-Carrier person	900.00	36.59	400.00	29.41
5	Loading and unloading of box	10.00	0.41	10.00	0.74
6	Carriage from bus stand to hotel/market	200.00	8.13	100.00	7.35
7	Wages paid, boarding/lodging of carrier person,	900.00	36.59	500.00	36.76
	Total cost	2460.00	100.00	1360.00	100.00
	Cost per kg	70.28	70.28	38.85	38.85
	Price of fish/kg	320		260	
	Net price received by the producers	249.72		221.15	





11.10 Human Labour Used in Trout Fish Production

Human labour used in feeding of fish, cleaning of tank, grading of fish, maintenance of tank, fish catching and watch and ward is given in Table 11.10. It can be seen from the table that both males and females are involved in the various activities related to trout fish production and both family and hired labour is used for this purpose but the hired labour is used more as compare to family labour on all the sampled trout fish farms. The proportion of both family and hired male labour is more as compared to female labour in all the categories of trout fish farms. On an average, per farm annual days devoted to various activities of trout fish production were observed to be 25 and 5 days of family male and female labour respectively while these are 146 and 38 days of hired male and female labour respectively. Out of the total time spent on these activities by all the sampled trout fish farmers maximum time goes to the activity of watch and ward ,followed by fish catching, feeding of fish, grading of fish, cleaning of tank and maintenance of tank. More or less the same pattern is observed in all the categories of trout fish farms.

Table-11.10: Annual Human labour used in fish production on sampled trout fish farms.

(Days/farm)

Item of labour use	Small				Medium			
	Family labour		Hired labour		Family labour		Hired labour	
	Males	Females	Males	Females	Males	Females	Males	Females
1. Feeding of fish	5	10	10	5	-	-	33.30	25.00
2. Cleaning of tank	2	-	2	-	1.70	-	5.80	-
3. Treatment & grading of fish	2	-	2	-	3.30	-	6.60	-
4. Maintenance of tank	1	-	4	-	-	-	5.00	-
5. Fish catching	7.50	-	7.50	-	-	-	38.30	-
6. Watch & ward	20	-	50	-	13.30	-	83.30	25.00
Total labour days	37.50	10	75.50	5	18.30	-	172.3	50.00

Contd….

Table-11.10: Contd…

Item of labour use	Large				All			
	Family labour		Hired labour		Family labour		Hired labour	
	Males	Females	Males	Females	Males	Females	Males	Females
1. Feeding of fish	-	-	62.50	25.00	2.50	5.00	27.50	15.00
2. Cleaning of tank	-	-	12.50	-	1.50	-	5.25	-
3. Treatment & grading of fish	2.50	-	13.75	-	2.50	-	5.75	-
4. Maintenance of tank	-	-	8.75	-	0.50	-	5.25	-
5. Fish catching	-	-	60.00	-	3.75	-	27.25	-
6. Watch & ward	-	-	125.00	75.00	14.00	-	75.00	22.50
Total labour days	2.50	-	282.50	100.00	24.75	5.00	146.00	37.50

11.11 Losses of Fingerlings and its Value

The losses of fingerlings on sampled trout fish farmers are given in Table 10.11. The farmers reported that loss occurs due to mortality, snakes, birds and theft. Out of total losses of 729 fingerlings/farm by all sampled trout fish farmers maximum (92.59%) loss is due to mortality. In terms of value, loss was observed to be Rs.3965/farm by all the sampled trout fish farmers. Losses were maximum of Rs.7350/farm in the case of medium category, followed by large category (Rs.3150/farm) and small category (Rs.2295/farm).

