‘ECONOMIC AND TECHNOLOGICAL ASPECTS OF FISHING IN WEST BENGAL, 1950-2008: A COMPARATIVE STUDY WITH JAPANESE EXPERIENCE’

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Certified that the thesis entitled

'*Economic and Technological aspects of Fishing in West Bengal, 1950-2008:A comparative study with Japanese Experience'* submitted by me for the award of the **Degree of Doctor of Philosophy in Arts at Jadavpur University** is based upon my own work carried out under the supervision of **Dr. Chittabrata Palit**, Director of Corpus Research Institute (former Professor of Department of History, Jadavpur University) and **Dr. N.A.Talwar**, Head, Department of Fishery Engineering, Faculty of Fishery Sciences, WBUAFS and that neither this thesis nor any part of it has been submitted before for any degree or diploma anywhere/elsewhere

Signature of candidate

Countersigned
by the Supervisors

Date:

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Contents

LIST OF TABLES

Chapter-III

Chapter-IV

Chapter-V

Chapter-VI

LIST OF ILLUSTRATIONS

Chapter-III

Chapter-IV

Chapter-V

Chapter-VI

Chapter-VII

INTRODUCTION

1. The Goals, Method and Expected Out Comes of the Research

The state of West Bengal is situated between latitudes 21^{o} 05′ N and 24^{o} 5′ N and longitudes 86^{o} E and 89^{o} E. It is the northernmost Indian state bordering the Bay of Bengal and has to its south the Indian state of Orissa, while Bangladesh is to its north and north-east. It is most distinguished provincial state of India with physical diversity. It has an area of only 88,752 km^2. Though West Bengal is not a very large state of India, It has been able to secure the leading position in fish-production for seven successive years and has been rewarded accordingly by the Central Government as best productivity aware. West Bengal is the only state in India, where fishes have been cultured and captured in every kind of water bodies, i.e. brackish water, sweet water, sewage water and marine water as well. Fishing is the principal means of livelihood of this region. 75% people of this area are living below poverty line. Cultivation of fishes occupies only three months of the year and fishers have no other alternative except survival with fishing. They have developed indigenous techniques of fish catch from the canals, rivers and the Bay of Bengal by using locally called Khaplajal, sanglenet, Galsanet, Powered trawler, Hooks etc. Trading is run through private and public enterprise. Each year huge stocks of fishes like hilsa fish are being exploited and preserved in store houses. As a conservational measures the fisheries department of the government of state had notified that no small sized hilsa can be hauled out. Besides hilsa fishes, other marine fishes enjoy high demand and the other adjoining provincial states of India. It goes out to the USA and European countries. Fresh catch, fresh marketing and instantaneous business transaction end the entire affair. Only a few government run store houses. Due to non-preservation and temporary transactions this very promising business of Bengal is suffering setbacks.

The study deals with the different fishing technologies like marine fishing and sailing, estuarine fishing and its comparison to Japanese fishing experience. The works will show every tenet of industrial, technical, commercial and technological interest of pisciculture. Indians economy is largely based on agriculture. Pisciculture, agriculture and forestry are combined produce though occupy 70% village living country living people. Protein food is very much essential for the poverty striken country like Indian. Secondly employment facilities thirdly in the field of

international trade commerce. It yields large profit by way of earning and formidable amount of foreign exchange. Japan has done remarkable progress in the field of fisheries. Indian coast line is broken like Japan various creeks and Kharis have been formed. There are immense scopes for the cultivation of fish. By applying this advanced fishing technology the south East Asian people can do remarkable progress in this industry. This communication on fisheries with Japanese counterparts will show a new dimension in this affair. The paper is based on various archival sources i.e. government reports, gazetteers, minutes, census reports, proceedings, guidebooks, memoirs, various other available data and fieldworks in different places and markets.

Japan is an island country located along the East Asian mainland, in front of Russia, North Korea, South Korea, China and Taiwan. It is surrounded by the Sea of Japan (to the west), the Sea of Okhotsk (to the north), the north-western Pacific Ocean (to the east), the East China Sea and the Philippine Sea (to the south). Japan has a total land area of 378 000 km² and more than 6000 islands. Four main islands constitute ca. 97% of Japan's land area (from north to south): Hokkaido, Honshu, Shikoku and Kyushu. In addition, there are numerous smaller islands. Most of them form the Ryukyu Islands (south-west from Kyushu to Taiwan), the largest of which is Okinawa, and the Izu and Bonin (Ogasawara) Islands (south of Tokyo). The body of water separating Honshu, Shikoku and Kyushu is known as the Seto Inland Sea.

The Japanese coastline is 29 751 km long. The continental shelf around the archipelago is 20 to 30 km wide, with the shelf break at an average depth of 140 meters. Continental shelves are broader in the Sea of Japan along the coast of south-western Honshu to Kyushu, and around northern Hokkaido (Figure 1). East of Honshu the seafloor morphology is marked by the 9000 m deep Japan Trench, created by the sub-duction of the oceanic Pacific plate beneath the continental Okhotsk plate.

Japan's 12-nm territorial waters and 200-nm Exclusive Economic Zone (EEZ) cover an area of 4.47 million km², which is the sixth largest in the world and covers 12 times the area of Japan's land. .As regards territorial claims; Japan is involved in three island disputes with its neighbouring countries Korea, China/Taiwan, and Russia.

Japan plays a leading role in global fisheries, both as one of the world's top producers and as a major importer of fishery products. Surrounded by some of the

most productive fishing grounds on earth, teeming with a wide variety of resources, Japan has long been a most important fish consumer and has developed an exquisite fish-rich food culture.

Japan is one the world's top producer countries (the 5th on a global scale in 2008; FAO 2010), and its fishing industry is an important sector for providing a vital source of food protein and for maintaining local communities. Nevertheless, the sector has been on a decline for several decades.

2. Description of the Proposed study

Proper Management of the natural resources like fish and the rights of the traditional communities to access the natural resources are no doubt important issues in the age of globalization and global warming. Nature is related to Human civilization. The life of every community is more or less based on nature. Fishermen always seek their fortune in the water of the seas and rivers. Many researches have been done on several communities of south East Asia but the fisheries, rights of the fishermen on water bodies and different aspects of fishing industries have been neglected. The fishermen communities have also been severely neglected in the history of the depressed class. The Art and technology of making their fishing implements have been overlooked, while other castes and their multicultural life have been broadly flourished in the writings of the colonial and post-colonial historians. The lifestyle of Bengali fishermen in the British period remained dark. On the other hand fishermen, their culture, have got remarkable place in the Bengali literature, folksong and in many other lifestyles, in the later stages. Whatever the situation may be the social, economic, and environmental history of the traditional fishermen should be reconstructed. In doing so their technology which is an important factor of modern life and civilization should be studied more critically.

The techniques and technology mostly needed for food production and food collection in the village society is in fish catching and pisciculture for the poor people. Fish is the most easily available protein food and its price is low. It is mentioned that 85% to 90% people of West Bengal are fish consumers. More or less 15% of the total populations have taken fish catching and pisciculture as their chief occupation and livelihood. The rivers like-Bhagirathi, Brahmaputra, Jamuna, Ganga and Hooghly their various branches and canals which control the whole of the Gangetic Delta are

the source of various species of fishes. Nearly about 240 species of fishes are available in the inland waterways. Many fish centers and store houses of different species of fishes are found on a vast area near Bay of Bengal. The total inland waterway was about eight thousand square miles. The modern embankment system of fishing in Sundarban area is an age-old system of fishing.

Environment had a great influence on cultural life of the people who were dependent on fishing. Independent sense of existence of the people grew a lot among them for the same reason. Modern techniques and technological knowledge were related to fishing and fish production. So called modern technologies were found among the village people from the ancient time. Fish catching and fish selling were also important part of their profession. With the breaking up of the village society many new races and classes were created. They also adopted the profession. A large section of fishermen used to catch fish without any fishing Implements. They depended only on their age-old techniques. They took fish catching as a part of their profession to get more food.

Today the limited quantity of food calories is a great matter of concern to many parts of the under developed countries. But the quality, notably of proteins is more crucial. Supplies of proteins are particularly scare and costly in poorer nations. For over one third of their populations, the protein calorie balance of the diet is inadequate. The gap is widening rapidly and the protein problem is reaching a crucial stage. All proteins are formed from amino acids in varying proportions. Only eight amino acids are essential to human nutrition. First class proteins have a relative abundance of all essential amino acids. Most protein in this class is derived from animal sources, meat, fish, egg and milk. To close the gap, the production of proteins from plant, animal and fishery resources should receive first emphasis. Fresh and processed fish already are making important contributions to the world protein supply. For countries like Japan, they are essential for survival. That is why high priority to the fishery resources of the seas and inland waters- a conventional source of protein is needed. The utilisation of these resources requires large fishing fleets and facilities in developing countries and suitable refrigeration facilities at the point of catch and throughout the distribution network. While other methods of preservation, such as salting, drying, canning, may protect the protein quality of fish, the dominant factors in selecting methods are acceptability and price of fish to the consumer. Developing

nations should intensify their efforts to catch more fish and this will involve large expenditures.

Nowadays a very large amount of fish are dried and used to produce animal food in developed nations rather than for direct human consumption in developing nations, where a large part of this dried fish meal is produced. The usefulness of fish is even greater than the figures for the potential suggests, because of the high biological value of this protein. The development of suitable transport and preservation procedures could result in diverting to human consumption. This need may become nutritionally desirable and economically important if these fisheries are to survive.

Fisheries play an important role in India's economy in augmenting food supply, generating employment, raising nutritional levels and earning foreign exchange. The fish production has shown a steep rise during last five decades. It has increased from 7.52 lakh tonnes in 1950-51 to 56.56 lakh tonnes in 2000-01 recording a rise of more than 7 times during last five decades. During 1950-51, the composition of total fish production in India was in the ratio of 71:29 to marine and inland which has been significantly changed to a ratio of 55:45 in 1995-96 and 50:50 during 2000-01. It is not like that total marine fish production in India has been declined, but the total production of inland fish has been increased over the years at higher proportionate rate as compared to marine fish landings. In fact total marine and inland fish production were 5.34 lakh tonnes and 2.18 lakh tonnes respectively 1950-51 which has been increased to a level of 27.07 lakh tonnes and 22.42 lakh tonnes in 1995-96 and 24.11 lakh tonnes and 28.45 lakh tonnes during 2000-01. West Bengal occupies a coastline of 7500 km (approx) and contributes 121.08 thousand tonnes recording 4.30% of the national marine fish catch during 2000-01. Although Kerala, Maharashtra, Karnataka and Tamil Nadu share 9.9%, 10.6%, 4.8% and 17% of the National Coastline, yet they contribute 20.13%, 14.33%, 6.26% and 13.09% respectively of the total marine fish output in India during 2000-01. It clearly indicates the poor performance of W.B. in landing the marine fishes.

The production of marine fish in W.B. which was 38.70 thousand tonnes in 1980-81 increased significantly to the tune of 53.58 thousand tonnes in 1985-86, 78.19 thousand tonnes in 1990-91 and 133.46 thousand tonnes in 1996-97. It declined

to 121.08 lakh tonnes in 2000-01. The maritime districts like Cuttack, Balasore, Puri and Ganjam contribute respectively 41.58%, 34.01%, 19.91% and 4.50% of the total marine fish landings in the State during 1996-97. 40% of the total marine catch of the state is consumed inside the state. Thus, the fishermen depend upon the intermediaries for sale of their catch. In this study an attempt has been made to examine the existing marketing structure, market price and its impaction fish catch, seasonality in the marine fish prices and its fluctuation and scope of export in the context of liberalisation of world trade.

The future of traditional fisheries will be shaped by the attention given to their special problems and by the recognition of their unique value. Declining stocks of readily accessible fish, competition from industrial fishermen, high operating costs, less than optimal gear and vessels, poor storage and marketing facilities, and little access to credit all tend to limit development for fishermen in the traditional sector. Culturally and economically acceptable technologies can help with some of these problems, but policy changes and interventions must also be part of the assistance strategy. The effort is worthwhile. Traditional fishermen are important contributors to the food supply in developing countries. They currently account for about one-quarter of the world's total fish catch- an estimated 20 million tons of a total of 80 million. Although only about one-fifth of the fish caught in Latin America come from the traditional sector, in Asia these fishermen provide two-thirds of the catch, and in Africa, five-sixths. Traditional fishermen are economically important for other reasons as well: their boats and gear are locally produced, easily repaired with local parts, and represent a low capital investment; their fish-capture techniques and propulsion methods are both low energy consumers. Commercial fishing boats and gear, in contrast, are largely imported, and therefore often require imported spare parts. Moreover, they require a high capital investment and consume large amounts of energy to reach and capture fish. There is also more wastage of by-catch from their operations.

Many developing countries have ignored traditional fishermen and have concentrated their assistance in industrial fisheries. Traditional fishermen have suffered more than neglect from this policy commercial trawlers operating near shore can simultaneously harvest large numbers of fish (including juveniles) and destroy spawning and breeding grounds. The adverse effects for the traditional fishermen are

both immediate and persistent; current stocks are depleted and the potential for recovery is reduced. Developing countries could increase their fish harvest and improve the quality of life for their coastal dwellers by providing traditional fishing communities with access to modest technical and financial resources and by assuring protection for their fishing grounds. The evaluation and introduction of some of the technologies described in this report could initiate this process. Thus modern technology has achieved more importance for the welfare of the fishing communities. So, ignoring all other drawbacks, the developing countries are using modern techniques and technologies for the all-round development of fisheries.

The relation between fish and man is found from the period when the world was very young. History of fish catching of man is very old. Ancient Human being named 'Homoirectus' started fish catching near the coastal area. Their implements were small or Big sharp stone, and spear. Different editions were found with the changes of the period. This relation is not only confined among seeing, touching and eating. It has been extended to cultural and social festivals like pujas, wedding ceremonies and many other social festivals. So the relation between man and fish is very cordial. Our motherland the Bengal is mainly rivers dominated. Different kind of crops has made it green. Fish is the only important source of human food, because it is the most cheaply produced form of diet that lies in the chemical consumption of the fish, which is rich in protein and minerals like calcium, phosphorus and iron. The Bengalis were most fond of fish so much so that fish occupied the second position next to rice as their diet; there is a proverb which runs thus "Machhe-bhate Bangali". Poet joydev mentioned fish as the first prophet of vishnu in his hymns of ten prophets. West Bengal holds the paramount position in the fresh water Fisheries. Rivers produce fish abundantly. West Bengal has perhaps the largest number of fish species and the most numerous types of fishing gears in the world with which the most specialised occupational castes of Bengal are engaged in fishing. They have their own technology for preserving fish from its very nature of immediate decomposition in response to the demand of the market. Fish catching is related to boat, trawler, Net, and life style of the fishermen. And many evolutions were also found among all these implements and the culture of their life. Even to the upper castes fishing is taken as a popular recreation. Thus, fish has been dominant in the Bengali's economy, religion and cultural symbolism about which we have various instance in the Bengali

literature, paintings, epigraphic records and folklores. Sundarlal Hora and Tarak Chandra Das in 1930s have given descriptions in detail of the social and cultural significance of fish and fishing in the popular lives of Bengal. Many essays have been published about the folk culture of the fishermen through many essays, novels & books. More publications on their culture and Business will be published in future because fish and fishermen are inseparable part of Bengali culture.

Fish and Fishing was an attractive subject of study in the modern history of India. Both were also regarded as food and as a profession in the social life. No remarkable research has yet been done on fish industry. Peter Reeves and some other scholars were trying to develop the industry through discussion. Yet they did not discuss the techniques and technologies with emphasis. The people who were busy with the modern research such as scientific technique also over looked this important subject. Though this poor fish industry was a centre of rural employment. The struggle for supremacy over water resources between old producer and modern producers is strongly seen. So, the application of modern technique and technology are getting more importance day by day.

Fishing is one of the oldest means of livelihood of the human society. In west Bengal a few traditional communities had adopted fishing and fish-related occupations as their profession due to the availability of fish, fisheries and love of the Bengalis to the fishes of large varieties. So their relationship with the fisheries and fish is very much close. The traditional fishermen had free access to the state controlled big fisheries and they could enjoy customary rights of fishing in the internal fisheries in pre-colonial days. However, the colonial state gradually established the state control on the water bodies and had considerably changed the pre-colonial relationship between the fishermen and the fisheries. The pre-colonial relationship between the fishermen and the fisheries had been violated in colonial period. In many cases the fishermen had protested against the violation of their customary rights. The partition of Bengal in 1947 and the post-colonial situation became more crucial for the survival of the traditional fishermen. The Bengali fishermen being to people of the Hindu community were compelled to migrate to India from East Bengal due to new type of atrocities committed on them. Moreover, most productive fisheries particularly fish producing big rivers have remained under the possession of East Pakistan. The river system and other fisheries of West Bengal

were proved insufficient for providing livelihood to the refugee fishermen and the settled traditional fishermen of West Bengal. In this time sudden growth of fish eating population in West Bengal had increased the demand of fish while the production was insufficient. So a serious fish crisis was almost irresistible in West Bengal at the cost of partition of Bengal. Improvement of Socio-economic status of the fishermen and increase of fish production were thus immediate necessity of West Bengal. The state government had adopted different schemes for the development of the fisheries particularly to bring more water area under the scientific pisciculture. But the existing legislative measures were not suitable for bringing uncultured fisheries from the private ownership to the state control. The master plan committee appointed by the state govt. in 1972 had stressed on the nationalization of the uncultured fisheries for the introduction of the modern pisciculture but it could not be done before 1984. Although the United Front (UF 1967-69) and Left Front (LF) government of West Bengal (1977) had stressed on the implementation of rights of the marginal peasantry by raising the demand Land is for the peasantry, but the same government did not properly consider the demand water is for the fishermen raised by the traditional fishermen. So inspite of formulation and adoption of several schemes for the development of the traditional fishermen they still are facing the question of their survival. Economically majority of them have below poverty line status and educationally majority of them are still illiterate. Higher and technical education is almost nil among them.

Remarkable development was not found in the fishery sector from 1950 to 70. But it has been flourished day by day since 1980 and has been reached to an expected expectation within the next fifteen years. And it will reach to the highest peak in future. The state has a well-established system of fisheries research, training and education centers i.e. Fresh water Fish Research Station and State level Fisheries Training Institute at Kulia in the district of Nadia, Pailan Research Centre in the district of 24 pgs (South), Fish Technological Station at Junput in the district of purba Medinipur and district level training centers located at Meen Bhavan in different districts. The state has also a full-fledged university on fishery sciences. There is also a full-fledged research institute of Govt. of India i.e. central inland fisheries Research institute (CIFRI) at Barrackpore in the district of 24 pgs (North). These research and training infrastructures have been built up for providing technological backup to

fishers for more productive and sustainable fisheries through optimum utilization of available water resources. Marketing and export promotion are further assisted by the Marine products Export Development Agency (MPEDA) and National co-operative Development council (NCDC). In the inland sector, about 30% of the all India fish production comes from West Bengal. It is Worth mentioning that in the year 1977 the total fish production in the state was 2, 34,000 MT. but now it has been possible to make a phenomenal progress in this sector increasing thereby the production to tune of 13.50 lakh MT against target of 12.99 lakh MT at the end of 2006-07.

The Fisheries Department targeted for increasing fish production from 11.20 lakh MT in 2002-03 to 14.00 lakh MT at the end of the 10^{th} five year plan i.e. at the end of 2006-07 for ensuring 'FISH FOR ALL' in the state. But actually the achievement was 13.50 lakh MT, even though a little below the target set it was more than the demand which was 12.99 lakh MT. This required a focus on sustaining gains already made in production, protecting the productivity of inland and marine fisheries, increasing production through extension of area and new technical break through, adding value to the produce, ensuring quality and creating avenues for increased living standard through remunerative and assured marketing opportunities. The state is striving for even more production for which adequate measures have been aimed at the 11^{th} plan.

