

# ECONOMICS OF FISH FARMING IN FLOOD PRONE AREAS OF BIHAR WITH SPECIAL REFERENCE TO KOSHI RIVER SYSTEM

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# PREFACE

Fish is any cold – blooded aquatic vertebrate without legs, but typically possessing paired lateral forms as well as median fins. There is a 2-chambered heart, a series of respiratory gills present throughout life in the sites of the pharynx and a body usually bearing scales and terminating in a caudal fin. As a subgroup of vertebrate the fishes are sometimes referred to collectively as Pisces. The chondrychthyes (800 living species) containing the sharks, rays and rat fishes are characterized by a cartilaginous skeleton and are commonly referred to as the cartilaginous fishes. By far the largest extant group is the bony fishes (ostrich thyes 20,000 living species) exhibiting a rich diversity and found in all aquatic habitats. Although many fish have the elongated shapes, body form shows great variety. Body length ranges from as small as a few centimeters to over 18m / 60 ft in the massive whale shark. Many species have bright coloration, others well – developed camouflage patterns. Light organs are common in those forms living in the darkness of deep oceanic waters. [*Wordsworth Encyclopedia, V-2 p. 803 & modern Encylopeida of world, v. 2, p. 363*]

Bihar is the fourth largest inland fish producing states in India. Yet per capita fish consumption in the state is one of the lowest in the county, less than 1 kg. per year compared to national average of 3.7 kg. annually and world average of 10.3 kg. per annum. The total fish production in Bihar is 2.8 lakh tones against the annual requirement of about 4.5 lakh tones. To achieve this level, there is urgent need to focus attention on the development of various types of aquaculture resources in the state. Apart from improving the availability of fish food to the masses, such a growth can generate employment opportunities for the poor and vulnerable sections of the society and will also check the flow of money from Bihar to the state of Andhra Pradesh to buy fish. It is to be mentioned here that the average price of Andhra fish (*fish from Andhra Pradesh – only one variety – Carp, i.e., Rohu*) is Rs. 40 per kg. in Bihar. In value terms, it means that Rs. 1.75 crores worth of fish is coming into this state every week from A.P. During the whole year in valued terms the annual imports exceed Rs. 84 crores. Thus, according to the latest estimate, about Rs. 7 crores are being drained out for fish imports every month from the state.

In Bihar the fish fauna and the water body in general and flood prone areas in particular are highly mismanaged. It is roughly estimated that

nearly 25 per cent of the total geographical area of Bihar is flood prone and 6 per cent of it falls in north- Bihar alone. The river basins of north Bihar is mainly known as Kosi river basin which has the largest flood prone areas (10.80 lakh ha.) and thus, there is the most common saying that 'Kosi is sorrow of Bihar'. The present study has been undertaken exclusively for Kosi river system in Bihar. The findings of the study clearly indicate that if fish farming is managed and organized properly by the inhabitants of the region, their income and employment will be generated at a large scale. It is hoped that the findings of the study will help the policy makers in formulating a comprehensive and integrated plans for the development of such type of flood prone and backward region of the country.

The present study is the outcome of sincere advice, cooperation and learned suggestions received from a galaxy of scholars, scientists and officials of related departments. Such an intellectual debt is too complex and entity to be acknowledged in a brief space.

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# **Chapter: One**

## **INTRODUCTION**

### **1.1 Background**

Sustainable agricultural development necessitates sustainable aquaculture or sustained production at a level which creates minimal impact on the environment. This is possible only when one carefully applies the economic and ecological principles to aquaculture. Presently most of the world's fishery resources are near the point of over exploitation it is because of the fact harvesters prefer to avoid under exploitation. Therefore, over exploitation of fish stocks becomes almost unavoidable. At global level, there has been observed a declining trend in fisheries due to pollution of water bodies, over exploitation and other anthropogenic disturbances etc. Therefore, there is urgent need to check or control these factors for sustainable development of fisheries.

It is stated that the sustainable development of aquaculture mainly depends on three critical contributing factors, such as, economic awareness, efficiency along with ecological awareness, social security and social equity. The term 'Economics of Fish Farming' refers to the application of economic policies and principles related to fisheries.

Fisheries economics discussed about the rules governing the behaviour of society with respect to fish populations and ecosystems. It mainly aims at applying economic principles to the production, proper use and conservation of fishery resources, planning of fisheries policy and management and the problems of fishing industries and to meet their growing needs in terms of human resources development.

Fisheries policies should be based on proper economic planning and that their analysis is very essential to ensure profitable pattern of production and proper processing and efficient marketing of fishery product. Further, it will also help in ensuring equitable distribution of net benefits created in the production process. Thus, there seems to be an urgent need to broaden and strengthen the base of fisheries economics to fulfill the dynamic needs of fishing industry.

## **1.2 Global View**

Before the introduction of refrigeration fish was considered as a perishable commodity and therefore it could not be exported. It met only local needs. During the period from 1950 to 1970, the global fish catch increased by an average of 7 per cent per year. On refrigerated factoryship filleting and processing are now done at sea. Japan evolved new techniques for locating shoals (by Sonar and radar and catching them with electrical charges and chemical baits). Because of the new technique there was indiscrimination over fishing. The result was serious depletion of stocks. Further, it led to

confrontation between the countries using the same fishing ground. A partial solution was the extension of fishing limits to 320 kms. North Sea countries have experimental with the artificial breeding of fish eggs. Marine pollution has caused increasing number of diseased fish in the North Sea.

The nutrient composition of fish is similar to nutrient composition of meat. But in fishes, there are no obvious deposits of fats. It is only the Salmon, Mackerel and Herring that have fat while fish contains only 0.4 – 4 per cent fat. Fishes are good sources of vitamin B and iodine. The fish liver is good sources of vitamin A and D. Roe and Caviar have high protine content, nearly 20 per cent to 25 per cent.

Fisheries can be classified on the basis of type of water, catch and fishing method. According to the type of water fishing is done either in fresh water like lake, river, and pond or in marine water. The fishing may be done in inshore, in mud water or in deep sea. According to catch, different verities like Salman and Mackerel can be obtained. The fishing method varies diving or stunning or poisoning harpooning or trawling or drifting net may be resorted to.

The greatest proportion of the world's catch comes from the ocean. The primary production area is the pholic zone. It is relatively thin surface layer of water. It is nearly 50 mt deep. It can be penetrated by light which allows photo synthesis by plant plankton to take place. Plankton eating fish are small in size.

Many factors have expanded fisheries industry. This industry includes not only fish but sponges also. Most fisheries of the world are belonged to the fisheries of USA, UK, Japan, France, Canada, Russia, Norway, Germany and the Netherlands. Annual production of the fisheries of the USA is estimated at 40 billion pounds. Its value is estimated at about 9.35 million dollar. The Chief American Fisheries are belonged to the cod fisheries of New England, the oyster industry of the Middle Antlantic State, the salmon fisheries of the pacific coast states and the great lake fisheries which are considered the largest fisheries in the world.

### **1.3 Indian Scenario**

In India, fish production has been continuously increasing every year but declined trend has been observed in the year 1981-82 or 1998-99 and 2004-2005. In the year 1982-83, the marine production was 14.27 million tonnes whereas in the previous year (i.e. 1981-82) it was 1555 thousand tonnes. Inland production there was an increase from 887 thousand tonnes to 999 thousand tonnes during these two years. In 1998-99, the marine production was 2696 thousand tonnes but in previous year i.e. 1997-98 it was 2950 thousand tonnes. Further, in the year 2004-05 the production was 2779 thousand tonnes but in the previous year i.e. 2003-04 it was 2941 thousand tonnes (Ayyappan, 2003). Thus, it is clear that there has been a continuous rise in inland fish production due to implementation of new technologies.

The rate of annual growth of fish production has shot-up to 16.21 per cent in 1965-66. It was 12.63 per cent in the year 1981-82 and 11.75 per cent in 1984-85 and 11.33 per cent in 1991-92 and 11.51 per cent in 1993-94 (K. Dilip, 1996). Another fact it is noted that marine fish production has been mostly lower than inland fish production except in the year 1989-90 in which the average annual growth rate of marine fish production spurted to 25.21 per cent. In 1950-51 the marine production was 534 thousand tonnes but it surged to 2816 thousand tonnes in 2005-2006. It indicated that the production short-up to more than 5 times but in the same period the inland production ballooned from 218 thousand tonnes to 3756 thousand tonnes. Thus the increase was nearly 16 times. Thus it is concluded that India is lagging in marine production as compared to inland production. The total average annual growth rate combining both marine production and inland production reached 16.66 per cent (Handbook of Fisheries Statistics – 2006)

#### **1.4 Fisheries in Bihar**

In Bihar, the total fish production was 159.93 thousand tonnes in 1990-91 and 239.58 thousand tonnes in 1995-96. In 2000-01, it dropped to 222.16 thousand tonnes but in 2005-06 it soared to 279.53 thousand tonnes. Bihar has now been divided into two parts Bihar and Jharkhand. Owing to this division Bihar has suffered in some sources of production of fishes. A sizeable number of medium reservoirs and large reservoirs have shifted to territory of Jharkhand. At the same time, Jharkhand has got a substantial number of ponds and tanks of different sizes which have remained with the state of

Jharkhand. As far as fish production is concerned, Bihar is a loser on this count. But the River Basin System has remained with the state of Bihar. It is true that Bihar is a land locked state. It has immense fresh water and aquatic resources. Resources are mainly of two types, i.e., culture and capture. Bihar cultivates farming of fishing and also captures the fishes which are born in the river system and flow in the rivers. The greatest potential development lies in culture of fishes.

In fact, after division of Bihar, it has left only two actual resources that are land and water. There is bountiful natural fisheries resources in the form of rivers, reservoirs, flood plains (chaur and mauns lakes, tanks and ponds, etc.) which are ecologically most conducive for aquaculture development but, unfortunately about 20-25 per cent of these resources could be exploited and 75 per cent are unutilized which lead to wide gap in demand and supply of fish in the market of Bihar. It may be stated that Bihar is a land locked state hence it has been deprived of the saline water which can be found only in seas and oceans. The saline water fishes which are available in tidal zones are not found in Bihar. Therefore, Bihar has to depend mainly and wholly on inland catch of fisheries. However, the river basin in Bihar is dominated and occupied by the mighty rivers like Kosi, Ganga and its tributaries like, Sone, Gandak, Burhi Gandak, Bagmati, etc. In Chhapra even the river Saryu meets the river Ganga. All these rivers are perennial rivers. They do not dry up even during the summer season. The level of water and its flow diminish a great deal during the summer season. At the same time it should be noted



that during the rainy season the rivers are swollen and burst through the banks and inundate vast tract of land.

In fact, north Bihar is known as flood prone area due to large number of small rivers which flood the neighbouring areas. But the word prone is not a suitable word. The word, prone, does not connote regularity of visitation and an area which is prone to anything means that things may sometime, visit and sometimes may not visit. An earthquake prone area is that in which there greater likelihood of earthquake is occurring. But it is not certain that it will visit every year and every time. Similar is the case with cyclone prone area. North Bihar in this sense cannot be said to be a flood-prone area. Flood is an annual and regular visitor. Therefore, flood sweeps through north Bihar every year. Further intensity or virulence or violence of the flood may vary from time to time and from year to year. Flood is sure to come and is sure to devastate the land.

It has been observed that culture fisheries constitute one-ninth (1/9<sup>th</sup>) of the total fish production in all over India. But in Bihar this share comes to about 20 per cent only. The remaining 80 per cent comes from the capture of wild stock of fish generated by nature in the rivers. Ganga traverses over 500 kms in Bihar. It is true that flood causes havoc and destruction. But it is also true that flood fills the lowlying lands, dried-up tanks and pools and abandoned river meanderings and canals with water which becomes a sure breeding ground of fishes.

During the period between 2001-02 and 2005-06, there has been a continuous increase in fish production in the state of Bihar due to awareness of the latest method of fish production. 10 years back, the share of fish production in total agricultural GDP was just half of what it is today. Thus, during the last ten years the fish production has made a quantum leap and doubled itself. Upto December, 2006 the fish production in Bihar was 170 thousand mt. tonnes. In 2001-02, it was 2 lakhs 40 thousand and in 2004-05 it came to 267.51 thousand tonnes. The Govt. of Bihar earns income from Jalkar settlement also. In 2005-06, it earned of Rs. 440 lakhs. (Economic Survey, 2006-07, Govt. of Bihar).

This is a fact that Bihar is one of the poorest states of India where more than 70 per cent population have their livelihood from agriculture and allied activities like aquaculture, dairy, poultry, etc. According to one source of information fishermen community constitutes 14 per cent of total population of Bihar (Nishad Jyoti, Manthly Fisheries Journal, and April, 2003). The fishermen community is one of the poorest of the poor sector of the society who sustain its livelihood on fish production and marketing. Aquaculture is one of the promising, fast growing foods farming sector of Bihar. It ranks 12 the largest fisheries resources in India and occupied 3<sup>rd</sup> position in inland fish production (Fishing Chimes, June, 2001).

The major impediments of fisheries development in Bihar is lack of knowledge about scientific fish culture, illiteracy and disorganized extension linkages among fishermen community. On account of these constraints majority of fish farmers is still practicing fish culture in traditional method. Further, against the present demand of 4.5 lakh mt. tonnes of fish, the present production is 2.2 to 2.5 lakh mt. tonnes (Singh, A.K. & Ahmad, SH, 2003). Despite vast resources and demand for consumption of fish the Blue Revolution is yet to take off in the state. The state Fisheries Extension Services which is supported by Fish Farmers Development Agencies (FFDAs) have to play an important role to fill the gap of potential production and existing production and augmentation of the fisheries/ aquaculture development in Bihar.

### **1.5 Kosi River System**

The Kosi river system comprises of several smaller rivers, viz, Bagmati, Burhi Gandak, Tilinga, Dhemura, Balan, Kamla, Jibachh and other rivurlets and innumerable dhars, Ox-bow lakes, Chauras, Wetlands, mauns and swamps which serve variously for irrigation, inland fisheries and for the production of several other aqua crops.

The river Kosi drains a total catchment area of 7403089 sq. kms. out of which only 1140817 sq. kms. (15.41 per cent) lies in Bihar and remaining 6262272 sq. kms. (84.59 per cent) is in Tibet and Nepal. It has a total length of 492 km. (Rao, 1975) which constitutes the mainstay of fresh water capture fishery of north Bihar. Fisheries from this region faced the requirement of not only various parts of

Bihar but also to other states (Srivastava & Munshi 1983). Right from the entrance of this river in the Indian territory of Bhimnagar Barrage, the river is bounded by two embankment the eastern and western to control flood. The river forms many interlacing channels due to its profuse branching. On account of vast ramification of the river course the fisheries of this region is greatly diffused with a multitude of landing and production centers. There are twelve leading fishing centers and Arhat (assembling centers) located at Bhimnagar barrage, Saraigarh (35 km. down stream of barrage), Supaul (20 kms down stream of Saraigarh), Naunatha (25 km down stream of Supaul), Saharsa, Simribakhtiyarpur ( 40 km. down stream of Nauhatta), Dumarighat (30 kms down stream of Simiribakhtiyarpur), (Narayanpur 99), Sonbarsaghat, Satishnagar, Kotana and 912) Kursella (situated near the confluence of Kosi and Ganga).

Fishing at all these centers are very lucrative over a major part of the year. So far the flood prone areas in Kosi river basin is concerned it is to be pointed out that out of 15 river basins in Bihar, 7 falls in North Bihar, one the Ganga stem and 7 in Central Bihar. The river basins of north Bihar is mainly known for kosi river basin, which has the largest flood prone areas (10.80 lakh ha). It is a snowfed river and hence perennial. The catchments area falling in Bihar is distributed under several districts of North Bihar plains (Sub-zone I) and North-East plains (Sub zone II) of middle Gangetic Plains Agro-Climatic Zone. The total population in the kosi river basin is about 85 lakhs and out of it 85 per cent population constitute the workforce

in agriculture which are destroyed by recurring floods. However, the occurrence of floods in the region has a peculiar advantage of possible fishery area in the form of flood plains, called in common parlance as 'chaurs' having a water spread area of about 2 lakh hectares as estimated in Investigation into Selected Waterland Problems in north Bihar (1991). Thus, the region has much of potentials of fish farming but due to non-promotional exercises of the government it is almost halted.

In Kosi river basin, floods are regular, recurrent and unending annual visitors. Between the year from 1953 to 1988 to 2003 the flood damages have been enormous and all crops washed away. Houses collapsed. Public utility vanished. Bihar is primarily agricultural state and floods destroy agriculture. The result is that the people have nothing to eat.

Keeping in view of the above facts, an attempt has been made to conduct this study. It may be stated that if flood waters are utilized as an income generating source, they will become a great boon for the people. Technique and will should be there to convert the destructive flood water into constructive and creative source of earning livelihood. The silt-laden flood water if used judiciously for fish culture purpose can improve the economic condition of local fishermen communities and also serve as a seat for fish protein supply to this economically backward region of Bihar.

## **1.6 Objectives:**

The main objectives of the study are as follows:

- (a) To study the prospects of fisheries development in water logged areas and the efficacy of reservoirs for fisheries development.
- (b) To evaluate reorganizing, improving and strengthening the infrastructural components of training and extension programmes, so as to improve the socio-economic status of the fishermen and providing part time and full time employment to the rural people residing in the region of the flood prone areas in Bihar.

Hence, the study aims at

- (i) To examine the socio-economic status of the people of the area.
- (ii) To investigate the prospects of fish farming in flood affected areas.
- (iii) To estimate the cost of cultivation and production of fish.
- (iv) To identify the various channels and system of fish marketing.
- (v) To identify the existing constraints of fish farming in the area, and
- (vi) To suggest policy measures for the development of fish forming in the area.

## ***1.7 Hypothesis***

The following hypotheses were tested:

- (i) Can the damage done by floods be converted into a source of benefits/profits for the disadvantaged people of the area?
- (ii) Can the fish farming be so viable that it can improve the socio-economic conditions of the people?
- (iii) What types and kinds of fishes be farmed so that profits may accrue assuredly?

## ***1.8 Methodology***

So far the methodological aspect of the study is concerned it relates to the methods adopted in selection of the study area, drawing the sample respondents, schedule-cum- questionnaire used in collecting the desired information both at macro and micro levels to arrive at analytical conclusion. The methodological details containing the research design, methods and tools and the analytical procedures, etc. have been outlined in sub-sections as below;

## **1.9 Research Design and Sampling Procedure**

The universe of the study is Kosi River Zone of Bihar. The study has been undertaken in two flood affected zone. The first sub-zone of Kosi River Basin is the north-western region of the basin and similarly the second sub-zone is the north-eastern region of the Kosi basin.

A multi stage stratified random sampling design has been used for the bottom unit of the sample. At the first stage, three districts from each of the zone were selected on the basis of (a) larger area

inundated under flood water for longer period, and (b) extent of larger crop damage and larger number of ponds, tanks, rivulets, ditches, dry catchment area of dams, canals, etc; are filled up with water. Therefore, six districts, namely, Madhubani, Darbhanga, Samastipur, Khagaria, Supaul and Purnea were selected for the intensive study.

At the second stage, two blocks from each of the selected districts were selected on the same basis as stated above. Hence, the total number of CD Blocks is 12 which are as Phulparas and Madhepur from Madhubani, Ghanshayampur and Kusheswar Asthan from Darbhanga, Rosera and Hasanpur from Samastipur. Khagaria and Parbatta from Khagaria district, Marona and Pipra from Supaul, and Dhamdaha and Purnea east from Purnea district.

At the third stage, a reconnaissance survey on the basis of Rapid Rural Approval method was made with a view to enlisting the fish farmers and non-fish farmers engaged in cultivation in the area with the help of District Fisheries Officers (D.F.Os.), Fisheries Extension Officers (F.E.Os.), NGOs and Cooperative Societies.

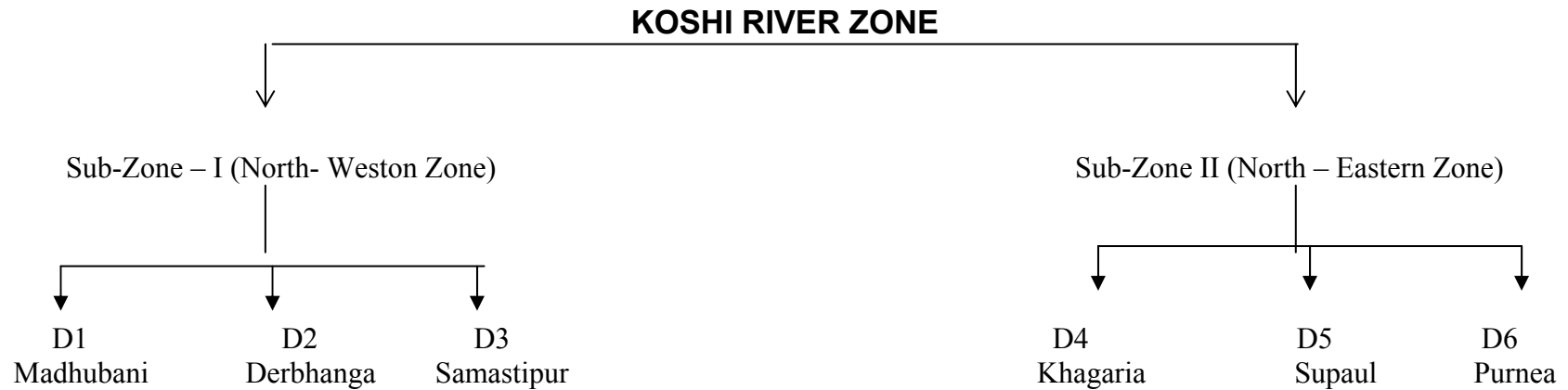
At the fourth stage of sampling 40 respondents comprising 20 fishermen and 20 non-fishermen from each block were selected from all categories, i.e. marginal, small, medium and large fish farming and three categories of other growing crop farmers on the basis of high damage, medium damage and low damage.

Thus the total sample size is 480 :  $2 \text{ zones} \times 3 \text{ districts} \times 2 \text{ blocks} \times 40(20+20) \text{ respondents} = 480$ .



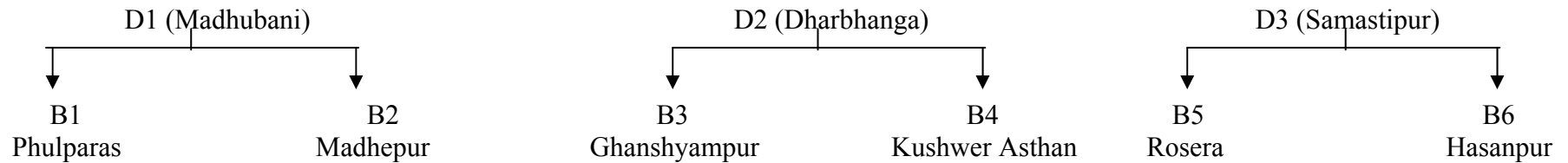
# SAMPLING DESIGN

## Stage-I - Selection of Zones and Districts

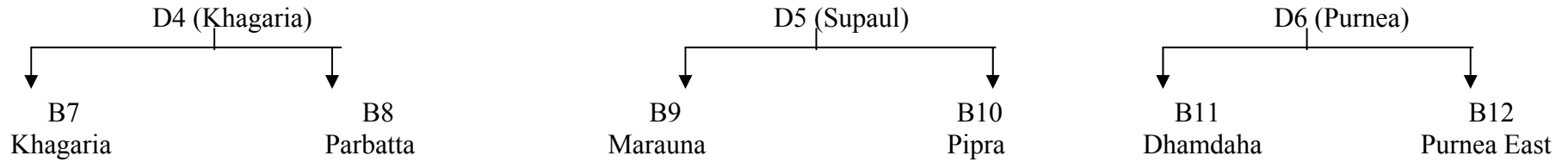


## Stage - II - Selection of Blocks

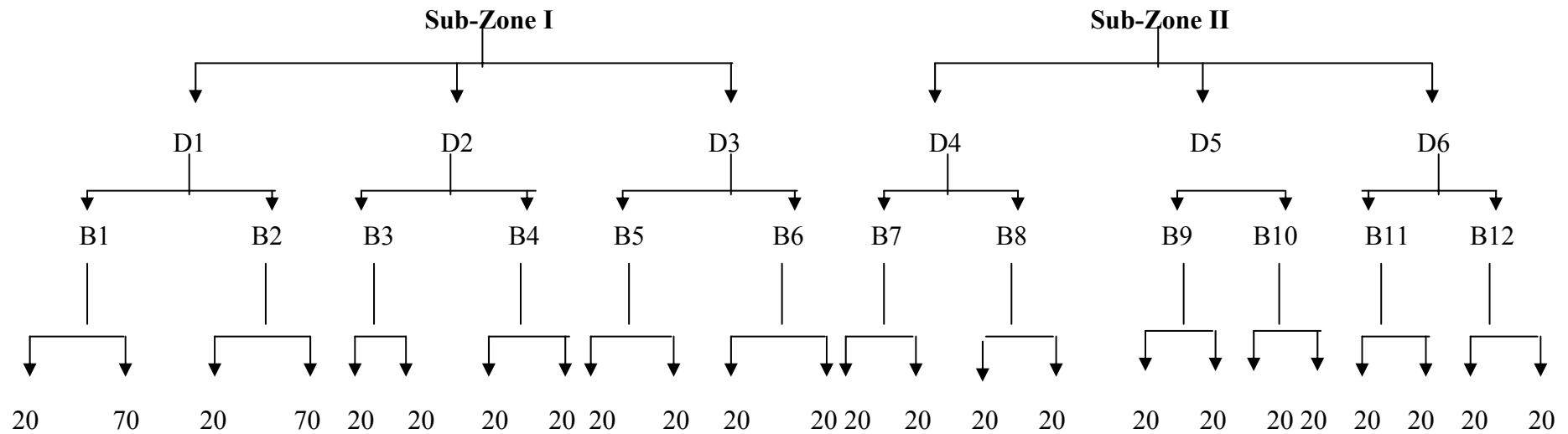
### Sub- Zone - I



## Sub- Zone - II



## Stage-III - Selection of Respondents



### **1.10 Research Procedure**

The research procedure followed for the study consisted of the methods used in the collection of relevant evidences and information as secondary data from Fisheries Department of the state level, District level, Block level, Cooperative Societies, Panchayats and NGOs operative in the sampled area. The primary data were obtained from the sampled respondents pertaining to financial year 2007-08 in order to achieve the objectives and hypothesis of the study. The survey method was used for collection of primary data as this method was found to be the most appropriate and feasible for descriptive type of study like the present one. The primary data were collected directly from the sampled respondents by visiting their premises several times to obtain required relevant information like their family structure, occupation, their assets, investment, expenditure incurred in fish farming, etc. with the help of specific and pre-tested schedule-cum-questionnaire.

### **1.11 Limitations of the Study**

The present study, being an empirical one, has certain in-built limitations such as:

- (i) It was not possible to cover entire area in view of time constraint and resource constraint.
- (ii) The respondents were mostly illiterate and shy and also in some cases they were disinterested.
- (iii) The investigation has been carried out only in six districts and 12 blocks of the Kosi region, therefore, the general acceptability of the results have its own limitation.

- (iv) Primary survey research method of data collection is based on recall of memory because the fishermen as well as other farmers of the region were not maintaining the records. So it can not be free from its biases particularly in case of literate and semi-literate respondents.

### **1.12 Layout of the Report**

The study has been organized in six chapters. The first chapter is an introductory one dealing with the significance of the study, review of literature, objectives, hypothesis, methodology and limitations and layout of the report. The second chapter presents the profile of the study area comprising state of Bihar, sampled districts and sampled blocks. The third chapter delineates the socio economic features of the sampled respondents and gives an account of results and discussions relating to the theme of the study. The fourth chapter highlights the prospects of Fisheries Development in the flood prone areas of Bihar. The last chapter contains summary, findings and recommendation for formulation of a rational policy for the development of fish farming in the study area.

### **1.13 Review of Literature**

A Number studies related to economics of Fish farming have been conducted by eminent social scientists and economists at national level, state level and district level in India. Their main findings have been discussed in the following paragraphs: Bihar has immense scope for inland fisheries development in India. Bihar ranks 3<sup>rd</sup> in inland fish production and 6<sup>th</sup> in fresh water seeds production in

India (Fishing Chimes June-2001). In Bihar, the fishing activities are mainly carried out by fishermen community which is one of the poorest sections of the society. Due to illiteracy, poverty and unawareness about scientific knowledge, the fishermen are unable to avail the real resources for the development or scientific technique in fisheries profession.

It was observed (1977) that a tank thus prepared for growing fish should always be stocked with good quality, fast growing fingerling. Although it is possible to grow only one variety of carp in a given tank it is more economical and profitable to grow three or four varieties of together, because different varieties carps feed at different levels. Some feed at the bottom others feed at the top, some feed in columns and yet others feed on grass the periphery. Catla, Rohu, Mirgal and the Common carp may be grown together. If the fish mix include Catla, Rohu and Mirgal the proportion should be 4:3:3. Should common carp be added the combination can be put at 4:2:2:2.

Prior to the release of fingerlings the water in the tank should be thoroughly agitated which will help in decreasing the surface water temperature. Fingerlings should then be lowered into the tank in a happa and after they are conditioned to the tank water for a while they may be allowed to escape into the water slowly. Alternatively, fingerlings can also be lowered into the water in buckets and allowed to escape slowly.

Srivastava *et. al.*, (1984) conducted a study on farm management in the country and observed that there are three types of farmer's income groups. (i.e., net income, family labour income and business income). The study revealed that, the yield of an average pond in all India level is 681 kg./ha. The income pattern of different income group of farmers were Rs. 1740, Rs. 2170, and Rs. 2898 for net income group, family labour group and business income group of farmers respectively. The state wise analysis revealed that, the fish farming achieved good results in Bihar, Madhya Pradesh, Orissa and West Bengal.

Srivastava *et. al.* (1984) year also made a study on marketing of fish in India and reported that roughly 60 per cent of the farmers in all India used to sell their harvest in part or full in local market while the remaining in the outside market. It was further observed that, the fish farmers sold their produce to variety of customers.

Srivastava *et. al.* (1984) conducted an experiment on culture practices of fish in different parts of India and reported that, organic fertilizer was used in about 44 per cent of pond and inorganic fertilizer in about 15 per cent of the pond. The data also revealed that, out of total fish production 77.4 per cent share come from Indian Major Carps while 27.6 per cent share for other species of fishes.

R. Korakandy (1984) revealed that traditional fishermen in Kerala find in the purse seine net a potential threat to their livelihood as it

sweeps all waters traditionally considered to be their preserve and leaves no fish to be caught by them or for breeding. The purse seine operates (mostly non-fishermen), on the other hand, consider it a highly productive field for investment despite all the attendant risks. The fish merchants have welcomed purse seine fishing as it assures them of a large quantity of fish for selling at considerable profit in the interior market. He concluded that fishing in the inshore waters by mechanised vessels continued uninterrupted with regular snatching of the catches by traditional fishermen and occasional protests and violence in the sea. The banning of purse seining at Cochin on more than one occasion is only a manifestation of the growing crises in the traditional fish economy of Kerala, characterized by declined catches, unemployment and low earnings. The development of the purse seine industry has only aggravated this problem.

B.N. Chodhary (1990) observed that, selection criteria of farmers in extension implementation programme, and selection of suitable site for demonstration of Aquaculture technology plays an important role in diffusion of fish farming.