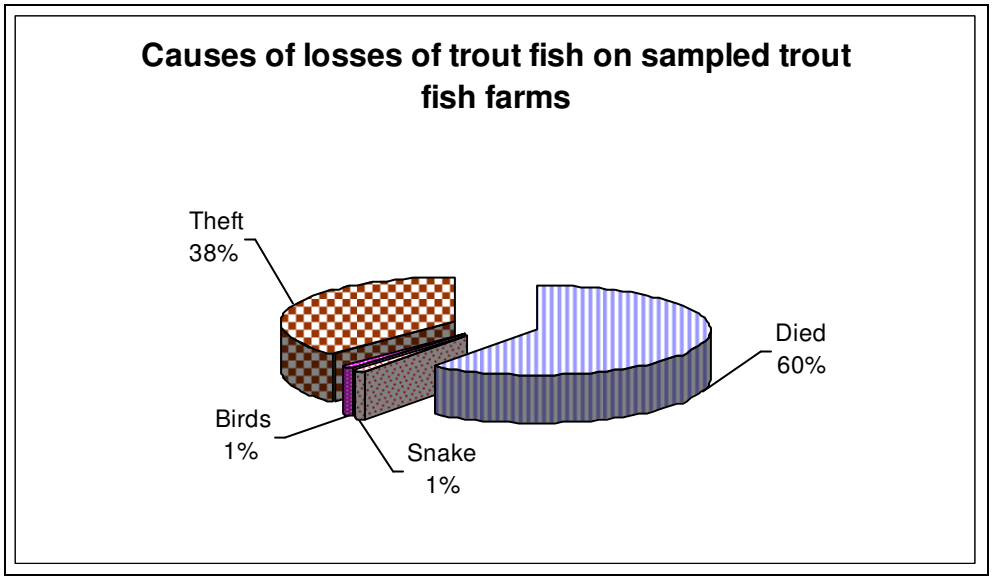


Table-11.11: Annual fish losses on sampled trout farms.

(Value in Rs/farm)

Particulars	Categories			
	Small	**Medium**	**Large**	**All**
1.Died	2295.00	2350.00	2700.00	2375.00
2. Snake	-	-	225.00	45.00
3. Birds	-	-	225.00	45.00
4. Theft	-	5000.00	-	1500.00
Total	2295.00	7350.00	3150.00	3965.00
No. of Fingerlings				
Died	625	608	900	675
Snake	--	-	75	15
Birds	-	-	75	15
Theft	-	80	-	24
Total	625	588	1050	729

11.12 Costs and Returns from Trout Fish production

The analysis of cost and returns from sampled trout fish farms has been shown in Table 11.12. Costs have been grouped into two categories for the purpose of presentation, viz., fixed costs and variable costs. Fixed costs include (a) prorated raceway cost, (b) interest on implements and tools, interest on covering net, depreciation on implements and tools and depreciation on covering net. The components of variable costs are (a) value of fingerlings, (b) feed cost, (c) value of salt and medicine, (d) value of human labour which includes value of family and hired labour and (e) interest on working capital. The analysis of Table 10.8 shows that total fixed cost constituted about 15 per cent of total cost incurred by all the sampled trout fish farmers. The variable cost is 85.17 per cent of the total cost. In the fixed cost the main component is the prorated raceway cost constitute about 14.50 per cent of the total cost. In variable cost, the main component of the cost is fish feed constituting 64.33 per cent of the total cost, followed by value of fingerlings (9.59%), value of human labour (6.39%), interest on working capital (4.05%) and value of salt and medicine (0.80%). Almost same pattern was observed in all the categories of trout fish farms. Category wise, per farm total cost on rearing of fish was observed to be Rs.1,36,255, Rs.3,25,070 and Rs.5,08,541 for small, medium and large category. On the whole per farm average cost was Rs.2,65,214 for all the sampled trout fish farmers. It may also be seen from the table that large category realized the highest per farm net income (Rs.3,34,591) followed by medium category (Rs.2,85,591) and small category (Rs.50,638). On an average the total per farm net income realized by all the sampled trout fish farmers was observed to be Rs.1,80,342.

11.13 Costs and Returns per kg of Trout Fish production

Per kg total costs, gross returns and net returns from trout fish farming has been analyzed and presented in Table11.12. On an average, per kg total cost of production of trout fish ranges between Rs 127.28 on medium category of farm to Rs 151.56 on small category of sampled trout fish farms. The per kg prices realized by the trout fish farmers were relatively higher in case of large category and lesser in case of small category of trout fish farms. Per kg net profit received by the trout fish producers was relatively higher on medium category and lesser on small category of trout fish farms under study.

Table- 11.12: Annual expenditure on fish production incurred by sampled trout fish farmers.