3. Review of existing literature

Extraordinary Researches on the fish, fisheries, fishing method and the fishermen are not great in number although there are a few government reports regarding the fisheries and the fishermen of Bengal. Survey Reports of Buchanan Hamilton on the districts of Eastern- India, conducted during the period between 1808-1814 are the earliest writings on the fisheries, and fishermen of Bengal. Hamilton had categorically recorded the fishing technology and the condition of the fishermen of Bengal particularly of the districts of Rangpur and Dinajpur districts of Bengal, Lower Assam and Bihar. However, there was no serious attempt of compilation of the fishery matter before the publication of *Statistical Account of Bengal* (20 vols.) in 1876 of W.W.Hunter. Hunter had gathered a lot of information from different sources including the first decennial census (1872) about the water resources of all districts of Bengal including the nature of the fisheries and their management procedure. In 1891

H.H.Risley had published a serious work entitled *Tribes and Castes of Bengal* (2 vols.) on the classification of whole population Eastern India on the basis of race, religion and caste. This is the earliest work on the caste and tribal communities of Bengal including the fishermen communities. Risley had conducted a systematic survey on the origin, social customs and socio-economic status of the fishermen. Sir K.G.Gupta's *Reports on the Result of Enquiry into the Fisheries of Bengal and into Fishery Matters in Europe and America* (1907) is another official attempt on the fisheries and the fishermen of Bengal. Official reports have their official approaches regarding the compilation of the fishery matter as well as fishermen communities. Buchanan Hamilton was instructed to conduct a survey in order to make an idea about Bengal where the East India Company was emerging as the ruling power. W.W.Hunter and H.H.Risley on the other hand were guided by the official needs of first hand material on the Indian population including their social customs and social behaviours. So these researches are not beyond the scope of re-examination.

The economic historians paid less attention to the fisheries. So N.K.Sinha's *Economic History of Bengal (3 Vols.)* and the *Cambridge Economic History of India* (1982) have merely mentioned the existence of fishing without any analysis of the fisheries and the fish industries. Nariaki Nakajato in his *Agrarian System in Eastern Bengal 1870-1920* has briefly dealt with the fisheries. Similarly K.T. Acharya's *The Food Industries of British India* has tangentially given a description of fisheries and the fish production of British India. However, since the 1990's historians are paying adequate attention to the writings of the history of the history of the fisheries and fishermen of Bengal. Dr. Sundarlal Hora, in a series of writings published in the *Journal of the Asiatic Society of Bengal* had initiated the historical writing on this subject. His *Ancient Hindu Conception of Correlations between form and Locomotion of Fishes, Knowledge of the Ancient Hindus Concerning Fish and Fisheries of India* and *Discussion on Hilsa and its fisheries* are remarkable.

Professor Reeves, in collaboration with researchers at the South Asia Research Unit at Curtin University of Technology in Perth, Western Australia, is engaged in studies of fisheries in the colonial period in South Asia and in studies of developments in fisheries in the last half of the 20th century. These studies include research on inland fisheries in Bengal Presidency from 1793 to 1947; the effects of the partition of Bengal on Bengali fisheries and the development of fisheries in West Bengal, East

Pakistan and Bangladesh since 1947; the role of the colonial state in marine fisheries in the Bengal, Bombay and Madras Presidencies, including colonial attempts to survey fishing grounds around the coasts of colonial India and the development of Fish-curing yards in all three presidencies, the effects of the introduction of the auction-lease system in British Lower Burma in the last quarter of the 19th century; the development of new property regimes for inland fisheries in West Bengal and Bangladesh from the 1970s onwards, and the development of intensive aquaculture in West Bengal and Bangladesh in the 1980s and 1990s. The project is researching the ways in which the Communist Party of India (Marxist)-led government of West Bengal- which has been in power in the State since 1977- has reacted to the development of 'new economic policies' since 1991. The announcement of these new policies by the Government of India opened much more important roles for State governments in matters of economic and industrial policy, foreign investment and overall fiscal policy. West Bengal has responded to those opportunities and the unique political circumstances in the state.

With the beginning of the historical writings of South Asia on the environmental perspective, a few scholars have taken fisheries and the water management as the subjects of their research. Peter Reeves happens to be the foremost among them. In case of Bengal, Peter Reeves initiated the writings of history of the fisheries with the publication of his *Waters and Fresh Water Fisheries: Some Issues of Control,* Access and conservation in colonial India. Similarly Bob Pokrant, Peter Reeves and John McGuire's studies like- *Riparian Rights and the Organization of Work and Market Relations among the Inland Fishers of Colonial Bengal C. 1793-1950, Mapping India's marine Resources: Colonial State Experiments, c. 1908-1930 and Bengal Fishers and fisheries: A Historiographic Essay* although constructed the history of the fisheries of Bengal but the lives of the fishermen have remained untouched. But S.K.Pramanik has paid adequate attention to the traditional fishermen in his *Fishermen Communities of Coastal Villages in West Bengal.* There are a few more studies on water bodies, wastelands and the traditional communities on the environmental perspective. But these works obviously are very much local in nature. So further research is essential to construct the relationship between the traditional fishermen and the water bodies of Bengal both of colonial and post-colonial periods.

Litterateurs such as- Dramatists, novelists and the poets could not avoid the rivers as the ground of their creation, so fishing is an important part of Human civilization. The river systems of different parts of the country and world have been the sources of inspiration to the novelists as these systems are the determinant factors of growth and survival of the civilization. *And Quiet Flows the Don* of Michal Sholokhov (got Nobel Award in 1965) is such type of novel, which depicted the river as the determinant of lives of the people. Similarly the platform of *The Old Man and the Sea* (1975) of Earnest Hemingway is also the water. The Indian as well as the Bengali novelists have also inspired by the variations of the rivers.

The Ganga River flows from the Himalayan Mountains across northern India, emptying into the Bay of Bengal. The river delta creates a vast archipelago of islands, the Sundarbans, where mangrove jungles grow quickly on land not reclaimed by the tide. The tidal surge from the sea can cover three hundred kilometers, constantly reshaping or devouring islands, with just the tops of the jungles often visible at high tide. This is the tide country, home to the Bengal tiger, huge crocodiles, sharks, snakes, impenetrable forests, and a few people trying to scratch out a living. At the beginning of the 20th century, Sir Daniel Hamilton decided to create a utopian society there, offering free land to those willing to work as long as they accepted the others as equals, regardless of caste or ethnicity. It's a difficult life that leaves most women widowed at a young age and land barely farmable if the saltwater of the hungry tide can be kept from flooding their fields. It's in this tide country, the Sundarbans, where Amitav Ghosh sets his engaging novel, *The Hungry Tide*. The book is told from the perspective of its two main characters, Kanai Dutt, a Delhi businessman, and Piya Roy, an American Scientist who has come to study the rare Irrawaddy dolphin which lives in the rivers of the tide country. Amitav Ghosh lets the tide country break down the barriers of both society and his characters.

The Bengali novelists, from Bankim Chandra Chattopadhyay to Debesh Ray, have paid adequate attention to examine the location of the rivers in the economy and society of Bengal. They portrayed the life style of economically downtrodden and socially marginalized communities of Bengal like the fishermen including their whole cultural pattern. As novels are the reflectors of image of the society, we must highlight some novels, which paid adequate attention to the fisheries and traditional fishermen. There are large variations in the Bengali novels dealing with the rivers and

the traditional fishermen. First category of novels comprises with those writings which are not directly related to the fishermen rather the lives of the non-fishermen settled communities of the river banks or the region have been critically identified. The novels of second category are the romanticized version of the fishermen. The novels of third category are more authentic as the source of contemporary Socio political and cultural history of the fishermen, which are the contributions of the novelists having direct knowledge on fishing and fishery management. Bankim Chandra Chattopadhyay, first successful Bengali novelist, is perhaps the pioneer to dedicate few words about the rivers. Bankim, in his *Devi Chaudhurani* (1882), had unconsciously left an impression on marginalized social status of the fisherwomen of Bengal although he never attempted to write about the fishermen. His *Kopal Kundala* (1866), *Bishabrikshya* (1873) and *Chandra Sekhar* (1875) have also left some impression about the river system of Bengal.

Rabindranath wrote about the river Padma and its people in his book *Galpaguchha*. This shows his love for the river Padma. The short stories like *Post Master, Sasti, Durbuddhi, Megh O Roudra, Khokababur Prattabartan, and Samasya Puran* etc. are the examples of the influence of the *Padma* to the mind of Rabindra Nath. His *Gora* (1920) is an exceptional type of novel, where he highlighted the conflict between the general peasant of the banks of the river and the state. His *Naukadudi* (1906) has highlighted the river system and the water transport. Sarat Chandra Chattopadhyay also loved the river. He described rivers in his book *Srikanta* (firs part, 1917). Tarasankar Bandopadhyay's novels like- *Chaitali Ghurni, Gana Debata, Kalindi* (1347 B.S.) and *Hasuli Baker Upakatha* (1354 B.S.) have occasionally left some impression about the impacts of river or the village society. Three novels of Saroj Kumar Ray Choudhury viz., *Mayurakshi* (1343 B.S.), *Grihakopoti and Somlata* are also such literature, which are based on the rural life of Bengal. Buddhadev Guha, another notable novelist; in his *Koyeler Kachhe* has also highlighted the people of the villages of the basin of the *Koyel* river located at Hazaribag-Giridih region.

Modern novelists have also attracted to the rivers of North Bengal. *Lalmati* (1951) and *Mahananda* (1951) of Narayan Gangopadhyay, *Madhu Sadhu Khan* (1988) of Amiya Bhausan Majumder and *Uttaradhikar* (1980) of Samaresh Majumdar have tangentially touched the role of the rivers in the sociopolitical lives of North

Bengal. Debesh Ray is another notable novelist of present day. His *Tista Parer Brittanta* (1988) is perhaps the most significant contribution to the literary world about the description of marginalized people of Postcolonial South Asian countries. This novel is based on the social lives and socio-political assertion of indigenous communities of North Bengal. River *Tista*, here is symbiotic with the local communities including their cultural life. There are few more Bengali novels written on the rivers and the people on the riverbanks such as- *Padma* (1342) and *Kopabati* (1941) of Pramatha Nath Bishi, *Padma Pramatta Nadi* (1346) of Subodh Basu, *Icchamati* (1356) of Bibhuti Bhushan Bandopadhyay, *Antarjali Jatra* (1369) of Kamal Kumar Majumder, *Jalangi* (1974) of shoukat Osman, *Jal Jangal* (1358) of Manoj Basu, etc. These novels although highlighted different aspects of village communities of the river basin, conceptualized the process of social change and have raised certain fundamental questions but the lives of the traditional fishermen has not been properly manifested. Even there was no Bengali novel on the fishermen and the boatmen before the publication of the *Padma Nadir Majhi* (1936) of Manik Bandopadhyay.

Manik Bandopadhyay has depicted the eventful life of the fishermen and boatmen of the bank of the river Padma in his book *Padma Nadir Majhi*. The hero of the novel named Kuber and his fellow fishermen were completely dependent to the availability of fishes. But the general fishermen were not the controller of the fishing activities. Even they did not have their own boats and nets. They worked as 'water labourer' in the boats supplied by the middlemen/traders/ moneylenders. On the other hand some fishermen had their own boats and nets who had comparatively better economic status than the 'water labourer'. Dhananjay and Jagat are two characters of this novel who represent the second category of fishermen. But the fishermen as a whole were dependent to the whims of the nature. In the natural calamity they lost everything including their boats and nets and took loan from the moneylender. It made them, dependent to the moneylenders. They never get release from the oppression of the exorbitant rate of interest of loans taken from the moneylenders. The *Padma Nadir Majhi* portrayed the best-romanticized image of the traditional fishermen and boatmen of Eastern Bengal.

Samaresh Basu has described the lives of fishermen and their various art of fishing in the big rivers and in the sea in his book *Ganga*. Central character of this

novel named Bilas was although hailed from a particular fishing caste called Malo but all the traditional fishermen castes of Bengal including the Kaibartyas, Poundras, Rajbanshis, Nikaries, Chunaries etc. had their equal mentioning in this novel. The traditional fishermen of 24 Pgs(North and South), their mode of fishing, marketing and exploitation by the *mahajans* have been critically examined by Samaresh Basu.

Adwaita Malla Barman has played the suprime role regarding the life of the fishermen in his book *Titas Ekti Nadir Naam*. It is an exceptional type of novel as the author himself was a man of same profession about whom he left his observations. Here we find the life of the Malo community, a primary fishing caste of Bengal of the basin of the *Titas.* The *Titas* is the symbol of prosperity to the Malos. But when the river dried up the fishermen lost their traditional livelihood of fishing and the land wake up from the riverbed became the possession of the peasants who had better economic status. This novel portrayed the true picture of the fishermen. The *Char Kasem* (1356) of Amarendra Ghosh is another novel on the fishermen of the *Padma* river. Struggle of the fishermen in the silt bed of the *Padma* has been reflected in this novel. *Ilish Marir Char* (1368) of Abdul Jabbar and *Padmar Palidvip* (1986) of Abu Ishak are also based on the traditional fishermen. The novelist image, however, is not beyond the scope of examination as history is now a day is a distinct science to construct the nature of the society. So in this work I tried to make a general idea about the fishermen communities, their socio-economic status and fishing technology of West Bengal and Japan.

Harishankar Jaldas pointed out the economy, social, political and religious aspect of the Fishermen's life but he did not touch fishing technology with emphasis in his novel 'Jal putra'. Bikash Roy choudhury proceeded in the same way though he slightly touched modern technology in fishing, in his book 'Moon and the Net'. Rupkumar Barman has discussed elaborately a socio Economic History of fisheries and Fishermen of colonial Bengal and post-colonial West Bengal but modern technology in fishing has not been illuminated up to the expectation. Subhas Chandra Sen has written much about Technique and technology in the age-old fish industry of Bengal and the colonial state in his essays but comparative study with Japanese fishing technology has not been flushed.

4. Research Questions

Economy of West Bengal is largely depended on fish trade and commerce beside food grain production and distribution. Agricultural land and agro based products that is rice, wheat jute etc. occupy our main share of economy, that too is narrowed now by the thin margin since cultivators depending on Agricultural land are now using their lands to culture fishes. Agricultural products today are not getting adequate marketing facilities. This is all not at all profiteering business now. Cost of production is getting higher and higher day by day. Marginal cost of production and market price are miserably fluctuating and creating misery to the producers. So many cultivators have been forced to commit suicide in the meantime. Trade and commerce on fish is now quite profitable, its demand is also very high from traditional stand point of agro-based economy's importance is shifted to pisciculture from age worn habit of self-complacency on exclusive food production. In the age of the globalization if advanced named technology is obtained from Japan the poor people of the eastern part of Asia can do remarkable progress in this industry.

5. Research Strategy

There are seven chapters in the proposed research work.

I. Geomorphological condition of West Bengal

Geophysical features of a region are sole determinant in the atmospheric coordinates of its habitats, culture and civilization. Henry Thomas Buckle's *History of Civilization* prepared in the early phase of 19th century England clearly speaks for anthropomorphic condition that develops in any part of the globe solely rests on geophysical condition. As the time advances further research works discovers strong contribution between genetic developments and nature. It can well be observed in the physical factors of West Bengal.

II. Economic Viability of Pisciculture.

Fishing is one of the oldest occupations of mankind. Pisciculture is supportive of .Agriculture. Next to agriculture fishing is the only important source of human food. It is not surprising because in India Bengal holds the paramount position in the fresh-water fisheries. Thus, the through the ages fish has been dominant in the Bengalis economy, religion and cultural symbolism. Though in the social and cultural life of

Bengal fish as food and fishing as a profession was an attractive subject of study in the modern history of India.

III. Habitats and ethnic varieties of the fishermen

Bangas the Bengalese highly skilled in pisciculture and agriculture etc. are the main habitat of this area. Working force here constitute mainly on the toils of labourers, landless labourers, fishermen and women. Muslims, Christians are there but Bangahindus are majority population here. They know the art of fishing and preserving methods. Social structure of this people are based on rural economic feasibilities.

IV. Trade, Stocks and Markets: of fishes in this Region

The Fishermen in Bengal experienced with the networks of the market economy. It is evident from Francis Buchanan Hamilton's report that the fishermen were then more directly linked with the market economy. They could control fish production and determine its market price. The problem of perishability of fish they would overcome by drying and curing and salting it by the application of their indigenous methods of technology. Bengals dried fish had lucrative demand -in Bhutan, Nepal, Garohill areas, Burma and even in Britain for consumption and use for medicine and manure in Cultivation. The beginning of the 20th century the demand side stimulated the expansion of fish trade.

V. Labourers and Brokers

Fishing is largely dependent on fishermen, labourers and brokers. There were 33 fishing castes engaged in such a specialised occupation. They were distributed throughout the districts of Bengal. There were different categories of fishermen in Bengal in terms of their possession to the capital goods of fishing. The aratdars and the nikaries were also the fishermen of the first category. Second category of fishermen who did not have nets and boats of their own and generally work as share fishers in the boats of fishermen of first category. The third category comprised with the fish retailers generally called paikar.

VI. Fishing Technology and its transfer

The village production system of catching fishes and pisciculture is mainly dependent on the physical labour yet; it needs skill, experience and techniques. The

fishermen earned these qualities from the environment. Nets and boats are main equipments for production. There were hundred kinds of nets. These were divided into five groups- a) Seine Net b) Drag and Trawl Net c) Bag Net d) Drift and Gill Net e) Cast Net. Locally called gillnets like Kona, Sangla and Chhandi nets were used for catching Hilsa fish. Different equipments i.e., Electronics plays a significant role in modern fishing Industry. The commonly used electronic instruments in fishing are the fish detecting devices, namely the echo sounder, sonar and net sonde. Recently the Japanese have set "Sono-buyos" in pound nets to carry by wireless to considerable distances news of the catch its kind and quantity by transmitting the underwater noise made by the fish.

VII. Comparative study with Japanese fishing technology

Japan is a strato-volcanic archipelago of 6,852 islands and it plays a leading role in global fisheries. The fishing technology of this country has developed for producing more fish catch. The techniques in fishing, gears, crafts and methods, market and trends will be compared with West Bengal's fishing techniques, gears, crafts and methods, market and trends to understand and report in enhancing the sustainable the fish production for Bengal fishermen livelihood.

Conclusion

It can be said that in the age of globalisation, fishing is an industry where the aboriginal technology of fish catching existed strongly side by side with modern scientific technology. There should be a mixture of indigenous technique of fishing with that of modern technology which is the only possible solution of the problems.

CHAPTER -I

Geomorphological condition of West Bengal

1. Three relief regions of West Bengal and its nature of climate

West Bengal, part of the undivided greater Bengal is most distinguished provincial state of India with physical diversity. It has an area of only 88752 sq. Km. it has latitudinal and longitudinal position (23º north and 87º East). Though West Bengal is not a very large state of India, a variety of land forms are there in the state. To the north lies the majestic Himalayas, to the south west lies the eroded old plateau. In the centre and to the south extensive plains are present until the waters of the Bay of Bengal lap the shores in the south.[1] According to this variation in topography, mainly three relief regions are found in West Bengal: i) Mountain region in the north ii) Plateau region in the west and the iii) Plain region.[2] (Fig. 1)

i) Mountain Region in the North

This region includes nearly the whole of Darjeeling district that is the sub-divisions of Darjeeling, Kalimpong and Kurseong and the northern parts of Jalpaiguri district.

The Himalayas extending in an east west direction to the north of west Bengal enters Darjeeling in two branches- singalila range in the north and Donkia range in the south. The singalila range runs along the border of Nepal Darjeeling. In the Darjeeling district the singalila range has three highpeaks- sandakphu (3630m) phalut (3596m) and sabargram(3543m). From the singalila range extends the Takdah Mountains to the east of Darjeeling Town. To the south lies Dowhill and to the west the Ghoom Mountains. The highest peak of the Eastern Himalayas is Kanchanjunga (8597m) lying on the Sikkim Nepal border, can be seen from Darjeeling town (2325m). To the south of Darjeeling lies Tigerhill (2600m) from where the highest peak in the world, Mount Everest (8848m) can be seen. It lies along the Nepal- china border. The hills in the Jalpaiguri districts are

lower. They are found in the Buxar and Jayanti areas. The highest mountain here is Sinchula, with the highest peak Raniganga nearly (2000m).[3]

ii) Plateau Region in the West

This region includes the entire district of Purulia and the western parts of Medinipur, Bankura, Burdwan and Birbhum districts.