S. Ganesau et al (1991) depicted that a net profit of Rs. 24.117 was obtained in mixed farming with duck-cum-fish culture and Rs. 13.790 was obtained from an existing up cropping system from one hectare farm. The introduction of duck-cum-fish culture as a component in mixed farming yielded more income. This was in conformity with the finding reported by Rajbanshi and Shrestha

(1980). By the introduction of duck-cum-fish culture as a component in mixed farming, the income per day increased from Rs. 37.78 in arable farming to Rs. 66.07 in mixed farming and the employment generated increased to 383 man-days. An additional 144 man-days of employment were generated by the introduction of mixed farming over the conventional cropping alone.

Satheesh et. al. (1985) has also made similar observations. From the above results, it can be concluded that in the Cauvery delta region of Tamil Nadu, mixed farming can be taken up with duck-cum-fish culture to earn a steady income and employment throughout the year.

Singh R.K.P. *et. al.* (1995) studied the economics of fish production in Hansanpur block of Samastipur district in Bihar, They emphasized that, the fish culture is the domain of the economically and socially backward sections of the society. Fish farmers are still using indigenous species of fishes and practicing traditional methods of fish culture. The uses of chemical fertilizer and supplementary feeds have just been introduced in the study area but the farmers are unaware of the scientific level of their use. Various institutions are making efforts to increase the supply of improved species of fish for stocking and educating fish farmers for improved fish culture.

P. Ratnam (1995) emphasized that the implementation of this shrimp culture project has shown that, aquaculture need not be confined to the big entrepreneurs and the Corporate Sector. With initial



financing, encouragement and technical supervision, the weaker sections of the Society, especially the SCs in the remote area can make shrimp culture as an economically viable activity to improve the standard of living of their families, improve their social status and above all to earn foreign exchange for the country in their own small way.

The experiment at Mulakuddu village has shown that a land based scheme like shrimp culture helps in bringing the poorest of the poor above the poverty line. At the initial stages of implementation itself, we faced “some’ discouragement and inhibitions from certain obvious sources, with futile attempts by scene to snatch away this land. But the beneficiaries proved their detractors wrong by living upto expectations.

Dilip Kumar (1996) emphasized the need for creating the awareness about the emerging advancement in aquaculture technology in the fishermen society. It is necessary to organize short term training for rural youth with emphasis on learning by doing for generation of self employment opportunities and socio-economic development of fishermen community.

Subrathum (1996) suggested that, integrated fish farming technology with emphasis on participatory approach is required for creating strong and effective linkage between the extension personnel and fish farmers.

Ahmad (1996) reported that, Makhana (*Euryal ferox*) cum Fish Farming and Singhra (*Trapa*) cum Fish Farming are most beneficial in Mithalanchal region (Darbhanga, Sitamarhi and Muzaffarpur) has a great scope for development of such type of package of technology.

Barr J.F.F. Cluwn (1998) concluded that the weight of evidence from many developing countries, including India, is that better and more sustainable management of natural resources occurs where resource users act collectively (Pretty, 1995, Farrington & Lobo, 1997). The properties of water mean that sustainable water management is best approached at a large (greater than field) scale. Carruthers (1992) states that “water development is an area where participation and empowerment can have real meaning”. Thus the options for better on-farm water management identified in this study must be set in the context of watershed management and collective actions.

The paper has identified a number of options for improved on-farm water management from both the sub-continent and Africa from both research efforts and farmers own technologies. These options are necessarily at a fairly high level of generality, they need to be informed by the local context and condition. Ideas from local farmers need to be allowed to “trickle-up” to provide practical farm-

scale insights into water management in the project area (Carruthers, 1992).

As has been shown in this paper, the project covers an area that is spatially diverse and temporally variable- an heterogeneous physical environment. Furthermore the farming systems are complex, diverse and risk-prone (CDR). It should be clear from the participatory research exercise to which this paper contributes that single off-the-shelf 'package' solutions are not suitable in these circumstances. This final section of the paper outlines a system whereby the diversity of farming systems and environmental situations can be broadly classified into like groups for whom there are sets of options that can be further tested and developed through the participatory research process. Thus sets of options and activities are given as loci for participatory research, they should not be seen as prescriptive, but rather as topics which might usefully be considered in relation to water management. Because of the "system nature" of water management, upstream and downstream cause and effect need to be taken into account in aquaculture development-these options provide a framework for that process.

M. Sinha (1999) emphasized that the development of inland fisheries in India is a must to meet the required quantity of fish but it is at a critical point in its development. Degradation and loss of fisheries habitats are increasing and a national perspective is essential for the sustainable development and exploitation of our inland fisheries resources. Ecosystems are threatened by first changing coastal

configurations, wetlands loss, environmental perturbations and destructive fishing practices. These resources in developing countries are especially vulnerable because the national priorities for their development are often in conflict with the norms of conservation. Development strategies need to have a holistic approach suiting to all aspects of the resource. In the integrated development of multipurpose use systems, it should be mandatory to develop all living resources together.

Thus, a system which links the management of fisheries, forestry and agriculture to agro-industrial and hydro-electric units will facilitate optimization of production from the river basin. Sound environmental protection norms, keeping fisheries in perspective, accompanied with due priority for proper utilisation of available inland fisheries resources is a must for sustainable development. CIFRI would continue to provide the required research back up to combine the environmental norms and sustainable development of inland fisheries resources in order to meet the requirement of the country. It is essential that all concerned (scientists, planners and development agencies) work together for utilisation of this most important resource bestowed to us by nature.

V.N. Pillai (2000) stated that, Fisheries Extension Programmes need to be strengthened in manifolds in the coming years through the active involvement of the fisher folks working in the inland, brackish, and marine water sector.

Dilip Kumar (2000) reported that, the task of extension becomes more difficult when the technologies to be introduced are developed with the object of long term benefit and sustainability. It is easy to convince them about the benefit of modern technology by demonstrating production and profit but is difficult to make them to understand about long term gain.

S.N. Dwivedi (2000) observed that, the knowledge system and knowledge society through Aquaculture policy have initiative advice to use WTO and IPR for patenting Indian technology.

T.K. Deka *et. al.* (2000) observed that, about 3000 fishermen households of 13 districts of Assam have evaluated the factor that determine the poor economic condition of fishermen community of Assam. A number of socio-economic factors were considered for the study.

Md. Abdul Brahman *et. al.*, (2000) observed that, the extension strategies of Proshika's fishermen programme is to make access to the organized poor working in derelict ponds and water bodies, providing farming, workshop, seminar, credit, follow up etc., where the key elements for implementation of programme and diffusion of fish farming in scientific way is used.

H. Chaudhary *et. al.* (2000) observed that, extension survey through Questionnaire has provided data relating to their socio-economic status.

R.S. Sisodia (2000) stated that, the Ministry of Agriculture, Govt. of India (Fisheries Division) has taken lead in this direction and launched a scheme during the 8<sup>th</sup> five year plan on “Strengthening of Infrastructural Facilities for Inland Fish Marketing”. Under this scheme, 100 per cent financial assistance is provided to the State Govt. for establishment.

S.N. Mohanty *et. al.* (2000) observed that, under a development of the project on “Women in Fisheries in Malkanagirl” Orissa, sponsored by UNIFEM/UNDP, a study was undertaken to identify and analyze the role of rural women’s with regard to fish farming activities.

S.K. Bhatnagar (2001) depicted that, the extension plays a major role in popularizing new technologies to be used in fish farming. It has been observed that, there is acute shortage of extension workers in various Govt. Departments who are supposed to provide extension services in the field to advise the farmers and as such they are not able to play effective role.

According to Yadava (2002), environmental issues have always been the point of debate in shrimp farm development. While the harvest from capture fisheries around the world has stagnated, aquaculture is viewed as a sound option to increase fish production, and play a vital role in providing food and nutritional security. However, the shrimp farming sector has been strongly opposed by environmental groups

on many occasions, not only in India but in many other countries around the globe. Legal interventions have been sought to curtail shrimp culture, to preserve the coastal environment and the ecology. Though the polarisation of options on the adverse impact of aquaculture in the nineties was very strong, there are signs of more tolerance to accommodate diverse views and options lately and allow development of shrimp farming in an environment-friendly and sustainable manner.

Returns from shrimp farming continue to be rewarding, benefiting small-scale farmers and coastal communities, as well as entrepreneurs engaged in seed production, farming operation of ancillary activities. Sustainable utilisation of available areas and infrastructure can lead to the development of under exploited resources with the potential of generating a large number of jobs and enormous social and economic benefits to the coastal regions of the country.

S.K. Thade IAS (2002) stated that, growing awareness among the rural people regarding practicing improved Aquaculture that can assure better benefit. Further progress will depend on the successful diffusion of eco-friendly improved technology.

S.N. Ojha *et. al.* (2003) depicted that, technological findings of the Aquaculture Institute should be tested for their eco-friendliness.

D.N. Singh, *et. al*, (2003) showed that, an aquatic resource is a vital tool for transforming India into nutritionally secured nation. Development of this product can bring both improvements of the socio-economic status as well as nutritional security in the country. The efforts of TIFAC in this direction have been fruitful from the encouraging result obtaining from various prospects.

P.K. Thakur et al (2003) depicted that pitiable condition of the fish marketing practices which are based on highly traditional patterns, unchanged and unfound elsewhere. The middlemen, however, placed in advantageous position having monopolistic control. As to price structure, the present set up seems to work with lowest price to fishermen highest price to consumers and maximum spread in between for middlemen, while it should be highest possible price for fishermen, lowest possible price for consumer and minimum spread in between (Berube, 1964). The overall management of Fisherman's Co-operative Societies was poor, as a result the real producers, the fishermen are being least benefited which is a matter of serious concern.

Ram Bharat Thakur (2004) reported that, the development of rural areas indicates that, the weaker sections of the society have been least benefitted from the economic growth which occurred in the country. The objective of poverty alleviation programmes such as IRDP, JRY, and PMRY are indeed commendable and need to be taken care of while suggesting measure for generation of employment and income.



C.J. Feare (2006) revealed that the many types of integration between fish and poultry farming clearly present opportunities for the dissemination of AI viruses through poultry. There is, however, no firm information that AI has been disseminated in this way, but this possible means of transmission should be considered where interpreting outbreaks of AI in wild and domestic birds at water bodies. The long distance transportation of poultry products for incorporation into fish feed, or already incorporated into exported fish feed, could provide opportunities for long distance spread of the virus. This assumes that the virus survives in such products but this has not, to my knowledge, been investigated. Once AI virus gets into poultry, IFF/IAA could lead to local spread, both to other poultry and to wild birds. In this case we might expect an initial outbreak in an area, followed quickly by satellite outbreaks nearby. Although details are sketchy, this is what appears to have happened in southern Russia and now in Romania and Turkey. One cannot say the fish farming has been involved in these outbreaks, but investigations of the possibility would be welcome.

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# **Chapter: Two**

## **PROFILE OF THE STUDY AREA**

In this chapter, an attempt has been made to examine the profile of the study area. It has been divided into five sections. The first section gives an account of the profile of the state of Bihar. The second section presents the features of the Kosi River Basin. The third section outlines the profile of the sampled districts. The fourth section portrays the profile of the sampled blocks. The last section gives a detailed account of Zalkars or water reservoirs of the study area.

### **2.1 Section I: Profile of the State of Bihar**

Bihar is the third most populous and the 12<sup>th</sup> largest state in India. It spreads over 9.41 million hectares of land. The state supports about 8 per cent population of the country with only 2.87 per cent of the landmass. The total population of the state was 8.28 crores (2001 census). Out of the total population, rural population constitutes about 89.5 per cent of the total population against 72.20 per cent of the country. The density of population per square kilometer as per the 2001 census was 880. In terms of density Bihar ranks 7<sup>th</sup>. The

zone-wise population varies with the variation of zone. The population composition of the state is divided broadly in four categories Scheduled tribes. i.e., General castes, backward castes, Scheduled castes and the percentage of caste categories are not uniform in the state.

The economy of the state of Bihar is predominantly rural. About 89.53 per cent of the total population of state lives in the rural areas and only 10.47 per cent of the population in urban areas. The pace of urbanization is more or less constant in last four to five decades. It has been noted as the lowest in north Bihar plains and highest in the south Bihar.

According to 2001 census, about 27 per cent of the population was workers. This shows that load of dependency is quite higher in Bihar. The proportion of workers to total population in the case of males and females work out to be 90.19 per cent and 9.81 per cent respectively. Nearly 81.22 per cent of the total workers are engaged in agriculture (as cultivator or agricultural labourers). The percentage of workers engaged in cultivation appears to be quite high in all the districts of the state of Bihar.

A marginal increase in literacy from 34.70 in the year 1991 to 47.50 in the year 2001 in the state has been observed. The proportion of literates in the state was much lower than the all- India average i.e. 72.70 per cent. The rate of literacy among Scheduled castes, Scheduled tribes, backward community was lower than that of forward caste categories.

Bihar is situated between 21°-58`-10`` ~ 27°-31`-15``N Latitude and 82°-19`-50`` ~ 88°-17`-40`` longitude. It is bounded on the north by Nepal and West Bengal, on the east by West Bengal, on the west by Uttar Pradesh and Madhya Pradesh and on the south by Jharkhand. Bihar is divided into three clear sub natural divisions or zones as per agro- climatic situation. They are: (a) North Alluvial Plains, (b) South Alluvial Plains, and (c) Gangetic Plains.

North Alluvial Plains is situated in north of the Ganga river. The districts coming under the zones are Saran, Siwan, Gopalgunj, East-Champaran, West- Champaran, Sheohar, Sitamarhi, Madhubani, Darbhanga, Muzaffarpur, Vaishali, Samastipur, and Begusarai .The entire zone of the plain is extending from Tarai region of Nepal to the northern bank of the Ganga. The elevation is 30-40 meters above minimum sea level. The major rivers flowing under the zones are Ghaghra, Gandak, Buchi Gandak and numerous streams flowing out from the Himalayas. The other major rivers of north Bihar are Bagmati, Adhwara group, Kamla Balan, and Kosi. Nearly 70.23 per cent of the sub zones is flood –prone. A good percentage of geographical area of this sub zone is afflicted with water logging problems and this is the most serious problem of the region.

South Alluvial Plains zone is spread in south of the Ganga and extends up to Kaimur hills and Chottanagpur and Santhal Pargana regions. The districts falling under this zone are Bhabhua, Rohtas, Aurangabad, Bauxar Bhojpur, Jahanabad, Gaya, Nalanda, Patna, Nawada, Sheikhpura, Lakhisarai, Jamui, Banka, Munger, and

Bhagalpur. This zone is overlapping from the other sub-zones and across the zone. This zone is further classified into two sub-zones i.e. zone (III)A and zone (III)B. In between these two sub-zones, a number of hills like Barakar hills, Rajgir hills and Kharagpur hills also lie in this zone. In this zone, Major River like Karamnasa, Sone, Punpun, Kiul, Badua and Chandan all fall into the river Ganga.

Bihar's climate is characterized by three different seasons i.e. Hot weather (from March to mid-June), Rainy season (from mid-June to mid-October) and Cold season (from November to February). The annual mean temperature varies from 24.1° C to 28.4° C. The maximum temperature varies from 38.7° C to 46.2° C, while the range of the minimum temperature is 2.3° C to 9.0° C. The rain starts in mid-June and continues upto mid-October. The normal rainfall in Bihar is 1272 mm approximately while the sub-zone wise rainfall varies with the variation of zones i.e. in Zone I(1040 -1450 mm) with average 1245 mm. In zone II it varies between 1200 mm and 1700 mm) with average 1450 mm and in zone III it ranges from 990 mm to 1240 mm and average is 1115 mm. In the entire zone and the state the period from mid-June to mid-October witnesses about 85 to 90 per cent of the total rainfall. The rainfall in late September and early October (Hathia and Chitra Nakhsatra) is of considerable importance for the production of grain and cash crops.

The soil in the plains, both north and south, is alluvium. This alluvium soil can be subdivided in three sub-zones i.e. clay and clayey loam soil in the areas lying north and north-east of Budhigandak and the sub-zone I. While in sub-zone II and diara

areas, the soils are well drained and high textured with free calcium carbonate. The soils near the stream of Ganga are sandy or coarser in texture which gradually becomes finer with the distance from the rivers and become heavy textured or clayey. Thus, the characteristics of the soil in the zone are Sandy loam and Clay loam. In sub-zone III. Sandy Loam, Clay Loam and Clay are found. The character of alluvium is closely related to the river system that forms it.

## **2.2 Land Holding Pattern**

As per the latest data, the number of holdings of Bihar has increased from 9936 thousand in the year 1976-77 to about 13500 thousand in the year 2002-03 i.e. by 36.20 per cent, which may be due to splitting of farm families. The marginal and small holdings (less than 2 ha) have increased from 64.60 to 91.30 per cent during the period. Whereas the number of large size farmer has decreased from 10.84 per cent to 0.23 per cent during the same period. The area share of marginal and small farmers has increased from 37.66 per cent to 59.68 per cent during the period while share of medium and large size farmers has decreased.

## **2.3 Flood Prone Areas**

The flood is a major and chronic problem of the State resulting in huge economic loss to the farmers as well as to the State. The area affected by different river system is presented in table 2.1.



**Table - 2.1**  
**Flood- Prone Areas of the State of Bihar**

Name of Rivers	Flood Prone (in lakh ha)
Ganga	12.92
Koshi	10.15
B. Gandak	8.21
Punpun	6.13
Bagmati	4.44
Mahananda	5.15
Kamla Balm	3.70
Sone	3.70
Gandak	3.35
Saryu	2.53
Chandan	1.13
Badua	1.05
<b>Total</b>	<b>68.80</b>

*Source: Irrigation Reports, Govt. of Bihar*

#### **2.4 Section II : Profile of the Kosi River Basin**

The Kosi, ‘the Sorrow of Bihar’ originates from Gosainthan, situated to the north-east of Kathmandu (Nepal), descends across Kanchanjunga and enters the Terai region near Chatra and then flows into Bihar. Kosi is also known as ‘Sapt Kausiki’ has been formed of seven Himalayan streams originating from some of the highest peaks of the Himalayas. These streams from west to east are the Indravati, Sun Kosi, Tamra Kosi, Likshu Kosi, Dudh Kosi, Arun Kosi and Tamur Kosi originating from Gosainthan (7330 mts.), Gaurishankar (6533 mts.), Cho-Oyu, Everest (8848 mts.), Makalu (7717 mts) and Kauchanjunga (7845 mts.) respectively. They cut across through narrow gorges of the Himalayas till chatra. When the Kosi enters in Bihar, it flows through braided channels and the

gradient becomes usually flat. The Kosi covers a total length of 730 kms, and its catchment area is 86,901 sq. km. which is next only to that of the Indus (265728 sq. kms.) and the Brahmaputra (253952 kms.). [Das & Lal, 1969]. Kosi river basin comprises some of the highest mountain peaks of the world and hence the river not only carries an enormous surface drainage, silt and sand of the vast Himalyan region, but the contribution of snow-melt water is also significant. The water discharge at Chatra is 18000 cubic feet per second, but this figure increases to 3,00,000 cubic feet per second during rainy season.

Kosi is supposed to have no middle course. It enters the plains of Nepal terai at Chatra immediately after a steep and high descends from the slopes of the Himalayas. That is why, there is a sudden change from the young valley in the mountains to the deltaic stage of building and uncertain shuffle in the plains. This is the most critical feature in the peculiar character of the Kosi. In hilly areas, its gradient is 14 meters per km. Thus, the swift current of its flood water engulfs miles of area within an hour, deposits 3 to 4.5 meters deep sand and coarse silt and consequently turns good arable land into infertile cultivable wastes. In fact, the river has shifted its course between Darbhanga and Purnea for innumerable times (Dayal, P. 2002). There are 15 river basins in Bihar. Kosi river basin is one of the major river basins of North Bihar. The main districts falling under this basin are Madhubani, Darbhanga, Samastipur, Khagaria, Supaul, Madhepura, Saharsa, Purnea, Katihar, Bhagalpur and other adjoining districts of north-east Bihar.

Since time immemorial, the Kosi river has been a constant source of trouble and misery to the people of north Bihar for its devastating flood, rapidity of stream and evershifting course of its main flow. About 20,000 Km fertile lands of Nepal and India are almost annually flooded by it causing disturbances in human settlements and rural economy of the area. No wonder, it has earned the epithet- ‘Sorrow of Bihar’, or “Hwang-Ho of Bihar” (Ahmad, 1947).

The river generally creates, while meandering through its course, different types of wetlands and aquatic systems called *dhars*, *ox-bow lakes*, *mans*, *swamps* and *chours*. The network of meandering streams, by spilling all along their banks during the rainy season, creates vast sheets of shallow but lentic waters, which serve as ideal breeding grounds for fishes. This has developed into lucrative fishery resource of north Bihar. Quite naturally, people of North Bihar, especially the inhabitants of North-Eastern region of Bihar, grew into great connoisseurs of fish due to its abundance and low price (Dehadral, 1977). This is further evident from the ‘Fish-emblem’ of the ‘Darbhanga Raj’ and beautiful verses in the Maithili literature:- “PAG-PAG POKHARI MACHH MAKHAN, SARAS BOLI MUSKI MUKH PAN” (*Densely dotted with ponds abounding in fishes and makhana, sweet tongued people inhabit it, who relish fragrant Pan or betel*). Besides the fishery output, a good quantity of aquatic fruits, namely *Makhana Singhara*, *Chickor* and *Barri* are easily available from these wetlands without any substantial investment.

In order to control flood in north-Bihar and shifting nature of its course, the Kosi barrage with bundhs and canals were constructed in 1959. They have, no doubt, helped to a great extent in abating the human agony but, at the same time, have certain detrimental side effects on the age old flourishing fishery resources of the area by checking the formation of new wetlands as well as inhibiting the replenishment of waters in them.

‘Kosi’: *The Kausiki*

The Kosi known for its antiquity has some myths behind it. It is mentioned as *Kausiki* in epics, such as, *the Skandha Puran*, *Matsyapuram*, *Balmiki Ramayan*, and *the Mahabharata*, etc. In ancient literature, the river has been described as a large, powerful and sacred stream for holy bath. According to *Skandha Puran*, Kosi is said to be the daughter of *Kausiki Raja*, a celebrated *Kshatriya* King of *Gadhi*. The legendary semidivine maiden (Nymph) *Kausiki* had a brother named *Vishwamitra*, a worshiper of Para *Barhma*, or the Supreme God. His sister *Kausiki*, though *Kshatirya* by birth, was wedded to a *Brahamin* sage, *Richik* by name, who, had attained perfection by virtue of worshipping gods. The saint later on, got furious with his wife, for his son, unlike his father, rose against worshipping of gods. *Richik* cursed his wife and prayed God to convert his wife (*Kausiki*) into a river (vide Buchanan, 1928).

*Kausiki*, according to another mythical writing, was a mermaid goddess, a sea woman having the head and body of a lovely lady and

her waist ending as the tail of a fish. She was worshipped by the people inhabiting the *Matsyadesha*, the land of fishes. The Kingdom by that time was delimited between the old beds of Brahmaputra and the Karatoyo to which the kosi was connected by a water way.

In the epic *Balmiki Ramayana*, the *Kausiki* is associated with the *Vishwamitra- Satyavati* episode. Satyavati, the elder sister of the sage, was married to a saint Rehika. She followed her husband to the heaven from where she was transformed into a river, later to be known as the 'Kausiki', and, it was on its banks that Vishwamitra built up his hermitage and used to live.

Much like the Ganga, the Yamuna, the Saraswati and the Brahmaputra, the Kosi too has its own religious importance. People of the area take holy bath in this river during festivals. Several temples have been built up on the banks of the river, of which the following deserve special mention- temples of Barraha Mahadeo (8 Km downstream of Tribeni), Koka Mukh, both on the Nepal Hills, Dewanbaba Temple (Nauhatta), Karubaba Temple (Mahishi) and Katyanasthan (Salkhua). All these temples are in Saharsa district of Bihar.

## **2.5 Siltation Problem of Kosi**

The river represents an abnormally high rate of silt yield per unit catchment area, which is higher than that of any other river in the world including the 'Yellow River of China' (Mookerjee, 1971). The devastating flood waters of the Kosi bring enormous quantities of

silt and sand as load which is adversely affecting the vast area of fertile land, estimated to be 5,20,000 to 8,00,000 ha in Bihar and 80,000 to 1,20,000 ha in Nepal (United Nations, 1951).

Geographically speaking, the bed slopes and nature of sandy rocks of the river course are crucial factors responsible for land degradation and heavy silt concentration in the runoff. The bed slope of the Kosi ranges from 5 to 1 foot per mile upto its middle reaches, and less than one foot per mile in its tailend near its confluence with the Ganga at Kursella (Das, 1967). On account of this progressive flattening of the slope, the river is unable to transport all the sediment-loads received at Chatra down to the Ganga. Hence, the sediment load gets deposited in the river bed at various places. In addition to these, some of the geomorphic characters of the Kosi catchment basin, viz., smallest width of the valley, steep sides, absence of wide basins (pockets), anticlinal cracks, fissures and joints in the rocks, and above all, the excessive deforestation and rainfall have a cumulative impact on heavy sediment loads (boulders, pebbles, shingles, sands, silt, big trees, etc.) in the flood waters (Jha, 1979; Singh, 1986). Bed-load consisting of boulders pebbles and shingles generally get deposited between Chatra and Hanumannagar (Kosi barrage), while bulk of the coarse sediment gets deposited between Hanumannagar and Karhara. Medium and fine silts are carried further upto Salkhua (Saharsa).

## **2.6 Shifting Courses of Kosi**

The river Kosi is well known for profuse branching into many interlacing channels in its course. It does not remain static in a fixed channel for a long time. Since ancient times, it has been oscillating over a vast tract of north Bihar. This wild movement of the river has neither been steady nor continuous, rather has it been taking sudden jumps from one channel to another. In this process, it deserts the previous ones which still hold on some water (Chibber, 1949), leading to the formation of swamps and wetlands. The only comparable river in this respect is the 'HwangHo of China' (Ahmad, 1947).

The oscillating character is associated only with the Kosi and no other river of the region. The causes of oscillation have puzzled hydrobiologists, geographers and geologists. Furthermore, the westward shifting tendency of the Kosi as against the natural slope (north-west to south-east) and configuration of the region is more amazing. Several explanations have been given by different authorities from time to time. However, the most common and widely accepted explanation given by Das (1968) and Singh (1986) deserves special attention. According to these authors, siltation, rapid water discharge, and bed slopes of the Kosi flood plain, are responsible for ever shifting nature of the river.

In the early part of the 18<sup>th</sup> century, the Kosi flowed down the town of Purnea but it has worked west-ward across 120 km upto Saharsa-Darbhangga border. The left out channel at Purnea is now known as

“Katikosi”. During the period, the Kosi after issuing forth from Chatra turned east and southeast through Prunea and met the Ganga near Manihari and later on in its neighbourhood of Karhagola (1856). Since then, the river has been known to have carved out numerous parallel channeals during its westward migration from Purnea (1736) to Nirmali (1950).

The oscillating shifting nature and its rate of movement has been shown in the Table 2.2

**Table No. 2.2**  
**Shifting Courses of Kosi River**

Year	Period of Movement	Distance (Miles)	Moved in Km (s)	Movement (%)	Average movement (%) per year
1736-1770	34	6.7	10.78	10	0.29
1770-1823	53	5.8	9.34	8	0.15
1823-1856	33	3.8	6.12	5	0.15
1856-1883	27	8.0	12.87	11	0.40
1883-1907	24	11.5	18.51	16	0.67
1907-1922	15	6.8	10.94	10	0.66
1922-1933	11	18.0	21.97	25	2.27
1933-1950	17	11.0	17.70	15	0.88
<b>Total</b>	<b>214</b>	<b>71.6</b>	<b>115.23</b>	<b>100</b>	

*Source: Journal of Freshwater, Biol 3(2), 1991 Munshi, et. at.*

It is evident from Table No. 2.2 that the west-ward movement of Kosi has not been a gradual process rather it has been in a very irregular fashion. Average per cent movement per year shows it to be highest (227) during the period 1922-33. It also suggests that this



movement rate gradually decreases from a previous peak-value (in the past) to regain another peak, many times higher than the previous peak. The dynamics of such movement is in all probability dependent, besides many other factors, on sediment load of water and sedimentation process in the new channel. However, with the establishment of flood embankments, barrage and irrigation canals, the shifting nature of the river have been greatly contained. It has been bound to flow in between the two Kosi flood embankments traversing partly the districts of Madhubani, Darbhanga, Khagaria and Bhagalpur, and Saharsa as a whole.

## **2.7 Water Logged Areas**

Kosi brings huge quantity of sediment load from the Himalayas during its course through mountains. As the gradient is very steep and the valley has no pockets to retain the load, it (sediments) gets distributed over the plains. After Chatra, the gradient gets suddenly flattened on the plain and most of the sediments (boulders, pebbles and shingles) are deposited in its bed and the river-bed (filled with the sediments) is elevated above the adjoining lands. As a result, the river has to leave its former channel and adopt another which is at a lower level and deeper than the present sediment choked course. Thus, the river branches off into many meandering channels for its passage and leaves off the sediment-choked courses as deserted channels locally known as *Mans* or *Dhars*. Such sediment choked water-areas spread over whole of the Kosi region result into swamps and wetlands.

The river has not well-defined course rather it uses to change its course at frequent intervals. As a result, several interlacing but active channels appear during the course of its flow towards the Ganga. These interlacing channels reunite into one channel near Dumaright (Khagaria dist.) before draining their waters into the Ganga. Thus, the Kosi shows a deltaic pattern in its flood plains. In the present course, the river is profusely branched into many channels from Kosi barrage to Koparia spreading over a distance of about 150 km. In these areas, river bed is nearly 5-10 km wide separated by 'Kosi diarrah land'. Further southwar, below Koparia and Dhamaraghat, the shifting tendency is reduced and it runs almost parallel to the Ganga in a welldefined channel.

**Table No. 2.3**  
**List of Important Dhars of Kosi basin**

1. Tilawa dhar	29. Baluaha dhar
2. Dhemra dhar	30. Joga dhar
3. Berdah dhar	31. Farhi dhar
4. Parwane dhar	32. Demra dhar
5. Patti dhar	33. Sone dhar
6. Gajna dhar	34. Matha dhar
7. Thailha dhar	35. Gai dhar
8. Konali dhar	36. Bharrahi dhar
9. Jaroor dhar	37. Pastpar dhar
10. Dhasah dhar	38. Resna dhar
11. Bhenga dhar	39. Kasnagar dhar
12. Naiya dhar	40. Banswara dhar
13. Bochah dhar	41. Gola dhar
14. Chhatapur dhar	42. Hareli dhar
15. Sursar dhar	43. Chausa dhar

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16.Chikni Bazar dhar	44.Pakilpar dhar
17.Madheli dhar	45.Khanua dhar
18.Gordhua dhar	46.Niren dhar
19.Sapha dhar	47.Bahadura dhar
20.Binania dhar	48.Khutahri dhar
21.Mogala dhar	49.Dudhi dhar
22.Khara dhar	50.Libri dhar
23.Maria dhar	51.Mara Brandi dhar
24.Kajra dhar	52.Karli Kosi
25.Fariyani dhar	53.Bora dhar
26.Sita dhar	54.Tinpania dhar
27.Soura dhar	55.Old Kosi dhar
28.Pema dhar	56.Kadal Nala 1 & 2

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*Source: Journal of Freshwater, Biol 3(2), 1991 Munshi, et. at.*

## **2.8 Production potentiality**

The Kosi river system serves variously for irrigation, inland fisheries (both fin-and shell-fisheries) and for the production of several aquatic fruits. As many as 87 species of fishes belonging to 20 different families have been recorded from this region. Quite a large number of air-breathing fishes viz., *Anabas testudineus*, *A. oligolepis*, *Heteropneustes fossilis*, *Clarias batrachus*, *Channa sp.*, *Monopterus albus*, *Macrogynathus aculeatum*, *Colisa fasciatus*, *Lepidocephalichthys guntia*, *Mastacembelus armatus*, *Notopterus notopterus*, *N. chitala*, etc, have made their permanent abode in the chaur, swamps and wetlands of the Kosi belt. Besides the local consumption in rural markets fishes from this region are sent to different bigger markets like Siliguri (W.B.), Calcutta, Patna, Hhagalpur, Darbhanga, Purnea, Katihar, Dimapor (Nagaland),

Silcher (Arunachal Pradesh), Guahati (Assam) and Gangtok (Sikkim) etc.