(Rs/farm)

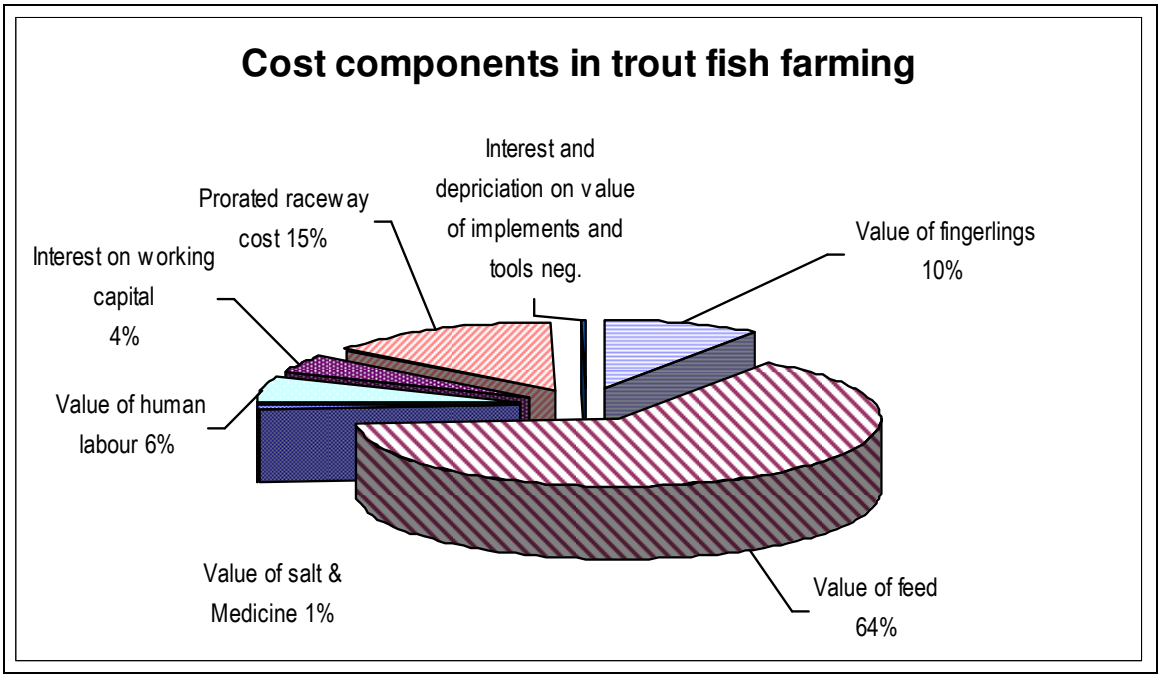
Cost of Component	Small		Medium		Large		Overall	
	Rs	%	Rs	%	Rs	%	Rs	%
A. Variable Cost								
1. Value of fingerlings	13600	9.98	32633	10.04	44250	8.70	25440	9.59
2. Value of feed	90765	66.61	207667	63.88	324957	63.90	170621	64.33
3. Value of salt & Medicine	390	0.29	1590	0.49	7225	1.42	2117	0.80
4. Value of human labour	10300	7.56	18982	5.84	30425	5.98	16937	6.39
- Family labour	3800	2.79	1431	0.44	250	0.01	2380	0.90
- Hired labour	6500	4.77	17551	5.40	30175	5.93	14555	5.49
5. Interest on working capital	5753	4.22	13043	4.01	20342	4.00	10755	4.05
Total variable cost	120808	88.66	273915	84.26	427199	84.00	225870	85.17
B. Fixed Cost								
1. Prorated raceway cost	14859	10.91	50237	15.45	79810	15.69	38469	14.50
2. Interest on value of implements and tools	107	0.08	322	1.00	588	0.12	268	0.10
3. Interest on covering net	118	0.09	38	0.01	-	-	70	0.03
4. Depreciation of Implements & Tools	245	0.18	520	0.16	944	0.19	467	0.17
5. Depreciation on covering net	118	0.08	38	0.01	-	-	70	0.03
Total fixed cost	15447	11.34	51155	15.74	81342	16.00	39344	14.83
Total cost A+B	136255	100.00	325070	100.00	508541	100.00	265214	100.00
Total production (Qtls.)	8.99		25.54		34.25		19.01	
Value of total production	186893		610661		843132		445556	
Net returns	50638		285591		334591		180342	

11.14 Input output ratio

The output per unit of input has been estimated and presented in Table11.13. The ratio was relatively higher on medium category of trout fish pond (1:1.88), followed by large category (1:1.67) and lesser on small category of trout fish farm. On an average, output per rupee of input was Rs 1.68 on all the sampled trout fish farms. This indicates that the medium category farms are operating efficiently as compared to other trout fish farms under study.

Table-11.13: Per Trout fish farm total costs, gross returns, net returns and input output ratio.