The entire region is an extension of the Chota Nagpur plateau in Bihar. According to age it is the oldest region or landform in West Bengal. The region is characterised by irregular land, rocky and stony plateaus with a few small hills. The entire region slopes down in steps towards the east and south east.

The western part of Purulia district between the Kangsabati and Subarnarekha rivers lies the highest part of the plateau the Ajodhya hills and its highest peak Gorgaburu (677m). The Bagmundi hills are also located here. To the north east lies the Panchet hills (643m). The western part of Bankura district also has some hills like the susunia hills (440m), to the north-west. It is covered by dense forests. To the north east lies Biharinath hills (624m). The western part of Burdwan and Birbhum districts also has some high mounds or tilla.[4] The western part of the Medinipur district is undulating.

iii) Plain region

This region extends from the south of the northern mountain region in the north to the coastal plains of the Bay of Bengal in the south, and the eastern part of the plateau region in the west to Bangladesh in the east. The entire plain region can be divided into 6 small divisions:- a) Tarai region b) Northern plain region c) Rahr region d) Ganga delta region e) Sundarban region f) Sandy coastal plains of Medinipur region.

a) Tarai region

It includes the southern part of Darjeeling district and the entire Jalpaiguri district except a small part in the north.

Tarai is a French word that means damp and wet soil or land. The Himalayan Rivers carry snow melt waters, rain water, large boulders, rocks, sand etc. which they deposit at the foot of the mountains. The entire region slopes from the north to the south with the slope being steeper to the north while to the south it gradually becomes gentle.

Irregular deposits of large stones, pebbles rocks etc form mounds and adjacent to them are marshy lands. At many areas plains have been formed by the rocks, sands and stones deposited by the rivers. The abundance of water and lowlands formed is covered by dense forests and the land is therefore damp.

b) Plain region

The region between the Ganga River in the south and Tarai region in the north forms the northern plain region. The region includes the entire districts of Cooch Bihar, north and South Dinajpur and Malda.

The plains in the Cooch Bihar district are slightly undulating but there are few high lands. The region has been formed by the deposits of sand and silt carried by the Tista, Torsa and Mahananda River. To the east of the Mahananda River that is the eastern part of the Malda district is formed of old alluvium. This part is called Barendrabhumi or Barenland. All the 4 districts slope from the north to the south.

c) Rahr Region

The rahr region includes i) The eastern part of Birbhum, Burdwan and Bankura districts ii) Most parts of Howrah and Hooghly districts iii) Western parts of Murshidabad district iv) The Medinipur district except the southern coastal plains and v) The western plateau.

This region is formed of old alluvium and slopes from the west to the east. Most of the region is covered by red soil. Near the bank of the Bhagirathi River in Murshidabad district there are some tillas of red soil. The Howrah, Hooghly and Burdwan districts and adjacent areas of the Hooghly River have extensive areas covered by lowland.[5]

d) Ganga Delta Region

The entire Nadia district, North and south 24 parganas except the Sundarban region and the eastern parts of Howrah, Hooghly and Murshidabad districts form this region.

The delta has been formed by the silt deposited by the Hooghly, Bhagirathi, Jalangi, Ichhamati, Damodar, Rupnarayan rivers etc. at some places the depth of silt deposited is more than 1000 ft. the Ganga delta region extends from Dhulian in Murshidabad district

in the north to the coast of the Bay of Bengal in the south. The delta has 3 parts i) dead ii) mature and iii) active parts. The active part is included in the Sundarban region. The dead delta comprises the northern part of North 24 Parganas, Nadia, Murshidabad, Howrah and Hooghly districts are eastern parts. In this part of the dead delta the silt is deposited by Bhagirathi, Hooghly, Jalangi, Ichhamati, Bhairav, churni rivers etc. And no more changes in the land form are lightly to occur. Thus this part is called the dead delta. Calcutta and the central part of south 24 Parganas form the matured part. In this part deposition of silt is still causing some changes in the land form. There are many beels and marshlands in the region. The wetlands to the east of Calcutta and the salt lakes are the marshlands. The entire delta slopes from the north to the south.[6]

e) Sundarban Region

The southern parts of north and south 24 parganas form the Sundarban Region. Very dense forests cover this region. Sundari is a type of tree extensively found in the forest so it is called Sundarbans.

The sundarbans form the active part of the Ganga delta. The delta formation activity is still going on in the sundarbans. Various creeks or Kharis allow the salt water from the Bay of Bengal to enter the region specially during high tides. Most of the areas have saline soil. Some areas have low marshes. The average elevation of the region is low, 3-7 metres. Continuous deposition of silt in the Sundarbans have formed many deltas in the region. The new moore or Purbasa Island is one such new island.

f) Sandy coastal Region of Medinipur

The south eastern part of the Medinipur district forms a sandy coastal plain of the Bay of Bengal. The northern boundary of this region is formed by the Hijlikhal or Orissa canal.

The south – eastern part of the Medinipur district forms a level plain, adjacent to the shores of Bay of Bengal, marine influence has caused this plain to be mainly formed of sand. There are many sand dunes lying parallel to the shore, that is extending in an east – west direction. These dunes are nearly 10 -15 metres in elevation. At many places between the sand dunes water has accumulated to form marshlands.[7]

Fig. 1 : West Bengal Physical Map

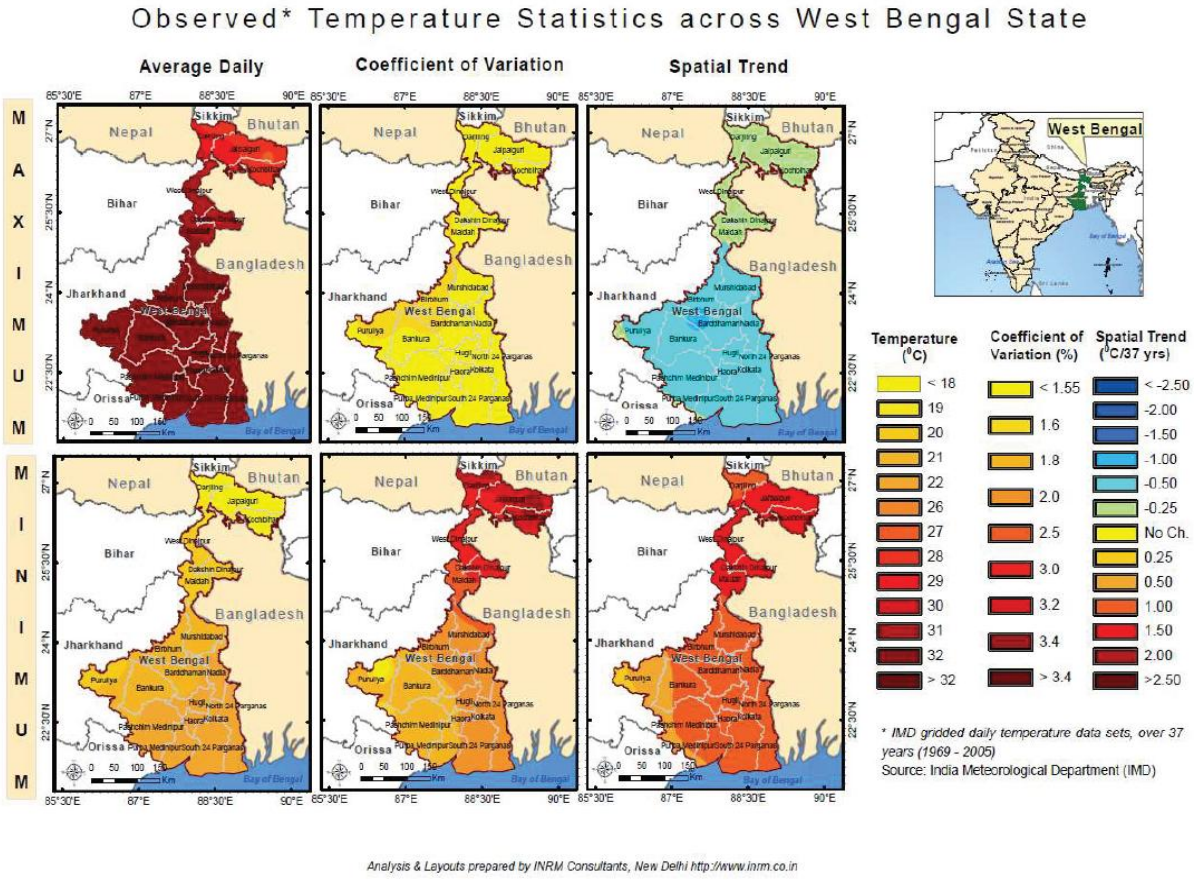


Fig. 2 : Temperature statistics of West Bengal

Nature of Climate in West Bengal

The climate of West Bengal is hot and humid type. Here the summers receive maximum rainfall and the winters are dry. This type of climate is called Tropical Monsoon climate. (Fig. 2) The Tropic of cancer (23 ½ º N latitude) extends over the districts of Purulia, Bankura, Burdwan and Nadia. The region lying to the south of this latitude is comparatively warmer.[8]

Seasons

Summer, monsoon, autumn, late autumn, winter and spring- are the six seasons that occur, but late autumn and spring seasons are not distinct, therefore only 4 seasons are actually felt-summer, monsoon, autumn and winter. These four seasons occur in a cycle in a year in West Bengal. The climate is greatly influenced by the moist S.W. monsoon winds and the dry & cold N.E. Monsoon winds. The meteorological department of the Govt. of India also divides the climate of West Bengal into 4 successive seasons, on observation of the speed and nature of the 2 monsoon winds,[9] The seasons are

Si.No.	Name of season	Months	Number of Months
1.	Summer	March –May	Three months
2.	Monsoon	June – September	Four months
3.	Autumn	October-November	Two months
4.	Winter	December – February	Three months

Summer

During this time the apparent north ward movement of the vertical rays of the Sun from the Equator to the Tropic of Cancer (that is 0º-23½º N) increases the temperature over West Bengal during April-May the heat is maximum. Then day temperatures rise to nearly 40º C it is more at Asansol, 45º C nearly as it lies on the plateau. In Darjiling the temperatures are lower (180º C) as its elevation is high. The hot dry winds blowing from the west over the western plateau region in summer is called “Loo”. Amount of rainfall is less, mainly received as storms in the Indian months of chaitra- Baisakh, so it is called “Kalbaisakhi” storms. During their storms rainfall and lightening also occurs,[10] (Fig. 3)

Monsoon season

Succeeding the extreme heat of the summers is the monsoons within 15th June the moist South- West Monsoon winds arrive over west Bengal from the Indian Ocean. As these winds blow over the water bodies of the Indian Ocean, Arabian Sea and Bay of Bengal, they pick up lots of moisture & cause heavy rainfall at the Himalayan foothills, as these mountains block these winds, force them to rise and give rainfall. The average annual rainfall over the whole state is nearly 175 cm, of which 125 cm of rainfall occurs in the S.W. Monsoon season.[11] In the mountain areas in the North maximum rainfall occurs 300-400 cm least rainfall occurs in the plateau region in the west, less than 120cm. the average rainfall over the Sundarbans is 160-200cm. (Fig. 4)

Autumn

This is also called the season of Retreating Monsoon as the S.W. monsoon winds return from this region to the Sea. Instead of thick clouds covering the sky, patches of clouds are seen in the sky. So rainfall decreases and temperature increases, sudden storms occur specially near the coastal regions. These cyclones are also called "Aswin Storms" as they occur during the Indian month of aswin.[12]

Winter

During winter cold and dry North- East monsoon winds blow over West Bengal from the North East. The Temperatures fall due to these cold winds, being 25º C on average. Maritime influence causes the temperature to be higher over Southern Medinipur compared to the North and South 24 Parganas districts. In the mountain region of Darjeeling district it is very cold with snowfall occurring some time. Sometimes the calm weather is disturbed by moist and cold winds coming from the west which causes some rainfall. It is called the western disturbances.[13]

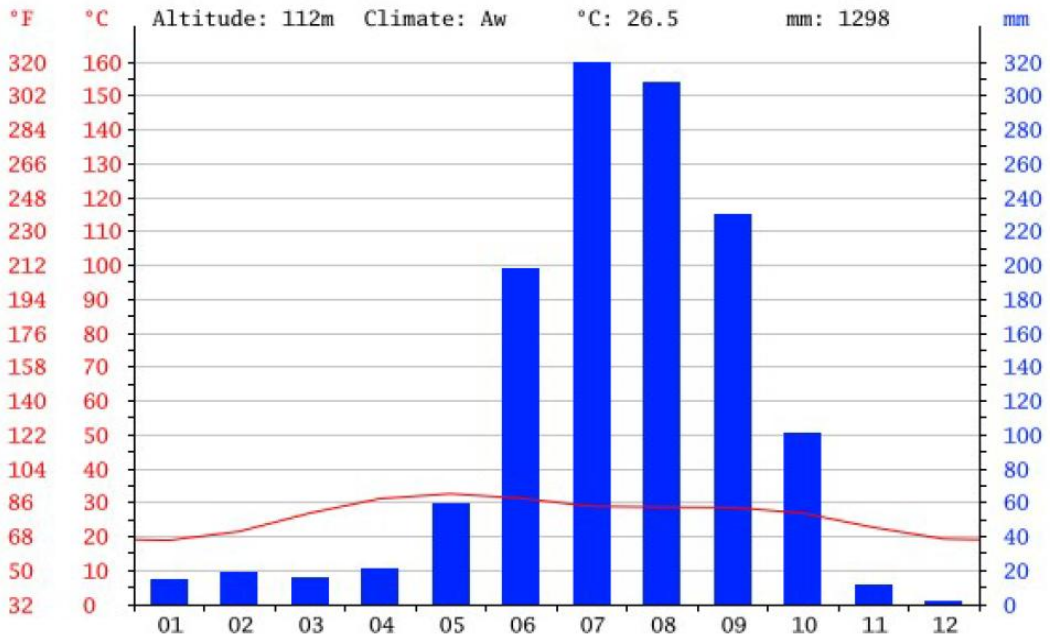


Fig. 3 : Temperature and Rainfall Statistics Graph

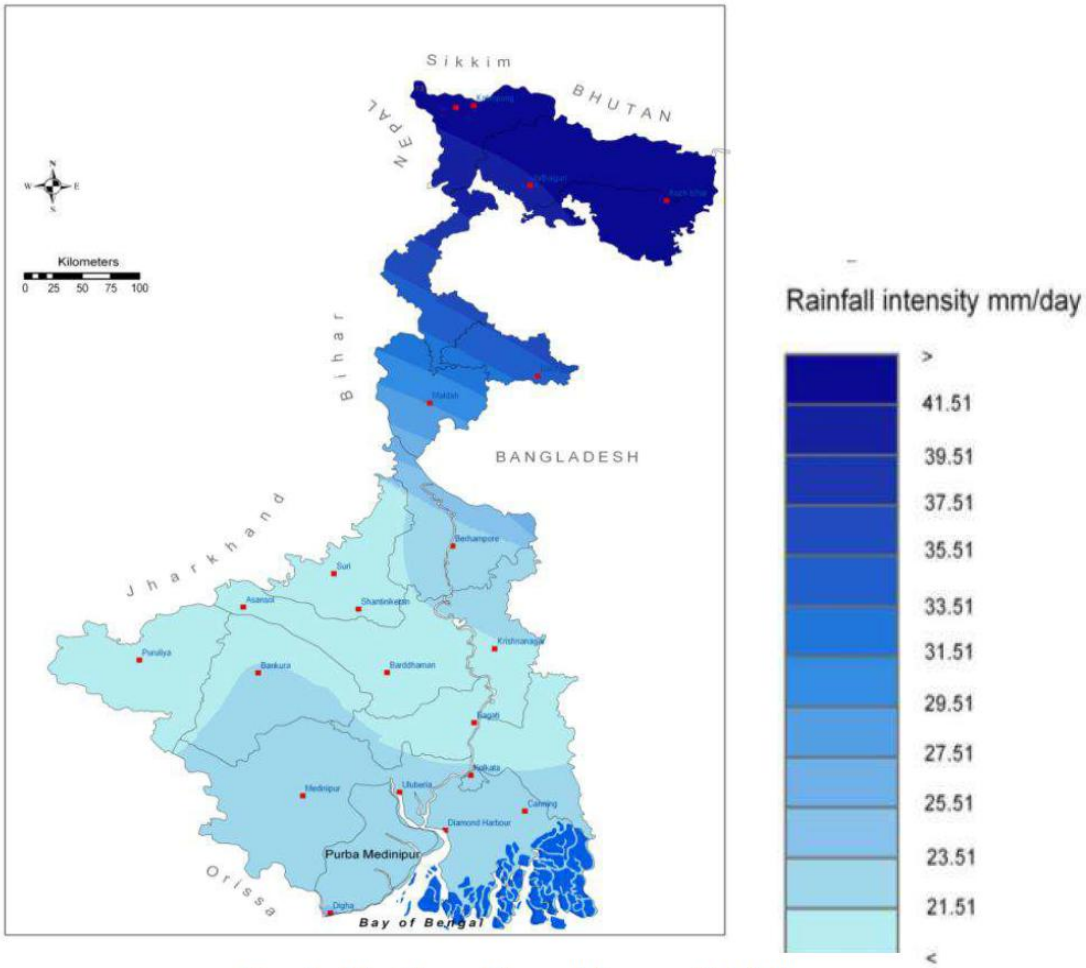


Fig. 4 : West Bengal Annual Average Rainfall

Climatic Regions

With only 3ºC (37.4ºF) difference in winter temperatures between north and south of west Bengal, there is very little climatic differences between northern and southern area. The tropical subtropical divide is not at all well marked. Trewartha's caw/Am is preferable to koppen′s cwg/Aw as being more representative of the climate, especially since the 'g' characteristic is not found in North Bengal. Because this work is on a micro level further climatic regions based on micro difference have been given.[14]

Humid subtropical (Caw-Trewartha) Region I

It extends over the Himalayan tract with its temperate characteristics, the coldest month having 10ºC (50ºF) mean temperature at 4,000 feet altitude. Since large sections extend above this altitude, means of 6ºC (24.8ºF) are not uncommon. August is the hottest month. Annual ranges are more than diurnal ranges. Rainfall is copious-3,060 mm (120.5 inches) and winters are drier than that of Region II. Nor′westers rarely occur, though some summer rain is associated with orography. This region is dominated by the westerly jet stream in winter and early summer and is at the southern rim of the mid-troposphoric high in the wet seasons.

Region II

This region markedly differs from region I in a) The temperatures are higher by 120º C (53.6ºF) in all seasons, b) Nor′westers are frequent**,** c) diurnal range of temperature exceeds annual temperature range, d) winter mean temperature is 17.6ºC (63.6ºF) a marginal temperature for sub-tropical climate, e) relative humidity is more than that of region I. The climate could be termed tropical for world classifications. However, at a micro-level the subtropical/ tropical divide has been maintained. This area is a source region of many Nor′westers rainfall copious 3,329 mm (130.7 inches). The area is occasionally under the influence of upper air western disturbances. In winter the westerly jet stream is at the 150 mb. Level and in summer broad easterly winds are found at higher level.

Humid Tropical climate (An-Trewartha) Region III

The temperature of this region differ from that of region II by an average of 5ºC (41ºF) in summer and 3ºC (37.4ºF) in winter. There is maritime influence in both the absolute and ranges. Both Nor′wester and annual rainfall is about 50% of the farmer. The incidence of upper western disturbance is much less and the area is subject to large number of easterly jet lets in summer.

Region IV

This area has more continental characteristics, summer temperature is higher by 3ºC (37.4ºF) and winter temperature is lower. There is much less frequency of Nor′westers and both annual and summer rainfall is markedly less. Diurnal ranges are also higher than that of Region III and relative humidity about 10% less. This area has the climatic characteristic of Bihar, rather than that of West Bengal.[15]

Mountain Climate in West Bengal

Generally the climate of West Bengal is hot and humid but the climate types over the mountainous region of Darjeeling & Jalpaiguri districts are slightly different. In summer when everywhere in West Bengal it is very hot in the Darjeeling and Jalpaiguri districts due to the high elevation of the mountains the climate is cool & very pleasant. In summer when at Kolkata the highest temperature is nearly 35ºC at Asansol it is nearly 45ºC at Darjeeling it is nearly 17º C.