Shell-fisheries of the Kosi region deserve special mention. Altogether 28 species of mollusks (Gastropods 18 sp and Bivalves 10 sp.) have been recorded from various aquatic systems of the region. These molluscan fauna are of commercial importance and cater to the requirements of various cottage industries of the region producing mother of pearl (MOP) button, lime, fertilizers, mosaic, tiles, poultry feed and chemicals. The annual landing data of bivalves obtained from the Common Service Organisation (CSO), Mehsi (E. Champaran), the main centre of MOP button industries reveal a sharp decline from during the recent years. This is mainly due to the construction of bundhs, barrage and canals on the Kosi river for the protection of human habitations confining its flow and formation of new aquatic system. This has also disconnected several of the *dhars* flowing in the region and has converted them into *mara dhar* (dead stream). These dhars which were highly productive earlier for the natural growth and propagation of commercially important bivalves have become unsuitable for them due to the stagnancy of their water.

River Kosi has also become an important centre for the collection of fish spawn of superior quality in India (Jhingran, 1985). Fishermen from West Bengal and Bangladesh prefer to come over to the Kosi region for collection of fish spawn. The production of *makhana* (*Euryale ferox*) is also noteworthy. About 10-15 monds (4-6

quintols) of makhana is produced from one acre of jalkar (water bodies of different types). As per the recent survey report of the Central Bank of India, about 2500 such types of Jalkars are located in Darbhanga district alone.

Hence, this unique freshwater system seems to be highly productive which could be developed further by innovating new ecodevelopmental strategies with the best utilization of the production potentialities of the area for the upliftment of the socio-economic condition of the inhabitants and for the prosperity of the region.

### **2.9 Section III : Profile of the sampled districts**

The sampled district of sub Zone I are Madhubani, Darbhanga and Samastipur and in sub zone the sample districts are Khagaria, Supoul and Purnea. The zonewise profile of the sampled districts have presented in Table No. 2.4.

**Table No. 2.4**  
**Profile of the Sampled Districts**  
**Zone-wise Profile of the Sampled Districts**

Sl. No.	Particulars	Sub-Zone I			Total	Sub-Zone II			Total	Grand Total
		D1	D2	D3		D4	D5	D6		
1.	Area (Sq. Kms.)	2,501.00	2,279.00	2,904.00	7,684.00	1,485.80	2,420.00	3,229.00	7,134.80	14,818.80
2.	Total Population	3,575,281.00	3,295,789.00	3,394,793.00	10,265,863.00	1,280,354.00	1,732,578.00	2,543,942.00	5,556,874.00	15,822,737.00
	Rural- Female	1,775,203.00	1,579,812.00	1,694,987.00	5,050,002.00	637,823.00	855,183.00	1,208,292.00	2,701,298.00	7,751,300.00
	Female	1,675,533.00	1,448,629.00	1,576,351.00	4,700,513.00	566,204.00	789,187.00	1,113,252.00	2,468,643.00	7,169,156.00
	Urban- Female	65,794.00	142,377.00	65,705.00	273,876.00	41,444.00	47,024.00	120,125.00	208,593.00	482,469.00
	Female	58,751.00	124,971.00	57,750.00	241,472.00	34,883.00	41,184.00	102,273.00	178,340.00	419,812.00
3.	SC Population	481,922.00	511,125.00	628,838.00	1,621,885.00	185,122.00	256,444.00	312,088.00	753,654.00	2,375,539.00
	Rural	469,894.00	482,915.00	610,975.00	1,563,784.00	179,584.00	251,086.00	292,461.00	723,131.00	2,286,915.00
	Urban	12,028.00	28,210.00	17,863.00	58,101.00	5,538.00	5,358.00	19,627.00	30,523.00	88,624.00
4.	ST Population	1,260.00	841.00	3,362.00	5,463.00	332.00	5,219.00	111,947.00	117,498.00	122,961.00
	Rural	1,210.00	575.00	2,871.00	4,656.00	276.00	5,185.00	103,493.00	108,954.00	113,610.00
	Urban	50.00	266.00	491.00	807.00	56.00	34.00	8,454.00	8,544.00	9,351.00
5.	Total No. of Literates	1,195,776.00	1,167,572.00	1,211,152.00	3,574,500.00	414,174.00	509,025.00	700,070.00	1,623,269.00	5,197,769.00
	Rural- Male	792,563.00	680,596.00	756,279.00	2,229,438.00	250,967.00	344,615.00	399,619.00	995,201.00	3,224,639.00
	Female	338,334.00	318,083.00	376,633.00	1,033,050.00	119,848.00	119,735.00	168,992.00	408,575.00	1,441,625.00
	Urban- Male	40,286.00	100,056.00	46,314.00	186,656.00	26,259.00	28,346.00	79,070.00	133,675.00	320,331.00
	Female	24,593.00	68,837.00	31,926.00	125,356.00	17,100.00	16,329.00	52,389.00	85,818.00	211,174.00

6.	Total No. of Illiterates	2,379,505.00	2,128,217.00	2,183,641.00	6,691,363.00	866,180.00	1,223,553.00	1,843,872.00	3,933,605.00	10,624,968.00
	Rural-									
	Male	982,640.00	899,216.00	938,708.00	2,820,564.00	386,856.00	510,568.00	808,673.00	1,706,097.00	4,526,661.00
	Female	1,337,199.00	1,130,546.00	1,199,718.00	3,667,463.00	446,356.00	669,452.00	944,260.00	2,060,068.00	5,727,531.00
	Urban-									
	Male	25,508.00	42,321.00	19,391.00	87,220.00	15,185.00	18,678.00	41,055.00	74,918.00	162,138.00
	Female	34,158.00	56,134.00	25,824.00	116,116.00	17,783.00	24,855.00	49,884.00	92,522.00	208,638.00
7.	% of Literacy	42.0	44.3	45.1	131.4	41.3	37.3	35.1	113.7	245.1
	Rural-									
	Male	56.1	54.2	56.5	166.8	50.1	51.2	42.2	143.5	310.3
	Female	25.4	27.6	30.3	83.3	27.3	19.3	19.6	66.2	149.5
	Urban-									
	Male	73.9	83.0	83.9	240.8	77.1	72.8	78.2	228.1	468.9
	Female	50.9	65.6	66.4	182.9	60.9	48.2	62.1	171.2	354.1
8.	Total No. of Workers	1,227,723.00	1,028,558.00	1,071,974.00	3,328,255.00	467,240.00	728,222.00	960,700.00	2,156,162.00	5,484,417.00
9.	Total No. of Non-Workers	2,347,558.00	2,267,231.00	2,322,819.00	6,937,608.00	813,114.00	1,004,356.00	1,583,242.00	3,400,712.00	10,338,320.00
10.	Total No. of Main Workers	877,412.00	761,464.00	843,356.00	2,482,232.00	333,262.00	526,267.00	782,364.00	1,641,893.00	4,124,125.00
11.	Total No. of Marginal Workers	350,311.00	267,094.00	228,618.00	846,023.00	133,978.00	201,955.00	178,336.00	514,269.00	1,360,292.00
12.	% of Main workers to Total Workers	24.5	23.1	24.8	72.4	26.0	30.4	30.8	87.2	159.6
13.	% of Marginal Workers to Total Workers	9.8	8.1	6.7	24.6	10.5	11.7	7.0	29.2	53.8

Source: Census 2001

## **2.10 Madhubani**

The area of this district is 250107 kms. The total population is 2832024. The rural population is 2729260 and the urban population is 102764. The total SC population is 361687 out of which the rural population is 351921 and in the urban area the SC population is 9766. The total S.T. population is only 597. In the rural area the ST population is 541 and in the urban area the population is 56. The district has five sub-divisions. They are Madhubani, Jainagar, Benipathi, Jhanjharpur and Phulparas. There are 17 blocks in the district. They are Jainagar, Pandaul, Rahika, Bisfi, Benipatti, Basopatti, Babu Barhi, Rajnagar, Madhepur, Khutauna, Khajauli, Jhanjharpur, Goghardiha, Ladma, Thadi, Lakhnaur and Phulparas. The agriculture is the main occupation of the people and the paddy is the main crop which is cultivated in the district. It should be noted that the district has some industries also. They are sugar factories. Some people have taken Pisciculture also. The principal rivers are Kamla and Bhutahi Balan. Its headquarter is Madhubani.

## **2.11 Darbhanga**

The area of the district is 2279 sq. kms. The total population is 2510959. The rural population is 2292568 and the urban population is 218391. The total SC population is 365542. Its rural population is 342375 and the urban is 23167. The total ST population is 259. In the rural area its population is 111 and in the urban area its population is 148. It has three sub-divisions. They are Darbhanga Sadar, Benipur and Biraul. There are 18 blocks which are as, Bahadurpur, Jale, Hayaghat, Singhbara, Benipur, Ghanshyampur, Baheri, Kewati, Manigachhi, Darbhanga, Biraul, Kushwarasthan, Alingar, Kushwarasthan East, Gauravauram, Kiratpur, Hanuman Nagar and



Tardih. Paddy is the main crop of the District Paper Mill, Sugar factory, Handloom constitute the industrial sector. Kamla, Kamla Balan and Kosi are the main rivers of the district.

### **2.12 Samastipur**

The area of the district is 2904 sq. kms. The total population is 2716929. The rural population is 2582052 and the urban population is 134877. The total SC population is 489985. In the rural area SC population is 470722 and in the urban area it is 19263. The total ST population is only 542. In the rural area, the ST population is 158 and in the urban area it is 384. It has 4 sub-divisions. Which are Dalsinghsarai, Patori, Rosera and Samastipur sadar. Blocks of the districts are Jitwarpur, Kalyanpur, Warisnagar, Rosera, Tajpur, Morwa, Patori, Sarairanjan, Pusa, Ujiarpur, Dalsingsarai, Singhia, Hasanpur, Mohaddinagar, Bibhutipur, Bithan Shiavaji Nagar, Vidyapati Nagar, Khanpur and Mohanpur.

Paddy and maize are the main crops of the district. The district has good number of factories and mills. There are Sugar factories. There is a paper mill. There is also a Jute mill. The main rivers are Burhi Gandak and Kamla Balan and Kosi.

### **2.13 Khagaria**

The area of the district is 1485.8 sq. km. The total population is 1280354. The rural population is 1204027 and the urban population is 76327. The number of SC is 185122 and in the rural area, the population of this category is 179584 and in the urban area it is 5538. The total population of ST is 332. In the rural area its population is 276 and in the urban area it is 56. There are only two subdivisions and there are seven blocks. The sub-

division are Khagaria and Gogri. The blocks are Khajoria, Alanli, Chautham, Mangi, Gogri, Parbatta and Beldaur. The rivers are Burhi Gandak, Ganga, Bagmati and Kosi. The main crops of the district are Paddy, maize and wheat.

### **2.14 Supaul**

The area of this district is 2420 sq. kms and the total population is 1342841 out of which the rural population is 1251309 and the urban population is 91532. The total SC population is 207782 out of which its rural population is 197573 and the urban is 10209. The total SC population is 3962. In the rural area the SC population is 3873 and in the urban area is 89. The district has four subdivisions. They are Supoul, Birpur, Nirmali and Tribeniganj. There are 12 blocks in the district. They are Supoul, Tribeniganj, Pipra, Narauna, Kishanpur, Raghapur, Nirmali, Basantpur, Chhatapur, Savaigarh, Bhaptiahi and Pratapgarh. There is no industry worth the name in the district. Paddy is the main agricultural crop in the district. It has only one river Koshi. Its headquarters is Supaul.

### **2.15 Purnea**

It is one of the most important districts of Bihar. During British days it has largest area among the districts. At present, its area is 3229 sq. kms. The total population is 187885. There rural population consists of 1720743 and the urban population is 158142. In the total population the SC population is 234478. In the rural area the population of SC is 220524 and in the urban area the population is mere 13954. When we come to ST population we find that in rural area ST population is 76554 and in the urban area it is 5591. Hence the total population of ST in the district of Purnea is 82145. This district consists of three sub-divisions. They are Banmankhi,

Dhamdaha, Purnea and Vaishi. The C.D. Blocks are Purnea, Amaur, Bhawanipur, Banmankhi, Dhamdaha Vaisa, Vaishi, Barhara Kothi, Kasba, Rupauli, Krityanand Nagar, Dagarua, Srinagar and Jalalgarh. The main occupation of the people is Jute, cultivation and therefore, the district contains many jute mills. The rivers of the district are Kosi, Mahananda, Suwarakali and Koli. Its headquarters is Purnea.

## **2.16 Section IV : Profile of Sampled Blocks**

The zone-wise profile of the sampled blocks has been presented in Table no. 2.5 (a) and Table no. 2.5 (b). To be acquainted with the profile of the both the zones and districts and blocks included in them is both necessary and desirable. Here the researchers are on firm and sure grounds because the figures relating to them were easily and authoritatively available. The total population of zone I is 923913 and that of zone II is 706684 and hence, the population of zone I is greater than that of zone II. Similar is the case with the figures of the house holds of the two zones. The number of households in zone I is 175699 and in zone II it is 235556. It is not necessary to consider the number of males and females in the two zones but it is worth while to consider the rural population and the urban population in the two zones. The rural population in zone I comes to 896421 and in zone II it is 1125005. The urban population in zone I is 27492 and in zone II it is 216908. In many of the blocks the urban population is nil. In zone I, in sampled districts of Darbhanga and Madhubani the urban population is nil in all the four sampled blocks. It is nil even in sampled blocks of Samastipur district of zone I. In zone II in sampled blocks of Khagaria, Supaul and Purnea districts the urban population is nil. The total number of workers in zone I is 320031 and in zone II it is 492885. The marginal workers in zone I number 83670 and in

zone II they number 112564. In fact the percentage of workers in total population is 13.52 in zone I and it is 11.54 in zone II. The percentage of cultivators to total workers in zone I is 28.32 and in zone II it is 27.78. The percentage of agricultural labourers to total workers is 54.30 in zone I and it is 47.90 in zone II. The question of literacy is also very important in considering the plight of the fish farmers. The number of literates in zone I is 288661 and in zone II it is 475608. The percentage of literacy in total population in zone I is 39.45 and in zone II, it is 42.20.

The Madhubani district has two sampled blocks, namely, Phulparas and Madhepur. Both these blocks are devastated by floods. Both are situated in two different directions. Phulparas is in north-west and Madhepur in south-east of the district headquarter. The sampled blocks fall under the area of two rivers Kosi and Bhutahi. Pulparas is particularly inundated by Bhutahi river. The fishermen of these areas are very expert in identifying the kind of fishes that are found in the rivers. Their knowledge is not gleaned from any text book but it is hereditary knowledge which they have received from their forefathers. They are very experts also in catching the fish. The entire area surrounded by the river Kosi is noted for the existence of fishermen who are experts not only in catching fish but also in having knowledge about different kinds of fish. It can be said that this is the heart land of fishing operations.

The sample blocks of Darbhanga district are Kushewar Astahan and Gahanshyampur. The Kusheswar Asthan block is very famous for its Chaur (Water bodies). The Barari Chaur covers the area of 400 hac. whereas Bhadaria Chaur covers 360 ha. These two are primary sources of fishing. The main source of fish is Bheader water bodies which cover 744.8

hectars. It should be noted that 80 per cent of Kusheswar Asthan block remains flooded and 20 per cent remains partially under flood. The main crops of cultivators are wheat, mustard and summer paddy. The old ponds are not suitable for pisciculture because of the fear of the flood havoc. The tendency to dig new ponds is virtually absent. The sale of fish is conducted by Doms, Paswans, Muslims and traditional fishermen. This block is mostly dominated by Brahmins, Oilmen and Rajputs. The present Mukhia of Hirni Panchayat purchases the right to fishing and sales this right to local fishermen at higher rates and pockets the difference.

Another sample block of Darbhanga district is Ghashyampur. Here there is one peculiar thing. Not only the Hindus are connected with the fish farming but Muslims also take part in large number. Among the Hindus the upper castes like Brahmins and Rajputs are also interested in capture fisheries. The tragedy is that there is no developed market and there is no arrangement for exporting the fish to other places. The cooperative society dealing with fish farming is extremely active and transparent here. The secretary of the society is trained one and disseminates his technical knowledge and experience. In fact he shares his knowledge and experience with other members. This block is connected with the district headquarter by road only and the condition of the road is deplorable.

In the district of Samastipur there are two sample blocks – Hasanpur and Rosera. Hasanpur block is very important one but the sad thing is that 80 to 85 per cent of the area of this block is ravaged by floods. In the past there was a sugar mill but it is closed for the last 10 years. It has a bad impact on the farmers of the area. Formerly the farmers raised sugarcane for the mill on a large scale but now only 8 to 9 per cent of the land is used

for cultivating sugarcane. This block has a cooperative society for fishermen but this society is plagued by factional fights and the present secretary is extremely unpopular with the members and the people of the area. The fishermen are extremely despondent in this area and people are not interested in digging new ponds and think that fish farming is not a viable and profitable endeavour.

Another sample block of Samastipur is Rosara. It has a network of roads and it is connected with railways also. Hence there is no difficulty in transportation. There are sixteen panchyat in the block and all of them except three are flood prone. The flood comes mainly from Burhi Gandak, Bagmati, Kosi and Kareh rivers. This block has 37 water bodies out of which 36 are settled and only one water bodies is free fishing area. There are two existing cooperative societies. But both of them are plagued by dynastic stranglehold. The secretary of one society is Amardip Sahni. He lives in Muzaffarpur and is an employee in a private firm. Hence he is not interested in the affairs of the society which is managed by his father on his behalf. Arun Kumar Sahni is a secretary of another society and runs a Kirana shop. Hence he also is not interested in looking after the affairs of the society. His father works as a defect secretary. Under these circumstances the fishermen cooperatives do not flourish at all and failed to serve the purpose for which they had been made.

The sample blocks of Khagaria districts are Khagria block and Parbatta block. The water bodies of Khagaria block which are generally settled by the Government. are not fit for culture fishing but are mainly used for capture fishery. The area falls under two mighty rivers – Ganga and Kosi. The fishes come in these two rivers during the flood season and there is a

traditional fishing method here. Generally 70 per cent of the capture fishes are dried in the sun and are transported to Kolkata. These exported and dried fishes are used as raw materials of fish food in aquarium. Five per cent of the dried fishes are consumed locally. The small size carps are sold in the local fish market at the rate of Rs. 30 to Rs. 40 per Kg.

The entire block is divested by flood in each and every year and therefore, there is no scope of culture fishery. Only capture fishery prevails which is done by traditional fishermen. Most of the fishermen work like daily wage workers. Most of them are highly indebted and are victims of corruption prevailing in cooperatives and fisheries department.

Another sample block is Parbatta. This block is connected only by road and is situated in the south of the railway network. The northern portion of this block and most of the Panchayats falling under its area are devastated by floods regularly. They remain water logged for three or four months a year. The block has no culture fisheries and hence only capture fisheries are carried on. There is a fishermen cooperative society but it is under the grip of a particular dynasty and family. The society had a woman secretary named Shiromani Devi. She held this post for nearly 20 years and the work of the society was being carried on by her husband Lakahman Sahni. It is not possible to export fish from this place because only roads exist and these roads are in a bad condition. The selling price of the fishes of the block is much less than that of Khagaria block. The people of the area have no knowledge about the Govt. schemes and programmes for the development of fish farming and hence they are not able to utilize the governmental resources. This is a great drawback. Another difficulty is that the DFO office has no legal right to take any action in the matter of

the development of fish farming. Even the water bodies which are settled with persons are unsafe and are exploited by the Mafia and musclemen and the officials of the fisheries department become powerless and helpless. They have to depend on police for taking any action in this regard. There is no hatchery in this block and if the fish seed is required the fishermen have to depend on the middlemen who bring it from Kolkata. It should be noted in this connection that fish seed of river Kosi is famous as the best in the entire country. Many water bodies are overgrown with water plants which do not allow fish farming. The selling of fish is carried on by fishermen and Gangotras. There is a deplorable shortage of trained personnel. The family of fishermen is landless and hence it is entirely dependent on fishing. When flood comes it is a gala time for fishermen who are not organised. They go on fishing without any let or hindrance.

The sample blocks of Supaul district are Pipra and Marauna. Pipra block is connected with headquarter by roads. From the point of view of fish farming this block is less important than the blocks of Darbhanga and Madhubani. There are two cooperative societies here. Sarwan Mukhia is the Secretary of one society and Ram Charan Mukhia is the Chief Executive of other society. The credit and influence of the secretaries are more on political leaders, officers of different departments and the dominating personalities of administration than on fishermen and the members of the society. Here there is one difficulty. Water bodies are poisoned and the result is the fishes die. The fishes are caught by the thieves or by musclemen. The result is that the actual fishermen or the members of the society do not gain anything. There is no market. Fishes are sold either on the road side or on cross roads and no facilities exist



either for the buyers or for the sellers. Big sized carps are sold at the rate of Rs. 60 – 70 per Kg. The less sized sell at Rs. 40 – 45 per Kg. and the fishes which are less than previous one in weight sell at the rate of Rs. 30 – 35 per Kg. Most of the water bodies are covered with plants and are very shallow. There is a great difference between the production of Govt. settled ponds and private ponds. The latter produce more fishes than the former.

The Marauna block is situated between Kosi Western and Eastern Embankments. Several persons have been displaced because of these empaulments. But the people are so much emotionally attached with the place that they do not leave it and have chosen to remain there. There are two panchyats, Mahuahi and Kasmaul which have negligible water bodies and hence their settlement is made on Govt. files itself. The result is that the fishermen do not gain anything from this procedure. Identity cards are issued for the fishermen living between the embankments. But the identity cards have no value because of the feudal tyrannical behaviors of the influential persons. The fishermen have no paternal or ancestral property and hence they cannot engage themselves in any other profession. They are virtually tied to the profession of a fisherman all their life. They catch fish from the morning to evening and yet they are not able to meet their both ends. Other features relating to fishermen and fish farming of this block are the same as are found in that of Pipra block.

There are two sample blocks, namely Purnea East and Dhamdaha of the Purnea district. The headquarters of Purnea East block is located near the Katihar bend of the road. There are 19 panchayats in this block. 55 per cent of the areas come under the flood every year but the havoc of the

flood is more destructive in some of the panchayats like Srinager, Singhia, Charaiya, Jhunnikala, Chunapur etc. There are three fishermen cooperative societies existing and operating here and therefore, the number of societies is greater than elsewhere. One society has Sri Khagendra Singh as its Secretary whereas other has Mithilesh Kr. Singh as Secretary. There is a lady Secretary known as Mrs. Reena Dhiraj. She also does not work anything. The work is done by her husband. The fishermen here are more conscious and more alive to their rights than the fishermen of other sample blocks and districts. Both the traditional fishermen and non-traditional persons have taken the training of fish farming. All castes of the Hindu and also Muslim religions are engaged in fish farming.

Another sample block of Purnea district is Dhamdaha. 45 per cent area of this block is ravaged by floods every year. This block has got the status of a sub-division also. There are 26 panchayats out of which 12 are victims of floods every year. Flood is caused by river Kosi and by Libri river which is a tributary of Kosi. The Secretary of the cooperative society here is Shri Avadh Nr. Singh who is a powerful and influential person and has been continuing as secretary since long. He is unpopular both in the fisheries department and in the camp of fish farmers. Due to non-cooperation of the society very few people could get training. The families of fishermen are mostly engaged in free fishing and by selling the fish thus obtained. Those who do not belong to the traditional fishermen caste are taking interest in culture fisheries and have been able to dig new ponds. The community of fishermen is more backward economically, politically and educationally than that of Khegaria and Samstipur and is more advanced than the community living in Darbhanga, Madhubani and Supaul.

**Table No. 2.5(a)**  
**Profile of the Sampled Blocks of Sub Zone I**

Sl. No.	Particulars	Madhubani		Darbhanga		Samastipur		Total
		B1	B2	B3	B4	B5	B6	
<b>1</b>	<b>Particulars</b>							
	No of House Hold	22,832.00	45,770.00	20,928.00	25,590.00	28,897.00	31,682.00	175,699.00
<b>2</b>	<b>Total Population</b>	130,036.00	217,289.00	106,568.00	131,075.00	159,977.00	178,968.00	923,913.00
	i) Male	66,833.00	112,090.00	55,197.00	67,783.00	82,863.00	92,662.00	477,428.00
	ii) Fimale	63,203.00	105,199.00	51,371.00	63,292.00	77,114.00	86,306.00	446,485.00
	III) Rural	130,036.00	217,289.00	106,568.00	131,075.00	132,485.00	178,968.00	896,421.00
	IV) Urban	0.00	0.00	0.00	0.00	27,492.00	0.00	27,492.00
<b>3</b>	<b>SC. Population</b>	12,880.00	33,220.00	15,660.00	26,984.00	28,412.00	30,873.00	148,029.00
	i) Male	6,624.00	16,955.00	8,081.00	13,754.00	14,540.00	15,850.00	75,804.00
	ii) Fimale	6,256.00	16,265.00	7,579.00	13,230.00	13,872.00	15,023.00	72,225.00
	iii) Percentage to total population	9.90	15.30	14.70	20.60	17.80	17.30	15.93
<b>4</b>	<b>ST Population</b>	57.00	517.00	0.00	0.00	13.00	3.00	590.00
	i) Male	34.00	262.00	0.00	0.00	13.00	3.00	312.00
	ii) Fimale	23.00	255.00	0.00	0.00	0.00	0.00	278.00
	iii) Percentage to total population	0.10	0.20	0.00	0.00	0.00	0.00	0.50
<b>5</b>	<b>No. of Literates</b>	41,049.00	65,545.00	34,483.00	34,855.00	58,036.00	54,693.00	288,661.00
	i) Male	30,693.00	45,899.00	24,073.00	26,200.00	38,654.00	38,312.00	203,831.00
	ii) Fimale	10,356.00	19,646.00	10,410.00	8,655.00	19,382.00	16,381.00	84,830.00
	iii) Percentage of Literacy in total population	40.20	37.90	40.10	34.00	45.70	38.80	39.45
<b>6</b>	<b>Total Workers</b>	52,697.00	77,705.00	34,301.00	42,352.00	49,796.00	63,180.00	320,031.00
	i) Male	33,210.00	54,641.00	26,354.00	30,737.00	38,344.00	45,121.00	228,407.00
	ii) Fimale	19,487.00	23,064.00	7,947.00	11,615.00	11,452.00	18,059.00	91,624.00
<b>7</b>	<b>Main Workers</b>	37,813.00	57,676.00	25,177.00	30,319.00	39,561.00	45,815.00	236,361.00
	i) Male	29,429.00	47,461.00	22,505.00	25,481.00	33,732.00	38,488.00	197,096.00
	ii) Fimale	8,384.00	10,215.00	2,672.00	4,838.00	5,829.00	7,327.00	39,265.00
<b>8</b>	<b>Marginal Workers</b>	14,884.00	20,029.00	9,124.00	12,033.00	10,235.00	17,365.00	83,670.00
	i) Male	3,781.00	7,180.00	3,849.00	5,256.00	4,612.00	6,633.00	31,311.00
	ii) Fimale	11,103.00	12,849.00	5,275.00	6,777.00	5,623.00	10,732.00	52,359.00
	iii) Percentage of Workers in total population	11.40	35.80	8.60	9.20	6.40	9.70	13.52
<b>9</b>	<b>Cultivators</b>	20,352.00	24,827.00	9,449.00	10,776.00	11,352.00	14,912.00	91,668.00
	i) Percentage to total workers	38.60	32.00	27.50	25.40	22.80	23.60	169.90
<b>10</b>	<b>Agricultural Labours</b>	27,912.00	43,899.00	19,480.00	24,963.00	23,385.00	33,919.00	173,558.00
	i) Percentage to total workers	53.00	56.50	56.80	58.90	47.00	53.70	54.30

Source: Census, 2001

**Table No. 2.5(b)**  
**Profile of the Sampled Blocks of Sub Zone II**

Sl. No.		Khagaria		Supaul		Purnea		Total	Over All
		B7	B8	B9	B10	B11	B12		
<b>1</b>	<b>Particulars</b>								
	No of House Hold	50,696.00	32,151.00	28,992.00	19,915.00	60,149.00	43,653.00	235,556.00	411,255.00
<b>2</b>	<b>Total Population</b>	295,480.00	192,212.00	157,779.00	113,192.00	350,154.00	233,096.00	1,341,913.00	2,265,826.00
	i) Male	157,230.00	101,992.00	81,912.00	58,359.00	186,263.00	120,928.00	706,684.00	1,184,112.00
	ii) Fimale	138,250.00	90,220.00	75,867.00	54,833.00	163,891.00	112,168.00	635,229.00	1,081,714.00
	III) Rural	250,259.00	192,212.00	157,779.00	113,192.00	178,467.00	233,096.00	1,125,005.00	2,021,426.00
	IV) Urban	45,221.00	0.00	0.00	0.00	171,687.00	0.00	216,908.00	244,400.00
<b>3</b>	<b>SC. Population</b>	46,509.00	11,920.00	24,506.00	13,305.00	40,173.00	36,352.00	172,765.00	320,794.00
	i) Male	24,608.00	6,358.00	12,571.00	6,783.00	21,020.00	18,715.00	90,055.00	165,859.00
	ii) Fimale	21,901.00	5,562.00	11,935.00	6,522.00	19,153.00	17,637.00	82,710.00	154,935.00
	iii) Percentage to total population	15.70	6.20	15.50	11.80	11.50	15.60	12.72	28.65
<b>4</b>	<b>ST Population</b>	76.00	1.00	0.00	37.00	20,726.00	23,822.00	44,662.00	45,252.00
	i) Male	39.00	1.00	0.00	18.00	10,782.00	12,112.00	22,952.00	23,264.00
	ii) Fimale	37.00	0.00	0.00	19.00	9,944.00	11,710.00	21,710.00	21,988.00
	iii) Percentage to total population	0.00	0.00	0.00	0.00	5.90	10.20	2.68	3.18
<b>5</b>	<b>No. of Literates</b>	105,897.00	76,107.00	43,889.00	28,310.00	159,304.00	62,101.00	475,608.00	764,269.00
	i) Male	68,895.00	49,179.00	32,857.00	23,200.00	99,104.00	43,085.00	316,320.00	520,151.00
	ii) Fimale	37,002.00	26,928.00	11,032.00	5,110.00	60,200.00	19,016.00	159,288.00	244,118.00
	iii) Percentage of Literacy in total population	45.40	50.00	35.60	32.10	56.40	33.70	42.2	40.8
<b>6</b>	<b>Total Workers</b>	95,767.00	66,744.00	70,651.00	51,887.00	107,354.00	100,482.00	492,885.00	812,916.00
	i) Male	72,516.00	50,008.00	42,204.00	30,266.00	84,470.00	64,502.00	343,966.00	572,373.00
	ii) Fimale	23,251.00	16,736.00	28,447.00	21,621.00	22,884.00	35,980.00	148,919.00	240,543.00
<b>7</b>	<b>Main Workers</b>	69,855.00	50,466.00	50,808.00	33,924.00	91,195.00	84,073.00	380,321.00	616,682.00
	i) Male	61,020.00	42,097.00	37,368.00	26,371.00	77,034.00	60,407.00	304,297.00	501,393.00
	ii) Fimale	8,835.00	8,369.00	13,440.00	7,553.00	14,161.00	23,666.00	76,024.00	115,289.00
<b>8</b>	<b>Marginal Workers</b>	25,912.00	16,278.00	19,843.00	17,963.00	16,159.00	16,409.00	112,564.00	196,234.00
	i) Male	11,496.00	7,911.00	4,836.00	3,895.00	7,436.00	4,095.00	39,669.00	70,980.00
	ii) Fimale	14,416.00	8,367.00	15,007.00	14,068.00	8,723.00	12,314.00	72,895.00	125,254.00
	iii) Percentage of Workers in total population	8.80	8.50	12.60	15.90	4.60	7.00	9.56	11.54
<b>9</b>	<b>Cultivators</b>	18,723.00	20,106.00	25,423.00	21,566.00	14,567.00	25,929.00	126,314.00	217,982.00
	i) Percentage to total workers	19.60	30.10	36.00	41.60	13.60	25.80	27.78	28.05
<b>10</b>	<b>Agricultural Labours</b>	47,236.00	33,821.00	38,867.00	26,814.00	42,195.00	67,441.00	256,374.00	429,932.00
	i) Percentage to total workers	49.30	50.70	55.00	51.70	13.60	67.10	47.90	51.10

Source: Census, 2001

## **2.17 Section V: Water Reservoirs of the Sampled Area**

The details of water reservoirs(Jalkars) of the study area has been presented in Table No. 2.6 The total water area of Jalkar or Water bodies in zone I is 1865.02 hectars and in zone II it is 587.85. Hence it was observed that the water area of zone I is nearly 3 times the water area of zone II. Further, it was observed that in zone I in Phulparas block of Madhubani district the water area is 180.43. In Kushewar Asthan block of Darbhanga district the water area is 143.26. But the area is the greatest in Ghanshyampur block of Darbhanga district and it comes to 1495.24 ha. The total area in both the zones comes to 2452.87 ha. The figures of water area of sampled blocks of Samstipur district could not be available to the investigating team. The least area is 9.4 ha and it is to be own in zone II Pipra block of Supaul district.