Category of pond	Per farm (Rs)			Per kg (Rs)			Input output ratio
	Total costs	Gross returns	Net returns	Total costs	Gross returns	Net returns	
Small	136255	186893	50638	151.56	207.89	56.33	1:1.37
Medium	325070	610661	285591	127.28	239.10	111.82	1:1.88
Large	508541	843132	334591	148.48	246.17	97.69	1:1.67
Overall	265214	445556	180342	139.51	234.38	94.87	1:1.68



11.15 Summing up

It can be concluded from the above analysis that average cost of construction of raceway was Rs.210215 and the source of finance for construction of raceway was the own and fishery department of the majority (60%) of the sampled trout fish farmers. The average expenditure on implements and tools was observed to be 2681/farm. Out of the total time spent by the trout fish farmers on the various activities of fish production maximum time goes to the activity of watch and ward and minimum for the maintenance of tank. Overall, the total cost for the production of trout fish was observed to be Rs.265214 per farm. The variable and fixed cost constituted 85.17 and 14.83 per cent of the total cost respectively. Fish feed is the main component of the cost constituted 64.33 per cent of the total cost. Per farm net income realized by all the sampled trout fish farmers was Rs.180342 and on an average input output ratio comes out to be 1:1.68. On the whole, out of total production of fish 95.32 per cent was marketed. Nearly 57 percent of marketed surplus was sold to hotels at Delhi and Shimla, 22 percent was sold to local contractors. The marketing cost incurred by the producers was Rs 70.28/kg at Delhi and Rs 38.85/kg at Shimla. Net price received by the producers was Rs 249.22/kg at Delhi and Rs 221.15/kg at Shimla.

Chapter – 12

PROBLEMS OF TROUT FISH FARMERS

Himachal Pradesh has become the first state in the country to introduce trout farming in the private sector besides emerging as a number one producer of this specie of fish. At present, trout is considered to be a highly priced fish in the country. The trout culture have very high potential but this venture has not developed as fastly as can due to various constraints such as lack of proper technology, untrained manpower and harnessing of adequate crystals clear quality and quantity of water. According to Ralhan, "For the success of trout farming as a small industry we still have some grey areas related to the key factors such as quantity and quality of water supply, feeding and feed management, level of hygiene maintenance schedule for health care and disease investigation" (The Tribune, 2007). The various problems related to trout fish farming faced by the trout fish farmers are discussed in this chapter. The problems revealed are multiple in responses as shown in Tables 12.1 to 12.4 .

12.1 Problems Related to Construction of Ponds

Of paramount importance for a model trout farm is the water and source of its water supply. It is essential that there should be abundant, clean fresh water always renewable and protected against heating in the summer season in order to ensure sufficient dissolved oxygen content. The quantity of water available decides the number of ponds or other breeding activities in the farm. The sampled trout fish farmers were asked about the problems which they were facing regarding construction of ponds and the responses are presented in Table 12.1. Forty per cent trout fish farmers reported the problem of shortage of water in summer and winter. Majority (75%) of trout fish farmers reported that the cost of construction of pond is very high and location of land is away from house. The same pattern was observed in all the categories under study. Overall, 45 per cent of farmers reported the problem of lack of finance and high interest rates. This problem was found more in the case of small category followed by medium and large category.

Table-12.1: Problems Related to Construction of Ponds faced by Sampled Trout Fish Farmers.

(Multiple response)

Problems		Small	Medium	Large	All
1. Lack of knowledge about establishing of Pond	No %	- -	- -	- -	- -
2. Lack of finance and high interest rate	No %	6 60.00	2 33.33	1 25.00	9 45.00
3. High cost of pond construction	No %	8 80.00	4 66.66	3 75.00	15 75.00
4. Lack of required land for pond	No %	1 10.00	1 16.66	-	2 10.00
5. Location of land is away from house	No %	8 80.00	4 66.66	3 75.00	15 75.00
6. Shortage of water in summer and winter	No %	4 40.00	2 33.33	2 50.00	8 40.00
7. Other problems	No %	1 10.00	-	-	-
Sample size	No %	10 100.00	6 100.00	4 100.00	20 100.00

12.2 Problems Related to Fingerlings

The sampled trout fish farmers were also asked about the problems related to fingerlings and their responses are given in Table 12.2. Majority (65%) of trout fish farmers reported that fingerlings are costly. About 60 per cent stated that fingerlings are not available in required place. More or less same pattern was observed in all the categories. About 25 per cent were of the view that fingerlings are not available in time and 10 per cent stated that required sizes of fingerlings are not available.