In winter when the lowest temperature over Kolkata is 10ºC and over Asansol it is 8ºC, in Darjeeling it is nearly 2ºC or less. Thus in the mountain region of Darjeeling it is extremely cold, coldest in West Bengal.In the monsoon season though sufficient rainfall occurs over West Bengal in the North over the mountain region rainfall is very heavy, nearly 400 cm.

The mountain region in Darjeeling district has a very pleasant climate in summer. This climate attracts not only the people from the hot areas in the South but many foreigners also arrive in Darjeeling to tour the region. Darjeeling, Kurseong, Mirik, Sandakphu etc are very attractive to tourists.[16]

Highest excellence of climate is absent in both 24 parganas (specially Sundarbans).Though it stands near the tropic of cancer, because of its location towards the immediate nearness of the sea and flushing of innumerable tidal creeks and rivers. The climate is found to be salutary (Healthy). A typical heavy monsoon with excess humidity is found almost half of the year.[17] Summer stay from the middle of March to middle of June. In February the temperature begins to rise, the mean for the month being 69º. The mean maximum temperature is 96º in April, and there is a decline of 1º in May. Night temperature increases slowly, and the highest monthly average is not reached till June and continue up to September and October. The south-west wind brings monsoon in this area.

Intermittent rain is found throughout the year in May monsoon weather is occasionally experienced when cyclone storms occur near the head of the Bay of Bengal. These storms bring heavy rainfall and the average consequently rises from 1½ inches in April and 5½ inches in May. In some years the fall is far heavier with the commencement of the south west monsoon which generally occurs in the later half of June, but sometimes is deferred till the beginning of July, humidity increases to 90 percent of Saturation, while heavy cloud is continuous and rainfall of daily occurrence. The average rainfall is 11 inches in June, 13 inches in July and August and 10 inches in September. The mean temperature slowly diminishes from 85º in June to 80º in October. During the later half of September and throughout October cloudy weather alternates with bright sunshine, the bright periods lengthening until they merge into the continuous fine weather of the cold season.

The cyclonic storm occasionally touches the area accompanied with high waves and tides from mid October to November, and it causes sometime disaster. The severe cyclones of the transition periods in may and later in October and November, sometimes enter the north west angle of the Bay of Bengal, in which case they move north wards into south west Bengal. The danger arises when a storm wave occurs in combination with a high tide, as happened in the historic cyclone of 5th October 1864. During the cold weather from November to January, there is an almost entire absence of cloud and rainfall.[18] The mean temperature falls from 72º in November to 65º in December and January, but humidity continues high. A feature of the cold season is the occasional

occurrence of low lying fogs which dissipate with the rising sun. Temperature gradually begins to rise in the month of February. A mid such unfavourable conditions the climate is of course very unhealthy. The ground is never dry except for the two or three months of the hot season.

2. Floral and Faunal diversity of West Bengal and its nature of soil

Forest of West Bengal

Natural vegetation is the combined result of climatic soil and biotic factors. Of these, the most important is the climatic factor, which comprises temperature and moisture and their combination and seasonal variation. Provided, adequate moisture is available, Temperature shows itself in the luxuriant growth of the forests big and small trees, shrubs, climbers, parasites etc. in height, density variety of species and rate of growth areas having rainfall of 200 cm and over contain evergreen rain forests while monsoon deciduous forests are found in areas with rainfall between 100 cms and 200 cms. In areas with 50 cms to 100 cms tropical savanna predominate, while drythorny forests occur in areas with less than 50cms. The conifers reach their best development in temperate climate where they surpass the broad- leaved species which grow best in tropical climate. At higher elevation with increasing cold, winter deciduous type becomes more prominent and further higher up vegetation degenerates into scrub with evergreen hard leaved species like rhododendrons. It less favourable moisture conditions are found the vegetation gets stunted, sparse and consists of few species, most of which are summer deciduous and have other xerophytic adaptations such as partial or complete absence of leaves, small size of leaves, thick barks, water storing cells, hair on stalk and other parts of the plants and secretory organs which exude salts and other secretions for the protection and survival of the plants.[19] (Fig. 5)

Here we see different types of forest which was based on rainfall, temperature and altitude. It must however be noted that there is a certain amount of mixture and over lapping of one type or the other both in the plains and the hills. In West Bengal Tropical moist deciduous forests are found such forests occur in areas with moderate or low annual rainfall of 100 cms to 150 cms, the mean annual temperature of 26ºC to 27ºC and humidity percentage of 60 to 80. The trees shed their leaves during spring and early

summer when the storage of water is more acute. Sub-soil water is not enough to allow the trees to keep their leaves all the year round. These forests are the most important forests yielding commercial timbers and various other produces of high value. The common trees of such forests are :- Sal teak, Arjun, Jarul, Laurel, Andaman Paduk, Ebony, Mulberry kusum, Kanju, Ber, Gular, Lendi, Siris haldu, Palas, Mahua, Simul, Har, Sandalwood, Bijasal, Dhaman, Amla and Jamun etc. Such forests occupy a bigger area than the evergreen forests. Most of these forests have been cleared from level land for cultivation.[20]

We see another important forests that is littoral or swamp forests. These forests occur in and around the tidal creeks and in the river deltas in spite of saline water, rise and fall of tides and deep accumulation of mud. These forests are found in the thickets on the western coast at a few places but on the eastern coast they form a fairly continuous fringe along the deltas of the Ganga, the Mahanadi, Godavari, Krishna and Cauvery- they are found in their densest form in the Sundarbans in the Ganga delta, where the predominant specie, the Heritiera (Sundri) occurs. Mainly evergreen species of varying density and height always associated with wetness, trunks supported by a number of stilt like roots which are sub merged under water and profuse growth with tangle of climbers are the main features of these forests. The important trees that are found here are:- Keora, Amur, Bhara, Rhizophora, Sonneratia, Screw pines, Canes and Palms, Nipa, Bruguiera, Sundri, and Agar etc.[21]

The flora of Sundarban is quite different from other parts of the district. In some places there are treees of 30 or 35 feet high the few attain any considerable girth. This seems to be the result of the closeness with which they grew and the poverty of the soil which is impregnated with salt. But when a tree can get room enough to grow freely, it will attain a much greater size. The deposits of enormous silt carried down by number of Sundarban rivers in the deltaic region provides the most favourable Condition for the growth of crops and thick vegetation.[22] The silt deposits, winds Birds, and animals also carried various types of grass seeds and other vegetations, from one place to another, various macro and micro fauna prepared the base and provided useful nutrients for the successive growth of the various plants on the virgin land. So it is simply the process of natural law of dispersal of seeds by various agencies, such as the sea, river, winds,

animals and lately also by human being. salinity, sandy soil, weather hazards, cyclones, floods all these obstruction had challenged the very survival and growth of each and every species, so struggle for existence with the alien environment began and diversity in plant species arose. The early condition of sundarbans stratum was most favourable for grasses and seeds to stick to the loamy soil. In newly formed islands where Dhani grass, Baruna grass, hargocha, Beam, Keora and Khalshi, flourished.[23]

The mangrove can be referred to as community of trees and shrubs, which grow in the particular inter tidal ecosystem of the tropics. The mangrove community (mangle trees) of course occupies the major portion of sundarbans and it must also be noted that the Gangetic delta of the lower Bengal supports the most extensive largest mangrove area of the world. Out of the fifty mangrove species of the world as many as thirty five more are found in Sundarban alone. The trees or shrubs which grow by the seaside are generally grown in the salinity of water, is called "mangle" species of this "mangle" is known as "mangrove". Of course mangroves have been found to exist in the areas of low rainfall, of low humidity.[24] The origin of a mangrove forest can be a single seedling which terminates while the fruit still remains attached to the tree and before separating from the parent tree it develops a long radicle. When fully developed this radicle falls down separated from the tree on the mud below by its own weight and fixes itself. Once rooted the mangrove seedlings has been observed to grow an inch an hour and bear fruit when four feet high.[25] The black mangrove develops special roots which instead of going down and spreading under the soil, rise from the soil with their tips out into the air. These aerial roots are provided with a seaborn bark full of groups of air holes, called lenticels through which the roots are aerated. Such roots are therefore known as breathing roots. These cable roots also provide food to the growing plant, give necessary anchorage for the trees so that they are not uprooted and can withstand the cyclonic weather and soil erosion and send offshoot upwards along with the anchoring roots downwards.[26] Mangroves are usually heavily populated beneath by the Snails, Crabs, and other marine species. 24 parganas has two types of forests- Salt Water Heritiera Forest and low mangrove. The Gnewa, Passur, Dhundul and Sundari all belong to the former group and is known as Black Mangrove while the latter group has composition similar to the first but the height of crop is much lower, Golpatta in almost absent while Red mangroves

which have no breathing roots are more common. The Sundari, Passur, Keora, Ora, Gnewa, Garan, Garjan, Hental, Singra, Bain, Amur, Dal Karamcha, are the principal trees of Sundarbans.[27] In addition to all these trees there are number of herbs, Shrubs and Creepers such as Tora, Bhautraj, Hargocha, Keya, Oradhan, Kasha, Tulatepari, Bet, Gilelata, Gub, Banjhau, Baolita, Jhau, Kankra, Kenkti, Lonakaera, Babla, Akashmani, Subabul, Debdaru etc.[28] Reclamation and Consequent human Settlement through centuries of remote past is also responsible for introducing several plant species in Sundarbans. Economic necessity is the primary cause for introduction of useful plants but inadvertently also several herbs, shrubs and trees were brought in Sundarbans.[29] (Fig. 6)

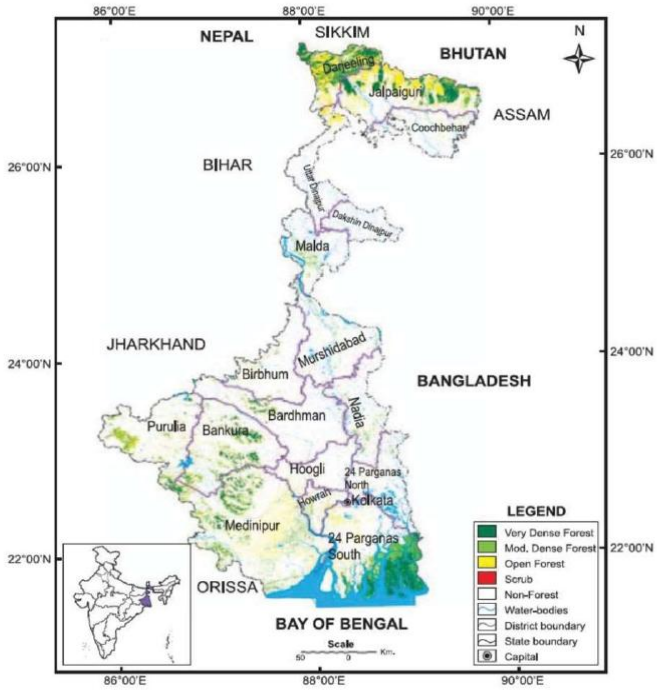


Fig 5. : Forest Map of West Bengal

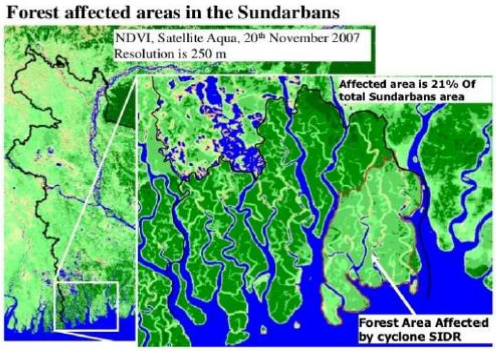


Fig 6. : Forest affected Areas of Sundarban

Fig. 7 : Life of Sundarban

North Bengal Forests

Besides owing to a variety of climatic conditions, the Himalaya (North Bengal) are rich in forest resources. On the lower reaches are largely found the tropical and Subtropical forests yielding good timber, while on the middle and upper reaches are found the coniferous and deciduous Soft and hard Woods, yielding wood for match-sticks, paper pulp, resin, turpentine oil and various medicinal herbs, etc.

But unfortunately the means of livelihood in the Northern region are very precarious. The cultivated land is very limited, for want of even land and even this is fragmented. Level land being scarce, the people have developed what is called terraced cultivation on hilly slopes at different levels, especially the western and central portion, while jhuming or Shifting cultivation is practised, both of which system involve strenuous labour. Rice, Madua are the Staple Crops though maize, barley, wheat, potatoes, chillies, tobacco and ginger are also grown in some places of Sikkim and Darjeeling. Opium-poppy is grown in the hilly regions of Assam and the eastern frontier hill areas.[30] Tea has become a major crop in this region. A wide variety of fruits is grown over the region, especially in hill distract and in Assam like- apples, pears, grapes, mulberry, walnut, cherries, peaches, apricot, currants, gooseberry, raspberry and strawberry, Saffron, many types of vegetables, flowers, cucumber and melon etc. In Assam oranges, pineapple and papaya are the most important fruits grown.[31]

T. Dry Deciduous Forests

Coniferous forests cover about 5% of the total forest area. These forests covering the entire Himalayan ranges, Assam and other parts. Some important species are deodar, chir, pine, blue pine, khasi pine and spruce while less important coniferous species are fir. Due to lack of transport facilities, and their inaccessibility these forests have not been fully exploited though they contain valuable species of soft wood.

Tropical Evergreen and Subtropical forests

Such forests flourish in the areas where the annual rainfall exceeds 200cms, and the average annual temperature is about 25^{o}C-27^{o}C, and average annual humidity exceeds

77 percent. Such forests are very dense, and composed of tall and medium- Sized trees and Shrubs, Several-Climbers and epiphytes, different types of bamboos and ferns, all in luxuriant growth they do not shed their leaves annually, at least not altogether. Such forests are found in tarai region, Assam, Khasi, Jointia and Garo-hills.[32]

Tropical dry deciduous forests, Sub- Tropical Broad Leaved Hill Forests, Evergreen forest, monsoon forest and montane wet temperate forests also are found in West Bengal. Indian forests contain over 5000 species of wood, of which about 450 are commercially valuable.

Riparian Forests

These are found along banks of rivers and other wetlands. Deciduous Vegetation like neem, shisham, pipal, mango, jamun, mahua, khair, tamarind, babul are usually found. Where rainfall is less than 50 cms, Short tree vegetation and grass predominate. It dies in hot dry months but bursts into life again during the rainy season. Kans and munj grasses grow in abundance.

Sub-tropical Broad Leaved Hill Forests

These forests are usually found between 915 to 1,830 metres above sea level, where the mean annual temperature is about 18^{o}C to 21^{o}C, mean annual rainfall about 75 cms to 125 cms, and the humidity percentage is 80. These forests occur largely on the lower slopes of the Himalaya in West Bengal and Assam. Trees like teak, sal, rosewood, Indian laurel, Shistram, Garyan, benteak & others. Their importance is too much high. These are luxuriant forests in which evergreen species predominate. Such forests are known as 'Shola' forests in South India.[33]

Montane wet temperate/and montane Moist temperate forests

These forests occur at a height of 1,800-3,000 m. above sea level, in areas where the mean annual temperature is about 11^{o}C to 14^{o}C, and mean annual rainfall is 150cm. to 300 cm. the humidity percentage being 83. These are found in the higher hills of west Bengal. Deodar, Indian chestnut, magnolia, birch, plum, michilus, blue pine, oaks and hemlock are important trees. Montane moist temperate forests are found Darjeeling and

Sikkim between 1,600 to 3,500 metres. Such forests are mainly composed of coniferous species, mostly pure, 30m. to 50m. high with varying under wood mostly evergreen, mosses and ferns grow on trees. The important trees are pine, deodar, Spruce, silverfir, oak, beach, birch, mixed with poplar, elm, rhododendrons, chestnut, maple, etc.[34]

With a view to better exploitation and protection against indiscriminate destruction. The forests have been classified into three sub-categories.

(i)Reserved, (ii) Protected (iii) Unclassed forests and (iv) On the basis of ownership. Reserved and protected forests canstitute the permanent forests which are maintained for the steady supply of timbers and other produce, and for climatic reasons. Therefore, their upkeep and maintenance is well looked after. The unclassed forests are largely open to the public for getting fuel-wood, grazing their cattle and hence are largely degraded and unprofitable economically. In certain parts of the country, there are also found private forests.[35]

The Value of forests is not confined to direct benefits of forest produce, the indirect advantages are of even greater importance. These are: i) The forests are rain holder and a rain banker. Without them the valleys and most of the areas lying around would be an arid waste. ii) The forests aid in checking soil erosion, reduces wind damages. The trees act like a million tiny dams and forests perform the duties of a barrage. iii) Forests have an ethical value. They provide fine scenery and excellent healthy air and thereby attract people as a source of recreation iv) The culture of India gathered strength in the tapovans all over the country where the sages lived and men of all affairs spent their retired lives.[36]

To sum up, the trees have a great place in the economy of nature. They hold up the mountains, the cushion the rain and storm, they discipline the rivers, they control the floods, they maintain the springs, they break the winds, they foster the birds; they keep the air cool and clean; they are the guardians of the perennial springs of water; the are the natural defenders against dust storms; they prevent erosion; they preserve the fertility of soil; they provide the fuel and timber. They make hydro-electric schemes possible and they give us a host of other products.