This is about the area. It will be pertinent if one scrutinize the figures of number of zalkars also. The total number of zalkars in zone I is 528 and in zone II it is 781 ha. The highest number is 251 ha and it is located in zone I, that is, in the district of Madhubani and Phulparas block. The least number is found to be 14 ha and it is located in zone II, that is, in Pipra block of Supaul district. According the physical status of the zalkars it was observed that they can be divided broadly into three categories. In the first categories, there are some water bodies which are perennial. Water is found them all the year round and therefore, they are fertile and sure sources of fish farming. In the other category are some zalkars which are only seasonal in character. Water is not found in them all the year round. It is only during some months that they have water and therefore, such zalkars are used or can be used for fish farming for only a

**Table No. 2.6**

**ZONE WISE DETAILS OF JALKARS (WATER RESERVOIRS) OF THE SAMPLED AREA**

Sl. No.	Particulars	Sub-Zone I						Total	Sub-Zone II						Total	Gross Total
		D1		D2		D3			D4		D5		D6			
		B1	B2	B3	B4	B5	B6		B7	B8	B9	B10	B11	B12		
1.	Water Area (in hac)	180.43	46.10	143.25	1495.24	N.A	N.A	1865.02	161.25	105.5	12.0 7	9.4	212.48	87.15	587.85	2452.87
2.	No. of Jalkars	251	73	38	71	36	59	528.00	55	24	26	14	77	57	253.00	781.00
3.	Physical Status															
	(a) Perenial	49	16	32	4	N.A	N.A	101.00	3	5	N.A	N.A	N.A	N.A	8.00	109.00
	(b) Seasional	196	52	5	65	N.A	N.A	318.00	38	19	N.A	N.A	N.A	N.A	57.00	375.00
	(c) Fallow	6	0	1	0	N.A	N.A	7.00	0	0	N.A	N.A	N.A	N.A	0.00	7.00
4.	Period of Settlement															
	(a) Long Term	N.A	6	N.A	N.A	N.A	N.A	6.00	N.A	N.A	N.A	N.A	N.A	N.A	0.00	6.00
	(b) Short Term	N.A	67	N.A	N.A	N.A	N.A	67.00	N.A	N.A	N.A	N.A	N.A	N.A	0.00	67.00
5.	Reserve Deposits	144025	86316	199048	275550	9500	1830	982939. 00	361088	1727 86	5094 9	258 47	260603	70025	941298 .00	192423 7.00
6.	Free Facing Area in hac.	N.A	N.A	N.A	N.A	N.A	N.A	0.00	11.07	0	N.A	N.A	39.61	46.17	96.85	96.85

**Source: Compiled from the collected Data.**

short duration which they are filled with water. Some of the zalkars can be termed only 'fallow'. They are not suitable for fish farming at all. The total number of perennial zalkars is 101 in zone I and only 8 in zone II. This means that zone II is the poorest from the point of view of perennial character. The seasonal zalkars number 318 in zone I and 57 in zone II. Here it was observed that the zone II is poor from this point of view. As far as 'fallow' zalkars are concerned they are 7 in zone I and figures of zone II are not available and where available they are found to be zero. In sampled blocks of Khagaria district, the number is zero and in other blocks and districts the figures in this head could not be made available from the records.

The zalkars can be considered from the point of view of settlement also. The settlements may be a long term settlement or it may be a short term settlement. Here there is a paucity of records. The long-term settlement was found to exist only in zone I, that is, in Madhepur block of Madhubani district and it was only 6 in number. It can not be said with certainty about the figure of long term settlement in other district and in other blocks because the records were not available. Hence, the total of the longer settlement come to only 6. The total short term settlement is 67 only in both zone I & zone II combined. It is surprising that all the 67 number of short term settlements are found in zone I, That is, in Madhepur block of Madhubani district. In none of the districts and in none of the blocks excepting this one was available to the research team.

The surprising thing is the figures of the reserve deposits were available. In zone I the total reserve deposits was Rs. 982939 and in zone II the

reserved deposits was Rs. 941298. The reserve deposits of both zone I & zone II come to Rs. 1924237.

The details of free fishing area in zone I could not be available that it can not be said with certainty. In zone II the free fishing area is found to be 11.07 ha in sampled blocks of Khagaria district. In Purnea East block of Purnea district it was 39.61 ha and 46.17 ha in Dhamdaha block of Purnea district. Therefore, the total free fishing area is 96.85 ha in both the zones combined.

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# **Chapter: Three**

## **ECONOMICS OF FISH FARMING: RESULTS & DISCUSSIONS**

### **3.1 Background**

‘Fisheries economics’ means application of economic policies and principles to fisheries. Fisheries economics looks at the rules governing the behaviour of society with respect to fish population and ecosystems. It aims at applying economic principles to the production, proper use conservation of fishery resources, planning of fisheries policy and management, and the problems of fishing industries and to meet their growing needs in terms of human resource development: Economic awareness and efficiency along with ecological awareness and security and social equity are the three critical contributing factors on which largely depends the sustainable development of aquaculture. Fisheries policies based on proper economic planning and analysis are very necessary to ensure profitable production and processing and marketing of all fishery-products. Fisheries economics will also help in ensuring equitable distribution of the net benefits created in the production process. There seems to be an urgent need to broaden the base of fisheries economics to meet the dynamic needs of fishing industry in respect of the following and the other related areas:

- i) Planning and management of fisheries
- ii) Economics (economic analysis) of fish culture, prawn culture, composite fish culture, and integrated fish farming in respect of total investment: net production, and profit (net income).
- iii) Fish marketing and related problems.
- iv) Socio-economic study of fishermen families.

- v) Manufacturing costs of crafts and gear and expenditure on fishing both in terms of human resource and other consumables.
- vi) Demand and supply of fish and per capita consumption of fish in different State of the country.
- vii) Economics of processing of fishery products and their export potential and related problems.
- viii) Data on per day catch, annual catch, and catch per unit effort (CPUE). There is a linear relationship between CPUE and stock size. Accordingly,  $CPUE = qB$ , where  $q$  is the catchability coefficient,  $B$  is the biomass of fish stock.

### **Economics of Fish Farming in Koshi Region**

In order to study economics of fish farming in flood prone areas of Bihar with special reference to Koshi river systems, an attempt has been made to investigate the following objectives: to examine socio- economic status of people in the study area, to investigate the prospects of fish farming in flood affected areas, to estimate the cost of cultivations and production of fish, to identify the various channels and systems of fish marketing and to identify the existing constraints of fish farming in the selected area. Further, an attempt has been made to test the following hypothesis: (i) Can the damage done by floods be converted into a source of profits for the disadvantaged people of the area (ii) Can fish farming be viable that can improve the socio economic conditions of the people (iii) What types and kinds of fishes be farmed so that profit may accrue assuredly.

In order to draw the inferences of the study, the variables which have been taken into account are: agro – climatic zones, larger area, inundated flood water for longer period, extent of larger crop damage, larger number of ponds, tanks, rivulets, ditches, dry catchment area of dams canal, etc. different types of farmers like marginal, small medium and larger, cropping pattern and maximum losses due to crop damage etc.

It may be stated that the respondents have been classified into two main categories: (i) Fishermen (ii) Non – Fishermen. Further, classification of fishermen has been done according to Zone – wise. These are two Zones. In one zone, three districts have been covered for intensive study. Two blocks have been taken from each district in order to represent total universe of the study. Characteristics of the respondents have been catagorised as below:

- (i) Size of fishermen - Small, medium and large.
- (ii) Sex - Male, Female
- (iii) Educational Status - Illiterate, just literate, upto primary, secondary, intermediate, graduate and above, and technical education.
- (iv) Age of the respondents - upto 25 years, 26 to 40 years, 41 to 55 years and 56 years and above.
- (v) Social Group - Scheduled Castes, Scheduled Tribes, other backward class (OBC), and General.
- (vi) Occupational Pattern - Agriculture, Fisheries Service Business/ Trade, Agricultural labour, Artisans.
- (vii) Marital Status - Married, Unmarried and widow.
- (viii) Religions - Hindu and Muslim

### **3.2 Educational Status**

Table 3.1 revealed classification of age groups of the sampled respondents according to educational status. It may be stated that total sample is 480 respondents which includes both fishermen and non-fishermen. The table indicated that 19.79 per cent of the respondents belonged to the first category of age group, i.e., up to 25 years. 29.16 per cent of the respondents belonged to the second category of age group, i.e., 26 to 40 years. 27.29 per cent of the respondents belonged to the third category of

the age group, i.e., 41 to 55 years and remaining 23.75 per cent of the respondents belonged to the fourth and last category of age group, i.e., 56 and above years.

The table further revealed that 42.92 per cent of the respondents belonged to the first category of educational status, i.e., illiterate. It means that 42.92 per cent of the respondents were selected as illiterate in the sample 8.33 per cent of the respondents was selected as just literate. 10.41 per cent of the respondents was selected as up to primary and 19.79 per cent of the respondents was selected as secondary and 6.25 per cent of the respondents was selected as intermediate, 12.08 per cent of the respondents was selected as graduate and above educational qualification and 0.20 per cent of the respondents was selected as technical educated persons.

**Table 3.1**  
**Classification of Age Groups to the Sampled Respondents According to Educational Status**

Age of the Respondents (years)	Educational Status							Total
	Illiterate	Just Literate	Up to Primary	Secondary	Intermediate	Graduate and above	Technical Education	
1	2	3	4	5	6	7	8	9
Upto 25 Years	30 (6.25)	20 (4.16)	20 (4.16)	15 (3.12)	05 (1.04)	05 (1.04)	-	95 (19.79)
26 - 40 Years	65 (13.54)	10 (2.08)	12 (2.50)	28 (5.83)	11 (2.29)	13 (2.70)	01 (0.20)	140 (29.16)
41 - 55 Years	63 (13.12)	05 (1.04)	10 (2.08)	27 (5.62)	6 (1.25)	20 (4.16)	-	131 (27.29)
56 and above	48 (10.00)	05 (1.04)	08 (1.66)	25 (5.20)	08 (1.66)	20 (4.16)	-	114 (23.75)
<b>Total</b>	<b>206 (42.92)</b>	<b>40 (8.33)</b>	<b>50 (10.41)</b>	<b>95 (19.79)</b>	<b>30 (6.25)</b>	<b>58 (12.08)</b>	<b>01 (0.20)</b>	<b>480 (100.00)</b>

*Note:- Figures in the brackets indicate percentage*  
*Source- Field Survey*

Table 3.2 depicted classification of age groups of the sampled respondents according to social groups. It may be stated that social groups have been classified into the four categories (i) Scheduled Castes (ii) Scheduled Tribes (iii) Other Backward Castes (OBC) (iv) General Castes, The table revealed that near about 4 per cent of the respondents belonged to the first category of social groups, i.e., Scheduled castes, 4.79 per cent of the respondents belonged to the second category of social groups, i.e., Scheduled Tribes, 78.12 per cent of the respondents belonged to the third category of social groups, i.e., Other Backward caste (OBC) and 13.12 per cent of the respondents belonged to the last and final category of social groups, i.e., General Castes. Thus, it may be concluded that the respondents belonged to the all categories of social groups in the sample.

**Table 3.2**  
**Classification of Age Groups of the Sampled**  
**Respondents According to Social Groups**

Age of the Respondents (years)	<i>Educational Status</i>				Total
	Scheduled Castes	Scheduled Tribes	Other Backward Class (OBC)	General Castes	
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
Upto 25 Years	04 (0.83)	05 (1.04)	74 (15.41)	12 (2.50)	95 (19.79)
26 - 40 Years	06 (1.25)	06 (1.25)	109 (22.70)	19 (3.95)	140 (29.16)
41 - 55 Years	04 (0.83)	04 (0.83)	106 (22.08)	17 (3.54)	131 (27.29)
56 and above	05 (1.04)	08 (1.66)	86 (17.91)	15 (3.12)	114 (23.75)
<b>Total</b>	<b>19 (3.95)</b>	<b>23 (4.79)</b>	<b>375 (78.12)</b>	<b>63 (13.12)</b>	<b>480 (100.00)</b>

*Note:- Figures in the brackets indicate percentage*  
*Source- Field Survey*

### 3.3 Marital Status, Sex and Religion

Table 3.3 described classification of age groups of the sampled respondents according to their marital status. The table revealed that 91.16 per cent of the respondents belonged to the first category of marital status, i.e., married, 3.33 per cent of the respondents belonged to the second category of marital status, i.e., unmarried and 5 per cent of the respondents belonged to the last and final category of marital status, i.e., widow. Thus, it may be concluded that the respondents belonged to all categories of marital status.

**Table 3.3**  
**Classification to Age Groups of the Sampled**  
**Respondents According to Marital Status**

Age of the Respondents (years)	<i>Marital Status</i>			Total
	Married	Unmarried	Widow	
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Upto 25 Years	85 (17.70)	04 (0.83)	06 (1.25)	95 (19.79)
26 - 40 Years	127 (26.45)	06 (1.25)	07 (1.45)	140 (29.16)
41 - 55 Years	122 (25.41)	03 (0.62)	06 (1.25)	131 (27.29)
56 and above	106 (22.08)	03 (0.62)	05 (1.04)	114 (23.75)
<b>Total</b>	<b>440 (91.64)</b>	<b>16 (3.33)</b>	<b>24 (5.00)</b>	<b>480 (100.00)</b>

*Note:- Figure in the brackets indicate percentage*  
*Source- Field Survey*

Table 3.4 revealed classification of age groups of the sampled respondents according to their sex. The table revealed that 94.16 per cent of the respondents belonged to the first category of sex, i.e., males and only 5.83 per cent of the respondents belonged to the second category of sex, i.e., females. Thus, it is concluded that majority of the respondents belonged to males and females respondents are negligible, i.e., around 6 per cent only.

**Table 3.4**  
**Classification of Age Groups of the Sampled Respondents According to their Sex**

Age of the Respondents (years)	Sex		Total
	Male	Female	
1	2	3	4
Upto 25 Years	90 (18.75)	5 (1.04)	95 (19.79)
26 - 40 Years	130 (27.08)	10 (2.08)	140 (29.16)
41 - 55 Years	123 (25.62)	8 (1.66)	131 (27.29)
56 and above	109 (22.70)	5 (1.04)	114 (23.75)
<b>Total</b>	<b>452 (94.16)</b>	<b>28 (5.83)</b>	<b>480 (100.00)</b>

*Note:- Figures in the brackets indicate percentage*  
*Source- Field Survey*

Table 3.5 depicted classification of age groups of the sampled respondents according to their religion, It may be stated that for the purpose of this study, religion has been classified into two categories: (i) Hindu, and (ii) Muslim. The Table revealed that 90 per cent of the respondents belonged to the first category of religion, i.e., Hindu and 10 per cent of the respondents belonged to the second category of religion, i.e., Muslim. Thus, it is concluded that majority of the respondents belonged to Hindu.

**Table 3.5**  
**Classification of Age Groups of the Sampled Respondents According to their Religion**

Age of the Respondents (years)	Religion		Total
	Hindu	Muslim	
1	2	3	4
Upto 25 Years	87 (18.12)	8 (1.66)	95 (19.79)
26 - 40 Years	126 (26.25)	14 (2.91)	140 (29.16)
41 - 55 Years	116 (24.16)	15 (3.12)	131 (27.29)
56 and above	103 (21.45)	11 (2.29)	114 (23.75)
<b>Total</b>	<b>432 (90.00)</b>	<b>48 (10.00)</b>	<b>480 (100.00)</b>

*Note:- Figures in the brackets indicate percentage*  
*Source- Field Survey*

### 3.4 Occupational Pattern

Table 3.6 described classification of age groups of the sampled respondents according to their occupational pattern. The table revealed that 43.75 per cent of the respondents belonged to agriculturist, 31.66 per cent of the respondents was fisheries, 10.62 per cent of the respondents belonged to business/trade communities, 7.29 per cent of the respondents belonged to agricultural labours, 4.16 per cent of the respondents belonged to casual labourers, 2.08 per cent of the respondents belonged to artisans and a very negligible number, i.e., 0.41 per cent of the respondents belonged to the service category. Thus, it is concluded that respondents were belonged to all occupational categories like agriculture, fisheries, service, business/trade, agricultural labour, casual labour and artisan.

**Table 3.6**  
**Classification of Age Groups of the Sampled**  
**Respondents According to their Occupational Pattern**

Age of the Respondents (years)	<i>Occupational Pattern</i>							Total
	Agriculture	Fisheries	Service	Business / Trade	Agricultural Labour	Casual Labour	Artisans	
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>
Upto 25 Years	25 (5.20)	21 (4.37)	-	18 (3.75)	16 (3.33)	10 (2.08)	05 (1.04)	95 (19.79)
26 - 40 Years	69 (14.37)	49 (10.20)	01 (0.20)	12 (2.5)	04 (0.83)	03 (0.62)	02 (0.41)	140 (29.16)
41 - 55 Years	65 (13.54)	40 (8.33)	01 (0.20)	12 (2.5)	08 (1.66)	03 (0.62)	02 (0.41)	131 (27.29)
56 and above	51 (10.62)	42 (8.75)	-	9 (1.87)	07 (1.45)	04 (0.83)	01 (0.20)	114 (23.75)
<b>Total</b>	<b>210</b> <b>(43.75)</b>	<b>152</b> <b>(31.66)</b>	<b>2</b> <b>(0.41)</b>	<b>51</b> <b>(10.62)</b>	<b>35</b> <b>(7.29)</b>	<b>20</b> <b>(4.16)</b>	<b>10</b> <b>(2.08)</b>	<b>480</b> <b>(100.00)</b>

*Note:- Figures in the brackets indicate percentage*

*Source- Field Survey*



### 3.5 Size of Fishermen

Table 3.7, described classification of age groups of the sampled respondents according to size of fishermen. Fisherman has been classified into three categories: (i) Small size fishermen (ii) Medium size and (iii) Large size fishermen. It may be stated that standard norms have been taken into account to classify the size of fishermen. The table revealed that 29.16 per cent of the respondents belonged to first category of fishermen, i.e., small size of fishermen 44.79 per cent of the respondents belonged to second category of fishermen, i.e., medium size of fishermen and 26.04 per cent of respondents belonged to third category of fishermen, i.e., large size of fishermen. Thus, in order to represent the universe of the study all size of fishermen have been included for the intensive study.

**Table 3.7**  
**Classification of Age Groups of the Sampled Respondents According to Size of Fishermen**

Age of the Respondents (years)	Size of Fishermen			Total
	Small	Medium	Large	
1	2	3	4	5
Upto 25 Years	26 (5.41)	45 (9.37)	24 (5.00)	95 (19.79)
26 - 40 Years	40 (8.33)	56 (11.66)	44 (9.16)	140 (29.16)
41 - 55 Years	36 (7.50)	56 (11.66)	39 (8.12)	131 (27.29)
56 and above	38 (7.91)	58 (12.08)	18 (3.75)	114 (23.75)
<b>Total</b>	<b>140 (29.16)</b>	<b>215 (44.79)</b>	<b>125 (26.04)</b>	<b>480 (100.00)</b>

*Note:- Figures in the brackets indicate percentage  
Source-Field Survey*

### 3.6 Kinds of Family

Table 3.8 revealed classification of age groups of the sampled respondents according to kinds of family structure. Family structure has been divided into three categories: (i) Nuclear family (ii) Joint family and (iii) Extended family. The table depicted that 65.62 per cent of the respondents belonged to joint family, 19.16 per cent of the respondents belonged to nuclear family and 15.20 per cent of the respondents belonged to extended family. Thus, it may be concluded that at present joint family has been prevailing in the sampled districts of Bihar. The respondents still followed traditional views and lived in joint family.

**Table 3.8**  
**Classification to Age Groups of the Sampled Respondents According to Kinds of Family**

Age of the Respondents (years)	<i>Kinds of Family</i>			Total
	Nuclear Family	Joint Family	Extended Family	
1	2	3	4	5
Upto 25 Years	23 (4.79)	56 (11.66)	16 (3.33)	95 (19.79)
26 - 40 Years	21 (4.37)	97 (20.20)	22 (4.58)	140 (29.16)
41 - 55 Years	23 (4.79)	90 (18.75)	18 (3.75)	131 (27.29)
56 and above	25 (5.20)	72 (15.00)	17 (3.54)	114 (23.75)
<b>Total</b>	<b>92 (19.16)</b>	<b>315 (65.62)</b>	<b>73 (15.20)</b>	<b>480 (100.00)</b>

*Note:- Figures in the brackets indicate percentage*  
*Source-Field Survey*

### 3.7 Ownership of House

Table 3.9 described classification of age groups of the sampled respondents according to ownership of house. It may be stated that for the purpose of the intensive study the ownership of house has been classified

into three categories: (i) own house (ii) rented house and (iii) relative's house. The table revealed that 90 per cent of the respondents lived in their own houses, near about 4.00 per cent of respondents lived in rented house and 6.25 per cent of the respondent lived in relative's house. It is indicated that the majority of the respondents lived in own houses.

**Table 3.9**  
**Classification of Age Groups of the Sampled Respondents According to Ownership of House**

<b>Age of the Respondents (years)</b>	<b><i>Ownership House</i></b>			<b>Total</b>
	<b>Own House</b>	<b>Rented House</b>	<b>Relatives House</b>	
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Upto 25 Years	83 (17.29)	05 (1.04)	07 (1.45)	95 (19.79)
26 - 40 Years	126 (26.25)	05 (1.04)	09 (1.87)	140 (29.16)
41 - 55 Years	118 (24.58)	05 (1.04)	08(1.66)	131 (27.29)
56 and above	105 (21.87)	03 (0.62)	06 (1.25)	114 (23.75)
<b>Total</b>	<b>432 (90.00)</b>	<b>18 (3.75)</b>	<b>30 (6.25)</b>	<b>480 (100.00)</b>

*Note:- Figures in the brackets indicate percentage  
Source-Field Survey*

### **3.8 Sources of Income**

Table 3.10 described classification of age groups of the sampled respondents according to sources of income. Sources of income of the respondents have been categorized into four groups : (i) Self earner (ii) Paternal income (iii) Government subsidies (iv) Others. The table revealed that 70.62 per cent of the respondents belonged to the first category of sources of income, i.e., self earner, 16.25 per cent of the respondents belonged to second category of income, i.e., paternal income, 8.12 per cent

of the respondents belonged to the third category of government subsidies and 5 per cent of the respondents belonged to last category of sources of income, i.e., others like sources of income from various miscellaneous economic activities. Thus, it is indicated that the sources of income of all the sampled respondents have been observed from different economic activities.

**Table 3.10**  
**Classification of Age Groups of the Sampled Respondents**  
**According to their Sources of Income**

Age of the Respondents (Years)	Sources of Income				Total
	Self Earners	Paternal Income	Govt. Subsidies	Others	
1	2	3	4	5	6
upto 25 years	69 (14.37)	15 (3.12)	07 (1.45)	04 (0.83)	95 (19.79)
26-40	101 (21.04)	18 (3.75)	13 (2.70)	08 (1.66)	140 (29.16)
41-55	93 (19.37)	22 (4.58)	09 (1.87)	07 (1.45)	131 (27.29)
56 and Above	76 (15.83)	23 (4.79)	10 (2.08)	05 (1.04)	114 (23.75)
<b>Total</b>	<b>339</b> <b>(70.62)</b>	<b>78</b> <b>(16.25)</b>	<b>39</b> <b>(8.12)</b>	<b>24</b> <b>(5.00)</b>	<b>480</b> <b>(100.00)</b>

*Note: Figures in the Brackets indicate percentage Source-Field Survey*

### 3.9 Type of Houses

Table 3.11 depicted classification of age groups of the sampled respondents according to their type of houses. Type of houses has been classified into the various categories such as: (i) Mud and Thatch (ii) Mud and Tiles (iii) Brick and Thatch (iv) Brick and Tiles (v) Cottage (vi) Semi-pucca and (vii) Pucca. The table indicated that 36.25 per cent of the respondents lived in the house. Which was built with mud and thatch,

27.50 per cent of the respondents lived in the house, built with mud and tiles, 8.54 per cent of the respondents lived in the house which was built with brick and thatch, 8.12 per cent of the respondents lived in the house which was built with brick and tiles and 6.04 per cent of the respondents lived in Cottage, 7.91 per cent of respondents lived in Semi-pucca house and 5.62 per cent of the respondents lived in pucca houses. Thus, it is indicated that the sampled respondents lived in all types of houses such as the house built with mud and thatch, mud tiles, brick and thatch, brick and tiles, collage, semi-pucca and pucca.

**Table 3.11**  
**Classification of Age Groups of the Sampled Respondents**  
**According to Type of Houses**

Age of the Respondents (Years)	Type of Houses							Total
	Mud and Thatch	Mud and Tiles	Brick and Thatch	Brick and Tiles	Cottage	Semi Pucca	Pucca	
1	2	3	4	5	6	7	8	9
upto 25 years	33 (6.87)	27 (5.62)	11 (2.29)	09 (1.87)	04 (0.83)	06 (1.25)	05 (1.04)	95 (19.79)
26-40	56 (11.66)	33 (6.87)	15 (3.12)	10 (2.08)	07 (1.45)	09 (1.87)	10 (2.08)	140 (29.16)
41-55	45 (9.37)	35 (7.29)	5 (1.04)	10 (2.08)	12 (2.50)	16 (3.33)	08 (1.66)	131 (27.29)
56 and Above	40 (8.33)	37 (7.70)	10 (2.08)	10 (2.08)	06 (1.25)	07 (1.45)	04 (0.83)	114 (23.75)
<b>Total</b>	<b>174</b> <b>(36.25)</b>	<b>132</b> <b>(27.50)</b>	<b>41</b> <b>(8.54)</b>	<b>39</b> <b>(8.12)</b>	<b>29</b> <b>(6.04)</b>	<b>38</b> <b>(7.91)</b>	<b>27</b> <b>(5.62)</b>	<b>480</b> <b>(100.00)</b>

*Note: Figures in the Brackets indicate percentage*  
*Source-Field Survey*

### 3.10 Details of Land

Table 3.12 described classification of level of education of the sampled respondents according to details of land. Details of land has been classified into three categories: (i) own land (ii) leased-in (iii) operational land. Further, details of land has been classified into two parts (i) Irrigated land (ii) Unirrigated land

#### Irrigated Land:

The table revealed that 41.66 per cent of the respondents used own land which is irrigated land. 21.25 per cent of the respondents utilized leased-in land which falls under the category of irrigated land, 12.08 per cent of the respondents used operational land which is considered as irrigated land. Thus, it is indicated that near about 75 per cent land used by the respondents, considered as irrigated land whether own land, leased-in land and operational land.

**Table 3.12**  
**Classification of Level of Education of the Sampled Respondents**  
**According to Details of Land**

Level of Education	IRRIGATED LAND			UNIRRIGATED LAND			Total
	Own Land	Leased in	Operational Land	Own Land	Leased in	Operational Land	
1	2	3	4	5	6	7	8
Illiterate	87 (18.12)	44 (9.16)	14 (2.91)	40 (8.33)	15 (3.12)	06 (1.25)	206 (42.92)
Just Literate	12 (2.50)	11 (2.29)	06 (1.25)	07 (1.45)	03 (0.62)	01 (0.20)	40 (8.33)
Upto Primary	26 (5.41)	9 (1.87)	05 (1.04)	07 (1.45)	01 (0.20)	02 (0.41)	50 (10.41)

Secondary	41 (8.54)	22 (4.58)	18 (3.75)	10 (2.08)	02 (0.41)	02 (0.41)	95 (19.77)
Intermediate	10 (2.08)	06 (1.25)	06 (1.25)	06 (1.25)	01 (0.20)	01 (0.20)	30 (6.25)
Graduate and Above	23 (4.79)	10 (2.08)	09 (1.87)	12 (2.50)	02 (0.41)	02 (0.41)	58 (12.08)
Technical Education	1 (0.20)	-	-	-	-	-	01 (0.20)
<b>Total</b>	<b>200 (41.66)</b>	<b>102 (21.25)</b>	<b>58 (12.08)</b>	<b>82 (17.08)</b>	<b>24 (5.00)</b>	<b>14 (2.91)</b>	<b>480 (100.00)</b>

*Note: Figures in the Brackets indicate percentage  
Source-Field Survey*

### *Unirrigated Land:*

The table revealed that near about 25 per cent of the respondents utilized land which do not have any source of irrigation which is called as unirrigated land. Further, 17.08 per cent of the respondents used own land which is unirrigated land, 5.50 per cent of the respondents used land which leased-in and near about 3.00 per cent of the respondents used operational unirrigated land. Thus, it is indicated that majority of the respondents used irrigated land for aqua-culture and agriculture.