Table-12.2: Problems related to fingerlings faced by Sampled Trout Fish Farmers.

(Multiple response)

Problems		Small	Medium	Large	All
1. Required size of fingerlings are not available	No %	2 20.00	-	-	2 10.00
2. Fingerlings are not available in time	No %	3 30.00	1 16.66	1 25.00	5 25.00
3. Fingerlings are costly	No %	7 70.00	3 50.00	3 75.00	13 65.00
4. Fingerlings are not available in required place	No %	6 60.00	3 50.00	3 75.00	12 60.00

12.3 Problems Related to Fish Feed

Feed constitutes an important component in trout rearing operations. Artificial dry feed are getting increasingly popular in view of their better conversion, easy handling, storage and transportation. Feed constitutes 64.33 percent of the total cost in trout rearing. Any compromise made with the quality or quantity of feed directly affects the growth and survival rate. The sampled trout fish farmers were asked about the problem of fish feed (Table 12.3). Majority (95%) of the trout fish farmers reported that feed is costly and not available at desired place. About 90 per cent stated that there is lack of availability of feed. Seventy five per cent were of the view that feed in not available in time or on credit and 55 per cent reported the lack of knowledge about fish feed.

Table-12.3 : Problems related to fish feed faced by Sampled Trout Fish Farmers.

(Multiple response)

Problems		Small	Medium	Large	All
1. Lack of knowledge about feed	No	5	3	3	11
	%	50.00	50.00	75.00	55.00
2. Lack of availability of feed	No	9	6	3	18
	%	90.00	100.00	75.00	90.00
3. Feed is costly	No	9	6	4	19
	%	90.00	100.00	100.00	95.00
4. Feed is not available in time	No	8	4	3	15
	%	80.00	66.66	75.00	75.00
5. Feed is not available in desired place	No	9	6	4	19
	%	90.00	100.00	100.00	95.00
6. Feed is not available in credit	No	8	4	3	15
	%	80.00	66.66	75.00	75.00
Sample size	No	10	6	4	20
	%	100.00	100.00	100.00	100.00

12.4 Problems Related to Marketing of Fish

Market intelligence and marketing plays an important role to take the advantage of high prices. If the grower does not have proper information regarding the market he cannot take the advantage of high prices. The problems concerning marketing of trout fish are given in Table 12.4. Ninety per cent trout fish farmers were of the view that there is no proper market for fish in the area and market is away from producing area. About 70 per cent stated problem of small quantity of produce, the problem of transportation and lack of market intelligence. Fifty five per cent reported the problem of lack of knowledge about fish packing and 35 per cent stated that there is lack of knowledge of fish catching. About 65 per cent of the total trout fish farmers reported that to facilitate the functions of marketing there is lack of middlemen in fish marketing.

Table-12.4: Problems related to marketing of fish faced by Sampled Trout Fish Farmers.

(Multiple response)

Problems		Small	Medium	Large	All
1. Small quantity of produce	No %	7 70.00	4 66.66	3 75.00	14 70.00
2. Lack of knowledge of fish catching	No %	5 50.00	1 16.66	1 25.00	7 35.00
3. No proper market for fishes in the area	No %	9 90.00	5 83.33	4 100.00	18 90.00
4. Lack of market intelligence	No %	7 70.00	4 66.66	3 75.00	14 70.00
5. Lack of knowledge about fish packing	No %	6 60.00	3 50.00	2 50.00	11 55.00
6. Problems of transportation	No %	7 70.00	4 66.66	3 75.00	14 70.00
7. Lack of middle men in fish marketing	No %	6 60.00	4 66.66	3 75.00	13 65.00
8. Market is far away from producing area	No %	9 90.00	5 83.33	4 100.00	18 90.00
Sample size	No %	10 100.00	6 100.00	4 100.00	20 10.00

12.5 Summing up

It can be concluded from the above that costly feed, lack of availability of feed and not available at desired place is the major problem faced by the majority (90.95%) of the sampled trout fish farmers. Regarding finger lings, costly fingerlings and not available at required place is the main problem faced by 60-65 per cent of the total farmers. No proper market for fish in the area and market is away from producing area are the problems faced by 90 per cent of the trout fish farmers. High cost of construction of pond was also the main problem of majority of the trout fish farmers.

CHAPTER-13

FISHERY DEVELOPMENT SCHEMES

In this chapter an attempt has been made to review the development schemes implemented in fishery sectors in Himachal Pradesh.