FAUNA

The fauna of 24 parganas as well as Sundarbans are wide in variety. But some difference is found in the Northern districts of West Bengal. This variety and species have come to a significant point for its strategic advantages of its special physical features which is completely absent in other district. Every species has got their own speciality of nature and food habit due to the changing physiography of this area. And only for this changing physiography of the area have given a unique place to this region in the history from other parts of the country. The circumstances have been created through mixing three important biocycles of sea, fresh water and land come into contact around the margins of the largest delta of the world. The suitable contact among sea, land and fresh water, through estuaries has made the deltaic region, the most fascinating field for ecologist. The surface of the water level and its warmth and suitable proportion of salt water have made the place suitable habitat of different kinds of fauna. Temperature, dense of fresh water and salt water, thickness of trees and bushes and different kind of their fruits has made the place for the existance of all kinds of animals. Some animals like Muddy and sticky substratum which is present here. Others like dense mangrove forest and have taken their alternative suitable habitat. Burrowing animals can easily Tolerate cyclone, tidal waves, climatic hazards by entering within a holes. Some animals take shelter in the bushes, some birds finds save place in the leaves, others like comparatively high place like domes for their shelters while they are in perils.[37] So it can be concluded sea, fresh water and Land contributed most for the habitat of different kinds of Animal. Moreover Animal lives in Sundarbans have been greatly influenced by Salinity of water, Mangrove forest, muddy and subsoil chemistry, tidal fluctuation, temperature and humidity.[38]

So it is almost clear that the animals of Sundarban have adapted themselves with the environment of Sundarban. Tigers drink salt water. They swim in the rivers. Deers like dry terrestrial zone. Mud skipper & burrowing animal know the rhythmic cycle of tides & conduct their movement accordingly. The Sundarban is full of savage wild animals both on the land & in its water. It is very interesting that man-eating tigers, man eating crocodiles, tortoises, fish, turtles, honey bee, sharks & snails live side by side in

their choiceable zone.[39] Tiger, wild pig, chital, Leopard & panther wild Buffalos and Rhinoceros, Mammals, Reptile, Snakes, fish, Birds, insects, deer, fishing cat, civetcat, mangoose, monkey, jackal, buffalo and many kind of Animals are found in the district. No less than 50 species and subspecies of mammals are available in this district. It can be easily said that the diversity of animal life is very vast which cannot be grouped and said to be restricted to their distribution.[40] The faunal wealth of Sundarbans will prove the existence of some endemic species restricted or peculiar to this area only. The fauna associated with the mangrove, their abundance or fluctuation in relation to salinity, temperature, humidity, subsoil chemistry, tidal fluctuation etc. attributed to sundarbans a unique character. The life in Sundarbans is incorporated to these floral and faunal wealth.[41] But nowadays unscientific method of forest resources exploitation coupled with gross ignorance of general public and greed of traders poses a serious threat on the complex food chain and consequent disbalance of animal population which is maintained by natural laws. This sort of disturbances may invite serious impact on the ecological balance as well as in the life of Sundarbans. The inhabitants of Sundarban have been living their lives amidst such innumerable floral and faunal species. Flora and Fauna have naturally left a great influence on their livelihood. Here the work is mainly based on fishing technology, so fish will be more highlighted that other fauna. (Fig. 7)

Fishes are most important among all the group of animal species available in South and North 24 Parganas (specially in Sundarban) because of its abundance, diversity and above all economic importance. They are plentiful and found at all times of the year. The notable fish that are available in the river and river mouth in the 24 parganas (Sundarban area) are as follows: Hilsa, different kinds of Khaira, Gule, Chital, Lotte, Fesha, Pangpata, Amudi, Tangra, Arrtangra, Kanmagur, Pungush, Chenosh, Nihera, Vetki, Varieties of Chanda fish, Bele, Katkoi, Tulbele, Gangbele, Nore-Vola, Lal-Vola, Pairatoli, Ramparse, Parse, Vangan, Topse, Gurjali, Menufish, Patafish, Shole, Boyal, Datne, Bain, Koi, Magur, Selanda, Rekha, Rucha, Chitra, Chuna, Gangtora, Gagra, Patka, Poa, Singi and Puti. The fish less frequently met with are Kharsola, Rohi, Chela, Gutia, Sankach, Kaua-thuti, Mirgal, Kakila, Bamli, Lata topsi or mangofish, Kalibaus, arr and Boyal. From this description it is clear that mainly uncommon fishes to the urban area

and specially the fish other than rohi, Katla, Kalbaus, Arr, Boyal etc. which are more common and abundant in the market are available in a large quantity.[42]

Varieties of shrimps are found in the Sundarban such as : Kuncha chingri, Gora Chingri ,Vusho Chingri, Lona Chingri, Chapra Chingri, Mocha Chingri, Golda Chingri, Bagda Chingri, Chamne Chingri, Lal Chingri, Hanne Chingri, Teko Chingri, Rasna Chingri, phul Chingri etc. Moreover much kind of crabs are found. Min of Bagda Chingri are got in the river from the month of Baishak to Ashar, Tortoise, Shark, Kamat (Shark) and Moroli fish are also available. The Sundarbans fishes are delicious to eat and demand for that in urban as well as village area is increasing heavily so that the supply of fishes to the town is one of the main livelihood of the people of Sundarbans.[43] A curious fish available only in Sundarbans is *Anabas Scandens* or Koee-Hindoostani which is an ugly, voracious little fish about five inches in length mottled brown and yellow. They may be seen on to the mangrove stems by spines arranged along the margin of the gills, three and four feet above the level of the receding tide from which elevated position they drop into the water by scores when disturbed by a boat or a steamer passing or they may be seen floundering about upon the black mud where they lie in hundreds, Sunning their little ugly bodies. They are also known as climbing fishes. The periopthalmus is another ugly little mud fish found in great quantities on all the mud banks in company with the scarlet crab. Fishing also goes largely amongst the creeks of the Sundarbans each days, catch being put into large bamboo cylinders, which when full are towed up to the marts. In addition to fishes, crabs and shrimps are common. Crabs are of several kinds-Such as fiddler Crab, Ghost Crab, Hermit Crab and King Crab. Besides these common crabs another kind of crab is found in Sundarbans. That is known as Horseshoe crab which is very peculiar. It may be called the living fossil of it. It is in the world for long 60 billenium years.[44]

Though it is crab, it has same similarities with the spider and scorpion. This kind of crabs likes to dig mud and eat snails and insects. They know how to swim. Its tail helps to dig the earth. The abundance of various crabs shows that they have wonderfully adopted with the environment of Sundarbans as well with Salinity. Shrimps known as

Mud lobster or patal chingri are available in the coastal forest belt. Good business is done in shrimps which are dried and despatched to Chittagong and Burma.[45]

Sharks are caught in nets for the sale of their fins, with which the Mughs and Arakanese do good business and obtain large profits. Sharks are numerous in the sundarbans, the hammer headed shark, a frightful animal is also occasionally caught off the Sandheads. Sharks are often found in the rivers and estuaries. Kamats are plentiful in the Ichhamati. Tortoises are found in the Hooghly but getting rarer. In Sundarban turtles and tortoises are found on the seashore. They generally lay eggs on the seashore. But this species is going to be extinguished due to the poaching and indiscriminate killing. The olive Rid leys turtle is also a vanishing species because meat of this turtle is very favourite food of the local people.[46] Frogs are also found in number in Sundarbans. Generally they are of white and green colour. Mangrove forest also provides shelter to a number of lizard species. Some toads are being exported to the foreign countries which creates a faunal crisis in this area because of the increase of harmful insects which were usually taken by the toads.[47]

In North Bengal there is many wild beasts like yak, leopard, bear and Sambhar on the West, Panthers and tigers in the central part, elephants, tigers and mithuns on the east. These attract a larger number of hunters and provide good game.[48] The jungle and forests of west Bengal represent more or less the animal world in its totality. The Royal Bengal tiger of the Sundarbans, elephants of northern districts, the great one horned rhinos of Jaldapara and Garumara- thump their feet to set the whole forests to shiver. Besides the rapacious cheetals, the tottering bears, the darting deer, the Sneaking Snakes and other reptiles and many many more species of quadrupeds as well as a few hundred species of birds, Great indian Bustard (Lukna), Great Indian Horn bill, Large Falcon, peacock, Pink headed Duck, white billed sea Eagle, White eared pheasent etc. including seasonal and migrating, have added flying colours to the forest green.

Table 1.1: List of Different Reserve forest of West Bengal and their selective conservative wild life.

Reserve Forest	State	Specific wild life
1. Senchal	Darjeeling	Kakar Harin, (Kakar Deer) Beer (Himalaya), Sheru, Goral etc.
2. Mahananda	Darjeeling	Tiger, elephant, Kakar Deer, Chital Deer, Sambar, Baraha Deer, Baison, Kotra wild pig e.tc.
3. Gorumara	Jalpaiguri	One horned rhinos, elephant Tiger, Kakar Deer, Sambar, Baraha Deer, Baison Wild Pig etc.
4. Jaldapara	Jalpaiguri	Tiger, elephant, one horned rhinos, wild pig, wild Deer, Kakar Deer, Chita, Sambar etc.
5. Chapramari	Jalpaiguri	Elephant, Tiger, Sambar, Kakar Deer, Baison, Baraha Deer etc
6. Lothian Deep	South 24 parganas	Crocodile, Civiet cat (Vhodor), Jackle, Wild Pig, Susuk etc.
7. Halide-Deep	South 24 Parganas	Crocodile, Civiet Cat, Jackale, Wild pig, Tiger, Susuk etc.
8. Sajne Khali	South 24 Parganas	Crocodile, Civiet Cat (Vhodor) wild pig, Susuk etc.
9. Sundarban	South 24 Parganas	Royal Bengal Tiger, Crocodile

Source : Data Compiled by Self

Sanctuary, National Park, and Reserve Forest are the three methods for the conservation of wild life. In West Bengal Parmadan (24 Pargana), Bethuadahari (Nadia), and Ballavpur (Birbhum) is significant for Deerpark, Which Place for the conservation of Deer. Another important is Bird Sanctuary in Pakhiralaya. Bauxa Tiger Sanctuary is situated in Jalpaiguri District.

SOILS OF WEST BENGAL

West Bengal with an area of 88,752 sq. kms. and a population density of about 810 persons per square mile, has two broad climatic regions: - **i) The Himalayan and Sub-Himalayan West Bengal** and **ii) The Gangetic west Bengal.** The variations in the climatic behaviour in each region together with the prevailing variable vegetation provide

enough causative factor for the formation of different kinds of soils observed in West Bengal. In so far as the geology of west Bengal is concerned, the larger portion of it is covered with alluvium. The lateritic region is located in the West and is traced north from Orissa through Midnapur, Burdwan, and Birbhum to the flanks of the Rajmahal hills, where in places it is as much as 200 feet thick. Thick gneiss of the well foliated type, frequently passing into mica Schist, constitutes the greater portion of the Darjeeling Himalayas.[49]

Table 1.2 : Areas of Soil Groups

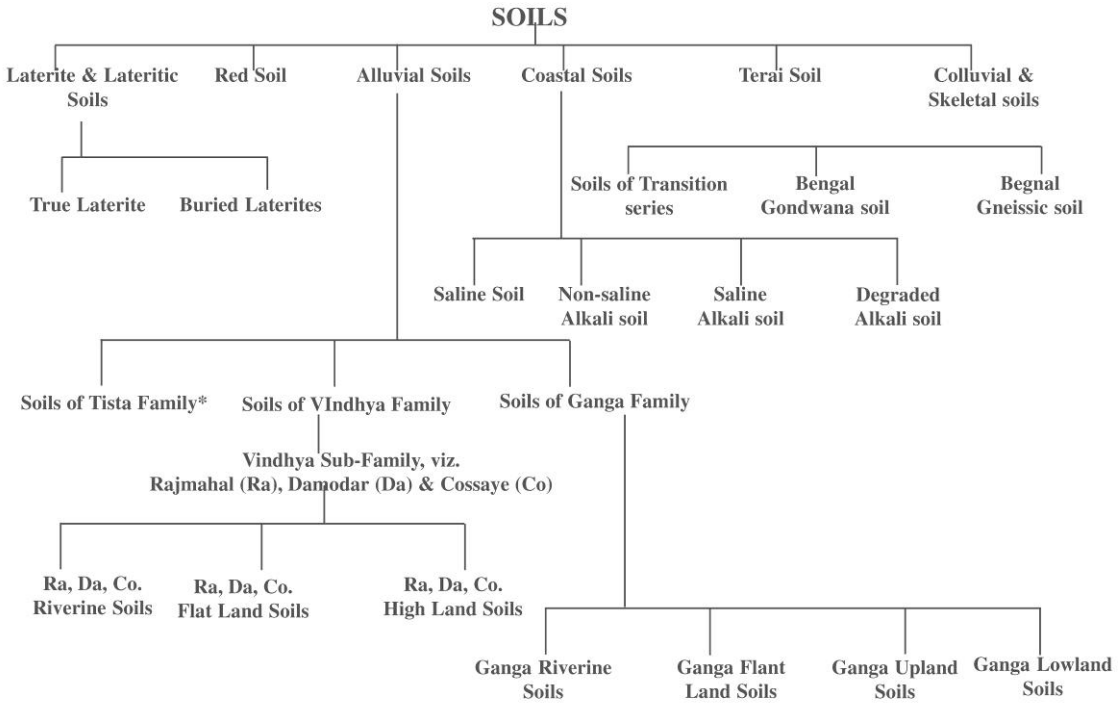
AREAS OF SOIL GROUPS

Soil groups	Areas in acres
1. Laterites	14,72,057
2. Red soils	12,40,864
3. Vindhya family	32,30,543
4. Ganga family	39,92,776
5. Torai and Tista family	16,19,443
6. Saline soils	28,54,256
7. Gravelly soils	32,84,047
8. Brown forest soils	4,85,832

Source: Technical Bulletin, No. 6, 1965, Department of Agriculture, Govt. of West Bengal

Three important soil groups were recognised i) Laterites, ii) red and iii) Alluvium. On the basis of survey the soils have been genetically distinguished into eight groups. They are- i) Laterites ii) Red soils, iii) Vindhya alluvium, iv) Ganga alluvium, v) Terai and Tista soils, vi) Saline soils, vii) Gravelly soils and viii) Brown forest soils.[50]

Table 1.3 : Different Soil Groups



Source: Technical Bulletin, No. 1-A Report on the Manurial Trials conducted in Different Farms of West Bengal, Govt of West Bengal.

Laterites

Laterites including the lateritic soils are formations peculiar to India and similar other tropical countries with intermittently moist climate. In West Bengal they coverabout the major parts of the districts of Birbhum, Burdwan, Bankura and Midnapur. The soils are acidic and are usually very poor in organic matter, nitrogen, available phosphorus and calcium. They are poorly aggregated and posses low water holding capacities.

Red Soils

The ancient crystalline and metamorphic rocks on weathering have given rise to red soils. These sometimes misrepresented as laterites, are the transported soils from the hills of Chotanagpur Plateau. Red soils are found in the districts of Birbhum, Burdwan, Bankura, West Dinajpur and Midnapur like laterites, the landscape is one of sal forests but in a number of places deforestation has resulted in soil erosion, especially near the banks of the Ajay. The red soils are rather shallow and coarse- textured.[51]

Alluvial Soils

Depending on the nature of the parent materials, the soils of the alluvium tract are divided into two families i) the Ganga alluvium and ii) The Vindhya alluvium.Each of these families is divided into a number of soil associations depending on their mode of formation and morphology indicating similar profile characteristics.

Vindhya alluvium

These soils have been formed from the alluvium brought down by the rivers, originating in the Chotanagpur plateau, which is physiographic continuity of the vindhya ranges. The soil associations of the vindhya family are: - i) Damodar, Rajmahal, Kasai riverine lands. ii) Damodar Rajmahal, Kasai flat lands. iii) Damodar Rajmahal, Kasai uplands.

i) Damodar, Rajmahal, Kasai-riverine lands

This association having different soil types, is characterised by profits, having layers without a regular sequence, immature irregular stratification, with occasional bands of sand. Sands are coarse and are of yellowish brown colour. They occur in the districts of Murshidabad, Birbhum, Bankura, Purulia, Burdwan, Hooghly and Midnapur. They have nearly neutral P^H and average lime and base status. They are poor in available plant nutrients and organic matter.

ii) Damodar, Rajmahal, Kasai flatlands

This association has different soil types which indicate some degree of weathering, leaching down of clay, mottling, and accumulation in the lower parts of the soil profile. The colour of the sand is brown. They occur mostly in the districts of Murshidabd, Birbum, Bankura, Hooghly and Medinipur. The soils are mildly Acidic, poor in base status and in plant nutrients and organic matter.

iii) Damodar, Rajmahal, Kasai uplands

They have different soil types having mature profiles. There is evidence of leaching of clay, Sesquioxides, alkaline earths, and alkali metal salts and their accumulation in the lower horizons. Mottlings are also present here. These associations have more or less similar chemical nature to that of the flat lands and occur mostly in the same districts.

Ganga Family

The associations occur mostly in the districts of Murshidabad, Nadia, and 24-parganas, Malda, Burdwan and Hooghly. The Ganag family are- i) Ganga riverine, ii) Ganga flat lands, iii) Ganga low lands and iv) Ganga uplands.

i) Ganga Riverine

They have immature profiles and the horizon sequence is not yet established fine sands predominate giving a greyish white appearance to the soil free calcium carbonate is present.

ii) Ganga flat lands

They have lightly mature profiles. Soil types from vary clay to sand depending on the micro-relief. At places, the subsoils are cakareous. Sands are fine and white to whitish grey in colour.

iii) Ganga low lands

Soils of this association have profiles the top horizon being clayey, followed by much lighter subsoil, Consisting of reverie loess or coarse sand. The profiles observed in this associations closely resemble lacustrine deposits and are found to overlie the riverine profiles.

iv) Ganga uplands

Soils are of older alluvium with more or less well developed profiles having moderate accumulation of clay in them and high concentration of lime in the form of concretions in the sub-soils.[52]

It is an undeniable fact that in the Sundarbans delta alluvium is formed out of the silt brought from the Himalayas by the river Ganges, Brahmaputra and their Tributaries.

Most of the soils derived from the alluviul depositer area Zonal with little or no profile development. Alluvial soils along with coast and especially in the Sundarbans area show white effloresence of Sodium Chloride, as they are impregnated with this and other salts by tidal estuaries. These soils have been formed from deposits brought by tidal currents.[53]

The Main deposits are either rich in calcium or magnesium or consist of half decomposed organic matter. According to the chemical composition of the coastal soils, they are classified as saline, non-saline, alkali and degraded alkali soils. Pure sands forming sand dunes occur mainly along the coast.[54] The soil in the Sundarbans can be classified into five categories, i) Clayey Soil or matial- found in sagar, Kakdwip, Namkhana, Patharpratima and in parts of Mathurapur, Joynagar, Kultali and Canning P.S. With an approximate area of 1,40,000 hectres. Matial is Subdivided into three varieties called Kala matal, Ranga Matal and Jhajhura Matal. ii) Loamy Soil or Doash or Buliara, is found in parts of Mathurapur, Kultali and Joynagar P.S. comprising an area of about 3,400 hectres. iii) Sandy loam is found mainly along the Thakuran Piyali and Kultali rivers, iv) Sandy Soil predominates along the newly formed Islands and is almost incapable of growing vegetation. v) Silty Soil is found in pockets in the reclaimed areas. All are not useful for cultivation among these five categories of soil. Dorasa Soil which is a mixture of clay and sand and matial produce chief crops of sundarbans. The dihi lands or elevated Lands and surrounding village sites come under this category. Being generally highly manured, they are devoted to sugarcane, tobacco, redpepper and vegetables. Besides Dorasa there is a soil called Balia, in which the portion of sand is more than that of clay. Such soils are used for the cultivation of tobacco, Potato, aush rice and mung.[55]

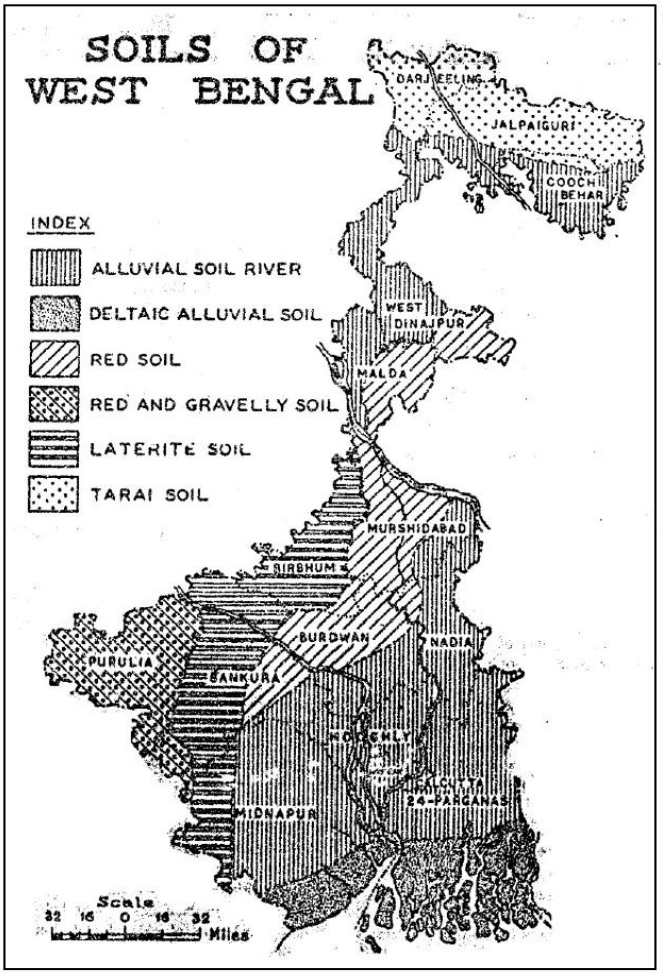
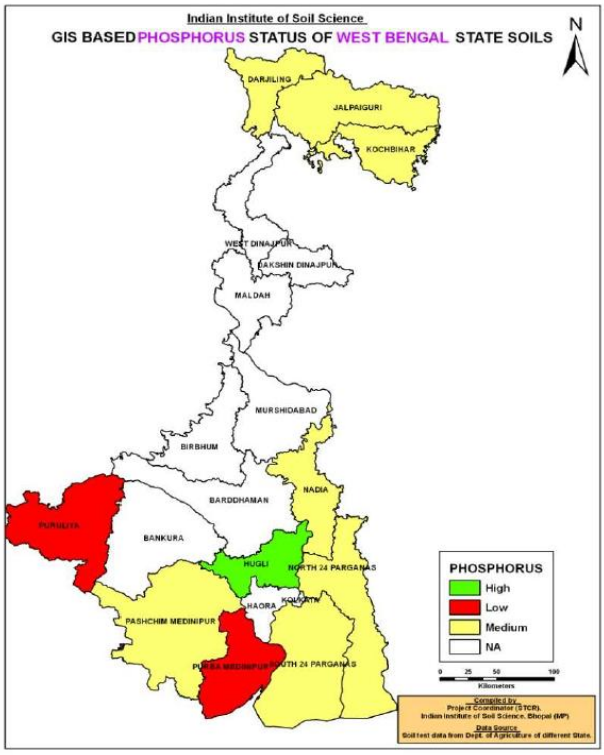


Fig. 8 : Soils of West Bengal



The soil is one of the most important natural resources and its organic and inorganic constituents determine the biotic components as well as physical topography of the area as a whole. A large section of sundarbans soil is wet saline soil in which ordinarily cultivation could not be possible otherwise it dries up sufficiently. This soil is known as Nona. Matial or clayey soil, whitish in colour, and loose and light in composition is very suitable for the 'patna' rice which is especially winter product and grows largely in Sundarbans. Dhaparchura is the another kind of soil in Sundarban. Whitish in colour, paddy can be grown on it when the salt is washed out by heavy rain, but the yield is usually small. Opposite to Dhap is Dhal which is the lowest land of all and consequently flooded earlier than the others. Like ranga matial it is reddish in colour, cracks when dry and is full of holes in the rains. If there is scanty rainfall coarse paddy can be raised on it. It has become clear that in different parts of sundarbans, different kinds of soil exist which are different in nature and produce different types of products. Here lies the difference of Sundarbans with the other districts of West Bengal.[56] (Fig.8)

Coastal Soils

These soils have been formed from deposits brought by tidal currents. The original deltaic branches of the Ganga had been choked up because the head water was cut off. As a result numerous tidal flats were formed. According to the chemical composition of the coastal soils they are classified as saline, non-saline, Alkali and degraded Alkali soils. These soils occur in the districts of 24 parganas, Medinipur and Howrah.