### **3.11 Cropping Pattern**

Table 3.13 described classification of level of education of the sampled respondents according to cropping pattern. Crops have been divided into three categories: (i) Kharif crops (ii) Rabi crops and (iii) Garma crops. The table indicated that near about 46 per cent of the respondents cultivated Kharif crops, near about 38 per cent of the respondents cultivated rabi crops and near about 17 per cent of the respondents cultivated garma crops. Further, 17.70 per cent of the respondents cultivated maize, near about 15 per cent of the respondents cultivated rice and 13.54 per cent of respondents cultivated different kinds of pulses. Further, the table

indicated 16.25 per cent of the respondents cultivated wheat, 11.25 per cent of the respondents cultivated the different kinds of pulses and 10 per cent of the respondents cultivated gram crops and other related crops. Regarding gamma crops, 7.50 per cent of the respondents cultivated vegetables, 5 per cent of the respondents cultivated Jowar and related crops and 4.16 per cent of the respondents cultivated Fruits, etc. Thus, it is indicated that the respondents cultivated all types of crops like Kharif, Rabi and Gamma crops. Thus, it may be concluded that the respondents are always engaged in economic activities all over the year.

**Table 3.13**  
**Classification of Level of Education of the Sampled Respondents**  
**According to Cropping Pattern**

Level of Education	Kharif Crops			Rabi Crops			Gamma Crops			Total
	Maize	Rice	Pulses	Wheat	Pulses	Gram	Vegetable	Jowar	Fruits	
1	2	3	4	5	6	7	8	9	10	11
Illiterate	54 (11.25)	33 (6.87)	20 (4.16)	29 (6.04)	19 (3.95)	15 (3.12)	12 (2.50)	13 (2.70)	11 (2.29)	206 (42.92)
Just Literate	04 (0.83)	6 (1.25)	04 (0.83)	07 (1.45)	05 (1.04)	05 (1.04)	04 (0.83)	04 (0.83)	01 (0.20)	40 (8.33)
Upto Primary	6 (1.25)	07 (1.45)	08 (1.66)	06 (1.25)	07 (1.45)	07 (1.45)	05 (1.04)	02 (0.41)	02 (0.41)	50 (10.41)
Secondary	12 (2.50)	08 (1.66)	19 (3.95)	25 (5.20)	10 (2.08)	11 (2.29)	05 (1.04)	02 (0.41)	03 (0.62)	95 (19.79)
Intermediate	03 (0.62)	04 (0.83)	06 (1.25)	04 (0.83)	05 (1.04)	03 (0.62)	03 (0.62)	01 (0.20)	01 (0.20)	30 (6.25)
Graduate and Above	05 (1.04)	12 (2.50)	08 (1.66)	07 (1.45)	08 (1.66)	07 (1.45)	07 (1.45)	02 (0.41)	02 (0.41)	58 (12.08)
Technical Education	01 (0.20)	-	-	-	-	-	-	-	-	01 (0.20)
<b>Total</b>	<b>85 (17.70)</b>	<b>70 (14.58)</b>	<b>65 (13.54)</b>	<b>78 (16.25)</b>	<b>54 (11.25)</b>	<b>48 (10.00)</b>	<b>36 (7.50)</b>	<b>24 (5.00)</b>	<b>20 (4.16)</b>	<b>480 (100.00)</b>

*Note: Figures in the Brackets indicate percentage*  
*Source-Field Survey*



### 3.12 Sources of Fish Production

Table 3.14 described classification of the sampled respondents according to sources of fish production. Sources of fish production have been classified into five categories: (i) Pond (ii) River (iii) Lake (iv) Canal (v) Others. The table revealed that 22.70 per cent of the respondents used ponds for fish production, 37.08 per cent of the respondents used river as source of fish production, 12.08 per cent of the respondents used lakes as source of fish production, 13.54 per cent of the respondents used canals as sources of fish production and 14.58 per cent of the respondents used other sources of fish production which are easily available in their respective areas. Thus, it may be concluded that all types of sources of fish production are available in sampled areas where the respondents have an ample opportunities for fish production.

**Table 3.14**  
**Classification of Level of Education of the Sampled Respondents**  
**According to Sources of Fish Production**

Level of Education	Sources of Fish Production					Total
	Pond	River	Lake	Canal	Others	
1	2	3	4	5	6	7
Illiterate	54 (11.25)	89 (18.54)	18 (3.75)	20 (4.16)	25 (5.20)	206 (42.91)
Just Literate	07 (1.45)	13 (2.70)	07 (1.45)	08 (1.66)	05 (1.04)	40 (8.33)
Upto Primary	09 (1.87)	21 (4.37)	05 (1.04)	08 (1.66)	07 (1.45)	50 (10.41)
Secondary	27 (5.62)	21 (4.37)	07 (1.45)	16 (3.33)	24 (5.00)	95 (19.79)
Intermediate	04 (0.83)	13 (2.70)	04 (0.83)	05 (1.04)	04 (0.83)	30 (6.25)
Graduate and Above	08 (1.66)	20 (4.16)	17 (3.54)	08 (1.66)	05 (1.04)	58 (12.08)
Technical Education	-	01 (0.20)	-	-	-	01 (0.20)
<b>Total</b>	<b>109</b> <b>(22.70)</b>	<b>178</b> <b>(37.08)</b>	<b>58</b> <b>(12.08)</b>	<b>65</b> <b>(13.54)</b>	<b>70</b> <b>(14.58)</b>	<b>480</b> <b>(100.00)</b>

*Note: Figures in the Brackets indicate percentage*  
*Source-Field Survey*

Table 3.15 described classification of level of education of sampled respondents according to their own sources of fish production. The table revealed that near about 33 per cent of the respondents used own ponds and lakes for fish production and 40 per cent of the respondents used rivers and canals as well as near about 28 per cent of the respondents used other sources of fish production. Thus, it is concluded that the respondents used own sources of production as well as other sources of fish production as provided by the government.

**Table 3.15**  
**Classification of Level of Education of the Sampled Respondents**  
**According to own Sources of Fish Production**

Level of Education	Own Sources of Fish Production			Total
	Own Pond/ Lake	River/ Canal	Others	
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Illiterate	81 (16.87)	90 (18.75)	35 (7.29)	206 (42.92)
Just Literate	09 (1.87)	19 (3.95)	12 (2.50)	40 (8.33)
Upto Primary	13 (2.70)	18 (3.75)	19 (3.95)	50 (10.41)
Secondary	32 (6.66)	34 (7.08)	29 (6.04)	95 (19.79)
Intermediate	10 (2.08)	07 (1.45)	13 (2.70)	30 (6.25)
Graduate and Above	13 (2.70)	24 (5.00)	21 (4.37)	58 (12.08)
Technical Education	-	-	01 (0.20)	01 (0.20)
<b>Total</b>	<b>158</b> <b>(32.91)</b>	<b>192</b> <b>(40.00)</b>	<b>130</b> <b>(27.08)</b>	<b>480</b> <b>(100.00)</b>

*Note: Figures in the Brackets indicate percentage*  
*Source-Field Survey*

### 3.13 Membership

Table 3.16 revealed classification of level of education according to water plants and members of fish society. The respondents were asked the question: Do you have water plants? 62.50 per cent of the respondents answered in an affirmative number. 37.50 per cent do not have any water plants of fish production. They are used as other means for fish production. Further, the respondents were asked another question: Are you a member of fish society? 58.33 per cent of the respondents answered in an affirmative manner and 41.66 per cent of the respondents did not answer in an affirmative manner.

**Table 3.16**  
**Classification of Level of Education of the Sampled Respondents**  
**According to Water Plants and Members of Fish Society**

Level of Education	Do You have Water Plants?		Are you a members of Fish Society		If Yes, tell the name of Society	If no, Name of the Jalkar
	Yes	No	Yes	No		
1	2	3	4	5	6	7
Illiterate	49 (10.20)	28 (5.83)	38 (7.91)	24 (5.00)	36 (7.50)	25 (5.20)
Just Literate	41 (8.54)	31 (6.45)	39 (8.12)	29 (6.04)	40 (8.33)	28 (5.83)
Upto Primary	45 (9.37)	34 (7.08)	44 (9.16)	32 (6.66)	43 (8.95)	32 (6.66)
Secondary	49 (10.20)	27 (5.62)	59 (12.29)	37 (7.70)	60 (12.5)	35 (7.29)
Intermediate	59 (12.29)	29 (6.04)	49 (10.20)	33 (6.87)	51 (10.62)	33 (6.87)
Graduate and above	39 (8.12)	20 (4.16)	41 (8.54)	32 (6.66)	26 (5.41)	24 (5.00)
Technical Education	18 (3.75)	11 (2.29)	10 (2.08)	13 (2.70)	24 (5.00)	23 (4.75)
<b>Total</b>	<b>300</b> <b>(62.5)</b>	<b>180</b> <b>(37.50)</b>	<b>280</b> <b>(58.33)</b>	<b>200</b> <b>(41.66)</b>	<b>280</b> <b>(58.33)</b>	<b>200</b> <b>(41.66)</b>

*Note: Figures in the Brackets indicate percentage*  
*Source-Field Survey*

### **3.14 Awareness of Jalkar Management Act**

Table 3.17 revealed classification of social groups of the sampled respondents according to awareness of Jalkar Management Act, 2006. The respondents were asked the question: Are you aware of Management Jalkar Act, 2006? 42.78 per cent of the respondents informed that they are well aware about Jalkar Management Act, 2006. 57.29 per cent of the respondents were not aware of the Jalkar Management Act, 2006. Further, the respondents were asked about the benefits of the Jalkar Act, 2006. 12.08 per cent of the respondents felt that they are well aware about the rules and regulations of Jalkar Management Act, 2006. Thus, 10.62 per cent of the respondents informed that this Act has been playing an important role in increasing fish production. 11.04 per cent of the respondents felt that this Act has been very helpful and useful for getting raw materials and near about 9 per cent of the respondents felt that there is no misuse of any resource due to awareness of Jalkar Management Act. Thus, it may be concluded that Jalkar Management Act, 2006 has been found very useful in fish production, marketing and government policies.

**Table 3.17**  
**Classification of Social Groups of the Sampled Respondents**  
**According to Awareness of Jalkar Management Act, 2006**

Social Groups	Are you aware of the Jalkar Management Act, 2006		If Yes, tell the profits from the Act			
	Yes	No	Awareness	Helping in Production	Helping in Raw Material	No Misuse
1	2	3	4	5	6	7
Scheduled Castes	31 (6.45)	78 (16.25)	11 (2.29)	09 (1.87)	08 (1.66)	10 (2.08)
Scheduled Tribes	37 (7.70)	73 (15.20)	13 (2.70)	11 (2.29)	14 (2.91)	13 (2.70)
Other Backward Class (OBC)	59 (12.29)	69 (14.37)	15 (3.12)	14 (2.91)	16 (3.33)	14 (2.91)
General	78 (16.25)	55 (11.45)	19 (3.95)	17 (3.54)	15 (3.12)	06 (1.25)
<b>Total</b>	<b>205</b> <b>(42.70)</b>	<b>275</b> <b>(57.29)</b>	<b>58</b> <b>(12.08)</b>	<b>51</b> <b>(10.62)</b>	<b>53</b> <b>(11.04)</b>	<b>43</b> <b>(8.95)</b>

**Note: Figures in the Brackets indicate percentage**  
*Source-Field Survey*

### 3.15 Cost of Fish Production

Table 3.18 described classification of social groups of the respondents according to any other sources of water production and cost of fish production. The table revealed that 40.62 per cent of the respondents felt that they got water from different sources for fish production. 59.37 per cent of the respondents did not get water for fish production. The respondents were asked the question about cost of fish production like land rent, digging cost, cost of ponds, tanks, depreciation, annual reserve deposits and interest on fixed cost. The respondents felt that they incurred own land rent, digging cost, cost of ponds/tanks, bear depreciation cost, annual reserve deposits and pay interest on fixed cost.

**Table 3.18**  
**Classification of Social Groups of the Sampled Respondents**  
**According to Any Other Source of Water for Fish Production**  
**and Cost of Fish Production**

Social Groups	Any other Sources of Water		Cost of Fish Production				
	Yes	No	Land Rent	Digging Cost of Lands/Tanks	Deprecations Cost	Annual Reserve Deposits (if Jalkar)	Interest on Fixed Cost
1	2	3	4	5	6	7	8
Scheduled Castes	51 (10.62)	73 (15.20)	10 (2.08)	9 (1.87)	8 (1.66)	9 (1.87)	10 (2.08)
Scheduled Tribes	49 (10.20)	69 (14.37)	12 (2.50)	11 (2.29)	13 (2.70)	7 (1.45)	9 (1.87)
Other Backward Class (OBC)	56 (11.66)	79 (16.45)	9 (1.87)	14 (2.91)	12 (2.50)	13 (2.70)	14 (2.91)
General	39 (8.12)	64 (13.33)	13 (2.70)	14 (2.91)	9 (1.87)	11 (2.29)	11 (2.29)
<b>Total</b>	<b>195</b> <b>(40.62)</b>	<b>285</b> <b>(59.37)</b>	<b>44</b> <b>(9.16)</b>	<b>48</b> <b>(10.00)</b>	<b>42</b> <b>(8.75)</b>	<b>40</b> <b>(8.33)</b>	<b>44</b> <b>(9.16)</b>

*Note: Figures in the Brackets indicate percentage Source-Field Survey*

Table 3.19 revealed the classification of social groups of the respondents according to operational costs of fish production. The aspects which have been included in the operational cost of fish production are as Lime, Fertilizers, Seeds, Feeds, Chemicals and Medicines, Water supply, Labour cost, Fishing cost, Security cost and interest on operational cost. From the table it is clear that labour cost (6.45 per cent) and lime cost (6.25 per cent) constitute the major items of the operational cost. Other cost like fertilizer, seed, feed, chemicals and medicines, water supply and security cost veer round 5 per cent. The respondents felt that without bearing operational cost of fish production; it is very difficult to produce fish and compete in the market.

**Table 3.19**  
**Classification of Social Groups of the Sampled Respondents**  
**According to Operational Cost of Fish Production**

Social Groups	Operational Cost									
	Lime	Fertilizers	Seed	Feed	Chemicals & Medicines	Water Supply	Labour Cost	Fishing Cost	Security Cost	Interest on operational Cost
1	2	3	4	5	6	7	8	9	10	11
Scheduled Caste	07 (1.45)	04 (0.83)	05 (1.04)	03 (0.62)	04 (0.83)	06 (1.25)	05 (1.04)	3 (0.62)	05 (1.04)	04 (0.83)
Scheduled Tribes	05 (1.04)	06 (1.25)	04 (0.83)	04 (0.83)	05 (1.04)	07 (1.45)	08 (1.66)	05 (1.04)	07 (1.45)	05 (1.04)
Other Backward Class (OBC)	08 (1.66)	07 (1.45)	10 (2.08)	09 (1.87)	09 (1.87)	09 (1.87)	10 (2.08)	07 (1.45)	06 (1.25)	06 (1.25)
General	10 (2.08)	08 (1.66)	09 (1.87)	08 (1.66)	08 (1.66)	05 (1.04)	08 (1.66)	08 (1.66)	09 (1.87)	06 (1.25)
<b>Total</b>	<b>30</b> <b>(6.25)</b>	<b>25</b> <b>(5.20)</b>	<b>28</b> <b>(5.83)</b>	<b>24</b> <b>(5.00)</b>	<b>26</b> <b>(5.41)</b>	<b>27</b> <b>(5.62)</b>	<b>31</b> <b>(6.45)</b>	<b>23</b> <b>(4.79)</b>	<b>27</b> <b>(5.62)</b>	<b>21</b> <b>(4.37)</b>

Note: Figures in the Brackets indicate percentage  
*Source-Field Survey*

### 3.16 Pattern and Sources of Technical Assistance

Table 3.20 described classification of social groups of the sampled respondents according to pattern of market. Sources of Technical assistance has been classified into four categories such as (i) Government Agencies (ii) Co-operative Societies (iii) Local Retailers (iv) Technical experts. Sources of seeds have been classified into five categories as (i) Natural (ii) Market (iii) Government Agencies (iv) Retailers and (v) Others. Regarding pattern of technical assistance, 20.41 per cent of the respondents expressed their opinion that government agencies have been helping in this regard. 23.75 per cent of the respondents felt that co-operative societies have also been participating in giving technical aid. 25.20 per cent of the respondents expressed their opinion that local

retailers have been found very useful and helpful in providing technical aid. 30.62 per cent of the respondents felt that technical experts have been playing very important role for strengthening fish market. The respondents were also asked to express their opinion about sources of seeds. The respondents felt that seeds naturally available from markets, government agencies and retailers. Thus, it may be concluded that technical aid aspects about fisheries playing an immense role for overall development of fish farming in flood prone areas of Bihar with particular reference to Kosi river system.

**Table 3.20**  
**Classification of Social Groups of the Sampled Respondents**  
**According to Pattern of Technical Assistance**

Social Group	Pattern of Technical Assistance				Sources of Seeds				
	Govt. Agencies	Cooperative Societies	Local Retailers	Technical Experts	Natural	Market	Govt. Agencies	Retailers	Others
1	2	3	4	5	6	7	8	9	10
Scheduled Caste	21 (4.37)	23 (4.79)	22 (4.58)	31 (6.45)	24 (5.00)	18 (3.75)	21 (4.37)	17 (3.54)	14 (2.91)
Scheduled Tribes	26 (5.41)	27 (5.62)	29 (6.04)	39 (8.12)	28 (5.83)	23 (4.79)	26 (5.41)	21 (4.37)	19 (3.95)
Other Backward Class (OBC)	30 (6.25)	34 (7.08)	38 (7.91)	37 (7.70)	29 (6.04)	29 (6.04)	36 (7.50)	25 (5.20)	25 (5.20)
General	21 (4.37)	30 (6.25)	32 (6.66)	40 (8.33)	21 (4.37)	29 (6.04)	26 (5.41)	33 (6.87)	16 (3.33)
<b>Total</b>	<b>98</b> <b>(20.41)</b>	<b>114</b> <b>(23.75)</b>	<b>121</b> <b>(25.20)</b>	<b>147</b> <b>(30.62)</b>	<b>102</b> <b>(21.25)</b>	<b>99</b> <b>(20.62)</b>	<b>109</b> <b>(22.70)</b>	<b>96</b> <b>(20.00)</b>	<b>74</b> <b>(15.41)</b>

*Note: Figures in the Brackets indicate percentage*  
*Source-Field Survey*

### 3.17 Training for Fish Production

Table 3.21 described classification of social groups of the sampled respondents according to training of fish production. The respondents were



asked to express their opinion about training of fish production such as year, place of training, duration, organizations etc. 43.33 per cent of the respondents expressed that they got training of fish production and they attended the training programme related to it. They attended the training in different years and different places and different duration and for different organisations including the government agencies.

**Table 3.21**  
**Classification of Social Groups of the Sampled Respondents**  
**According to Training of Fish Production**

Social Groups	Training of Fish Production		Yes, Explained the Details				
	Yes	No	Year (Last Five Years)	Place District Head Quarter	Duration 1 to 3 month	Organisation (Govt. Agency)	Training of Fish Production
1	2	3	4	5	6	7	8
Scheduled Caste	42 (8.75)	72 (15.00)	09 (1.87)	07 (1.45)	05 (1.04)	06 (1.25)	08 (1.66)
Scheduled Tribes	49 (10.20)	65 (13.54)	11 (2.29)	10 (2.08)	6 (1.25)	8 (1.66)	12 (2.50)
Other Backward Class (OBC)	55 (11.45)	70 (14.58)	13 (2.70)	12 (2.50)	16 (3.33)	12 (2.50)	14 (2.91)
General	62 (12.91)	65 (13.54)	14 (2.91)	13 (2.70)	12 (2.50)	12 (2.50)	08 (1.66)
<b>Total</b>	<b>208</b> <b>(43.33)</b>	<b>272</b> <b>(56.66)</b>	<b>47</b> <b>(9.79)</b>	<b>42</b> <b>(8.75)</b>	<b>39</b> <b>(8.12)</b>	<b>38</b> <b>(7.91)</b>	<b>42</b> <b>(8.75)</b>

*Note: Figures in the Brackets indicate percentage*  
*Source-Field Survey*

Table 3.22 described classification of occupation of the sampled respondents according to benefits from training. The table depicted that 60.41 per cent of the respondents expressed their opinion that they have been benefited from the training. 39.58 per cent of the respondents expressed their views that they did not get any benefits from training.

Benefited respondents felt that the training has been very helpful to procure different varieties of seeds, helpful in fish production and marketing.

**Table 3.22**  
**Classification of Occupations of the Sampled Respondents**  
**According to Benefits from Training**

Occupation	Benefits of Training		If Yes, which type of Benefits		
	Yes	No	Helpful in Seeds/ Varieties	Helpful in Production	Helpful in Marketing
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
Agriculture	42 (8.75)	30 (6.25)	14 (2.91)	11 (2.29)	9 (1.87)
Fisheries	45 (9.37)	24 (5.00)	19 (3.95)	13 (2.70)	12 (2.50)
Service	36 (7.50)	22 (4.58)	20 (4.16)	19 (3.95)	14 (2.91)
Business / Trade	43 (8.95)	26 (5.41)	20 (4.16)	17 (3.54)	11 (2.29)
Agricultural Labour	45 (9.37)	29 (6.04)	15 (3.12)	14 (2.91)	9 (1.87)
Casual Labour	39 (8.12)	32 (6.66)	6 (1.25)	13 (2.70)	17 (3.54)
Artisan	40 (8.33)	27 (5.62)	5 (1.04)	17 (3.54)	15 (3.12)
<b>Total</b>	<b>290</b> <b>(60.41)</b>	<b>190</b> <b>(39.58)</b>	<b>99</b> <b>(20.62)</b>	<b>104</b> <b>(21.66)</b>	<b>87</b> <b>(18.12)</b>

*Note: Figures in the Brackets indicate percentage*  
*Source-Field Survey*

### 3.18 Awareness of the Assistance

Table 3.23 depicted classification of occupation according to assistance from district headquarters: 41.25 per cent of the respondents expressed their opinion that they got assistance for fish farming from district headquarters. 58.75 per cent of the respondents did not get any assistance from district headquarters. The respondents expressed their opinion that they got the assistance from district head quarter in the form of awareness

about varieties of seeds and marketing. 14.58 per cent of the respondents talked about training, 12.91 per cent of the respondents expressed their opinion about varieties of seeds and 13.75 per cent of the respondents explained about awareness of marketing. Thus, it may be concluded that assistance in the various forms from district headquarter has been playing a pivotal role in strengthening in fish farming on the sampled area.

**Table 3.23**  
**Classification of Occupations of the Sampled Respondents**  
**According to Assistance from District Headquarters**

Occupation	Assistance from District Headquarters		If Yes, tell the details (Awareness about)		
	Yes	No	Training About	Varieties of Seeds	Awareness about Marketing
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
Agriculture	30 (6.25)	42 (8.75)	08 (1.66)	07 (1.45)	08 (1.66)
Fisheries	29 (6.04)	39 (8.12)	08 (1.66)	08 (1.66)	10 (2.08)
Service	27 (5.62)	37 (7.70)	07 (1.45)	07 (1.45)	06 (1.25)
Business / Trade	31 (6.45)	44 (9.16)	16 (3.33)	10 (2.08)	13 (2.70)
Agricultural Labour	26 (5.41)	43 (8.95)	12 (2.50)	12 (2.50)	09 (1.87)
Casual Labour	28 (5.83)	39 (8.12)	9 (1.87)	11 (2.29)	13 (2.70)
Artisan	27 (5.62)	38 (7.91)	10 (2.08)	07 (1.45)	07 (1.45)
<b>Total</b>	<b>198</b> <b>(41.25)</b>	<b>282</b> <b>(58.75)</b>	<b>70</b> <b>(14.58)</b>	<b>62</b> <b>(12.91)</b>	<b>66</b> <b>(13.75)</b>

*Note: Figures in the Brackets indicate percentage*  
*Source-Field Survey*

### 3.19 Fishing Mechanism And Resources

Table 3.24 described classification of occupation of the sampled respondents according to work of fisheries and its resources. Work of fisheries has been classified into three categories: (i) Own (ii) Hire and (iii) By fishermen. 35 per cent of the respondents expressed their opinion that they worked for fisheries by themselves with the help of the various

resources such as manual, boat, net and others. 27.50 per cent of the respondents expressed their views that they got the work done for fisheries on hire basis and 37.50 per cent of the respondents expressed their opinion that they got the work done by fishermen. Thus, it is indicated that all methods are being adopted by the respondents for fish farming.

**Table 3.24**  
**Classification of Occupations of the Sampled Respondents**  
**According to Work of Fisheries & its Resources**

Occupation	Work of Fisheries			If own, tell the Resources			
	Own	On Hire	By Fisher Men	Manual	Boat	Net	Other
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
Agriculture	22 (4.58)	15 (3.12)	25 (5.20)	05 (1.04)	04 (0.83)	06 (1.25)	04 (0.83)
Fisheries	30 (6.25)	21 (4.37)	30 (6.25)	09 (1.87)	07 (1.45)	09 (1.87)	06 (1.25)
Service	19 (3.95)	16 (3.33)	24 (5.00)	06 (1.25)	03 (0.62)	04 (0.83)	03 (0.62)
Business / Trade	34 (7.08)	26 (5.41)	34 (7.08)	10 (2.08)	09 (1.87)	08 (1.66)	08 (1.66)
Agricultural Labour	24 (5.00)	20 (4.16)	22 (4.58)	06 (1.25)	06 (1.25)	05 (1.04)	06 (1.25)
Casual Labour	22 (4.58)	18 (3.75)	25 (5.20)	05 (1.04)	07 (1.45)	06 (1.25)	05 (1.04)
Artisan	17 (3.54)	16 (3.33)	20 (4.16)	05 (1.04)	04 (0.83)	06 (1.25)	06 (1.25)
<b>Total</b>	<b>168</b> <b>(35.00)</b>	<b>132</b> <b>(27.50)</b>	<b>180</b> <b>37.50)</b>	<b>46</b> <b>(9.58)</b>	<b>40</b> <b>(8.33)</b>	<b>44</b> <b>(9.16)</b>	<b>38</b> <b>(7.91)</b>

*Note: Figures in the Brackets indicate percentage*  
*Source-Field Survey*

### 3.20 Market System

Table 3.25 described classification of occupation of the sampled respondents according to market systems. Market systems have been classified into four categories: (i) Direct to Consumer (ii) To Middlemen (iii) To Commission Agents/Arahats (iv) Retailers. The table indicated that 23.75 per cent of the respondents felt that they directly approached the consumers, 25.83 per cent of the respondents felt that they directly dealt

with through middlemen. 28.12 per cent of the respondents expressed their opinion that they dealt with Commission Agents/Arahats and 22.29 per cent of the respondents felt that they dealt through retailers. Thus, it may be concluded that all indicated market systems has been used by the respondents for fish farming.

**Table 3.25**  
**Classification of Occupation of the Sampled Respondents**  
**According to Market System**

Occupation	Market System				Total
	Direct to Consumer	To Middlemen	To Commission Agent / Arahats	To Retailers Loss	
1	2	3	4	5	6
Agriculture	50 (10.41)	54 (11.25)	59 (12.29)	47 (9.79)	210 (43.75)
Fisheries	29 (6.04)	42 (8.75)	51 (10.62)	30 (6.25)	152 (31.66)
Service	-	01 (0.20)	01 (0.20)	-	02 (0.41)
Business / Trade	15 (3.12)	12 (2.50)	10 (2.08)	14 (2.91)	51 (10.62)
Agricultural Labour	13 (2.70)	08 (1.66)	06 (1.25)	08 (1.66)	35 (7.29)
Casual Labour	05 (1.04)	05 (1.04)	04 (0.83)	06 (1.25)	20 (4.16)
Artisan	02 (0.41)	02 (0.41)	04 (0.83)	02 (0.41)	10 (2.08)
<b>Total</b>	<b>114</b> <b>(23.75)</b>	<b>124</b> <b>(25.83)</b>	<b>135</b> <b>(28.12)</b>	<b>107</b> <b>(22.29)</b>	<b>480</b> <b>(100.00)</b>

*Note: Figures in the Brackets indicate percentage*  
*Source-Field Survey*

### 3.21 Problems of Fish Production

Table 3.26 revealed classification of fishermen of the sampled respondents according to problems related to fish production / fish farming. Problems related to fish farming have been classified into five categories: (i) Pollution of water bodies (ii) Over exploitation (iii) Anthropogenic

disturbances (iv) Lack of modern equipments and (v) Lack of Training facilities. The table revealed that 20.41 per cent of the respondents expressed their opinion that pollution of water bodies may be considered as the main problem. 17.50 per cent of the respondents felt that over exploitation is the main hurdle for fish farming/production. 22.50 per cent of the respondents expressed their views that anthropogenic disturbances are the main problem in the fish farming. 24.16 per cent of the respondents expressed their views that lack of modern equipments has been observed as main problem in fish farming. 15.41 per cent of respondents felt that lack of training facilities is the main hurdle in fish farming of the study area. Thus, it may be concluded that these problems are considered the main constraints for better fish farming/fish production.

**Table 3.26**  
**Classification of Occupation of the Sampled Respondents**  
**According to Problems related to Fish Product on**

Category of Fishermen	Pollution of Water Bodies	Over Exploitation	Anthropogenic disturbances	Lack of Modern Equipment	Lack of training facilities	Total
1	2	3	4	5	6	7
Small	18 (7.50)	15 (6.25)	19 (7.91)	19 (7.91)	15 (6.25)	86 (35.83)
Medium	17 (7.08)	16 (6.66)	18 (7.50)	20 (8.33)	12 (5.00)	83 (34.58)
Large	14 (5.83)	11 (4.58)	17 (7.08)	19 (7.91)	10 (4.16)	71 (29.58)
<b>Total</b>	<b>49</b> <b>(20.41)</b>	<b>42</b> <b>(17.50)</b>	<b>54</b> <b>(22.50)</b>	<b>58</b> <b>(24.16)</b>	<b>37</b> <b>(15.41)</b>	<b>240</b> <b>(100.00)</b>

*Note: Figures in the Brackets indicate percentage*  
*Source-Field Survey*

### 3.22 Suggestions by the Respondents

Table 3.27 described classification of fishermen of the sampled respondents according to their suggestions for the betterment of fish

farming/production. Suggestions given by the respondents are as : (i) To eliminate over exploitation (ii) To control water pollution bodies (iii) To eradicate anthropogenic disturbances (iv) To provide training facilities, and (v) The Need for proper economic planning. 22.91 per cent of the respondents felt that there is need to eliminate over exploitation in the study area. 19.58 per cent of the respondents suggested that there is need to control water pollution bodies. 17.91 per cent of the respondents suggested to eradicate anthropogenic disturbances. 21.25 per cent of the respondents felt that there is a need to provide training facilities to both fishermen and non-fishermen. 18.33 per cent of the respondents suggested that there is still need for proper economic planning for the betterment of fish farming and / fish production.