13.1 State Government Sponsored Welfare Schemes

13.1.1 Reservoirs Fishermen Accident Insurance Scheme: Fishing in the big reservoirs is a hazardous job. There is every risk of life during heavy rains and storms. Keeping this in view all active fishermen working in the reservoirs have been insured for Rs. 25000/- in case of permanent disability and Rs. 50000/- in case of death of the fishermen. The insurance premium of Rs. 14/- is being shared by the Government of India and Government of Himachal Pradesh in 50:50 ratio.

13.1.2 Saving-cum-Relief Scheme (Close Season Assistance): In order to ensure sustained yield of fish from the reservoirs apart from the other management measure a fishing 'closed-season' of two months from 1st June to 31st July every year has been enforced. This measure has helped in building up fisheries of considerable magnitude by facilitating free run to the mother fish spawner during breeding season and the auto stocking of the fish seed. Every year fish over 4 crores value is being harvested accounting an income of Rs. 60 lakhs to the State exchequer. This measure has also generated considerable resentment in the fishermen community and they were insisting on the provision of some financial assistance during this period. Himachal Pradesh is perhaps the 1st State in the country which has acceded in the demand of fishermen by introducing a 'Contributory Saving –cum- Relief Scheme' to its reservoir fishermen. Under this scheme each fishermen who is member of the cooperative society deposits Rs. 50/- for ten consecutive fishing months from August to May. Proportionate amount is contributed by the Central and State Government with contribution of Rs. 225/- and

300/- respectively. The total amount of Rs.1025/- thus, raised is distributed to the fishermen in two installments during the 'closed season'.

13.1.3 Fishermen Risk Fund Scheme: Fishing in the reservoir is nocturnal in nature and hence involves a considerable element of risk to the life of the fishermen as well as his fishing equipments. Due to changes in atmospheric pressure, followed by cyclonic storms the reservoir become quite rough and such situation create a lot of hardships to the poor fishermen. To mitigate to a certain extent the losses to the fishermen a 'Fishermen Relief Fund Scheme' has been formulated in the State. Under this scheme each reservoir fishermen contributes Rs. **6/-** annually, to be collected from him at the beginning of the year while issuing the licenses. The State Government contributes an amount equal to the total contribution of the fishermen. The assistance from the fund to the fishermen is given only on loss of gill nets, wooden boats, and tents. Based on the present value of the equipments the compensation is given up to **33**% of the loss of each item. Maximum assistance is given in case of total loss/ destruction of the equipment.

13.1.4 Grant-in-Aid / Subsidy For The Construction of Fish Ponds: Fish culture is an important activity and aims at improving the nutritional standard of people by increasing production and consumption of fish as well as to improve the economic condition of the operators by providing them with gainful avocation. In order to assist the people to take the fish culture the States Govt. has formulated a scheme to provide subsidy up to maximum of Rs 5,000 for the construction/renovation of ponds. The subsidy is available @ 50% of the total project cost to Scheduled Castes/Tribes, while other living below poverty line @ 20%. The State Government is also providing training and technical guidance to the entrepreneurs.

13.2 Centre Govt. Sponsored Welfare Schemes

Objectives of the Fish Farmer's Development Agency

a. Progressively reclaim and bring all potential under water bodies fish culture such as swamps, beels, silted up/ neglected ponds, water logged/ low lying areas etc. for optimum fish production in the State;

b. To work out the programme in such a way that it serves as a nucleus of activity for further spread to other areas;
c. To provide training and popularize a new avocation by way of fish culture to the people thereby build-up a trained cadre of fish farmers to undertake intensive fish farming thus providing increased employment to rural unemployed;
d. Contribute to the strengthening of rural economy by making fish farming economically viable;
e. To effectively involve financial assistance to provide loans for capital investment to fish farmers for excavating ponds or for improving existing water areas; and;
f. To provide initial technical and financial assistance to the fish farmers and also as required from time to time.

A package of assistance is provided to the prospective fish farmers under different segments of the schemes, the detail of which is as under:

13.2.1. Renovation/Reclamation of ponds and Tanks: The scheme envisages renovation/reclamation of old ponds and tanks which are owned or taken on lease by the farmers. The estimated per hectare renovation cost of the pond is Rs. 60,000/- and subsidy @ 20% with a maximum of Rs. 12,000 /- for Non Scheduled Castes / other fish farmers and for S.C/S.T it is Rs. 15,000/-.per ha. (25%)

13.2.2 Construction of New Ponds: This scheme has been introduced only during 1991-92 with an aim to create more ponds for increased fish production. The unit cost of the scheme is Rs 3.00 lakhs per hectare in the plain areas including arrangement water supply either in the form of tube-well or gravity flow. The subsidy component is available @ 20% with a maximum of Rs. 60,000/- per hectare for Non Scheduled Castes / other farmers and for S.C/S.T farmers it is 75,000/- per hectare (25%).