Terai Soils

These soils have been derived from the mountain regions of the Himalayas. These are brought down by the hill rivers- the Tista, Mahananda, Torsa, Jaldhaka and their numerous tributaries. They occupy a majority of the rice areas in the Jalpaiguri and Coochbihar districts. The soils are acidic, poor in bases and available plant nutrients.

Colluvial soils

They occur in Purulia and in the Western parts of Birbhum, bankura and in the Asansol subdivision. The colluvials are derived from the hills which are extension of the Chotanagpur plateau.[57]

The soils of West Bengal are generally poor in organic matter as well as in nitrogen. Organic matter is decomposed quickly in our soils and owing to lack of the binding influence of organic matter the clay soils become sticky and compact, and the light ones remain open. The status of nitrogen is thus lowered. Although the total phosphorus is present in moderate amounts, the available content found in most of the soil groups is very low. The deficiency can be specially observed in laterite and red soils and even in some of the alluvium Soils.[58] Soil tests should be done diffrent districts of West Bengal like Darjeeling, Jalpaiguri, Cooch Bihar, Some parts of the Birbhum, Hooghly, Burdwan, Purulia and Midnapur districts regarding P^H and total Soluble Salts. There is hardly any Problem with salt content (T.S.S.) of the soil in the Majority of the districts. However in some portions of Midnapur, Howrah and 24 parganas, the salt content may be high enough to require attention in course of cultural practices. It is particularly important that there should be adequate and proper arrangement for drainage. The Soils of all the districts have got low to medium available nitrogen-phosphate and patash. The available nitrogen content is particularly low in most of the districts except Darjeeling, Jalpaiguri and Cooch Bihar. As regards available phosphorus & Potassium, the problem is more or less the same in all the districts. Hence it is apparent that appropriate doses of N, P and K fertilizers will show response in all the districts of West Bengal.[59]

Table 1.4: ***Approximate Chemical Composition of the Soils***

Soils	pH	CaO	K_2O	P_2O_5	Carbon	Nitrogen
Laterite & Lateritic soils	5.5–6.5	0.1–0.4	0.1–0.4	0.01–0.05	0.05–0.5	0.01–0.08
Red Soils	6.0–6.6	0.1–0.5	0.1–0.8	0.01–0.05	0.05–0.5	0.01–0.05
Ganga Family						
(a) Ganga–Riverine soils	7.5–8.2	1.0–5.0	0.3–0.7	0.10–0.15	0.20–0.3	0.02–0.05
(b) Ganga Flat land soils	7.0–8.0	1.0–6.5	0.4–1.0	0.10–0.15	0.30–0.5	0.04–0.06
(c) Ganga–Up land soils	6.0–7.5	0.5–2.0	0.1–0.4	0.03–0.06	0.30–0.5	0.03–0.06
(d) Ganga–Low land soils	7.0–8.2	0.6–3.0	0.1–0.4	0.06–0.1	0.50–1.0	0.05–0.09
Vindhya Family:						
(a) Vindhya–Riverine soils	6.5–7.2	0.3–0.6	0.1–0.45	0.025–0.04	0.05–0.15	0.005–0.02
(b) Vindhya–Flat land soils	5.8–6.8	0.4–0.7	0.1–0.2	0.01–0.05	0.10–0.4	0.02–0.05
(c) Vindhya–High land soils	5.8–6.9	0.3–0.6	0.4–0.5	0.02–0.05	0.20–0.5	0.03–0.06
Coastal soils:						
(a) Non–Saline alkali soils	7.2–8.3	0.45–0.8	0.5–1.5	0.10–0.2	0.20–0.6	0.04–0.08
(b) Saline soils	6.5–7.6	0.6–0.8	0.3–1.0	0.06–0.1	0.30–0.8	0.05–0.1
(c) Degraded alkali soils	5.0–7.0	0.4–0.5	0.4–0.8	0.07–0.15	0.50–2.0	0.05–2.0
(d) Saline alkali soils	7.5–9.0	0.4–0.8	0.5–1.0	0.10–0.15	0.20–0.6	0.04–0.07
Terai soils	4.7–5.8	0.1–0.2	0.1–2.0	0.10–0.2	0.80–3.0	0.09–0.2
Colluvial & Skeletal Soils:						
(a) Gneissic	5.5–7.5	0.25–2.0	0.2–1.3	0.02–0.2	0.15–0.7	0.02–0.11
(b) Gondwana	6.0–7.0	0.10–0.50	0.2–0.6	0.02–0.06	0.30–0.8	0.03–0.08
(c) Transition	5.5–7.0	0.08–0.65	0.3–0.7	0.03–0.07	0.20–0.6	0.02–0.08

Source : Technical Bulletin, No. 1-A Report on the Manurial Trials conducted in Different Farms of West Bengal, Govt of West Bengal.

From the strict observation, it has been clear that though different kinds of soil have different aspect in the field of the production of fish. The soil of West Bengal except hilly areas is almost same to produce fish in a satisfactory quantity. Specially the southern district are highly noted for this purpose. The soft alluvial soil and black muddy soil are highly fit for fish cultivation. For this reason the people of northern district keep eye on the fish supplied from Sundarban and wait with thirst for different kinds of fish produced in this region.

3. RIVERS, ESTUARIES, CANALS, PONDS, BHERIES AND OTHER WATER BODIES

The Rivers of West Bengal

That water is closely related to the development of human civilization is a well-known fact. Bengal used to be known as the land of rivers. Its network of rivers with numerous tributaries and distributaries covered whole of the low lands between the Bhagirathi Hooghly on one side and Meghna- Brahmaputra on the other. We find the famous hymn in Bamkim Chandras' Anandamath; Sujalam, Sufalam, Malayajasitalam, Sasyasyamalam mataram, all these blessings of nature are infact the gifts of its great river systems the Ganges and the Brahmaputra. The most prominent feature of Bengals landscape is the existence of innumerable rivers and streams both large and small. They criss cross the entire land. In fact the soil of the Gangetic delta of Bengal is believed to be the gift of the great rivers, when the Delta was properly settled it was one of the most fertile and populous.[60]

Yet to be infected by the modern mania of Economic development and continued growth and living a simple life in peace and plenty the Bengalis of earlier times were generally well contented with what they got without many exertions from the bounteous nature. Their water resources being profuse they do not seem to have felt it necessary to manage it by excavating canals and reservoirs or building dams. In low-lying areas over flow by annual flood naturally served the purpose of irrigation and what the farmer was required to do was only to cultivate suitable crops. The application of technology here was practically none. A little ingenuity was enough to meet their needs of irrigation in times of relative scarcity or to irrigate lands which were away from rivers. It was what todays experts call water harvesting by ponding. They dag up innumerable tanks. Some places rivers are poor like the western districts of Birbhum, Bankura, Medinipur and Burdwan. Many villages derived their names from their tanks. They end with Sayar, Pukur, Dighi daha or dihi. They also harvested rain water.[61]

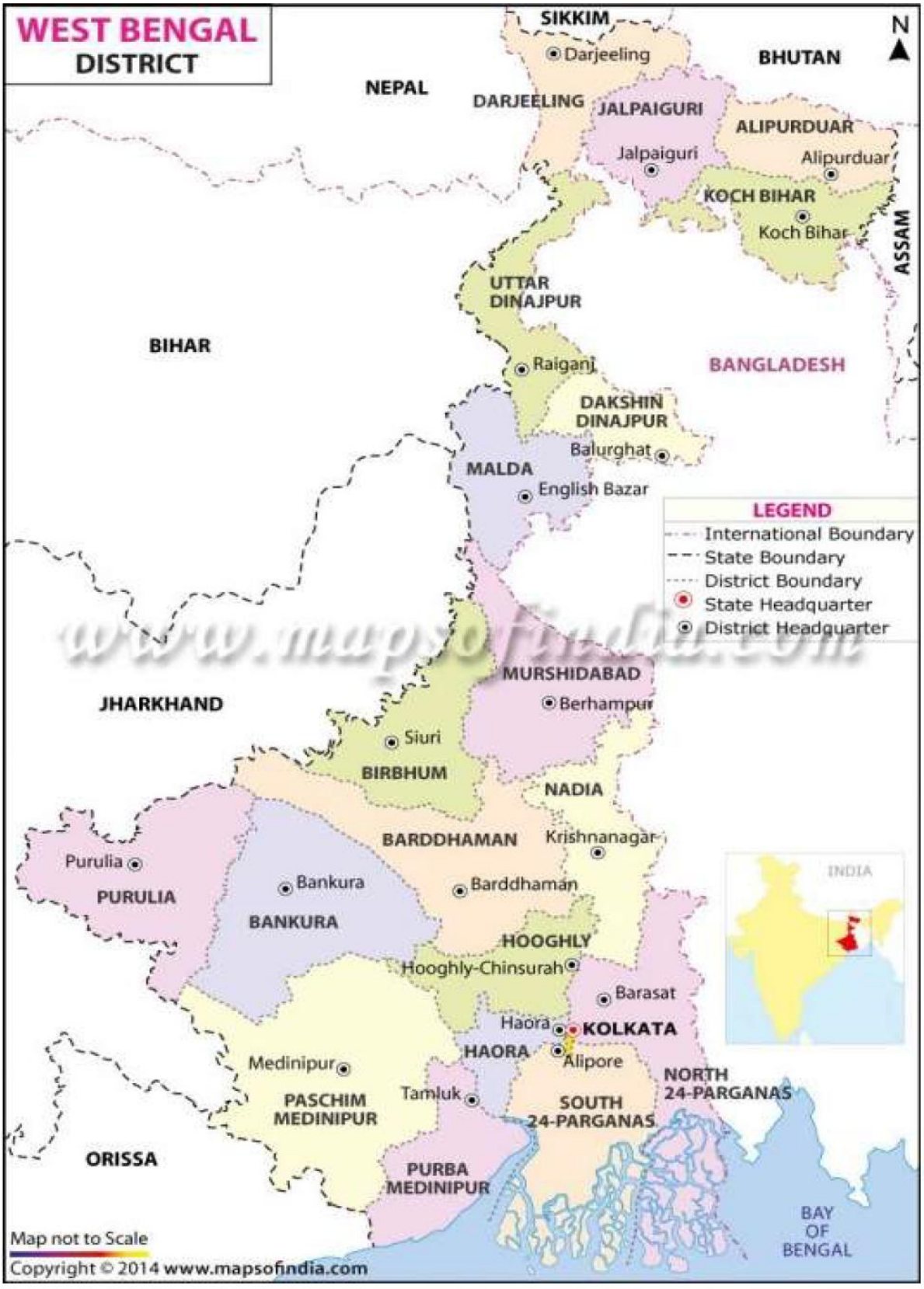


Fig. 9 : District Map of West Bengal

Day by day civilization has progressed, the traditional agricultural society has become industrialized, population has increased, mens ways of life have become sophisticated and their outlook has changed. There was a compulsion to improve the economic conditions of the country. The farmers, fishermen and other communities were no longer happy with their production, now they wanted profits from their operations. This necessitated the quick modernization. A large number of river valley projects were undertaken with high optimism. Without technology civilized existence is impossible and interference with natural river regimes is unavoidable. We should develop and adopt environment friendly technology. In this programme the most important item should be the conservation of our rivers.

West Bengal extends from North to South. Its length is about 580 k.m, but its widest extension from the East to west is only 320 k.m, the province West Bengal is consisted of 19 (Nineteen) districts. They are Darjeeling, Jalpaiguri, Coochbihar, North Dinajpur, South Dinajpur, Maldah, Murshidabad, Nadia, Purulia, Birbhum, Bankura, Burdwan, Medinipur, Hooghly, Howrah, North 24 Parganas and South 24 Parganas. With Kolkata the total No of districts stands 19 (nineteen). Tallest mountain, hills, ocean, thick forest, rivers and tributaries have given it a variety of nature and have formed it a very fine small province. (Fig. 9)

In order to give the identity of the rivers of North Bengal, first Darjeeling district comes to the phase. Darjeeling ling district lies at the top of the West Bengal. The two main rivers Tista and Mahananda work as a main drainage of the whole district. It has an area of only 3075 sq. km. Terai soil is found in the Terai region. The notable rivers of this district are:- Mechi, Balason, Manjadhara, Changnala, Tista, Mahananda, Chotta Rangeet, Baro Rangeet, Jaldhaka, Lish, Ghish, Murti and so on. They flow to the south and south east and come down to the plain. In the rainy season when they get rain water they become furious and bring flood in the south. In the summer most of the rivers become dried up except those who-have originated from glacier. Tista has originated from Jemu glacier of Sikkim. Water flow remains normal in this river for the whole year. The rivers of this region continually fade away the valley's as a result all the rivers are too deep and seems to be V slope of English alphabet. Boats cannot be ferried because current is very strong.

Siliguri sub-division of Darjeeling district, North East of Jalpaiguri district and the Northern part of West Dinajpur district are known as Terai region. The main rivers of this region are :- Mechi, Balason, Mahananda, Tista, Lish, Ghish, Murti, Jaldhaka, Torsha, Vima, Cheko, Gadadhar, Kaljani, Raidak, Karala, Dharala, Neora Khola, Kartoa, Dudhua, Sangkosh etc, all this rivers flow to south and south east region. Tista, Jaldhaka, and some other rivers have been originated from different glacier of the Himalayas and they keep smooth flow all the years round. But other rivers are flourished with rain water, so most of them dried up in the summer. Most of the rivers have been silted. Flood frequently occurs in the rainy season due to excessive rain in the rainy season. As a result the rivers change their course and flows to the new direction. The boat can be ferried easily.

The plain region of the North covers the southern part of the JalPaiguri, West Dinajpur except a few parts of North Coochbihar, and Maldah district. In the Northern part the hilly rivers like: - Tista, Jaldhaka, Torsha and Raidak are partly seen, all of them have fallen to the Bramhaputra in Bangladesh. Mahananda nagar, Kalindi, Tongon, Punorbhava, and Atrai are seen in the middle and in the southern part of the region. Except Atrai all other rivers flowing south have fallen to the Ganga and Padma. The Atrai have joined to the Yamuna in Bangladesh. All this rivers are swallowed due to silt, so in the rainy season floods are frequently seen due to heavy rains. But in the summer most of them become dried up. But in the plain region boat can be ferried all the year round.[62]

Murshidabad, Birbhum, Bankura, Burdwan, and most of the part of the Medinipur district lies between delta and plateau region are called Rahr plain region. Jalangi, vairab, Sialmari, Mathabhanga, Mayurakshi, Daroka, Brahmoni, Banshloi, Pushkani, Kopai, Bokreshar, Ajoy, Damodar, Sali nadi, Gandheshwari, Darkeshwar, Birai, Arhkusha, Joypanda, Amodar, Silabati, Kasai, Vairab baki, Tarajuli, Borakar, Rupnarayan, Kaliaghai, Subarnarekha, Dulung, Rasulpur nadi, Medinipur canal, Hijali Canal are the main canals and rivers in this region. Maximum main important rivers have been originated from Chotanagpur plateau and flowing on the eastern and south eastern part of this region, have fallen to the Bhagirathi and Hooghly rivers. Some part of the river Subarnarekha flowing on this region have fallen to the Bay of Bengal. Most

of the rivers have been silted particularly in the plain region due to excessive silt. Once Damodar would become furious in the rainy season and caused devastating flood, now it has been removed by making barrage over it. But now a days the river Ajoy creats flood in the rainy season due to the excessive rain water. In the summer most of the rivers become dried up because most of them are flourished with rain water. In this Region Rivers change their course frequently, boats can be ferried. In order to make possible irrigation, creating water electricity and preventing flood, all this rivers have been damed.

Western decayded plateau and billowing highland covers the area of entire Purulia district, Medinipur, Burdwan, Birbhum, and some parts of Bankura district. Among the rivers of this region Subarnarekha, Rupai, Kangshabati, Damodar, Kumari, Silabati, Darokeshwar, Gandheswari, Kopai, Ajoy are the main. Being originated from Ajodha hill the river Kumari has joined with the river Kasai in the plain. Kasai River has been originated from the hilly region of the Bihar. These rivers are often dried up in the summer. But they keep strong current in the rainy season. These rivers create often flood in the low land. Some parts of the river Damodar have flown through this region. Devastating flood also be seen in the Damodar in rainy season. Having flown over laterite region the river Kopai finally has fallen to river Daroka. Some parts of the river Ajoy are the part of this region.[63]

Delta region of Ganga covers Murshidabad, Nadia, Howrah, Hooghly, Kolkata, 24 Parganas (except the Sundarban) and Eastern part of the Burdwan and Medinipur. The middle region of the Ganga and the river Vagirathi Hooghly is known as the biggest part of the Ganga delta. A very small part of Ganga has flown through this region. Being divided into two parts near Giria in Murshidabad one part has entired into Bangladesh named padma, and other part has fallen into the Bay of Bengal near Sagar deep named Vagirathi Hooghly. Among the tributaries of the right bank of the Vagirathi Hoogly, Banshloi, Brahmoni, Moyurakshi, Ajoy, Damodar Darokeshwar, Rupnarayan and Kasai are the main tributaries. These rivers have been originated from Chotanagpur and Purulia plateau region. They are often dried up in the summer. But flood are frequently seen in the rainy season. Once flood was so devastating in the river Damodar that the people called it the “Sorrows of Bengal”. Now it has been removed by making barrage over it. Among the tributaries of the left bank of the Bhagirathi Hooghly- Jalangi, Mathabhanga are the main. Being originated from the river Ganga they turned into south

west and finally had fallen into Vagirathi Hooghly. As it has been separated from the padma it carries no water except in rainy season. Some parts of the river Piyali, Matla and Bidyadhari are the part of this region. Due to carrying saline sea- water they have been silted.[64]

The modern Sundarban area of the south 24 Parganas have been comprised of 15 police stations they are → Sagar, Kakdweep, Namkhana, Mathurapur, Pathorprotima, Joynagar Kultali, Canning, Basanti, Haroa, Minakhan, Sandeshkhali, Gosaba, Hashnabad and Hingalganj. It has an area of only 9,600 sq.km. Vidyadhari, Piyali, Matla, Raimangal, kalindi have flown upon this region. They have no link with the rivers flown from the north. As a result they become swelled up in the high tide and shrinked at low- ebb. All these rivers have been mostly silted due to the sand and silt carried by the water of the sea at its high tide. Communication through boats faced a lot of difficulties. Communication has been easy through these rivers like → Barotala, Saptamukhi, Thakuran, Matla and Gosaba. Through this route communication with Bangladesh has been possible.