**Table 3.27**  
**Classification of Fishermen of the Sampled Respondents**  
**According to their Suggestions for better and of Fish Production**

Category of Fisher Men	Suggestions					Total
	To Eliminate over exploitation	To Control Water Pollution Bodies	To Eradicate anthropogenic disturbances	To Provide Training Facility	Need for Proper Economic Planning	
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
Small	18 (7.50)	15 (6.25)	17 (7.08)	19 (7.91)	17 (7.08)	86 (35.83)
Medium	19 (7.91)	15 (6.25)	15 (6.25)	19 (7.91)	15 (6.25)	83 (34.58)
Large	18 (7.50)	17 (7.08)	11 (4.58)	13 (5.41)	12 (5.00)	71 (29.58)
<b>Total</b>	<b>55</b> <b>(22.91)</b>	<b>47</b> <b>(19.58)</b>	<b>43</b> <b>(17.91)</b>	<b>51</b> <b>(21.25)</b>	<b>44</b> <b>(18.33)</b>	<b>240</b> <b>(100.00)</b>

*Note: Figures in the Brackets indicate percentage*  
*Source-Field Survey*

### 3.23 Occupational Pattern of Non-Fishermen

Table 3.28 described classification of occupations of non-fishermen. Occupation of non-fishermen has been classified into seven categories: (i) Agriculture (ii) Fish farming (iii) Service (iv) Business/trade (v) Agricultural labour (vi) Daily wage labourer and (vii) Artisans. The table revealed that 29.16 per cent of the respondents belonged to the first category, i.e., agriculture. 18.33 per cent of the respondents belonged to fifth category, i.e., agricultural labour. 15.83 per cent of the respondents belonged to daily wage labourer. 11.66 per cent of the respondents belonged to business/trade category. 5.00 per cent of the respondents belonged to fish farming and 8.33 per cent of the respondents belonged to the service category.

**Table 3.28**  
**Classification of Fishermen of the Sampled Respondents**  
**According to Occupation of Non Fishermen**

Category of Non-Fishermen	Non Fishermen							Total
	Agriculture	Fish Farming	Service	Business / Trade	Agricultural Labourers	Daily wages Labour	Artisans	
1	2	3	4	5	6	7	8	9
Small	24 (10.00)	04 (1.66)	05 (2.08)	10 (4.16)	18 (7.50)	13 (5.41)	12 (5.00)	86 (35.83)
Medium	26 (10.83)	05 (2.08)	08 (3.33)	10 (4.16)	11 (4.58)	13 (5.41)	10 (4.16)	83 (34.58)
Large	20 (8.33)	03 (1.25)	07 (2.91)	08 (3.33)	15 (6.25)	12 (5.00)	06 (2.50)	71 (29.58)
<b>Total</b>	<b>70</b> <b>(29.16)</b>	<b>12</b> <b>(5.00)</b>	<b>20</b> <b>(8.33)</b>	<b>28</b> <b>(11.66)</b>	<b>44</b> <b>(18.33)</b>	<b>38</b> <b>(15.83)</b>	<b>28</b> <b>(11.66)</b>	<b>240</b> <b>(100.00)</b>

*Note: Figures in the Brackets indicate percentage*  
*Source-Field Survey*



### 3.24 House Ownership of Non-Fishermen

Table 3.29 described classification of fishermen of the sampled respondents according to house ownership of non-fishermen. Classification of house of non-fishermen is as (i) Mud and thatches (ii) Brick and thatch (iii) Brick and tiles (iv) Cottage (v) Semi-pucca (vi) Pucca. 18.75 per cent of the respondents (non-fishermen) lived in the houses built by mud and thatch, 16.66 per cent of non-fishermen lived in the houses built by mud and tiles, 15.00 per cent of non-fishermen lived in the houses built by brick and thatch, 15.41 per cent of non-fishermen lived in the houses built by brick and tiles, 14.58 per cent of non-fishermen lived in cottage houses. 11.66 per cent of non-fishermen lived in semi-pucca houses. 7.91 per cent of non-fishermen lived in pucca houses. Thus, it may be concluded that non-fishermen have been living in all types of houses as indicated in table 3.29.

**Table 3.29**  
**Classification of Fishermen of the Sampled Respondents**  
**According to House Ownership of Non Fishermen**

Category of Non-Fishermen	House Ownership of Non Fishermen							Total
	Mud and Thatch	Mud and Tiles	Brick and Thatch	Brick and Tiles	Cottage	Semi Pucca	Pucca	
1	2	3	4	5	6	7	8	9
Small	18 (7.50)	14 (5.83)	13 (5.41)	12 (5.00)	14 (5.83)	09 (3.75)	06 (2.50)	86 (35.83)
Medium	15 (6.25)	16 (6.66)	12 (5.00)	12 (5.00)	09 (3.75)	11 (4.58)	08 (3.33)	83 (34.58)
Large	12 (5.00)	10 (4.16)	11 (4.58)	13 (5.41)	12 (5.00)	08 (3.33)	05 (2.08)	71 (29.58)
<b>Total</b>	<b>45</b> <b>(18.75)</b>	<b>40</b> <b>(16.66)</b>	<b>36</b> <b>(15.00)</b>	<b>37</b> <b>(15.41)</b>	<b>35</b> <b>(14.58)</b>	<b>28</b> <b>(11.66)</b>	<b>19</b> <b>(7.91)</b>	<b>240</b> <b>(100.00)</b>

*Note: Figures in the Brackets indicate percentage  
Source-Field Survey*

### 3.25 Price Behaviour of Fishes

Table 3.30 indicated views of the sampled respondents about price behaviour of fishes according to their occupation. The Table revealed that 50.20 per cent of the respondents expressed their views that low prices are observed in the market. 32.08 per cent of the sampled respondents opined that average prices of fishes are observed and 17.70 per cent of the respondents felt that no change in prices is observed in the market. It concluded that more than 50 per cent of the sampled respondents have sold their fishes on low prices in the market.

**Table 3.30**  
**Views of the Sampled Respondents about Price Behaviour of Fishes According to their Occupation.**

<b>Price Behaviours</b>				
<b>Occupation</b>	<b>Low Price</b>	<b>Average Price</b>	<b>No change in Price</b>	<b>Total</b>
Agriculture	110 (22.91)	70 (14.58)	30 (6.25)	210 (43.75)
Fisheries	80 (16.66)	48 (10.0)	24 (5.0)	152 (31.66)
Service	-	1 (0.20)	1 (0.20)	02 (0.41)
Business/Trade	20 (4.16)	16 (3.33)	15 (3.12)	51 (10.62)
Agricultural Labour	13 (2.70)	12 (2.5)	10 (2.08)	35 (7.29)
Casual Labour	12 (2.5)	5 (1.04)	3 (0.62)	20 (4.16)
Artisan	6 (125)	2 (0.41)	2 (2.41)	10 (2.08)
Total	241 (50.20)	154 (32.08)	85 (17.70)	480 (100.00)

*Note- Percentage indicated in the brackets*  
*Source- Field Survey*

### 3.26 Export of Fishes

Table 3.31 depicted views of the sampled respondents about export of fishes according to their occupation. The table revealed that 60.33 per cent

of the sampled respondents felt that they sell their product in the local market and export their product very less. 20.83 per cent of the respondents are exported their products in terms of average only and 10.83 per cent of the respondents exported more their products. It concluded that more than 60 per cent of the respondents do not export their fish production and they are completely dependent upon local markets only.

**Table 3.31**  
**Views of the Sampled Respondents about Export of Fishes**  
**According to their Occupation.**

<b>Occupation</b>	<b>Less Export</b>	<b>Average Export</b>	<b>More Export</b>	<b>Total</b>
Agriculture	160 (33.33)	35 (7.29)	15 (3.12)	210 (43.25)
Fisheries	100 (20.83)	30 (6.25)	22 (4.58)	152 (31.66)
Service	1 (0.20)	1 (0.20)	-	02 (0.41)
Business/Trade	30 (6.25)	15 (3.12)	6 (1.25)	51 (10.62)
Agricultural Labour	20 (4.16)	9 (1.87)	6 (1.25)	35 (7.29)
Casual Labour	11 (2.29)	7 (1.45)	2 (0.41)	20 (4.16)
Artisan	6 (1.25)	3 (0.62)	1 (0.20)	10 (2.08)
<b>Total</b>	<b>328</b> <b>(60.33)</b>	<b>100</b> <b>(20.83)</b>	<b>52</b> <b>(10.83)</b>	<b>480</b> <b>(100.00)</b>

*Note- Percentage indicated in the brackets*  
*Source- Field Survey*

### **3.27 Infrastructural Facilities for Fish Farming and Marketing**

Table 3.32 revealed views of the respondents about available infrastructural facilities for fish farming and marketing including exports according to their occupation. The table emphasized that 19.37 per cent of the respondents feel that adequate infrastructural facilities are available in the sampled area. 54.37

per cent of the respondents opined that infrastructural facilities are observed inadequate and 26.25 per cent of the respondents did not comment about availability of infrastructural facilities in the sampled area. It concluded that infrastructural facilities are not found adequate as expressed opinion of more than 50 per cent respondents.

**Table 3.32**  
**Views of the Sampled Respondents About Available**  
**Infrastructural Facilities for Fish Farming According to their**  
**Occupation Infrastructural Facilities**

Occupation	Infrastructural Facilities			
	Adequate	Inadequate	No Comment	Total
Agriculture	30 (6.25)	130 (27.08)	50 (10.41)	210 (43.75)
Fisheries	25 (5.28)	85 (17.78)	42 (8.75)	152 (31.66)
Service	1 (0.20)	-	1 (0.20)	02 ((0.41)
Business/Trade	14 (2.91)	22 (4.58)	15 (3.12)	51 (10.62)
Agricultural Labour	10 (2.08)	15 (3.12)	10 (2.08)	35 (7.29)
Casual Labour	8 (1.66)	7 (1.45)	5 (1.04)	20 (4.16)
Artisan	5 (1.04)	2 (0.41)	3 (0.62)	10 (2.08)
Total	93 (19.37)	261 (54.37)	126 (26.25)	480 (100.00)

*Note- Percentage indicated in the brackets*  
*Source- Field Survey*

### 3.28 Problems of Fish Marketing

Table 3.33 revealed views of the sampled respondents about problems being faced in marketing of fishes according to their occupation. The table depicted that 47.29 per cent of the respondents felt that middlemen have been playing very critical role in marketing and due to major role of middlemen, producers

are not getting good profit of their products. 32.70 per cent of the respondents expressed their opinion that they are not aware about actual prices of fish products in the market. 9.58 per cent of the respondents felt that they do not know anything about exports of their fish product. 10.41 per cent of the respondents do not know anything about the latest technology about fish farming, marketing and export facilities. Thus, it concluded that the respondents have been facing lot of problems in fish farming, prices, production, marketing, infrastructural facilities, export and lack of awareness about latest technology etc.

**Table 3.33**  
**Views of the Sampled Respondents About Problems Being Faced**  
**in Marketing of Fishes According to their Occupation**

Occupation	Problems in Marketing				
	Middlemen Play main Role	Lack of Awareness of Prices	Lack of Awareness of Export	Lack of Modern Technology	Total
Agriculture	105 (21.87)	80 (16.66)	10 (2.08)	15 (3.12)	210 (43.35)
Fisheries	75 (15.62)	40 (8.33)	16 (3.33)	21 (4.37)	152 (31.66)
Service	2 (0.41)	-	-	-	02 (0.41)
Business/Trade	21 (4.37)	15 (3.12)	9 (1.87)	6 (1.25)	51 (10.62)
Agricultural Labour	11 (2.29)	13 (2.70)	6 (1.25)	5 (1.04)	35 (7.29)
Casual Labour	9 (1.87)	6 (1.25)	3 (0.62)	2 (0.41)	20 (4.16)
Artisan	4 (0.83)	3 (0.62)	2 (0.41)	1 (0.20)	10 (2.18)
Total	227 (47.29)	157 (32.70)	46 (9.58)	50 (10.41)	480 (100.00)

*Note- Percentage indicated in the brackets*  
*Source- Field Survey*

### **3.29 Prices and Their Behaviours :**

Considering the significance of price variation in the adjustment of demand and supply, price variation (monthly average) of commercially important fishes have been recorded for a period of one year (January-December 2007) at different market channels. There are three distinct seasonal prices during the period from September to January (the height of the season), February to May (the ebb of the season), and June to August (fish scarcity due to monsoonic flood). The prices are usually low during the post monsoon period (Sept. to Jan.) and high during the monsoon period (June to August).

It may be stated that the prices of fish depend on several factors:

- (i) Species preference to its size, weight and quality.
- (ii) The distance of the producing centre from the place of consumption; and
- (iii) The elasticity of demand It depends upon custom, religion and prejudice.

Like other agricultural products fishes are carried to a suitable market place where it finds a good numbers of consumers for returns. This involves several intermediaries at various marketing stages resulting in the increase of marketing cost. It may be stated that the fish marketing channel of Koshi belt involves at least three to four intermediaries who operate in the distribution of fishes from the landing site to the consumers of distant places.

# **Chapter: Four**

## **PRODUCTION, PROPAGATION AND MANAGEMENT OF SHELLL FISHERIES IN KOSI REGION**

In this chapter an attempt has been made to analyse the system of production, propagation and management of shelll fisheries in the study area. It is to be mentioned here that infact our original proposal contained this theme as one of its objectives, but subsequently it was dropped in the revised proposal on the advice of the expert and as per direction of the Planning Commission. Now after the comments on the Draft report of the study, a separate study has been made on the referred objective.

### **4.1 Background**

Shelll fishes belong to Arthropoda and Mollusca containing highest animal biodiversity of this biosphere. These fishes are great natural resource and form easily available protein steroid, mineral and vitamin containing natural food to down trodden human beings of the rural settlements. In addition to these they form an important component of the food chain for the higher animal taxi transferring energy and matter from phytoplankton, macrophytes, zooplankton to fishes, amphibians, reptiles, birds and, mammals and other form of wild life. In Arthropoda freshwater crab and prawn are the most dominant and outstanding shelll fishes closely and intimately associated with local people for providing protein-rich food to them. In Mollusca a number of species have been

recklessly exploited by local people for food as well as for commercial purposes in manufacturing buttons, lime ornaments and also natural peals. Thus, shellfishes are economically important animal biodiversity interacting intimately with local indigenous people of the rural sector of the region. Of these animal biodiversity, the species belonging to Paratelpusa, Macrobrachium, Bellamya, Pila, Achatina, Lamellidens, Novaculina and Parreysia are edible to aboriginal and indigenous people and particularly they have been used as medicines for the cure of a number of ailments such as rheumatism, cardiac diseases, controlling blood pressure, asthma, rickets, calcium metabolism, nervousness, giddiness and also providing missing vitamins and minerals.

Considerable work has been done on the taxonomy, biology, ecology and behaviour of molluscs of this sub-continent (Annandale, 1921; Gupta, 1969; Hornell, 1921; Hora, 1925; Prasad, 1932; Subba Rao and Mitra, 1982; Subba Rao et al, 1986; Tonapi, 1917; and Mulherkar, 1963; Tonapi, 1971; Rao Vasishta and Gulati, 1971; Sharma et al, 1983; Roy, 2003; Singh, 1990;) but practically no information is available on the shellfisheries potential of the Kosi basin and the uses of shellfishes as medicines to cure various ailments of the local people apart with meeting their nutritional requirements and food supplements.

#### **4.2 Methodology**

Keeping in view of the significance of the theme and to have quicker and effective results, the universe of the study has been reduced to only five districts of the Kosi river basin, viz. Khagaria, Saharsa, Supaul, Madhepura and Purnea having potentialities and possibilities of production and management of shellfisheries were selected as the universe of the study.

The study area has vast lentic resources in the form of ponds, tanks, ox-bow lakes, swamps, chauris, canals, road and railway side depressions, flood plains and these water bodies have enormous potential for fish culture (Dehadrai,



1994; Verma, 1994;) These wetlands have tremendous biotic potentialities in the form of plankton, macro-invertebrates, fishes, amphibians apart with avian fauna. The physico-chemical conditions of these wetlands are congenial for the proper growth and sustainable development of shell fishes. The entire Kosi basin is famous for sustainability of mollusc's biodiversity as this river carries high amount of alkalinity from the foot hills of the Himalayas.

### 4.3 Research Techniques

Delphi technique was adopted for the studies of the potentiality of shell fisheries with some modifications (Limestone and Turoff, 1975). In this technique 25 members of fish farmers co-operative societies functioning in each blocks of five districts were personally interviewed and information regarding their occupation were collected. Population of fishermen was categorized on the basis of their occupational choice into primary, secondary and tertiary. Shell fishes exploited by different categories of people in these five districts were identified with the help of available literature. Marketing costs and marketing margins were calculated as follow:

$$\text{Gross margin of retailer} = \mathbf{PRr - PPr}$$

$$\text{Net margin of retailer} = \mathbf{PRr - (PPr + CMr)}$$

$$\text{Percentage margin of Retailer} = \frac{PRr - (PPr - CMr)}{PRr} \times 100$$

Whereas,

PRr = Total Value of receipts per unit sale;

PPr = Purchase Value of shell fishes per unit;

CMr = Cost incurred in marketing by retailer per unit sale.

Total number of members of fish farmers' co-operative societies of each block was obtained from the enquiries and interviews. Adoption of improved fishery technology by the fish farmers and different constraincy faced by them were

collected. Percentage of indigenous people and their preferential shellfishes as food stuffs has known through house hold and village schedules.

#### **4.4 Results and Discussions**

##### **Shellfisheries**

In five districts of Kosi basin, Khagaria, Saharsa, Supaul, Madhepura and Purnea had 31550, 25767, 30811, 18540, and 17498 people depending up on shellfish & fish culture activities respectively. Table-4.1 indicates that highest percentage of fisherman community depends upon fish culture in Supaul, Madhepura, Saharsa, Purnea and then Khagaria districts of Bihar respectively. General Hindu by religion but not fishermen by caste had also adopted this occupation for their livelihood next to the fishermen community.

The shellfisheries and fish culture as primary occupation was recorded in the order of 69.67 < 65.10 < 64.16 < 63.49 < 61.16 in Madhepura < Khagaria < Supaul < Purnea < Saharsa districts respectively and the number of such fishermen in five districts such as Khagaria, Saharsa, Supaul, Madhepura and Purnea was recorded as 20540, 15500, 19750, 12890 and 11950 individuals respectively. (Table 4.2) Thus Madhepura and Khagaria districts have more people depending upon for their livelihood on the shellfisheries and fish culture occupation. However secondary and tertiary shellfisheries and fish culture occupation are more prevalent in Khagaria district of Bihar. It was also investigated that the number of shellfisheries and fish farmers' co-operative societies members in Khagaria, Saharsa, Supaul, Madhepura and Purnea were 3,543, 2,325, 1,752, 1,533 and 1,441 showing maximum fish farmers co-operative societies members in Khagaria district (Table 4.3) Any Person who is interested to adopt fisheries as occupation be provided adequate facilities and information for the culture and propagation of shellfishes. It is the policy of the Government of Bihar to settle the issue with fishermen shellfishes are primarily cultured in paddy field, chaur, swamps, flood plains and break Water River. The paddy field is used to produce rice and fish together. Recently in Kosi

region of Bihar Makhana/ Singhara (*Euryale ferix/ Trappa bispinasa*) – cum-airbreathing fishes culture-cum-shell fish culture programme is successfully propagated and a good income generated apart with environmental management for the sustenance of aquatic life support systems in wetlands Ponds/ Chours / tanks/ to the Secretary of the society who distributes the leased of water bodies among member of the society.

#### **4.5 Sustainable Exploitation**

Among shellfishes, Pila is the favourite food stuff of scheduled tribes (ST) scheduled castes (SC), OBC and general population has percentage preference in the form of 88 < 80 < 59 < 5 respectively in rural population while 51 < 40 < 10 < 1 in urban population respectively (Table 4.4). Crab, *Paratrophus spinigera* are also the favourite food stuffs for scheduled tribes, scheduled castes, OBC and general population in rural area and their preference ranges from 95% < 90% < 69% < 10% respectively while in urban area the range of preference varied as 55% < 50% < 20% respectively (Table 4.5). Thus the maximum amounts of rural population of Kosi basin, Shellfishes are favourite food stuffs of scheduled tribes, scheduled castes, other backward castes and some general castes population.

Among muslim community of the study area only 10% population like pila galobosa as food stuff especially in rural area of Purnea, Saharsa, Madhepura, Supaul and Khagaria district. However 22% population of muslim favour *Paratrophus spinigera* as substantial food stuffs in rural area of Kosi basin. Five percent 5% urban Muslim population also favour *Paratrophus spinigera* as food stuffs of this region (Table 4.6). In the present investigation it was observed that maximum percentage of scheduled tribes, scheduled castes, other backward castes and even general and muslim depend upon shellfishes which are considered as delicious and favourite food items.

#### **4.6 Threat on shell fishes**

As this region is highly diversified with aquatic biodiversity and human population directly depend upon the animal resources for food, finance, medicines and other purposes posing a great threat on sustainability of the shell fishes. Shell fishes has great role in the ecosystem because they are directly linked with food chain serving natural diet for birds, reptiles, amphibians, fish and a number of wildlife. Thus over exploitation of shell fishes for food, finance, medicine and commercial use by different categories of people in the Kosi basin play a significant role in steady decline of the population of shell fishes in the region, posing a great threat on the life support system of the endemic fauna.

#### **4.7 Taxonomic diversity of shell fishes**

In the present study 27 species of shell fishes were recorded and identified in the Kosi river basin of North-Bihar. The outstanding abundant and dominant species of the shell fishes were *Bellamya bengalensis* race *mandiensis*, *Pila*, *Pila globosa*, *Pila virens*, *Lymnaea accuminata* F Typica, *Melanoides Lineatus*, *Indoplanorbis exustus*, *Novaculina gangetica*, *Lamellidens marginalis*, and *Macrobrachium* and *paratelpusa spinigera* (Table 4.7). The taxonomic diversity and relative status of these shell fishes have been determined. The study on shell fish diversity indicates that this ecosystem harbours appreciable number and abundance of molluscan fauna as compared to other ecosystem. It seems that the general hydrobiological characteristics of the water of this vast stretch of Kosi river basin favours much for the more taxonomic diversity of shell fishes. Our finding are in conformity with the observation of other fishery biologists, Datta Munshi and Srivastava (1988) reported that the Kosi river basin harbours more than 110 species of teleostean fishes of 66 genera belonging to 27 family and 10 others. The Swamps, Chaur and Wetlands are the natural abode of about 15 species of air breathing fishes which are well adopted to the physico-chemical conditions (Jhingaran 1975). Bilgrami and

Datta Munshi (1982), however, have also reported high taxonomic diversity of shellfishes in the Ganga ecosystem.

#### 4.8 Market Value

Shellfishes in Kosi river basin is intimately related with socio-economic conditions with local endemic people. Table -4.8 indicates that in rural and urban sector there is much difference in cost of these shellfishes *Paratrophus* and *Macrobrachium* have great market value both in rural and urban sector.

Thus, shellfish farming is not only the solution of the protein rich food, finance and medicinal demand of both low and high income population to Kosi basin, but it is also the solution for maintaining the ecological balance.

**TABLE-4.1**  
**Number of farmers and their percentage depending on shellfish and fish culture.**

Districts	Caste	Number of farmers	Percentage(%)
Khagaria	Fishermen	7050	22.34
	Scheduled Caste	18500	58.63
	Scheduled Tribe	--	--
	General Hindu	5661	17.93
	Muslim	1339	4.24
Saharsa	Fishermen	19400	75.33
	Scheduled Caste	1350	5.24
	Scheduled Tribe	17	0.33
	General Hindu	4053	15.74
	Muslim	746	3.65
Supaul	Fishermen	26497	86.09
	Scheduled Caste	563	1.81
	Scheduled Tribe	31	0.1
	General Hindu	3497	11.37
	Muslim	220	0.71
Madhepura	Fishermen	15541	84.0
	Scheduled Caste	549	2.5
	Scheduled Tribe	40	0.21
	General Hindu	2200	11.89
	Muslim	210	1.13
Purnea	Fishermen	8450	48.42
	Scheduled Caste	2544	12.85
	Scheduled Tribe	48	0.27
	General Hindu	6355	36.41
	Muslim	101	0.57

**TABLE-4.2**  
**Importance of Shell fisheries and fish culture**  
**as occupation for fishermen.**

Districts	Caste	Number of Fishermen	Percentage(%)
Khagaria	Primary	20541	65.10
	Secondary	8449	26.7
	Tertiary	2550	8.08
Saharsa	Primary	15752	61.16
	Secondary	7817	30.30
	Tertiary	2248	3.73
Supaul	Primary	19750	64.16
	Secondary	9231	29.91
	Tertiary	1830	5.94
Madhepura	Primary	12889	69.67
	Secondary	4576	24.64
	Tertiary	1096	5.89
Purnea	Primary	11957	63.49
	Secondary	4388	25.03
	Tertiary	1153	6.52

**TABLE-4.3**  
**Number of members of shell fish and fish Farmers**  
**Co-operative Societies.**

Districts	Number of Block	No. of Member
Khagaria	7	3543
Saharsa	10	2325
Supaul	11	1752
Madhepura	13	1533
Purnea	14	1441

**TABLE 4.4**  
**Among population- Percentage age of different caste who like pila as**  
**favourite food stuff**

In rural area				In urban area			
ST	SC	OBC	General	ST	SC	OBC	General
88%	80%	59%	5%	51%	40%	10%	1%

**TABLE 4.5**  
**Among Hindu population – Percentage of different caste who like**  
**Crab as favourite food stuff.**

In rural area				In urban area			
ST	SC	OBC	General	ST	SC	OBC	General
95%	90%	69%	10%	55%	50%	20%	5%

**TABLE 4.6**  
**Percentage of Muslim population who like pila and Crab**  
**as favourite food stuff**

Shell fish	Rural area	In urban area
Pila	10%	0%
Crab	22%	5%

**TABLE 4.7**  
**Taxonomic diversity of Shell fish fauna and**  
**their relative abundance**

No.	Species/Genera	Abundant	Common	Rare
1	Bellamya bengalensis race mandiensis	+++++	++	
2	Bellamya bengalensis f. typica	++++	++	
3	Bellamya bengalensis race eburnean	+++		+
4	Bellamya variata	+++	++	
5	Pila globosa	+++++	++	
6	Pila virens	+++++	++	
7	Achatina fulica fulica	+++	++	
8	Lymnaea accuminata f. rufescens	+++		+
9	Lymnaea accuminata f. typica	+++++	++	
10	Lymnaea accuminata F. typica	++++	++	
11	Lymnaea luteola f. ovalis	+++	++	
13	Melanoides tuberculatus	+++++	++	
14	Digonisostroma ceraneopoma	++++	++	+
15	Alocinma orcula	+++		+
16	Indoplanorbis exustus	+++++	++	

17	Gyraulus convexiusculus	+++	++	+
18	Segmentina calathus	++++	++	
19	Corbicula striatella	++++	++	
20	Corbicula bensoni	++++	++	
21	Novaculina gangetica	+++++	++	
22	Lamallidens corriamus	+++++	++	
23	Lamallidens marginalis	++++	++	
24	Parreysia favidens	+++		+
25	Parreysia corrugata	+++		+
26	Macrobrachium sp	+++++	++	
27	Paratelphusa spinigera	+++++	++	

Note: +++++ = Most abundant  
++++ = Abundant  
+++ = Frequent  
+ = Rare

**TABLE 4.8**  
**Marketing cost of shell fishes specially Macrobrachium, Paratelphusa and the meat of Pila and Bellamya**

Genera / Species	Cost in kilogram rate	
	Local Hats and fish in Rural Area	Market Hats of fish in Urban Area
Pila and Bellamya	10 to 20 rupees/kg	20 to 30 rupees/kg
Paratelphusa	25 to 40 rupees/kg	30 to 50 rupees/kg
Macrobrachium	30 to 60 rupees/kg	50 to 100 rupees/kg

#### 4.9 Interaction with Local people

Shell fishes play a vital role in the life and economy of the local endemic people. Bivalves and gastropods are the resources for the cottage industries, buttons, ornaments, pearls, poultry feeds, piggery feeds, lime and other resource based activities of the local people. Paddy-cum-fish-molluscs-prawn-crab cultures are the basis of aquaculture programmes of the region.

Thus the great interaction between shell fishes and local human population exists in the Kosi river basin.



#### 4.10 Conservation and Management of Shellfishes

Commercial fishing of this faunal diversity has brought many species on declining trend in the habitat. The tremendous exploitation of molluscs and pelecypoda for food, finance, cosmetics and medicine by the aboriginal and semi-aboriginal anthropoginics has posed a great threat on the survival and propagation of these shellfishes. Recently the declining trends of shellfish biodiversity has been greatly affected the air-breathing fishes and avian biodiversity of region.

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# **Chapter: Five**

## **PROSPECTS OF FISHERIES DEVELOPMENT IN THE STUDY AREA**

### **5.1 Background**

The sector of fish production has become very important because of many factors. There are 49 lakhs of fishermen in the country and it is urgently and absolutely necessary to improve their economic condition. One gratifying fact in this connection is that this sector is being augmented at an accelerated pace of development. If in the year 1951 the total fish production was 0.752 million tonnes it shot up to 4.94 million tonnes in the year 1995-96. This means that it has a phenomenal growth and it has tremendous potentialities for further growth. Fishes give protein to the consumer and the proteins are very necessary for the maintenance of human life. The domestic requirement of the fish is about 15 million tonnes. The sources are both inland and marine fisheries.

The people of Bihar and especially of the study area are suffering from protein deficiency in their daily diet(Economic Survey of Bihar- 2006-07). That is why Bihar needs an enormous increase in fish production to meet the needs of the domestic consumption. There is one adverse factor to be noted in this connection. Bihar is a land locked state and hence there is no

possibility of securing marine production. But there is one compensating factor. If Bihar has no access to sea, the advantageous factors are the existence of several rivers, canals, reservoirs, flood plain wetlands and innumerable water bodies both small and big. They are great sources of fishes. Further, floods are annual and sure visitors in Bihar and if floods cause havocs and destruction, they also lay the foundation of pisciculture. When the flood waters recede, they fill the small and big water bodies which can be easily used for the culture of fishes of different kinds.

The prospects of fisheries development in the study area are tremendous. All the requirements, factors, features and the elements for the development of fish farming are there in abundance. The first requirement of development of fish farming is that there should be copious water and water should be available through out the year. The area is flood prone and therefore, the first requirement of fish farming, which is water, is made available by nature. If there is flood or abundance of water the first condition of fish farming is fully satisfied. The area which is full of rivers is suitable for catch fishing. But it is not farming for farming also there are great prospects because of the existence of numerous water bodies like ditches, ponds, tanks, mauns, chauras, etc. which hold water and retain it when flood recedes. These two requirements of fish farming – availability of water and the retraction of water in tanks etc. are abundantly available in the study area. These are gifts of nature. They provide and constitute the foundation of fish farming. In order to develop it human action are needed and they can be provided by individuals, by any society, by any organisation or by the government. Hence, it is clear that the area is may be considered with full possibilities and potentialities for the development of fisheries.

## **5.2 Government Initiatives**

The Govt. of Bihar has taken suitable steps for the increase in the sector of fish production. The result has been encouraging. There has been a steady increase in fish production from the year 2001-02. The satisfactory result has been evidenced from the fact that the share of fish production in the total agricultural GDP has doubled in the last decade. The production in December 2006 was about 170 thousand MT. The production came to 300 thousand MT by the end of the financial year, 2006-07. The Government has formulated free housing plan for fishermen. One house is to be provided to one family. In the year 2001-02 the number of families which became beneficiaries in this head was 117. There was a decline in the next financial year and the number came to 56. But in the year 2006-07 the number of families getting free house shot up to 405. In the year 2001-02 the fish production in Bihar was 240 thousand MT and in the year 2005-06 there was an increase of 39 thousand MT. It is a good record. The private fish farmers have also received the attention of the Government which has started giving training to the fish farmers in pisciculture. In the year 2001-02, 861 private fish farmers were given training but in the year 2003-04 the number increased nearly more than six times. In fact, 5063 private fish farmers were given training. The Government of Bihar has been very liberal in granting loans to the private persons who are the owners of the ponds. The loan money is to be utilized for the maintenance of the ponds and also for their renovation. In the year 2001-02 Rs. 4 lakhs were given as loan under this head. But in the year 2006-07 it shot up to 74 lakhs. This figure covers the period only upto December, 2006. After this period also loans have been given but the actual figures are not available.