13.2.3 Fish Culture in Running Water Raceways: The State has abundant network of perennial kuhals & channels. In the past this important resource was being utilized for irrigation only and for running water flour mills. Realizing the potentiality of these kuhals for fish culture this scheme has been initiated. The size of the culture unit has been fixed 100 Sq. meters with a construction cost of Rs. 20,000/- per unit. The above cost is inclusive of Rs. 4,000 under inputs. The available subsidy is @ 20% with a maximum of

Rs. 4000/- per unit for Non Scheduled Castes/other farmers and for SC/ST it is Rs. 5,000/-per unit (25%). Individual farmer can avail this facility for 3 such units.

13.2.4 Integrated Fish Farming: Population outburst and limited resources have necessitated integration of various activities, for increasing employment avenues, and enhanced productivity with minimum inputs. The scheme envisages "Fish-cum-Dairy-cum-poultry/duckery-cum-piggery farming. The unit cost of the scheme is Rs. 80,000/- per hectare and subsidy @ 20% with maximum ceiling of Rs. 16,000/- per hectare for Non Scheduled Castes/ other farmers and for SC/ST farmers it is Rs. 20,000/-per hectare (25%).

13.2.5 Construction of Fresh Water Prawn & other Fish Hatchery: Fish seed is the nucleus of aquaculture. The State department of Fisheries at its seed farms is producing 20.0 million fish seed annually which is even not sufficient to meet the fish seed stocking requirements of its reservoirs and open waters. Hence there is a need to involve private entrepreneurs in fish seed production. The scheme envisages Rs. 8.00 lakh for a fish seed hatchery with 10 million (fry) capacity for the plain areas and Rs. 12.00 lakh with same capacity for the hill States/ districts. Subsidy @ 10% with a maximum ceiling of Rs.1.60 lakhs in the plain and Rs. 1.20 lakhs in the hilly areas for entrepreneurs only.

13.2.6 Aerators/ Pumps for Seed Hatchery: In order to meet out the gap between the requirements of the water with its oxygen contents in the available water. For this purpose aerators/ pumps are provided to the beneficiaries. Under this scheme Rs. 50000/-per unit of two 1hp aerator/ one 5hp diesel pump are given with subsidy @ 25% with a maximum ceiling of Rs. 12500/- for each set of aerators /pump for all categories who have attained a level of production of 3000kg/ha/year and to raise it further. A maximum of two 1hp aerator/one 5 hp diesel pump for one ha. area is given.

13.2.7 Establishment of Fish Feed Unit: After meeting out the seed requirement of the beneficiaries. The next important part in the aquaculture is availability of the optimum quantity of the fish feed. For setting up of a fish feed unit the Govt. of India

sanctioned the cost@ Rs. 5 lakh for building, machinery and equipment. These will be set up in the private sector. Subsidy @ 20% with a maximum ceiling of Rs. 1.00 lakh is admissible for all groups of farmers.

13.2.8 Training to Fish Farmers: Prospective entrepreneurs desirous of taking up fish culture are imparted training by the technical personnel of Fish Farmer's Development Agency & Department of Fisheries in aquaculture practices. Apart from the established training center the training camps are held at block level. The trainees are given stipend @ Rs. 100/- per day during the training period of ten days and a lump-sum Rs.100/- towards travel expenses/field visits is given per trainee.

13.2.9 Subsidy on 1stYear Inputs: The fish farmers who avail the benefits of Grant-in-Aid subsidy for the renovation and construction of ponds are also provided subsidy on the purchase of 1st year inputs such as fish seed, feed and manure etc.@ 20% with a maximum ceiling of Rs 6,000/- per hectare for all farmers except SC's/ST's for whom it is Rs. 7,500/- per ha (25%). The total cost per hectare has been allowed to Rs.30,000/-

13.3 Schemes for Youths

13.3.1 Construction of New Ponds: Assistance for construction of a pond (size 1 ha) Rs. 75,000/- for SC/ST and Rs. 60,000/- for General Category farmers.