Table 1.5: The river system of West Bengal

Si. No.	River system	Main rivers
1.	Northern system of North Bengal	The Tista, the Baro Ranjit, the Choto Ranjit, the Balason, the Torsha, the Raidak, the Sankosh, the Mujnai, the Korotoya, the Dudua, the Kaljani, the Mansai, the Jaldhaka, the Singimari, the Gadhadhar, the Mahananda, the Punarbhaba, the Kulik, the Nagar, the Gamiri, the Kalindi, the Girmati, the Pagla, the Baramasia, the Tangon etc. and their tributaries are flowing through the districts of North Bengal.
2.	River system of western West Bengal	The Damodar, the Mundeswari, the Kana Damodar, the Mayurakshi, the Behula, the Darkeswar, the Ajay, the Kana Darkeswar, the Kumar, the Khari, the Banka, the Kangsabati, the Brahmani, the Kaansai, the Silabati, the Rup Narayan, the kelighai, the Rasulpur, the Subarnarekha, the Bakreswar, the Dwarka, the Pagla, the Bansloi etc. and their tributaries are flowing through the districts of western West Bengal.
3.	The river system of Central western west Bengal	The Ganges, the Bhagirathi or Hooghly, the Bhairav, the Jalangi, the Mathabhanga, the Churni etc.

4.	The Tidal system of Southern Bengal	The Hoghly, the Kalindi, the Ichhamati, the raimangal, the Bantala, the Saptamukhi, the Piyali, the Matla, the Bidhyadhari, the Thakuran, the Kaikalmari, the Haribhanga, the Garba, the Jamira, the Gosaba, the Haroagang, the Kultigang, the Kalgachia etc.

Source: Cited in Rup kumar Barman, Fisheries And Fishermen.

The tidal creeks, rivers, canals and lagoons of the Sundarbans continuously supply enormous quantity of fishes and other crustaceans. The fish fauna either spend throughout their life cycle or a part of their life in this estuarine environment, as both the marine and fresh water fish species migrate seasonally into or through this estuarine system. In the Sundarbans water over 120 fish species are caught in the commercial catches. [65]

Saptamukhi, Jhilla, Vidya, Harinbhanga, Moni nadi, Muriganga and Karjora are the important rivers. Soil mostly peluvial helps growth of Mangrove, Hargaza, Goal, Sundari, Vadal, Ora, Keora, etc. very interesting and peculiar land composition with trees and plants where no dert is accumulated. It is cleaned everyday with clean sweep of full river tide as a result forest animals can survive without any Hazards. Deer, Hogs, Cocks, Monkeys, Frogs, and Tiger are all happy breed over here. Rainfall is sufficient. Sometimes water is loged beyond the periphery of Sundarbans due to manmade encrossment, embankment, roads and breezes etc. Growth of paddy and other crops are sometimes get retardation for uncontrolled flood situations. Natural calamities are there due to storm, cyclone, haricane and Tsunami. Heavy down pour storm along with gust of turbulent sea waves. Errossion is a regular phenomenon. Some villages or localities vanish without much fan fare. Artificial measures to protect errossion are hardly effective. Island is grown due to shilting, rolling and littering of underground soil due to earthquake or similar natural causes. There are hundreds of Island add-joining areas of south 24 parganas. People often recide on the outskirts of one of the finest forest reserves of India it is known as Sundarbans (forest of sundari tree). In this localities mostly fishermen, cultivators, land less labourers, small traders reside. Water is sayline. It helps breeding of different types of sea fishes and sea animal like tortoise, Susuk, Dolphin, Crocodile, etc. [66]

After independence for the shake of the placement of the good administration whole 24 Parganas has been divided into two parts one is 1) South 24 Parganas and other is 2) North 24 Parganas. Previously the whole 24 Parganas has been called the Sundarban. Now the courses of the rivers and canals of the North 24 Parganas are given → having originated from Nadia the river Betna has touched Bagda. It has finally entired into the District Jessore now in Bangladesh. Another important river is Ichhamati, having originated from Nadia it has flown through by the side of the Bangaon subdivision. It has been divided into two. i) East wings. ii) West wings. West wings have touched Sarup nagar, Arbelia, Basirhat. It has been reunited with the main wings (East wings) near Taki. Some Swamps are found surrounding Basirhat, such as → (Eastern Bog, Western Bog, padma beel, Madhyapurer Beel etc). All these swamps get sufficient water in the rainy season. So a large quantity of fish is produced. The river Jamuna is another important wings of Vagirathi, flowing from Tribeni it has touched Baduria, Sarupnagar, Gobordanga, Gaighata, and Itinda ghat. One day it was a flourishing river now its trace is hard to find out. [67]

RIVER SYSTEM OF SUNDARBAN

A large number of Rivers and Streams, mouth of the river (outlet), creeks, rivulets and many estuary are the beautiful objects of the southern region that is sundarban areas. All the rivers have been flowed from north to south. Uncounted canals have flowed from East to West and connected all these rives and gave easy transport facilities. According to Binoy Ghosh all the rivers have flown towards the sea and on their way they have assumed the aspect of cobweb and have created little islands among their currents.[68] Most of the rivers become quite in the winter, but become furious at the end of the Bengali month Falgun. During the period of rainy season all the rivers become furious due to the effect of opposite currents in these region. Most of the rivers have strong current according to Manoj Bose. Moreover there are so many esturary in these region. The rivers are jigjag. The two important rivers are Ganga and Ichamati. The Ganga has flown to the West and the Ichamati has flown to the East. One day the matla was considered as one of the important river of this region, It was called Matla for its whimsical behaviour. The ships could go but today it has been dead. Shib Sankar Mitra mentioned the river

moisheli in the deep Sundarban region. The moisheli neither very big nor very small. Ora, Keora trees of its bank supply food for fish by dropping their fruits in the river and have created green avenue like structure over head. One day the Sundarban region was beautifully flourished with Golpata and Sundari trees, but they are now partly absent due to lack of sweet water current of the main teritory.[69]

Kamal Chowdhury important information (data) about the characteristics of the rivers of sundarban areas. Two times high tide and two times low ebb occur in the rivers in 24 hours. High tide and low ebb depend on Lunar (tithi). The fishermen are fully accumulate with the knowledge of high tide and low tide and of the basis of that knowledge they sail across the sea and start their journey. According to Kapil Bhattacharya, the dam made in the Sundarban have created much problem. As they have stopped the smooth flow of the river, the surface of the river has been swelled up with the silt & as a result the current of the river has slowed down. Moreover the dams have not been made scientifically and they are not well protected.

A jotder could keep only 95 Bighas of land after the zamindari system had been wiped out. But they can keep 1000 Bighas of low-land on their name as a fishery. As a result they have changed their agricultural land into fishery and have earned a lot of money. They cannot repair dam and willingly keep water stagnant for long time. Thus many agricultural land of Barasat, Bashirhat, Harowa and Sandeshkhali have changed into fishery and have reduced into a land of deposited water.

According to the Expert there are three phases of High tide and low tide in sundarban. (1) From March-June (Summer): The Water of the high tide does not rise to the highest but the water of the low tide descends to the lowest (2) July-October (rainy season) : Water increases in the river in rainy season. Though water of the high tide reaches to the highest, the water of the low tide does not descend to the lowest. (3) November-February (winter): Water of the high tide does not rise to the highest, but water of the low tide descends to the lowest.

In Sundarban there are some rivers where High tide and low tide prevail throughout the years. This is called Interior High tide low tide region. The Spring tide

and Neap tide depend on the location of the Sun and the Moon. High tide and low tide are limited from 3 to 5 millimeter in different seasons in some rivers and estuary. The water of the high tide in Spring tide rises to the highest on the 1st week in September, water Level rises 15.5 in the Mechua Khal of the tiger project in Sundarban, water Level rises 12.5 in the Nowabaki Khal. The water of the sea swell up upto 4 meter whereas sea Level goes up 0.31 in the Hooghly river near Kolkata.

The colour of the water of the river is changed at high tide and low tide. Colour of the water gets muddy with the increase of water during high tide because mud of the banks are mixed with the water. The river water is found the most clear in the Bengali month of (Poush). Again colour may be changed due to the presence of the different kinds of fish,[70] when hilsa fish come first the water becomes blue then it gets black. The presence of the different kinds of prawn (chingri) bring change in the colour.

In order to stop the current of the saline sea water many experts have thought to make such arrangements that high tide water of the sea cannot enter into the river. In this regard Dutch experts placed a proposal to seal the mouth of some prominent rivers like Saptamukhi, Thakuran & Roymongal. Thus reducing big rivers into Damage some new land can be obtained, but this will do harm to the trees of Sundarban. Woodlands are naturally scanty in West Bengal. If this process is adopted more woodlands will be destroyed, as a result natural calamity will happen.[71]

Fish is an important wealth of Sundarban. Most of the people of this region are related to fish & fish catching. Fish is the favourite food of the Bangalees. Khal, Beel, river, haor related Bengali life has been closely connected with the fish and fish catching. Fish also have occupied a significant place in Bengali literature too. A glorious life philosophy has been related to fish in the famous novel "Ganga" written by Samaresh Basu.

A large quantity of Bagda chingri are exported to the foreign countries from the sundarban area every year. Great demand of lobster and crab are found in the world market. From the year 1971-72 Bagda chingri export became less because heavy silting occured on the surface of the rivers of this area.[72]

The rivers and estuary of Sundarban are known as Fish Empire. The people had engaged themselves in catching fish here from the period when the world was very young. Many people have chosen fish catching as their livelihood. But Fish trade has not yet reached to the expected position as a mature industry. But Fish industry has ripen to some extent in Kakdwip, Sagar, Mothurapur & Jambodwip lying to the western side of the matla river. People are adopting modern technology to catch fish. State Govt. has taken constructive measure in this affair. But to the Eastern side of the Matla this kind of effort is still absent. The fishermen of this locality are still economically backward. (Fig. 10)

The great trunk channels enter the sundarbans from the north and are connected by innumerable distributaries which after bifurcations and interlacing unite into large estuaries falling into the Bay of Bengal. The Most authentic old record on the physiography of this region is Rennell's Map (1779) on which all the subsequent discussion of water bodies of this area is based. In Rennell's records references to the lower Bengal has made as a land of hundreds of rivers and rivulets.[73]

Every river stream whether large or small flowing through such a flat tends to raise its own bed or channel by the deposit of the silt. Silts which the rivers raise the banks and the river beds in this area. The deposition of silt material in a delta gradually blocks the main flow of water, the original soon takes a slight turn due to obstruction. A new channel is thus formed and the process continues. The delta is intersected from north to south by many broad rivers and by endless creeks running one into the other filled for the most part with salt water where near the sea. In the sea-front of the Delta there are some principal openings having a head stream. That is having water flowing direct from Ganges or from the Meghna or Brahmaputra. They are i) The Ganges, ii) The Meghna or Brahmaputra iii) Horinghatta iv) pussur, v) Murjatta vi) Mollinchew vii) Roymangal or Juboona viii) Hooghly. Beside these large rivers there are numerous openings having no head streams.[74] Most of the river of the district were formerly distributaries of the ganges. Their waters were discharged into the sea through the channels. The main current of that river has long. Maximum channels of the river has been silted up. A large volume of water is conveyed to the Hooghly during the flood season by the Gangetic tributaries.

(Table 1.6) Sundarbans as a whole is often called as the product of the tidal estuary. The formation of delta regions and the navigability of the rivers are also directly linked up with the tidal flow.[75]

Table 1.6 : Ganga and its tributaries

Rivers	Source	Total length (km.)	Area Drained (sq. Km)	Important Tributaries
Ganga and its Tributaries				
Ganga comprised of two head streams:	(i) Alkananda, at an elevation 7,800 m. (ii) Bhagirathi at an elevation of 6,600 m.	2,071	951,600	Yamuna, Ramganga, Ghaghra, Kosi, Burhi Gandak, Baghmati Kosi, Son, Mahananda, Damodar, Jalangi Bhairab, Matabhanga, Gorai Confluence of Yamuna at Allahabad
Yamuna	West of Ganga source at an elevation of 6,315 m. from a hot spring at Yamunotri	1,300	359,000	Chambal, Betwa, Son from Central India
Ramganga	near Nainital in the lower Himalaya	690	32,800	Joins Ganga below Farukkahabad
Ghaghra	rises east of Ganga	1080	127,500	Rapti, Sarda
Gandak	at an elevation of 7,600 m. in the Central Himalaya	425 (in India)	9,540 (in India)	In Nepal it is known as Narayani; it joins Ganga at Patna Total drainage; 45,800 sq. Km.
Burhi Gandak	Western slopes Sumesar hills	610	12,200	Joins Ganga at Monghyr
Kosi	From Tibet/ Nepal	730 (in India)	21,500	Kosi, Arun, Tamur total drainage 86,900 sq. Km. Notorious for floods and hence known as River of Sorrow
Damodar	Rises in Chota Nagpur plateau (near Tori) at an elevation of 1,366 m.	541	22,000	Joins Hooghly 48 km. Below Calcutta-floody river. Tributaries are Gartus, Konar, Jamunia and Barakar

Source: Collected from G. K. Viz and R. C. Shenoy, " Hydrology of Indian Rivers", in B. C. Law (Ed.) , The Mountains and Rivers of India, 1968.

Hooghly is very important river of Sundarban. The Hooghly which is the most Westerly of the channels by which the waters of the Ganges enter the Bay of Bengal

marks western boundary of the district. After Diamond Harbour the river resumes a southerly direction until it debouches in the Bay of Bengal, its mouth is locally known as the Burha Mantreswar. Shortly before it falls into the sea it bifurcates the main channel passing west and another channel east of Sagar Island. This latter channel is called the Baratala River or channel of Creek but is known locally as the Muriganga. Muriganga is the Southernmost river channel of Bhagirathi. The tide of the Hooghly is occasionally so strong that it gives rise to the phenomenon known as a bore. This is the name given to the head wave which is formed when an unusually high tide is checked by the narrowing of the river channel.[76] Thousands of people, boatmen sailors and others who are familiar to this much-dreaded wave. This kind of bore is also present at Meghna estuary on the western boundary. Dr. Hooker mentious that at the mouth of the Meghna river. "The great object in the navigation is to keep about, and to make progress towards the top of the tide and during the flood and to ground during the ebb in Creeks where the bore (tidal wave) is not violent, for where the channels are broad and open, the height and force of this wave rolls the largest coasting craft over and swamps them."

Saptamukhi is eastward river which originates from near Sultanpur and has connected with Muriganga or Baratala the branch of the river Hooghly. It falls to the sea through hatania, Duania and Deogra Khal. Sundarbans another river is Thakuran connected with Saptamukhi. It has been orginated from Joynagar and also known as Jamira before reaching the Sea. Sundarban is specially known for the river Matla or Raimatla river, Situated about thirty miles eastward of sagar island. The river Matla was considered as the largest and deepest canal navigable throughout the year by the sea going vessels. The river Matla has wide connection with Bidyadhari and falls to the sea.[77]

Bidyadhari is very well known tidal river. Beginning in the Sundarban, it flows north east, past Harua where it is known as the Harua Ganga, and then bends eastward, is joined by the Nona Khal. In Rennell's Map it is shown that this river met with matla following through the canning line. It is joined by Karatoya and Atharabanka river. It is a sweet water river. Bangaduni River the next to the eastward of Matla is a small river, but with comparatively deep water at its mouth, the course of the channel to the sea, being about south-south-east. Guasuba River is of considerable size, but the most difficult to

enter on any of the coast, on account of the bending channel at its mouth. Number of Canals from Roymangal and Matla rivers Joined and formed this river. Roymangal River is one of the remarkable rivers of Sundarban. Starting from saheb Khali, it is connected with Rampurakhal by Barakalagachi and Guasuba rivers by the Terobanki and Haribhanga and reaches the sea. The Roymangal entrance which is situated about twelve miles to the eastward of the Guasuba river receives the united streams of three rivers the Haribhanga, being the western most, the Roymangal river next and Jamuna the eastern most. The Malancha River situated from four to six miles eastward of the Roymangal estuary has a channel running to seaward in a South- South-westerly direction.

Piali is another river of sundarban. The river originates from the South east part of Bidyadhari. It is also a tidal river. Leaving Bidyadhari after flowing 9 miles it joins the Matla River about 20 miles below canning. Jamuna enters the district from Nadia and flows South-East to Dhibi where it meets with Ichamati. Ichamati arises from the river churni fed by Hooghly near kishengunj, meets with the river Jamuna near Dhibi. It flows towards south, reaches sundarbans, after meeting with the river Kadamtali and falls to the Bay as river Malancha. Ichamati is another sweet water river of Sundarban. Garai is shown as a mere creek which gradually developed into a big river carrying large vessels throughout the year. The Haringhata, the next large river to the eastward is situated about fifteen miles north east of the Bangara and about a hundred miles eastward of sagar Island. The Rabnab channel is the next river to the eastward, with a large island of the same name at its mouth.[78] The other large rivers of the Sundarbans are as follows : (1) The Passar (2) Bishkhali (3) Kabadak (4) Haribhanga (5) Kholpetna (6) Sibsa, (7) Bhadra (8) Bhola (9) Buriswar (10) Bahadur, (11) Andharmanik (12) Madhumati (13) Arpangashia (14) Bhadder (15) Meghna (16) Kalindi (17) Kalagachia (18) Bangara (19) Marjata. These rivers are all navigable throughout the year. The minor rivers and streams are innumerable. Scarcely any changes are perceptible in the courses of the Sundarbans rivers as they are near the sea. All rivers have a clayey bed all are affected by the tide.

The rivers system of Sundarban may be divided into three groups, Such as i) Western, Comprising mainly Saptamukhi, Thakuran, Matla, Gusaba and Roymangal etc. ii) Central, mainly Arpangashiya, Sibsa, Bhairab, Haringhata etc. and iii) eastern, mainly

Biskhali, Baleswar, Bhola, Tentulia and Shahabazpur etc. The eastern sector of sundarban rivers complex receives water also from the excess rain of the north eastern hilly tracts and surma valley. Here the main water flows through Brahmaputra and feeds the eastern sector rivers. Among all these rivers only three Hooghly, Ichhamati and Bidyadhari are sweet water rivers. Western Sundarban rivers carry much less silt and sweet water consequently draw more sea water inside. Salinity is intense and have pronounced bearing on the forest complex and fauna in this area.[79] The writer of the Calcutta Review, 1859 F.E. Pargiter Seems that the names of the rivers and creeks in the sundarban are for the most part of Sanskrit, Hindu or Bangalee extraction, the most of names allude to the Hindoo Gods and Goddesses, some to the tree, most common on their banks, a few to the animals, most numerous in their vicinity, all are named well known and frequented.[80] For example Ganges : 'Gunga' the river par excellence. Meghna : 'Meg' a cloud 'na' not the advice given by boatmen not to attempt the passage of these dangerous river if the weather is cloudy or threatening.[81]

The main characteristic of the rivers of sundarban is that they are doing the job of reclamation of precious fertile land from the domb of the Bay of Bengal for thousand of years. Constant periodical changes of water flow, tidal effect, silt deposition and above all the cyclones are constantly changing the water bodies of the area. Rivers have played a significant role in the daily lives of the people of sundarbans. It has moulded their nature of living and made them adopted with usefulness as well as danger of the river system. The rivers and other water bodies are abound with fishes of all kinds, support a large fishing population and earn a considerable revenue.