In the budget of the year 2008-09, presented on 25 the Feb, 2008, many measures were announced by the Government of Bihar to improve the living condition and the income of the fishermen. It has been announced that 405 houses are being built for the fishermen in 5 districts. The districts are Katihar, Supaul, Rohtas, Chapra and Madhubani. Community houses for them are also under construction. Collective life insurance has been introduced to cover the lives of 50 thousand active fishermen. If the insured fisherman dies or he becomes permanently disabled then his dependents get Rs. 50,000/- in case of death and Rs. 25,000/- in the case of permanent disablement. The annual premium for these insurance policies is given by the Government. In the financial year, 2008-09 there is a target to cover the life of 57,000 fishermen. The Government has introduced a particular kind of insurance policy which is known as 'Janshree' (People's welfare). Under this policy if the insured fisherman meets an accident and dies as a result thereof , then his family will get Rs. 75,000/- But if he meets a normal death his dependents will get Rs. 30,000/-

The Government of Bihar has introduced a training programme for fish farmers. The training is to be given in Kakinada in Andhra Pradesh. One thousand fish farmers are to be given training in an Institute for 10 days. The expenses of giving such training are being met cent per cent by the Government.

In Bihar there are 121 fish seed farms which have been closed and are not functioning. The Government has formulated a programme to open such farms on the basis of public-private partnership. The Government has done one more laudable thing. Fish farming has been given the status of agriculture with the result that the fish farmers have become entitled to the

same privileges and facilities as are available to an agriculturist. Further, the fisheries department of Government of Bihar has proclaimed that the persons who have technical knowledge of science of fisheries should be appointed to such posts created for the purpose. The Govt. has framed a body of rules for the recruitment of such persons. In order to co-ordinate the functioning of district fisheries offices 25 districts have been brought under computer networking and have been linked to state headquarters. A draft of fishery policy of the state of Bihar has been prepared after great deliberations. Fish marketing complex is being constructed in the district of Darbhanga. Fish marketing shed is also being constructed in Benipur and Bishanpur. In the district of Supaul a laboratory to examine soil and water is being constructed. More than 10 fish farmers have been honoured with Kisan Samman Yojna. Another programme of survey of tanks in 10 districts has been started. In 10 districts Para-extension workers are being made available to the fish farmers at the village level and at the Panchyat level. In north Bihar districts, the development of 36 'mans' is being undertaken for fish farming.

The net result of all these measures undertaken by the Govt. of Bihar is that Bihar which was importing fishes from Andhra is now exporting fishes outside the state. It is Katihar, Darbhanga, Muzaffarpur, Madhubani and Khagaria which have become exporting districts. The destination of export is Punjab, Hawrah and Shilliguri.

### **5.3 Prospects and Potentialities: Field Observations**

The pious and pre-dominant intension of the Govt. is to give every kind of assistance to fishermen so that they may improve their standard of living and become independent operators. They should be made free from the

clutches of moneyed persons and musclemen. The suggestions and recommendations flow from the actual conditions and realities obtaining on the ground. From the profile of the respondents it is found out that they are mostly illiterate. What is required is the knowledge of fisheries and the problems connected with identification, management and presentation and protection of the fishes which are being cultured under scientific supervision. The persons engaged in Pisciculture have to know when the fish grow and how they grow and what dangers they are facing. These items of knowledge can be given by the relevant science but if the fishermen are illiterate and not educated it is not possible to equip themselves with necessary knowledge; this is the greatest limitation and obstacle. Hence, the first attention of the Govt. should be to see that the fishermen get not only the traditional and general education but also the special knowledge about the life style and behaviour of different kinds of fishes.

The second limitation is inherent in the way in which the fish trade is carried on from landing ground to the ultimate consumers. In this system the fishermen have only one role. They merely catch fishes and they are paid for this work. If the fish trade has five stages or phases a fisherman appear only in the first stage and they play this part only in catching the fish after which their role comes to an end and the successive roles are adopted, grabbed and played by groups of people who are not fishermen by caste. It is the other castes who invest capital and become prominent players in the fishing trade. The wholesale market, transport operation and all other subsidiary and consequential phases come into the hands of the non-fishermen. The Rajputs, the Brahmins, the Muslims and persons belonging to other castes enter this profitable trade and wholly control it.



Hence the actual fisherman is left high and dry and they are reduced to the status of a necessary labour force. Under such a system it is not possible for actual fishermen to gain anything from the fish trade. Hence the system should be changed and important roles should be assigned only to the fishermen at every stage.

Further there is a question of strong and unbreakable nexus between the officers of fishery departments influential and domineering area leaders and office bearers of the Co-operative societies of the fishermen. In this triumvirate the actual labouring fishermen have no place in the working of the system and therefore, they can not gain any thing in monetary terms. This nexus has to be broken by suitable changes in the law and the method and procedure of setting the water bodies.

The structure and organization of co-operative societies of fisherman must be changed so that the societies should not become a monopoly of a particular person or a particular family. At present such a tragic and sad situation prevails. It is true that the Govt. settles water bodies with the co-operative societies but the secretary of the society has succeeded in converting it into a happy hunting ground for himself and his family. This is done with the full complicity and connivance of the interested parties & factors.

Further this study has revealed that the secretary sells the right to fish to others at a higher rate and grabs the profit. Sometimes it has been found that the right is given to the fishermen but exorbitant money is realized from them. If these fishermen have no money to pay at a high rate the secretary is cunning and clever enough to arrange money from the village

money-lender. Steps must be taken to put an end to this system in consonance with enacted provisions of law.

This study has further revealed that the musclemen and the rangdars of the area do not permit anybody to fish unless some money is paid to them. Hence the cost of production of fish is increased because such an illegal payment has to increase the price of the fish and lessens the profit which might have accrued to the fishermen.

The study has also revealed that a share has to be given to those landowners whose land is around the water body and through whose land the catch is carried towards the market. This is an additional factor which increases the price of the fish and diminishes the earning of the fishermen. This is a problem of law and order and should be dealt with accordingly.

The study has further revealed that if fish follow water then the earning from fish trade follows the dominant and influential personage of the area. If the secretary of the society is powerful and can terrorise the rangdars and musclemen he can carry on the catching operation without any let or hindrance. If the person obtaining the settlement of the Jalkar is a weakling the weakling, is not permitted to undertake and carry on the catching operation and selling the fishes.

The study has again revealed that the fishermen are mostly addicted to drinking and squander their money in this way. Hence it is very difficult to improve their standard of living unless they eschew this nefarious and bad habit.

#### **5.4 Concept of Fisherman: Bihar Fish Jalkar Management Act, 2006**

When the main theme is the economics of fish farming in flood prone areas of Kosi River zone it becomes highly pertinent and necessary to have

the real conception of a **‘fisherman’**. The Government of Bihar has enacted Bihar Fish Jalkar Management Act, 2006 and has given a definition of a fisherman in 2(viii) section.

Here a very pertinent question arises – who is a fisherman? After identifying him and making ourselves conversant with his social, economic and cultural condition, we have to formulate policies and programmes targetting him as a beneficiary. We have to guard against the fact that money released and allotted for the amelioration of the condition of fishermen should not go into the pockets of the affluent sections. Here the word “Fisherman” has two connotations. The first meaning has been given by the Bihar Fish Jalkar Management Act, 2006, In Section 2(VIII) it is specifically laid down that a fisherman is a person who is a professional fisherman engaged in fishing and fish culture. This definition includes all power - even a million airc – who is engaged professionally in fishing and fish culture. Obviously and candidly the intention of the Govt. can not be to improve his standard of living because he is already enjoying an enviable standard of living.

The second meaning of a ‘fisherman’ refers to the caste and all those persons who belong to the ‘Machhuara’ caste are fishermen and no body outside this caste can be described as a fisherman. It is this caste which should be the target and beneficiary of the Govt. project and assistance. Hence the Jalkar Management Act should be amended so as to include this caste as a primary beneficiary. There may be technical snags and constitutional hurdles but the Govt. should find a way out to overcome or to sidestep them.

Further the Act provides the constitution of a Managing Committee with Collector as Chairman. The Collector and the District Magistrate are one and the same person. The Collector is the District Magistrate and the District magistrate is the Collector. If the Chairman of the Managing Committee takes real interest and abundant care and caution, the obstacles and hurdles created by local ruffians, rangdars, musclemen in the sphere of fishing can be easily solved. Hence the District Magistrate should be inspired and specific responsibility should be cast on him.

The Fisherman's Cooperative Society should be activated and the government should see that the genuine fishermen are not denied membership and participation in the functioning of the society, the family stranglehold on the Co-operative Society must be broken. If need be, such a society should be dissolved and people should be inspired to form another society.

### **5.5 Fisheries Development Programmes**

Fishery is being considered as most important sources of revenue for the rural people. There are some basic differences between aquatic (including marine) and land-based (terrestrial) resources. In the extractive industries such as coal, oil, ore, and fish, the object of labour is not utilized before its natural production. As such these are gift of nature in which labour is not utilized for manufacturing the commodity. Fish, for instance, are available in the rivers and oceans as it is and ready for exploitation, unlike agricultural commodities in which several inputs including seed, water and fertilizer are essential, besides being costly. Thus, the flowing streams, the vast oceans, common petroleum wells, and migratory birds are generally termed as 'common property (or free) resources'.

In the case of fisheries there is sufficient competition among the fishermen as well as countries for use and exploitation of this unclaimed resource in order to get maximum profit. Resources, which cannot have individual ownership rights due to basic economic reasons, such as, cost of protecting or defending them, offer huge expenditure in comparison to the meagre returns they usually bring. Even after the declaration of exclusive economic zones (EEZ) of 200 nautical miles (370 km) by many maritime nations, the sea resources are still largely under the common property concept, although the State has sovereignty over these resources. Even if a State has sovereign rights to manage these resources, it has to meet difficulties of practical nature. Further, no individual can manage efficiently huge areas, which have no boundaries. Opacity of the marine resources is another serious problem, which affects fishing activities. One unique characteristic of common property resources is that usually there is no restraint or rationing to use it. Any fisherman can take away as much quantity of fish as caught by him. In many cases common property resources yield little profit or rent if there is no regulation on fishing.

Maximum Sustainable Yield (MSY) is the highest number of new fish that could be removed from the population each year that the population itself could replenish. In other words, the MSY is the largest harvest that can be removed from the population regularly and indefinitely. To achieve the MSY, a narrow path between under and over exploitation of fishery is necessary. Beyond the point of MSY catching of fish is most “uneconomic”, besides resulting in the depletion of fish stock.

The MSY concept has been the guiding principle in resource management for many years in fishery, forestry, and wild life exploitation. There are two simple ways of obtaining an MSY on a regular basis – through a fixed quota and through a fixed effort. In “fixed quota MSY harvesting”, the same amount, the MSY, is taken away from the population every year. In “fixed effort

harvesting”, an effort is made to maintain a constant harvest through a constant harvesting through a constant harvesting effort (e.g., the number of trawler days in a fishery). However, MSY is the optimum for biologists, but for economists it is not an optimum since the total fishing effort in terms of labour and cost is very high at the MSY point. Thus, more effort does not give better economic returns, through it may give higher fish catch.

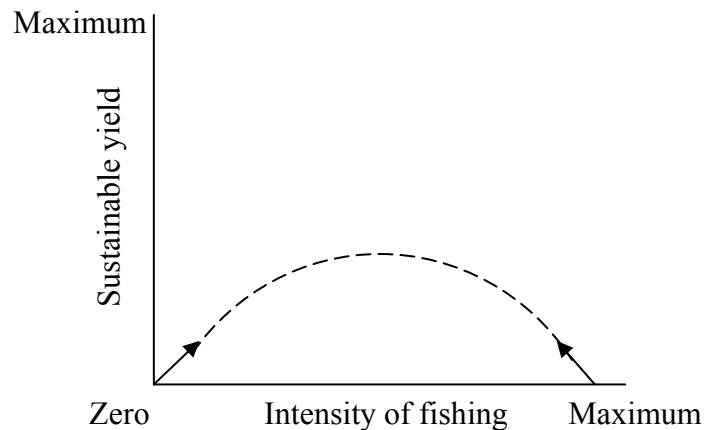


Fig. Schematic relationship between sustainable yield of fish and fishing intensity.

Figure shows a schematic relationship between sustainable yield of fish and fishing intensity. There is no yield at all if there is no fishing intensity. Zero-yield is assured at no fishing, as at very high intensities of fishing. Between these two extremes, there is a positive yield that can be sustained over time. The shape of the interaction between these two limits is uncertain, but is often assumed to be a simple parabola. Mathematical analysis based on simple parabola suggests that the MSY from fish population is attained when the population is equal to  $\frac{1}{2}$  of the carrying capacity.

Maximum economic yield (MEY) is the yield of fishery based on the principle of cost economics in fishery (amount spent on fishing voyage). Maximum economic yield is usually less than the MSY as in most cases MSY may be profitable but uneconomical.

MSY may not be able to meet the expenses incurred or to compete with the market price. It is much more economical in terms of profit to catch 300 kg of shrimp than 3000 kg of catfish or ribbon fish. The concept of maximum economic yield is less complex than the concept of maximum sustainable yield. The optimum catch is that which can be removed by fishing effort without deteriorating the equilibrium biomass. The yield in fishery at this level is called optimum sustainable yield (OSY).

The production of fish is affected by a number of factors including growth (growth rate), reproduction (reproductive potential) and mortality (both fishing and natural caused by disease or old age, etc.). When not exploited, growth, natality and mortality rates balance one another so that the biomass of fish population comes to a state of equilibrium, i.e. neither increases nor decreases. The optimum sustainable yield (OSY) does not disturb the equilibrium biomass. Depending on the situation it may be the result of low, or medium level of exploitation. However, high level of exploitation would certainly disturb the equilibrium biomass.

The Asian countries contribute about 60 per cent of the total aquaculture production and India occupies second position in the world after China. It is estimated that out of about 24.38 lakh tones fish production in the country from the inland sector during 1997-98, about 19 lakh tones was contributed by aquaculture and the remaining from capture fisheries. This was possible due to fisheries/ aquaculture extension activities. Adopting the integrated approach to aquaculture taking into account the need for sustainable aquaculture has been the main objective of fisheries extension programmes. Besides enhancing the production of fish and the productivity of fish farmers, fisheries extension programme has also been aiming to generate employment and higher incomes in aquaculture sector as also to improve the socio-economic condition of traditional fish farmers.

Brackish water Fish Development Agencies (BFDAs) were initiated to promote aquaculture in brackish water areas by providing incentives and technical assistance. The MPEDA (Marine Products Export Development Agency) was created to support development of export oriented commercial scale aquaculture units. All these efforts have yielded significant positive results.

However, aquaculture extension faces several challenges ahead. Providing sustainable livelihood opportunities for ever-increasing population of rural communities is perhaps the biggest challenge faced by the country. Aquaculture will have to play an important role in meeting this national challenge. Essential ingredients required for contributing to rural livelihood development through aquaculture are adequate natural and human resources, infrastructure facilities, viable technologies, and research support. There is need at this time is a dedicated extension services system to assist the large population of resource poor rural communities-target groups of aquaculture extension-to enable them to draw benefit from fisheries and aquaculture. Also there is a need to switch over from directive to participatory extension. Experts now feel that there is a need to have a comprehensive aquacultural extension policy that fully supports coordination between education, research, input supply and fisheries extension services, all aiming together to achieve the desired goal of sustainable aquaculture.

The extraction of fish riches from the rivers, based on the principle of maximum sustained yield, has not been possible in the Indian context. Fishing has been guided by the principles of economic profit rather than biological principles. The intensity of fishing, nature of exploitation and species orientation in the characteristic artisanal fisheries of Indian rivers are governed by (1) seasonally of riverine fishing activity: (2) unstable catch composition: (3) conflicting multiple use of river water: (4) cultural stresses leading to nutrient loading: (5)



lack of understanding of the fluvial system and infirm data base: (6) fragmentary and outmoded conservation measures lacking enforcement machinery: (7) inadequacy of infrastructure and supporting services: (8) defective marketing and distribution systems: (9) demand directed by availability: affordability, and palatability and (10) socio-economic and socio-cultural determinants. Infirm database of inland fisheries resources has been another serious constraint plaguing the development process. Even market intelligence statistics suffered from various drawbacks due to disposal of appreciable quantity of fish that passed directly from the primary producers to consumers. Through a Central Sector Scheme on Inland Fisheries Statistics, launched during Seventh Plan by Union Ministry of Agriculture, CIFRI has been able to evolve a methodology for data collection on inland fisheries.

Absence of suitable fish yield models for the multi-species fisheries of our waters is a major biological constraints for formulating a successful management strategy. Developing such a model, keeping an eye on hydrology and fish stocks, accompanied with observance of closed season and setting up of fish sanctuaries, will definitely prove its efficacy in fostering recovery of impaired open water fishery of our country.

The riverine fishers constitute a section of economically weak, tradition-bound society. Most of them live at subsistence level or below poverty line. The environmental degradations and the resultant decline in fish population have deprived them of a steady catch. The problems are further compounded by the competition among fishers due to increase in their population.

Socio-economic milieu under which the inland fishermen operate is not conducive enough to attract credit and infrastructure support for required modern crafts and gear from traditional banking and financial Institutions. A sector's ability to attract finance and especially loanable funds depends largely

on evaluation of risk elements by prospective funding agencies. The migratory character, seasonality of fishing activity and unstable catch composition of capture fishery does adversely effect investment appraisal and assesment of funding possibilities because of various reasons. There is an inescapable need to evolve some distinct criteria for financing the capture and culture based capture fisheries of inland open waters where the input-output relations are relatively less precise. This would need evolving a new set of criteria for the creditworthiness and repaying capacity of such fishers.

In contrast to terrestrial farming systems, where the bulk of global production is based on a limited number of animal and plant species, more than 210 different as being farmed in 2000. In fact this number is considered by some to be higher due to an unspecified 9.7 million tones not being reported as specific species.

Some examples of the most popular fish species being raised are:

Arctic Char, Atlantic Salmon, Atlantic Cod, Bass, Barramundi, Blue Gill, Brook Trout, Brown Trout, Carps, Catfish, Chinook Salmon, Crappie, Drum, Halibut, Flounders, Rainbow Trout, Hybrid Striped Bass, Tilapias, Tunas, Walleye and Yellow Perch. There are many more fishes that are cared for in captivity including numerous species of baitfish for recreational fishing and ornamental species.

New fish species are being added to the farmed list as research and development efforts identify their farm performance and determine factors such as nutrition and quality, market demand / acceptance, price and production costs are also addressed before a species is farmed on a commercial level.

Farmed shellfish and crustaceans include; Blue Mussels, Cray Fish, Crabs, green Lip Mussels, Lobster, Oysters, Shrimps, Scallops, Clams and more.

Many aquatic plants are being cultured or sea ranched such as Seaweeds, Duck weed, Sponges and kelps. Other plants including lettuce, tomatoes, Chinese cabbages, Cucumbers, Watercress, and various herbs and ornamental plants are being raised in conjunction with aquaculture. The farming of plants with fish is known as Aquaponics, a practice that is continually expanding in many areas.

During the several decades, aquaculture has expanded, diversified, intensified and made technological advances. The potential of this industry to enhance local food security, alleviate poverty and improve rural livelihoods has been well recognized.

Aquaculture shares many similarities in concept to many land based agriculture industries such as cattle farming and many of the same management techniques are used in aquaculture. Like more traditional forms of agriculture the goal of commercial aquaculture is to maximize healthy and robust production at a minimal cost to maintain a profit margin.

Aqua Farming is a non resource extractive food sector that is sustainable, renewable and provides safe high quality food products to consumers while creating considerable benefits for the general population. Based on science and technology, it is a market driven sector that has emerged to provide consumers with value, taste and products similar to that expected from other food role to the wild fishery by making possible restocking and enhancement activities and by filling a complimentary niche in export markets.

Aquaculture requires clean growing waters to maintain a good level of production. Therefore, the industry encourages environmentally friendly practices and has taken many practical steps to protect the local environment. In fact without ensuring protection of the environment, itself, the industry would flounder. Such safeguards include government measures controlling the health

protection, better site selection, and actions to minimize fish escapes and prevent waste discharges.

Land based fish farms that utilize technology to recycle and reuse water supplies to prevent waste discharge are among the most eco-friendly and sustainable methods of aquaculture. Taking these systems one step further involves the incorporation polyculture, where plant crops are grown with the nutrients produces by the fish crop. This is known as aquaponics a farming technique that is becoming more common in the design of small or large scale farms.

# **Chapter: Six**

## **SUMMARY AND CONCLUSIONS**

### **6.1 Background**

Fish production has been continuously increasing every year in India. The sources are both inland and marine water. There has been a continuous rise in inland production but there is lagging in marine production. Bihar presents more or less a rosy view. It is a land locked state and therefore, exploitation of marine sources is out of question. There are several rivers both mighty and small and these are great sources of fish production. It is equipped with immense fresh water resources which can be used both for capture fishing and culture fishing. The potential of culture fishing is also very great and encouraging. Further, mighty rivers like Ganga, Kosi and Gandak are numberless small and tiny brooks, reservoirs, chauras, lakes, tanks, ponds, and mans etc. These rivers are extremely conducive for development of fish farming.

It may be stated that north Bihar occupies a very important role for fish production. The entire area of north Bihar is prone to floods which are save and certain annual visitors. Intensity or virulence or violence of the flood varies from time to time and from year to year. But one thing is common which is observed every year. It is the arrival of the flood and devastation caused by it. Culture fisheries are of great importance and necessity for the people of North Bihar. The inhabitants of the flood prone

areas of north Bihar are poor and need nutritious food to ward off malnutrition. Further, they need an increase of their income which can come from fish farming also. These are great impediments of development of fisheries in this area. There is need to be removed and flood which is a source of devastation and ruin can be converted into a source of blessing and prosperity through the adoption of fish farming on a large scale.

The Kosi river system is a part of river system of the entire state. The network of the Kosi river has immense potentiality. Several small rivers like Kamla, Bagmati, Burhi Gandak, Tilinga etc. flow in the area. Thus, the development of fisheries in flood prone areas of north Bihar is not only a necessity but a desirable good for the well –wishers of the state of Bihar.

In this study, an attempt has been made to analyse the main objectives, like the prospects of fisheries development in water logged areas and the efficacy of reservoirs for fisheries development. Further, it has been sought to evaluate reorganizing, improving and strengthening the infrastructural components of training and extension programmes in order to improve the socio-economic status of the fishermen and providing employment opportunity to the rural people in the study area.

The main hypotheses which were tested are: (i) Can the damage done by floods be converted into a source of benefits/profits for the disadvantaged people of the area? and (ii) Can the fish farming be so viable that it can improve the socio-economic conditions of the people?

The universe of the study is Kosi River Zone of Bihar. The study has been undertaken in two flood affected zones. The first sub-zone of Kosi River Basin is the north-western region of the basin and similarly the second sub-zone is the north-eastern region of the Kosi basin. A multi stage sampling design has been followed for the bottom unit of the sample.

## **6.2 Empirical Findings**

It has been observed that 42.92 per cent of the sampled respondents were illiterate and only 19.79 per cent of the respondents have education up to secondary level. Only 6.25 per cent had intermediate level of education. This state of affairs is alarming. The level of education of the fishermen must be improved. The findings indicate that only one sampled respondent out of 480 had technical education. It indicated that 479 respondents were carrying on fishing operation without any technical knowledge. Thus, it is a sorry state of affairs because highly technical operation like fish farming is being carried without any authentic knowledge.

It has been observed that all sections of social groups are engaged in fish farming. The Scheduled castes, Scheduled tribes, OBCs and General castes – all are participated in fish farming. But it is the OBCs which play a dominant role as revealed by their number. Out of 480 respondents 375 belonged to this OBC group.

The married respondents overwhelmingly outnumber the unmarried ones. The married respondents number 440 whereas the unmarried are only 16. Fishing is mainly and predominantly a male preserve because 94.16 per cent of the respondents are males and only 5.8 per cent are

females. Hindus constitute 90 per cent of the respondents and obviously only 10 per cent are Muslims. No follower of other religions existed.

It has been observed that fish farmers are drawn from several other occupations like agriculture, fisheries, service, business, trade, agricultural labour, casual labour and artisans. The occupational pattern revealed that 43.75 per cent of the respondents were agriculturists and they have adopted fish farming as their secondary occupation. Only 31.66 per cent of the respondents were entirely dependent on fish farming and only 0.41 per cent of them were service holders.

Respondents belonged to all sizes but only the medium size (44.79 per cent) dominated whereas small and large fishermen hovered between 26 and 29 per cent. All kinds of families – nuclear, joint and extended-participated in the fish farming. But the pre-dominant role is of the joint family (65.62 per cent). When it is considered the question of ownership of houses then it has been observed that 90 per cent of the respondents had own houses. But large number of houses (36.25 per cent) was made of mud and thatch and pucca houses constituted only 5.26 per cent. The respondents were mainly self – earners. They constituted 70.62 per cent of the respondents. Only 16.25 per cent had paternal income. 8.12 per cent of the respondents were dependent on Government subsidies. When the question of land and its irrigation, status is concerned, it is observed that 41.66 per cent of owned land was irrigated whereas 17.08 remained unirrigated. All kinds of crops – Kharif, Rabi and Garma – have been cultivated by the respondents. The maize under Kharif crop constitutes 17.70 per cent followed by rice (14.58 per cent) and pulses (13.54 per cent) . In case of rabi crops the highest percentage (16.25) belongs to



wheat followed by Pulses (11.25) and gram (10). Vegetables constitute 7.50 per cent and jwar and fruits constitute 5 and 4.16 per cent respectively. Thus, it is clear that respondents are not idle in any part of the year.

The main source of fish production is the river (37.08 per cent) followed by pond (22.70 per cent). The lake, canal and other sources are 12.08, 13.54 and 14.58 per cent respectively. Thus, it is observed that all sources of fish production are available in the study area. The respondents used own sources of production and also other sources. Production from river or canal constituted 40 per cent followed by ponds and lakes (32.91 per cent) and other (27.08 per cent).

280 respondents were found members of fish society. 300 of them had water plants. The fishing operation comes under Jalkar Management Act, 2006 but strangaly enough 57.29 per cent of the respondents had no knowledge of it and 42.71 per cent had some knowledge of the same. 10.62 per cent of the respondents felt that the Act helped then in increasing fish production. 11.04 per cent felt that because of the Act they had knowledge to get raw materials and other useful things. 9 per cent of the respondents were of the opinion that there was no misuse of the resources.

Only 40.62 per cent of the respondents got water from different sources and the rest could not secure water for this purpose. Respondents incurred entire cost of production themselves. The cost included rent of land, digging cost and others. So far the operational cost is concerned it has been fond that labour cost (6.45 per cent) and lime cost (6.25 per cent)

constitute the major items. All other items of operational cost veer round 5 per cent.

Fish farmers need technical assistance which is provided by Government agencies, cooperative societies, local retailers and technical experts. It is the opinion of 30.62 per cent of the respondents that technical assistance comes from experts and 25.20 per cent of the respondents held that local retailers also give technical knowledge. Hence both experts and lay persons are useful in providing technical knowledge in fish production. It is the Government agencies which are the major supplier of seeds (22.70 per cent). The next source is nature (21.25 per cent) followed by market (20.62 per cent) and by retailers (20 per cent). It is clear that the technical aid plays a very important part in the sphere of fish farming.

As far as the training in fish farming is concerned only 43.33 per cent of the respondents informed that they were trained but 56.67 per cent were not trained. The training was received in different time, places and in different organisation and for different duration. As far as benefits of training are concerned 60.41 per cent of the respondents had got benefits in increasing production and marketing. The training also helped them in identifying and getting varieties of seeds. It was 41.25 per cent of the respondents who had got assistance from the district headquarter and 58.7 per cent were not able to get any help from the district headquarters. Those who got assistance came to know about the training programmes, varieties of seeds and methods of marketing.

The fish farming is done through three ways. 35 per cent of the respondents did the entire work themselves. 27.50 per cent got it done

through hired labor but the largest chunk of the work was done by fishermen or through fishermen. It is clear that all methods of farming were in practice. 23.75 per cent of the respondents directly sold fishes to the consumers followed by 25.83 per cent to middlemen and 28.12 per cent to commission agents/arhats whereas only 22.29 per cent to the retailers.

20.41 per cent respondents pointed out that pollution of water bodies was the main problem. It was 22.50 per cent of them who opined that anthropogenic disturbances were main problems in fish farming. The opinion of 24.16 per cent was that lack of modern equipment was the main problem. Only 15.41 per cent held the view that lack of training facilities was the main hurdle. Hence it is clear that different views and opinions about the problems facing fish farming were expressed by the respondents. There was no identify of views. 22.91 per cent felt that the water bodies or sources of fish production was being over exploited and there was need to stop it. Only 19.58 per cent felt that water body should not be polluted. Others (17.91 per cent) felt that anthropogenic disturbances should be eliminated. 21.25 per cent felt that provision of training facilities was the need of the hour. 18.35 per cent of the respondents laid stress on economic farming.

As far as the involvement of non-fishermen in fish farming is concerned it is observed that 29.16 per cent of the respondents were from agriculture followed by fish farming ( 5 per cent) service (8.33 per cent) and businessmen or traders 11.66 per cent. Agriculture laboures (18.33 per cent) , daily wage laboures 15.83 per cent and artisans 11.66 per cent were involved in fish production.

When considered the house of non-fishermen it is found that they live in different types of houses. 18.75 per cent of the respondents lived in mud and thatch houses. Next come houses of mud and tiles in which 16.66 per cent of respondents lived 15 per cent of the respondents lived in brick and thatch houses followed by brick and tiles (15.41 per cent), by cottage (14.58 per cent), semi-pucca (11.66 per cent) and pucca houses (7.91 per cent). Thus, it is clear that the pucca houses had very few owners and mud and thatch house owners were largest in number.

### **6.3 Prospects of Fisheries Development**

The prospects of fisheries development in the study area are tremendous. All the requirements, factors, features and the elements for the development of fish farming are observed in abundance. The area which is full of rivers is suitable for catch fishing. There are great prospects because of the existence of numerous water bodies like ditches, ponds, tanks, mauns, chaur, etc. which hold water and retain it when flood recedes. There are two requirements of fish farming – availability of water and the retraction of water in tanks etc. which are abundantly available in the study area. These are gifts of nature. They provide and constitute the foundation of fish farming. In order to develop it human action are needed and they can be provided by individuals, by any society, by any organisation or by the government. Thus, it is clear that full possibilities and potentialities are existed in the area for the development of fisheries.

### **6.4 Suggestions and Action Points:**

On the basis of the findings of the study the following suggestive majors should be adopted to bridge the gap of existing production and potential production for sustainable fisheries development:

- There is need to eliminate over exploitation of water bodies Government and other societies should look after it.
- Fish farming is hindered because of pollution of water on a huge scale. This pollution is caused by the people using water bodies for various purposes like washing clothes or utensils or bath to the cattles, etc. These must be put an end to because fishes cannot survive in polluted water and even when they survive they are not fit for human consumption because poison residing in them.
- Anthropogenic disturbances must be completely eradicated in order to fishes live in healthy water.
- Those who are engaged in fish farming are wholly untrained persons. One may say that cent per cent people engaged in fish farming have no training of fish farming at all. Therefore, a massive training campaign should be launched.
- The fish farming is conducted by persons who have no knowledge of economics of cost accounting, of optimum use of resources, of deriving maximum advantages from minimum resources, etc. The fish farmers should be advised by the economic planners also.
- Majority of the fish farmers are illiterate people. It is absolutely necessary that they should be made literate. Literacy does not mean more knowledge of three 'R' ..... Reading, Writing, Rithmetic but it should mean knowledge of requirements, problems and solution of the problems of fish farmers. A person

who is graduate in humanities may be termed literate but his literacy is of no avail in the sphere of fish farming. Literacy should mean knowledge of zoology.