13.3.2 Reclamation/ Renovation of Ponds: Assistance for a pond (size 1 ha) Rs. 5,000/- for SC/ST and Rs. 12,000/- for General category farmers.

13.3.3 First Year Inputs: Assistance for a pond of one ha Rs. 7,500/- for SC/ST's and Rs. 6,000/- for general category farmers.

13.3.4 Running Water Fish Culture: (Earthen pond) Assistance for a unit of 100 sq. meters Rs. 5000/- for S.C./S.T. & Rs. 4000/- for general category fish farmers.

13.3.5 Integrated Fish Farming: Additional Assistance for integrated fish farming Pond (size 1 ha) Rs. 20,000/- for S.C./S.T. & Rs. 16,000/- for general category.

13.3.6 Aerators/Pump: Assistance for purchasing of 1hp aerator/5hp diesel pump. Rs. 12,500/- for each set for all categories of farmers.

13.3.7 Freshwater Fish Seed Hatchery: Assistance for setting up hatchery with 10 million seed capacity Rs. 1.2 lakh for each unit only.

13.3.8 Fish Feed Unit: Assistance for setting up fish feed unit in Rs. 1.00 lakh on a unit cost of Rs. 5.00 lakh.

13.3.9 Setting up of integrated units including hatcheries for ornamental fishes: Assistance for setting up hatchery with 5-10 million (fry) capacity Rs. 1.50 lakh to all categories of fish farmers.

TRAINING: Stipend @ Rs. 100/- per day during the training period & lump sum @ Rs. 100/- towards travel expenses/ field visits.

CHAPTER – 14

EMERGING POLICY ISSUES

Some important recommendations that emerged from the analysis, and need greater policy focus are:

- Feed is the most important aspect in fish farming. Short of feed and high prices are the main problems reported by the fish farmers particularly trout fish farmers. The efforts should be made to establish the feed processing plants in producing areas. The supply of fish feed in remote areas should be ensure through establishing feed distribution centers in the producing areas. Incentives should be provided to marginal and small unit of fish on feed purchased by these farmers so that optimum quantity required by the fish be fed to the stock for proper growth.

- Strengthen and promote institutions such as co-operatives, producers' organizations and contact farming that link producers to markets and reduce marketing and transaction costs.

- Strengthen of markets for fish, evolve new market institutions, to incentives farmers to scale up fish production and adopt best production practices.

- Encourage and facilitate fish producers to collective as organization to effectively deal with market firms.

- Concerted efforts have to be made by different stakeholders to increase the pond fish production. The extension services should be strengthen to disseminate the technical know-how to the small pond fish producers located in remote areas.

- The menace of frequent floods in the area has also been an important factor for low input use in fish production since flooding of ponds leads to out migration of fish with flood water to water bodies.

Damage of fish ponds and raceways due to flood were reported by the farmers particularly in high altitude region. It is suggested that the insurance cover of the fish farm should be provided to cover the losses due to damage by natural calamities.

- The production of fingerling at hatcheries established by the government should be increased and new hatcheries in the producing areas be established to ensure the timely supply of fingerlings to farmers particularly small fish farmers.

- Adequate financial assistance should also be given to fish farmers for construction of new ponds and rejuvenating old ponds for fish production.

References

Biswas, K.P., **"Economics in Commercial Fisheries**", Daya Publishing House, Delhi – 2006.

Pathare, Pankej B., Jain, Dilip, Prasad Suday and Singh Hardial, "Present Status and Prospects of Inland Fisheries Sector in India", **Agricultural situation in India**, Vol. LXII, No.7, Oct. 2005.

Martyshav, F.G., "**Pond Fisheries"**, Amerind Publishing Co. Pvt. Ltd. , New Delhi, 1983.

Santhanam, R., Sukumaran, N. and Natarajan, P. , "**A Manual of Fresh – Water Agriculture",** Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1990.

Chauhan, S.K., "Economics of Production and Marketing of Reservoir Fisheries in Himachal Pradesh", Department of Agricultural Economics, Himachal Pradesh Krishi Vishvavidyalaya, Palampur, June, 1995.

Himachal Top Trout Producer, Times of India, 20-06-07.

Sandhu, Kulwinder, "Lackluster Rainbow", The Tribune, Himachal Plus, September, 26, 2007.

Construction of fish Farm, Directorate of Fisheries, Govt. of Himachal Pradesh.

Himachal Pradesh Agricultural Hand Book, Himachal Pradesh Krishi Vishvavidyalaya, Palampur, 1990.