- Scheduled Castes and Scheduled Tribes should be given special training and incentives to take to the profession of fish farming. At present the number of Scheduled Castes and Scheduled Tribes in the sphere of fish farming is virtually negligible. If this is done it will have double advantages. The govt. policy is to uplift the scheduled castes and scheduled tribes and this can be done through the development of fisheries.
- Similar is the case with females, the Government wants to empower the women and at the same time wants to improve their living status. This can be done by giving incentives and facilities to the women in fish farming. At present 5 to 6 per cent of the female are engaged in this profession.
- It has been observed that the fisheries are being carried out by those persons whose main profession is not fish farming but something else. Thus, steps must be taken to improve the living standard of those who are fishermen by tradition and by birth.
- Fish farming is usually done on a small scale or at best on a medium scale. But it must be undertaken as a large scale. This will improve the living standard and increase the income of a large number of persons.
- The fish farming is mostly suited for joint families. Thus, all measures should be taken to give encouragement and incentives

to those joint families which have opted for undertaking and conducting the business of fish farming.

- Emphasis should be laid more on culture fishing than on capture fishing. Thus, the ponds, lakes, etc. must be properly looked after and taken care of.
- The cooperative societies of fishermen should be strengthened there and made free from corruption and factionalism fishermen societies for the production of fishes should be adequately funded and helped in time.
- Arrangements should be made for proper marketing of the fishes which are a perishable commodity. Refrigeration of transport vehicles should be done on a large scale.
- Jalkar Management Act, 2006 should be suitably amended and the District Magistrate should be encouraged and directed to see that the provisions of the Act are implemented in both letter and spirit. At present, the District Magistrate who is regarded as the highest authority in the district by the Act finds no time for this. He should be held responsible for negligence in implementing the provisions.
- In lean season when water is not available in the small ponds or tanks, arrangements should be made to supply water to those tanks or ponds.
- An organisation should be set up by the Government to give technical assistance to the fish farmers. The organisation should consist of persons who have a vast store of experiences in the

sphere of fish farming and some of the members of the organisation should be experts in fish farming.

- The Government officials of the fisheries department should be equipped with the knowledge and invested with the necessary power to solve the day to day problem faced by the fish farmers.
- Integrated Resources Management Approach like Fish-cum-Duck-farming, Fish-cum-Poultry Farming, Fish-cum-Dairy Farming, Fish-cum-Horticulture, etc. should be introduced to reduce the chemical fertilizer and input cost. Such integrated approach will help the farmers in nutrient enhancement, pest control, feed supplementation and biological control of their system.
- In Kosi region a package of technology should be introduced to Makahana-cum-Fish culture and Singhara (Trapa)-cum-Fish culture.
- It has been observed that the existing government and private hatcheries are insufficient to meet the local demand of fish seed. Fish farmers use to transport seed from West Bengal. Hence, one hatchery in each district should be established to meet the local need.
- Keeping in view of the production potential of flood plains wet lands there is urgent need to introduce a suitable package of aquaculture technology for 'wet land area development' as these culture based capture fisheries hold the key for future of fisheries development in Kosi region.



- The existing bottom feeder fish like common carp and mrigal should be replaced and a fresh water ‘prawn farming technology’ should be introduced along with the composite fish culture.
- The Government of Bihar should establish at least one ‘fish market centre’ in each district with proper facilities including cold storage.
- There is need to strengthen the ‘extension service system and human resource development’ to improve the knowledge, skill, attitude and practice of people engaged in pisciculture.
- For collection of field information and investigation into the problems and prospects of aquaculture in the region emphasis should be laid on ‘Participatory Approach’ among the researchers, scientists, and extension market and fish farmers. Such type of approach will create strong and effective linkage between the extension personnel and fish farmers to build their capacity.
- Emphasis should be given to establish Regional Research and Training Centre by the Government. In order to solve the field problems of fish farmers it is essential to organize training to make them up to date with the advancement in aquaculture research. ‘Long term vocational training programme’ should be organised for rural youth with emphasis on ‘learning by doing’ for generation of self-employment.
- Emphasis should be given to strengthen the existing fishery cooperative societies and to establish more primary cooperative

societies and Self-Help Group (SHG) at Gram Panchayat level for strengthening the service delivery system.

- A comprehensive Aquaculture Policy is to be formulated by the Government for providing efficient extension programme, planning, research, training, education, input supply, and credit and marketing system.

In addition to above the following are the specific recommendations related to better marketing management in the Kosi regions:

- The concept of agricultural system can easily be applied to maintain the quality of fish. There should be at least a cold storage in the vicinity of fish market for keeping the catch overnight. Installation of ice factory in the vicinity of assembly centre is a prime need to protect the fish from decomposition. Establishment of marketing co-operatives at important fishing centre is essential through which the entire marketing should be done. Transportation facilities being another important aspect must be provided by marketing co-operatives. Boats, nets and other fishery requisites, for which the fishermen depend on the middlement, must be provided by the co-operatives.
- The credit agencies such as commercial and co-operative banks should be specifically instructed to pay more attention to the credit demand of the fishermen for various purposes. Vocational fisheries school, primarily for riverine fishery should be started to promote production because fishermen were found to catch juvenile as well as

broods fishes which affects net production. The State Govt. should take responsibility that Inland Fishery Co-operatives may avail NCDC's financial assistance for various activities.

- In the large wholesale and retail markets the condition is unhygienic as the washing and cleaning is not done thoroughly due to lack of water. Municipal authorities should look for proper sanitation by providing underground drainage system. District level marketing co-operatives should be organized under FFDA for creation of necessary marketing infra-structure. NABRAD should undertake a high level review of fisheries co-operatives to identify their financial needs. A national policy for overall development of fish marketing should be chalked out by the Govt. of India.

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**Table No. A1**  
**Zone Wise Socio - Economic Features of the Sample Respondents (Fishermen)**

Particulars	Sub - Zone I						Total	Sub - Zone II						Total	Grand Total
	D1		D2		D3			D4		D5		D6			
	B1	B2	B3	B4	B5	B6		B7	B8	B9	B10	B11	B12		
<b>A Size of Fishermen</b>															
i) Small	10	10	7	8	6	7	48	7	7	6	8	5	5	38	86
ii) Medium	6	5	11	6	12	5	45	8	4	6	7	7	6	38	83
iii) Large	4	5	2	6	2	8	27	5	9	8	5	8	9	44	71
<b>B Sex</b>	0														
i) Male	20	19	17	17	16	20	109	19	17	20	20	15	19	110	219
ii) Female		1	3	3	4		11	1	3			4	1	9	20
<b>C Educational Status</b>															
i) Illiterate	10	10	10	13	15	14	72	12	8	10	10	5	12	57	129
ii) Just Literate			4				4		1	1	1	3	2	8	12
iii) Upto Primary					3	5	8	3	2	2	2	7		16	24
iv) Secondary	6	4	1	3			14	1	3	1	1	3	3	12	26
v) Inter		1	1	1	1		4	1	2	1	1	1	2	8	12
vi) Graduate and above	4	5	4	3	1		17	3	4	5	5	1	1	19	36
vii) Technical Education						1	1								1
<b>D Social Group</b>															
i) Scheduled Castes				1			1								1
ii) Scheduled Tribe															
iii) Other Backward Caste	20	17	16	16	20	20	109	20	20	20	20	19	13	112	221
iv) General		3	4	3			10					1	7	8	18
<b>E Primary Occupation</b>															

	i) Agriculture				5	2	4	11	1		3	1	2	7	14	25
	ii) Fisheries	20	20	20	15	18	16	109	19	20	17		17	13	86	195
	iii) Services															
	iv) Business/Trade												3		3	3
	v) Agricultural Labour															
	vi) Casual Labour										2	19			21	21
	vii) Artisans															
	viii) Others															
<b>F</b>	<b>Secondary Occupation</b>															
	i) Agriculture	3	6	7	3		6	25	5	12	3		8	2	30	55
	ii) Fisheries											1	3	6	10	10
	iii) Service										1				1	1
	iv) Business/Trade	13	5	10	11	10	10	59	7	4	6		7	9	33	92
	v) Agricultural Labour										5	18			23	
	vi) Casual Labour	13	10	9	10	10	12	64	4	2	7		4	7	24	88
	vii) Artisans			2	3	4	4	13	3	1	3		2	2	11	24
	viii) Others				8	1		9	6	11	8		2	9	36	45
<b>G</b>	<b>Marital Status</b>															
	i) Married	20	20	20	19	18	18	115	18	16	20	20	18	19	111	226
	ii) Unmarried															
	iii) Widow				1	2	2	5	2	4			2	1	9	14
	iv) Widower															
<b>H</b>	<b>Religion</b>															
	i) Hindu	20	20	17	18	20	20	115	20	18	17		20	20	95	210
	ii) Muslim			3	2			5		2	3				5	10

Table No. A2

### Zone Wise Family Details of the Sample Respondents (Fishermen)

Particulars		Sub - Zone I						Total	Sub - Zone II						Total
		D1		D2		D3			D4		D5		D6		
		B1	B2	B3	B4	B5	B6		B7	B8	B9	B10	B11	B12	
<b>A</b>	<b>Family Type</b>														
	i) Individual	7	16	16	17	14	17	87	5	9	17	17	10	15	73
	ii) Joint	9	4	4	2	6	3	28	14	8	3	3	10	4	42
	iii) Extended	4			1			5	1	3				1	5
<b>B</b>	<b>No. of Family Members</b>	225	136	115	156	149	145	926	168	153	135	135	126	241	958
	i) Male	139	64	61	81	76	80	501	89	73	70	70	58	80	440
	ii) Female	86	72	54	75	73	65	425	79	80	65	65	68	76	433
	<b>iii) Children</b>	126	70	71	106	87	82	542	84	76	84	84	57	85	470
	i) Boys	82	44	39	56	45	45	311	44	36	43	43	25	44	235
	i) Girls	44	26	32	50	42	36	230	22	40	41	20	32	41	196
<b>C</b>	<b>House Ownership</b>														
	i) Own	20	20	20	20	20	20	120	20	20	20	20	20	20	120
	ii) Rental														
	iii) Relative's														
<b>D</b>	<b>Source of Income</b>														
	i) Paternal	6	4	10	9	8	8	45	9	6	12	12	5	9	53
	ii) Self Earned	12	14	10	11	11	12	70	9	11	8	8	10	8	54
	iii) Govt. Aid/ Help	2				1		3	2	3			5	3	13
	iv) Others		2					2							
<b>E</b>	<b>Type of House</b>														
	i) Mud and thatch			2	2		4	8	2	3	6	6		1	18
	ii) Mud and tiles			5	8	3	8	24	1	1			1	3	6
	iii) Brick and thatch	13	2	3	3	4	1	26	3					2	5
	iv) Brick and tiles		5	4	3	2	4	18	10	5			6	5	26
	v) Cottage	4	9			10	3	26			14	14			28
	vi) Semi - pucca	3		6	4	1		14	3	6			9	5	23
	vii) Pucca		4					4	1	5			4	4	14

**Table No. A3**  
**Zone Wise Land (in hac) Details of the Sample Respondents (Fishermen)**

Particulars		Sub - Zone I						Total	Sub - Zone II						Total	Grand Total
		D1		D2		D3			D4		D5		D6			
		B1	B2	B3	B4	B5	B6		B7	B8	B9	B10	B11	B12		
<b>A</b>	<b>Own</b>															
	i) Irrigated	0.6	7.8	10.6	35.0			54	6.0	34.8	0.8	0.8	42.2	50.7	135.3	189.3
	ii) Unirrigated															
	iii) Total	0.6	7.8	10.6	35.0			54	6.0	34.8	0.8	0.8	42.2	50.7	135.3	189.3
<b>B</b>	<b>Leased In</b>															
	i) Irrigated			7.8	27.0			34.8	6.0		0.8	0.8			7.6	42.4
	ii) Unirrigated															
	iii) Total			7.8	27.0			34.8	6.0		0.8	0.8			7.6	42.4
<b>C</b>	<b>Operational</b>															
	i) Irrigated	0.6	7.8	10.6	62.0			81	12.0	34.8	1.6	1.6	42.2	50.7	142.9	223.9
	ii) Unirrigated															
	iii) Total	0.6	7.8	10.6	62.0			81	12.0	34.8	1.6	1.6	42.2	50.7	142.9	223.9

**Table No. A4**  
**Zone Wise Details of Fish Farming of Sample Respondents (Fishermen)**

Particulars	Sub - Zone I						Total	Sub - Zone II						Total
	D1		D2		D3			D4		D5		D6		
	B1	B2	B3	B4	B5	B6		B7	B8	B9	B10	B11	B12	
<b>A Sources of Fish Production</b>														
i) Ponds	17	16	20	9	17	7	86	1	1	7	1	9	7	26
ii) River		4				2	6				19	3		22
iii) Chours/Mans/Lakes				8		1	9	19	2	1		4		26
iv) Canal														
v) Others	3			3	3	10	19		12	12		4	13	41
<b>B No. of Jalkars</b>	14	6	13	12	16	11	72	1	19	12	0	10	15	57
<b>C No. of Private Ponds</b>	9	23	9	9	4	10	64	0	1	14	1	8	8	32
<b>D No. of Chours/Rivers/ Canals</b>														

**Table No. A5**

**Zone Wise Details of Annual Reserve Deposites of Jalkars of Sample Respondents**

Particulars	Sub - Zone I						Total	Sub - Zone II						Total	Grand Total
	D1		D2		D3			D4		D5		D6			
	B1	B2	B3	B4	B5	B6		B7	B8	B9	B10	B11	B12		
<b>A No. of Jalkars</b>	14	6	13	12	16	11	72	1	19	12		10	15	57	129
<b>B Year of Jalkar Settlement</b>	2007-08	2007-08	2007-08	2007-08	2007-08	2007-08		2007-08	2007-08	2007-08	2007-08	2007-08	2007-08		
<b>C Reserve Deposites (Rs.)</b>	30569	5807	7159	122136	19180	1845	186696	15156	5317	8482		2514	1931	33400	220096

Table No. A6

### Zone Wise Cost of Fish Farming of Sample Respondents

Particulars		Sub - Zone I						Total	Sub – Zone II						Total	Grand Total
		D1		D2		D3			D4		D5		D6			
		B1	B2	B3	B4	B5	B6		B7	B8	B9	B10	B11	B12		
A	<b>Total Water Area (Hac.)</b>															
B	<b>Fixed Cost per Hac. (Rs.)</b>															
	i.) Land Rent	41034	157414	97000	95000	78500	99500	568448			106000	20000	140125	130000	396125	<b>964573</b>
	ii.) Digging Cost of Ponds/Tanks															
	iii.) Depreciation Cost	12000	40250	21500	22500	8950	16950	122150			25000	4000	10900	22800	62700	<b>184850</b>
	iv) Annual Reserve Deposit (if Jalkar)	49868	11488	12869	3553	28268	1599	107645	9760	3490	12289		3620	4439	33598	<b>141243</b>
	v.) Intrest on Fixed cost	25000	24000	30900	28872	75015	19800	203587	10000	18703	19989	2500	13243	25300	89735	<b>293322</b>
	vi.) Others	76734	78292	43477	11137	22688	72421	304749	11485	12252	75256	15900	22152	8243	145288	<b>450037</b>
	<b>Total Cost (B)</b>	204636	311444	205746	161062	213421	210270	1306579	31245	34445	238534	42400	190040	190782	727446	<b>2034025</b>
C	<b>Operational Cost (Rs.)</b>															
	i.) Lime (Price Rs.)	4500	15750	22900	5900	4300	5600	2672108		3700	8900	1000	9050	8570	31220	<b>2703328</b>
	ii.) Fertilisers (Price Rs.)	37250	30900	27800	12200	18200	22300	2820758		12500	30250		30100	27200	100050	<b>2920808</b>



iii.) Seeds (Price Rs.)	104500	135500	190000	76000	48000	65500	3440258	190000	29500	115000	10000	79000	65300	488800	<b>3929058</b>
iv.) Feed (Price Rs.)	10500	33000	46700	14800	14700	20300	3011810		12500	42000	2500	33800	28900	119700	<b>3131510</b>
v.) Chemicals & Medicines (Price Rs.)	3375	7900	21800	4200	2700	3700	3055485		2500	5400	500	6350	5550	20300	<b>3075785</b>
vi.) Water Supply (Cu. Ft.)									5000			25500	31700	62200	<b>62200</b>
vii.) Labour Cost									6000					6000	<b>6000</b>
viii.) Fishing Cost	88000	115000	134500	116000	101500	76000	631000	90476	124000	113000	2000	134500	122300	586276	<b>1217276</b>
ix) Security Cost	88350	98369	93608	32669	66722	25785	405503	13044	92730	82155		57600	68555	314084	<b>719587</b>
x.) Interest on Operational Cost	225885	155441	227882	70424	30650	28950	739232	205044	21271	35500	12600	31300	36900	342615	<b>1081847</b>
xi.) Others	40000	41250	56000	20550	138348	129658	425806	89785	125851	208983	5000	98300	60090	588009	<b>1013815</b>
<b>Total (C)</b>	<b>602360</b>	<b>633110</b>	<b>821190</b>	<b>352743</b>	<b>425120</b>	<b>377793</b>	<b>3212316</b>	<b>588349</b>	<b>435552</b>	<b>641188</b>	<b>33600</b>	<b>505500</b>	<b>455065</b>	<b>2659254</b>	<b>5871570</b>
<b>Grand Total (B+C)</b>	<b>806996</b>	<b>944554</b>	<b>1026936</b>	<b>513805</b>	<b>638541</b>	<b>588063</b>	<b>4518895</b>	<b>619594</b>	<b>469997</b>	<b>879722</b>	<b>76000</b>	<b>695540</b>	<b>645847</b>	<b>3386700</b>	<b>7905595</b>

Table No. A7

### Zone Wise Total Fish Production of Sample Respondents

Particulars		Sub - Zone I						Total	Sub - Zone II						Total	Grand Total
		D1		D2		D3			D4		D5		D6			
		B1	B2	B3	B4	B5	B6		B7	B8	B9	B10	B11	B12		
A	<b>Gross Fish Production (Qtint.)</b>	173.05	376.97	281.5	692.2	300.6	271.1	2095.42	745.4	1416.8	374	20.6	542.9	373	3472.7	5568.12
	<b>i.) Rate of Production of Fish</b>	17.26	20.31	17.74	14.59	23.32	17.82	111.04	42.72	73.6	23.79	15.75	23.37	17.07	196.3	307.34
	<b>ii.) Rate of Production of Other Products</b>															
B	<b>Net Production</b>	173.05	376.97	281.5	692.2	300.6	271.1	2095.42	745.4	1416.8	374	20.6	542.9	373	3472.7	5568.12
C	<b>Cost of Fish (Qtint. Rs. per hac)</b>	602360	633110	821190	352743	443920	377793	3231116	588349	435552	445038	33600	50500	455065	2008104	5239220
D	<b>Cost - Benefit Ratio</b>															

Table No. A8

### Zone Wise Details of Fish Marketing Systems of Sample Respondents

Particulars	Sub - Zone I						Total	Sub - Zone II						Total	Grand Total
	D1		D2		D3			D4		D5		D6			
	B1	B2	B3	B4	B5	B6		B7	B8	B9	B10	B11	B12		
A Total Production (Qtint.)															
B Total Sale (Qtint.)															
C Sale Agencies (Price)															
i) Total House to House Sale (Qtint.)															
a) Quantity (Qtint.)	102.2	76.87	80.12	87.7	121.76	62.07	530.72	63.2	206.3	129.35	1748.75	138.3	110.75	2396.65	2927.37
b) Price (Rs.)	365365	338228	360540	188905	323272	178431	1754741	174432	595588	393741	69950	304260	282912	1820883	3575624
ii.) To Midle Man															
a) Quantity (Qtint.)	7.2		31.43	114.35		12.5	165.48	137.6	196	31.7		126	3	494.3	659.78
b) Price (Rs.)	26640		110005	280157		22500	439302	247680	375536	100647		335916	6600	1066379	1505681
iii.) To Commission Agent/Arahats															
a) Quantity (Qtint.)	63.65		169.98	417.2	163.9	184.55	999.28	544.6	1014.5	212.95	3.15	278.6	259.25	2313.05	3312.33
b) Price (Rs.)															
iv.) To Retails															
a) Quantity (Qtint.)		44.9		73	15	12	144.9								144.9
b) Price (Rs.)		16403		160600	34500	27600	239103								239103
v.) Others															

Calculation of actual market price of fish on the basis of retail, whole sale etc.

Table No. B1

## Zone Wise Socio - Economic Features of the Sample Respondents (Non-Fishermen)

Particulars	Sub - Zone I							Sub - Zone II						Total	Grand Total
	D1		D2		D3		Total	D4		D5		D6			
	B1	B2	B3	B4	B5	B6		B7	B8	B9	B10	B11	B12		
<b>A Size of Fishermen</b>															
i) Small															
ii) Mediam															
iii) Large															
<b>B Sex</b>															
i) Male	20	20	20	18	18	20	116	18	19	20	20	19	20	116	232
ii) Female				2	2		4	2						2	6
<b>C Educational Status</b>								6	7	9	7	8	6	43	
i) Illiterate	2		49	13	11	11	86	1	1	3		2	4	11	97
ii) Just Literate	6	3	6	2	2	1	20	4	2	3		5	3	17	37
iii) Upto Primary		3	1	1	2	2	9	5	5	3	7	2	2	24	33
iv) Secondary	6	8	71	2	1	3	91	1	3	1	1	1	1	8	99
v) Inter	4		2	1		1	8	1	3	1	3	2	4	14	22
vi) Graduate and above	2	6	1	1	1	2	13	3	2	1	3	2	4	15	28
vii) Technical Education															
<b>D Social Group</b>															
i) Scheduled Castes				3	2		5	5		1		3		9	14
ii) Scheduled Tribe		20					20			1				1	21
iii) Other Backward Caste	20		16	12	16	15	79	12	20	16	5	12	10	75	154
iv) General			4	5	2	5	16	3		2	15		9	29	45
<b>E Primary Occupation</b>															
i) Agriculture	20	20	17	20	13	17	107	12	20	18	16	10	18	94	201
ii) Fisheries			3	4			7								7

	iii) Services																
	iv) Business/Trade	3						3									3
	v) Agricultural Labour																
	vi) Casual Labour																
	vii) Artisans																
	viii) Others												2		2		
<b>F</b>	<b>Secondary Occupation</b>																
	i) Agriculture					6		6					5	2	7		13
	ii) Fisheries				1			1					1	2	3		4
	iii) Service																
	iv) Business/Trade	3		5				8				6			6		14
	v) Agricultural Labour		7	2		3	4	16		4	2	2			8		24
	vi) Casual Labour	5	5		5		3	18									
	vii) Artisans																
	viii) Others	12	11	13	17	11	20	84	14	13	6	13	13	18	77		161
<b>G</b>	<b>Marital Status</b>																
	i) Married	20	20	17	18	17	17	109	17	17	20	17	16	18	105		214
	ii) Unmarried								3	3		1	1		8		
	iii) Widow			1	2	3	3	9	1			2	3	2	8		17
	iv) Widower																
<b>H</b>	<b>Religion</b>																
	i) Hindu	20	20	9	17	20	20	106	18	20	18	20	20	20	116		222
	ii) Muslim			11	3			14	2		2			4			18

Table No. B2

### Zone Wise Family Details of the Sample Respondents (Non-fishermen)

Particulars		Sub - Zone I						Total	Sub - Zone II						Total
		D1		D2		D3			D4		D5		D6		
		B1	B2	B3	B4	B5	B6		B7	B8	B9	B10	B11	B12	
<b>A</b>	<b>Family Type</b>														
	i) Individual	14	16	9	14	7	11	71	9	8	6	19	10	17	69
	ii) Joint	6	4	11	6	13	9	49	10	10	14	1	9	2	46
	iii) Extended								1	2			137	1	141
<b>B</b>	<b>No. of Family Members</b>	78	107	163	134	166	145	793	164	137	172	105	66	137	781
	i) Male	42	17	84	71	89	81	384	76	75	93	54	71	83	452
	ii) Female	36	20	79	63	77	64	339	88	62	79	51	70	54	404
	<b>iii) Children</b>	94	61	99	75	79	78	486	87	55	92	76	33	69	412
	i) Boys	52	33	52	38	44	45	264	40	33	51	38	37	46	245
	i) Girls	42	37	47	37	35	33	231	43	22	41	38		23	167
<b>C</b>	<b>House Ownership</b>														
	i) Own	18	20	18	20	20	20	116	20	20	19	20	20	18	117
	ii) Rental	2		2				4			1			2	3
	iii) Relative's														
<b>D</b>	<b>Source of Income</b>														
	i) Paternal	18	15	6	5	8	7	59	8	10	5	11	6	6	46
	ii) Self Earned		3	14	15	12	13	57	9	6	15	8	10	9	57
	iii) Govt. aid/ Help	2	2					4	2	4		1	4	2	13
	iv) Others														
<b>E</b>	<b>Type of House</b>														
	i) Mude and thatch	4		7	10		3	24	1	2				1	4
	ii) Mude and tiles		3	2	3		5	13	4	3	1		1	1	10
	iii) Brick and thatch	8	14	1	1	1	5	30	2		2	1	1	1	7
	iv) Brick and tiles			6	2	8	3	19		2	5	2	5	5	19
	v) Cottage			1		5		6			4	16			20
	vi) Semi – pucca	8	3	2	3	6	4	26	9	5	3	1	10	5	33
	vii) Pucca			1				1	6	8	5		3	6	28

**Table No. B3**  
**Zone Wise Land Details of the Sample Respondents (Non-fishermen) in hac.**

Particulars		Sub - Zone I						Sub - Zone II						Total	Grand Total	
		D1		D2		D3		D4		D5		D6				
		B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12			
<b>A</b>	<b>Own</b>															
	i) Irrigated	32		37.4	37.3	48.7	62.8	218.2	37.2	123.7	117	62.8	41	50.4	432.1	268.6
	ii) Unirrigated															
	iii) Total															
<b>B</b>	<b>Leased In</b>															
	i) Irrigated															
	ii) Unirrigated															
	iii) Total															
<b>C</b>	<b>Operational</b>															
	i) Irrigated				11	4	28.9	43.9	5.5	10	7.5	28.9	1.8	17	70.7	60.9
	ii) Unirrigated			37.5	28.3	44.7	31.9	142.4	31.7	113.7	40	31.9	39.2	33.4	289.9	175.8
	iii) Total															

**Table No. B4**  
**Zone Wise Cropping Pattern of the Sample Respondents (Non-fishermen) in hac.**

Particulars	Sub - Zone I						Total	Sub - Zone II						Total
	D1		D2		D3			D4		D5		D6		
	B1	B2	B3	B4	B5	B6		B7	B8	B9	B10	B11	B12	
<b>Kharif</b>	23.2	32.5	36.4	28.3	47.6	30	198	31.4	101.2	36.8	30	38.8	35.8	274
<b>Rabi</b>	12.8	11.5	42.9	28.3	47.6	31.5	174.6	31.5	109.5	27.8	31.5	37	39.3	276.6
<b>Garma</b>			29.4	25.1		10.9	65.4				10.9			10.9



## Comments on the Draft Report

F.No. 0-15012/49/2005-SER  
Government of India  
Planning Commission  
(SER Division)

Yojana Bhawan, Sansad Marg,  
New Delhi- 110001  
Dated:- 27<sup>th</sup> August 2008

To,  
**The Managing Trustee,**  
**Chanakya Education Trust,**  
(Anga Institute of Research Planning & Action)  
**Suryalok Colony, Bagbari, Mirjanhat,**  
**Bhagalpur-05**

Subject: - Research Study on **“Economics of Fish Farming in Flood Prone Areas of Bihar with special reference to Koshi River System”** – Submission of draft Report

Sir,

I am directed to refer to your letter dated nil on the subject cited above and to return with following comments of the Planning Commission thereon:-

1. Report has not been drafted in a systematic manner, in line with the objectives and methodology proposed. The statements and sentences are not coherent and understandable.
2. Observations of Planning Commission on various short comings/factual errors have been indicated in the margin of the report right from the preface in the draft report itself.
3. There is ambiguity in data, interpretation of data/results generated, through out the text.
4. The original proposal contained seven objectives, whereas in the draft report only six objectives have been mentioned, leaving out one of the main objectives, namely, **“to study the production, propagation and management of shell fisheries in the area”**.
5. Review of literature has not been cited systematically and recent references have also not been quoted.
6. It appears that most of the data used are secondary and out dated. Efforts made to collect primary data are not reflected anywhere in the report.
7. Figures on percentage are not tallying/matching. Data has been subjected to simple percentage analysis only where too inferences have not been drawn clearly.
8. Facts and figures of the main theme i.e. Economics of fish farming in flood prone areas has not been spelt anywhere in the draft report.
9. Most of the statements are generalized statements. Clear cut findings of the study have not been spelt out.

In the light of the above, the report may be revised and redrafted properly with due focus on all objectives, elaborating methodology and giving analysis of data collected so as to improve its quality. The draft report containing observations of Planning Commission, being returned herewith may also be sent back along with revised report for reference.

Encl: A/a  
faithfully

Yours

S/d S. Mukherjee

Deputy Secretary of Govt. of India  
☎:- 23096791

## **Action Taken Report**

*{Pointwise reply of the letter no. F.No. 0-150/49/ 2005-SER Planning Commission, Govt. of India}.*

1. The report has been drafted in synch with the objectives and methodology proposed in the revised project proposal. The entire report is based on the established and well-settled norms of writing such project report. The report has been drafted in a logical and systematic manner and also in tandem with objectives and methodology as explained in the revised research proposal.
2. Action has been taken as per the comments.
3. Action has been taken as per the observations.
4. The objective “**to study the production, propagation and management of shell fisheries in the area**” was incorporated in the original research proposal but it was dropped in the revised proposal on the advice of the expert referred by the Planning Commission. However, the analysis of this objective has been included in the final report as **Chapter IV**.
5. Action has been taken and objections have been met.
6. It is not correct to say that the most of the data are secondary and outdated – rather truth is just otherwise. In support of this a few of the collected primary data relating to the research project are being appended for the needful.
7. Action has been taken.
8. Facts and figures relating to the main theme, i.e., Economics of fish farming in flood prone areas have been exclusively dealt with in **Chapter III** of the Final Report.
9. Action has been taken.

In addition to above, our responses to other comments are as hereunder.

- The facts and language used in the first paragraph of the Preface has been taken and adapted from (i) *The Wordsworth Encyclopedia, Volume-2, page 803* and (ii) *The Modern Encyclopedia of World, vol. 2, para-363*. This is because the type of description given here does not belong to economics but comes under the pale of zoology.
- Andhra fish means the fish from Andhra Pradesh. It is the only one variety, Carp (Rohu) and Silonia (Silan).
- ‘Mans’ menas a kind of chaur water reservoir.
- Objectives, methodology, hypothesis presented anywhere in the report cannot be changed rather they have to be produced in same form and language in the conclusion chapter of the report. In fact summary is the presentation of facts and figures in briefs of the entire report.
- Typing errors have been removed.

(Ugra Mohan Jha)  
Project Director