Sundarban is not only full of innumerable rivers but also divided and sub divided by estuaries and island. The chief estuaries of the sea, from west to east are the baratala or channel creek, the saptamukhi, the Jamira, the Matla, the Gusaba and the Roymangal the last including the mouths of the Haribhanga and Kalindi. These estuaries are separated by large islands of which the chief from west to east, are as follows. : (1) Sagar island between the Hooghly and channel creek. This is the largest and most important of the island is itself cut up into many smaller islands by cross-streams. (2) Mecklenberg island recently renamed freserganj, west of the Saptamukhi (3) Lothian island in the

mouth of Saptamukhi (4) Bulcherry islands between Jamira and Matla (5) Halliday Island in the Matla (6) Dalhousie Island between Matla and Gusaba (7) Bangaduni Island in the mouth of the Gusaba.[82] Between the large estuaries and rivers are innumerable streams and water courses, called Khals, forming a perfect network of channels, ultimately in little channels that serve to draw of water from each block of land. There are high ground along the bank of the Khals surrounding it. The water collects into depressions and is drained off by little khals into the larger khals and ultimately into the rivers. Many of the khals connect two large ones and consequently the tide flows into them through both ends. Such khals are called 'do-aniya khals'. F.E. Pargiter in his article "Sundarban" in Calcutta review 1889, also accepted this view. According to him these khals are closely shut in by jungle and the condition of the water in them increases their insalubrity. There are also large number of marshy lands and swampy areas in sundarban.[83] The tidal creeks, rivers, canals and lagoons of the sundarban continuously supply enormous quantity of fishes and other crustaceans. The fish fauna either spend throughout their life cycle or a part of their life in this estuarine environment as both the marine and fresh water fish species migrate seasonally into of through this estuarine system. In the sundarban water over 120 fish species are caught in the commercial catches.

Estuaries of Gangetic Delta to riverine regions of Bay of Bengal are rather principal rearing grounds of fishes of west Bengal An estuary is created between river courses it spreads in differnet directions depending on the water currents and cross currents of the rivers. River like Matla, RaiMangal, Masjad the Ganges had developed many estuaries in the region. One particular characteristic of this estuaries is balanced distribution of fishes and their growth. Water during low tide some fishes return to the main water body of the rivers. This movement of fishes in the some course of the stream of the rivers help create a region of fish breeding, fish rearing and fish growing field. Fishes often like to live in the particular region of rivers and its estuaries. This fishes are categorized in different sect like- bhangan, pomphret, bele, prawn etc.[84] They are developed in a particular region which is very essential to be learnt by the fishermen that a group of fishes enjoy soil and water condition of a particular region. Estuary has got two different types of existence. One type of estuary is natural estuary, another type is seasonal. Natural means in the process of errosion by currents and cross currents of

Fig. 10 : River Map of West Bengal

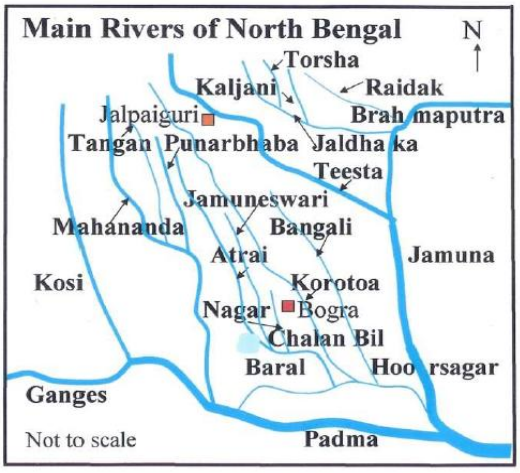


Fig. 11 : Main Rivers of North Bengal

canals and rivers and artificial ones are developed through utilization of water resource in different forms. Fishes prefer to stay in this region only because there is no water turmoil. Besides this regions are deep and without any strong currents. This undisturbed condition and depth of water fishes captivate to live in.[85]

North Bengal Rivers

Before the Ganga enters West Bengal at Farakka it flows by the foot of the Rajmahal hills. From old records available, it appears that the river course has always been round the crops at Rajmahal where during Mughal days a satrap of the emperor of Delhi used to rule between this point of Lalgolaghat, where the river enters East Pakistan it receives a number of streams of which Mahananda is the principal one. The Mahananda is a rainfed river receiving almost no snowmelt from the Himalayas. It drains almsot the whole of North Bengal passing through numerous marshy pockets before it joins the Ganga on the left Bank. The ruins of the ancient city of Gour lie on its banks. The graceful Mahananda river is in the northern hilly region which rise in the Himalayas and flow in a southerly direction through the districts of Darjeeling, Jalpaiguri, coochbehar, North and South Dinajpur and enters Bangladesh.[86] As most of the rivers of North Bengal are snow fed, so most of the rivers are perennial in nature and often floods during the rainy season. The entire region is made up of sand, gravel and pebbles laid down by these rivers. The Mahananda rises from the Dow Hills forest, near the town of Darjeeling and are fed by similar small rivers like, Mahanadi, Balason, and Machi and runs in a zig-zag way through the district of Malda and joins the Padma in Bangladesh. In the central region the main river is the Mahananda. The Tangon Punarbhabha, and Atrai arises in the plains, while the former two joins together and flows into Mahanadi, Atrai flows into the padma. It (Mahananda) comprises of three tributaries such as Trinai, Ranochondi and the pair of chokor and Dauk taken as single tributary. Siliguri and Malda are two most significant settlement placed alongside the Mahananda River. It flows through North Bengal, Bihar before finally entering Bangladesh. (Fig. 11)

Teesta and Mahananda are the two primary rivers of Siliguri. People of this region share emotional bond with these two rivers. These rivers have found a place in several compositions which prove that man and nature cannot live without each other. These

rivers are the lifelines of the people of this region. There are other tiny river systems such as the panchanadi and Balasun.[87]

The Teesta River is one of the major rivers of North Bengal. Teesta flowing from the glaciers of the Himalayas in Sikkim and Bhutan enters East Pakistan beyond Jalpaiguri and Joins the Brahmaputra. Centuries ago it used to flow into the Ganga (padma) from where its course has been diverted by heavy earthquakes of 17th Century. Projects are being worked out to control this river by a retention dam near Teesta Bazar in the Himalayas and a diversion barrage near Jalpaiguri. It is a rain and snow fed river, famous for river rafting. Ferocious, adorable and admired, river Teesta has a strong emotional bound with the inhabitants of this region for its mysterious aura and power. This powerful river forms the boundary between Sikkim and West Bengal.

North Bengal is endowed with numerous fresh water rivers. River Teesta is one of them. The main stream of this river is connected by different tributaries. One of them is Karala which originates from the Baikunthapur forest and flows down to the river Teesta near Daspara in Jalpaiguri Town. This River bisects the Japaiguri district town in two halves. The total catchments area of the river is 141 Km^2 most of which is covered by arable land. The basin of this river sustains life and livelihoods of tea gardeners, fishermen and slum dwellers. Tea gardeners consume the water resource for tea plantation and drain of the utilized excess water. Which carries variety of pesticides and fertilizers to that river (Karala). The fisherman utilize the downstream of this river for fish capture. Slum-dwellers exploit the water resource for bathing, washing of cloths etc. Sewage from municipality, garbage from market and ash of cremation directly mixup with this river. As a result the physical, chemical and biological characteristics of the river water are gradually changing and producing the harmful effect on aquatic biota and thereby human beings. Many researches have been concerned about the ichthyofauna diversity in North Bengal. The earliest report seems to be of shaw and shebbeare who reported 131 species from the river, streams and ponds in the hills and plains of the Darjeeling district and the adjoining Duars. This is followed by Hora and Gupta who reported 58 species of fishes from kalimpong, Duars and siliguri Terai, North Bengal. During 1977, Jayaram and Singh, reported 96 species of fishes from the confluence of

river Tengan with Mahananda, Atrai river, purnabhasa river, river Dharla at changrabandha, river kalindri, river Mahananda at Malda Town, Jamuna at Hilli village of Balurghar, Teesta, Karotayar, Panga, Balasan, Jaldhaka etc of North Bengal.[88]

Water bodies naturally show changes in temperature seasonally and daily, however, manmade changes to stream water temperature will affect fishes' ability to reproduce. Many lakes and rivers exhibit vertical temperature gradients. At the confluence of Teesta and Karala the water was more turbid. One of the important factors that serve as an indicator of pollution of water body is pH. Depth of water body is another important physical factor of lotic systems that controls the productivity and diversity of living things. Electrical conductivity in natural waters is the normalized measure of the water's ability to conduct electric current. This is mostly influenced by dissolved salts present in water body. Dissolved oxygen in water indicates water quality and diversity of living things.[89] The biological oxygen demand (BOD) gives an idea of the quantity of biodegradable organic matter present in an aquatic system which is subjected to aerobic decomposition by microbes. carbon dioxide quickly combines in water to form carbonic acid, a weak acid. The presence of carbonic acid in waterways may be good or bad-depending on the waters' pH and alkalinity. If the water is alkaline (high pH), then carbonic acid will act to neutralize it. But if the water is already quite acidic (low pH), the carbonic acid will remain un-dissociated. Chloride concentration is one of the indicators of water pollution. It is also related with the concentration of salinity. The importance of salinity of aquatic life is reflected in the difference between fresh water and marine water species.[90] Nitrate is one of the important nutrients in water body and is the common form of nitrogen in natural water. Nitrate stimulates the growth of plankton and water weeds that provide food for fish. This may increase the fish population. Phosphate is the ionized form of orthophosphoric acid. in solution and in natural water, phosphate ion will have many forms and will be at a pH dependent equilibrium. In general phosphorous is an essential nutrient to living organisms. Silicate is another nutrient of fresh water body. Now in respect of ichthyofauna diversity a total of fifty five species belonging to eight orders and twenty families were identified from the rivers of North Bengal.[91]

The Domestic sewage, garbage from market, drainage materials from hospital, leaching of fertilizers and pesticides from tea gardens, use of ichthyotoxic substances for fish capture and ashes of cremation directly mixup with that river and are clearly manifested in these results. The deterioration of water quality is related with above causes. India belongs to one of the top twelve mega diversity countries and it is a developing country. The fish constitute one of the main food items of substance for many people of India. They provide a staple diet and supplement of proteins. Fish constitute almost half of the total number of vertebrates of world. Out of 39,900 identified vertebrates, fish contains 54.44% of which 38.72% is fresh water species.[92] The knowledge of the diversity of fishes is one of the prerequisite for adopting the proper conservation strategies of fish fauna. Till date it is unfortunate that the karala River of Jalpaiguri District has not received any attention from the ichthyological aspects.

POND OR TANK

The number of Big and small ponds are more about 10 lakhs in West Bengal. There are 4 lakh ponds in the District of Midnapur. If scientific process of pisciculture is adopted in the ponds of the rural areas our poor economy must be developed. Sweet water fish is called fresh water fish. Most of the water of the pond are sweet. So the cultivation of fish in this kind of water is called sweet water fish. By diging 7-8 feet on the surface of a plain land and by making an embankment surrounding it a pond or tank is made in a artificial way. Among the ponds small are called Doba, Big are called ponds and the extraordinary is called Dighi, those which are bigger than ponds and smaller than Dighi are called sayar.[93] Ponds are classified according to Location, quality of mud, longibity, and production. Here it may be classified into six according to location.

1. Ponds made in lowland: In the rainy season this kind of ponds are filled with rain water. But in the summer in the extreme hot this kind of ponds keep 5-6 feet deep into the water. Though this kind of ponds are suitable for pisciculture Due to their overflow in the rainy season. They should not be selected for scientific pisciculture.

2. Ponds made in high land : They never over flow in the rainy season and at the same time water cannot be supplied from the neighbouring pond or marsh. Even in the summer this kind of pond keep 5-6 feet deep water.

3. Ponds of low land: these are dug in the low land and naturally they overflow in the rainy season and completely dried up in the hot summer or keep slight water. For this reason small fish (chara pona) can be cultivated in this kind of pond and they are caught before rain comes.

4. Ponds of High land: As they completely dried up in the summer season only Dhanipona or chara pona can be cultivated.

5. With high embankment or water controlled pond: This kind of pond may stand either in high land or in low land. But they should have high embankment at any cost and for this they have been named so. These kind of ponds are connected by canal with neighbouring marshes. As a result water level can be maintained according to will. Naturally this kind of pond does not go under in the rainy season. Water- equilibrium is maintained with consistent flow so they are called water controlled pond. These kind of ponds are suitable for scientific pisciculture profitably.

6. With high embankment large pond: They are large in size with have high embankment, so they are called Dighi. Enormous or Huge quantity sediment of thin mud were reserved in the bottom of this kind of pond. Yet 5-6 feet water level are maintained here. A Huge number of geol fish and weeds are grown here. They can be profitably used for scientific pisciculture by proper reform and manuaring in a business way.[94] Ideal fish farming is mainly depend on different types of tanks-which is (1) Nursery tank (2) Rearing tank (3) Stocking Tank.

In order to increase the fish production, the fish farmers Development agency of our state is playing a vital role and has been putting sustained efforts on development of pond fisheries and jhora fisheries. Under the centrally sponsored scheme the FFDA set up was first created in seven districts of the state in 1980-81. Thereafter at different phases all the districts have been covered.[95] During the year 2006-07, an area of 1,21,373.37 hectare of water area has been covered and the productivity has been raised from 600-800

kg/hectare per annum to 3500-4000 kg/ha/annum. District wise and year wise water area covered under FFDA are shown at Table 1.7.

Table 1.7: District wise water area covered and no. of Beneficiaries up to 2006-07 since inception under FFDA and BFDA programmes

Si. No.	Districts	Water area covered under FFDA programme (in ha)	No of Beneficiaries Under FFDA	Water area covered under BFDA programme	No of Beneficiaries Under BFDA
1.	Darjeeling (DGHC)	3960 jhora unit	4763	0	0
2.	Darjeeling (Siliguri)	188.54	830	0	0
3.	Jalpaiguri	2182.02	15561	0	0
4.	Coochbehar	2113.04	6256	0	0
5.	Uttar Dinajpur	897.95	3576	0	0
6.	Dakshin Dinajpur	5587.53	12307	0	0
7.	Malda	3759.11	16800	0	0
8.	Murshidabad	8315.47	23423	0	0
9.	Nadia	8498.03	29615	0	0
10	Birbhum	9513.07	27330	0	0
11	North 24 Parganas	7396.36	29002	1917.050	1214
12	South 24 Parganas	12194.85	48490	1946.744	2023
13	Howrah	2685.03	13947	0	0
14	Hooghly	10711.36	21681	0	0
15	Burdwan	12669.59	21285	0	0
16	Purba Medinipur	10053.77	48723	1773.520	3498
17	Paschim Medinipur	6588.31	31960	0	0
18	Bankura	6340.26	9900	0	0
19	Purulia	9304.64	30092	0	0
Total		120998.93 & 3960 jhora unit	395541	5637.314	6735

Source: Report, Dept. of Fisheries, Govt. of West Bengal

Intensive efforts have been put forward for development of ponds throughout the state in the interest of bringing more and more water areas under pisciculture operation. Individual owners of the ponds are being encouraged under various programmes to take up pisciculture as one of the sustainable alternative means of livelihood. It is one of the avowed aims of the Department to bring all the available water areas under pisciculture and with that object in mind provision has been made in the West Bengal inland fisheries Act, 1984 to take over management of any water body by the Department for pisciculture in the event of failure on the port of the owner to do the same. Every year more and more water areas are being covered under pisciculture. Efforts are also on to bring all other water areas owned by various Govt. Departments, Govt. undertakings and educational institutions under pisciculture operation under the directive from the Govt. of India in the Ministry of Agriculture. Particulars showing district wise impounded water area is given at

Table 1.8: District wise impounded water areas in West Bengal

(in hectare)

SI.NO	Name of the District	Culturable area	Semi-Derelict area	Derelict area	Total area
1	Coochbehar	567.86	990.67	327.44	1886.06
2	Darjeeling	210.29	-	-	210.29
3	Jalpaiguri	2404.53	3068.00	527.47	6000.00
4	Uttar Dinajpur	2910.80	978.00	816.00	4704.80
5	Dakshin Dinajpur	5910.03	1056.00	1294.00	8260.03
6	Maldah	1958.32	3055.42	3557.23	8570.97
7	Murshidabad	16161.76	646.29	-	16808.05
8	Nadia	4709.76	900.13	508.23	6118.12
9	24-Parganas (N)	25960.69	1068.76	277.80	27307.25
10	24 -Parganas(S)	47485.85	1389.87	361.28	49237.00
11	Howrah	4240.45	415.70	898.45	5554.60
12	Hooghly	9224.22	4545.76	2498.03	16268.01
13	Purba Medimipur	17854.80	5282.31	1350.27	24487.38
14	Paschim Medinipur	10325.18	6667.30	1827.52	18820.00
15	Bankura	20669.55	3810.75	1332.70	25813.00
16	Purulia	1398.68	9229.64	4947.37	18575.69
17	Burdwan	20618.79	7386.63	3189.49	31194.91
18	Birbhum	15720.62	1596.57	413.54	17730.73
Total		211332.18	52087.89	24126.82	287546.89

Source : Department of Fisheries report, Govt. of W.B.

During the year 2006-07 a sum of Rs. 179.63 lakh was spent for this purpose on account of payment of subsidy and training cost to the farmers. In addition an amount of Rs. 706.50 lakh was spent for payment of salary and wages to the employees and office expenses out of the states non-plan budget.[96]

Table 1.9: The following table illustrate the development of pond fisheries in West Bengal since 1996-97:

Year	Pond fishery (Cumulative) in hectare	Unit of Jhora Fishery (Cumulative) 1 unit=140 sq.m
Up to 1997	101837.20	2576
1997-98	103825.96	2691
1998-99	105961.32	2841
1999-00	107814.27	2983
2000-01	110236.46	3102
2001-02	112562.45	3272
2002-03	114672.61	3416
2003-04	116585.60	3538
2004-05	118286.01	3692
2005-06	119373.37	3810
2006-07	121373.37	3960

Source : Extracted from hand book of fisheries statistics, 2004, GOI, MOA

Development of cold water Jhora fishery in more number in three hill sub-divisions of Darjeeling districts

Pisciculture, an age old practice in the hill areas of Darjeeling district got the needed impetus. With the help of a few-dedicated fishery personnel having a missionary zeal of the Govt. of West Bengal. Scientific fish culture first started in small excavated ponds fed by perennial Jhora water type pond at kalimpong in the year 1981-82 by setting up of nine units (1500 sq.ft = 1 unit) as demonstration centre in different altitudes to study the growth of fishes in running water system viz. Species combination to suit the agro-climatic condition and economic viability of the units. After proper management and strict supervision for about 9 to 10 months fishes were harvested from each pond approx. 100 to 200 kg. i.e., 7.5 to 9.0 tons/hq, which were very high in comparison to that of plain areas. It was unbelievable, unexpected and beyond anybody's imagination that such an excellent growth and production of fishes could be achieved from such tiny pools

of the hill areas of Darjeeling district. It was a turning point and moral booster to the hill people to come forward to this new endeavor. Due to encouraging result of growth of fishes in the running water system and maximum return with minimum imputes prompted the state fishery department to launch jhora running water fish culture scheme exclusive for the people of hill areas of Darjeeling District in the interest of upliftment of socio-economic condition of the poor hill persons by adopting fish culture as one of the income generating programmes for their livelihood.

This is a unique project for alleviation of poverty of hill people and supplementing more protein diet in their menu. So far 3960 units of such fisheries have been developed. A programme has been undertaken at Reyang for production of fingerlings in collaboration with DGHC and is running in full swing. The Department aims at setting up of such units in more number for supply of fingerlings to the local fishermen in the interest of development of Jhora-fisheries in the three hill sub-divisions of Darjeeling district. Along with the development of pond fisheries, efforts are also being taken for ensuring coverage of more area under the FFDA programme by forming Jhora Fisheries in the three hill sub-divisions of Darjeeling district in order to make the hill people economically self dependent by adopting pisciculture as one of the sustainable alternative means of livelihood. Fingerlings of common carp and grass carp are liberated in the Jhora water in the months of July and August overy year. This apart one fish seed farm at Reyang has been established in collaboration with DGHC to ensure supply of fish seed to the farmers. One Jhora unit measures about 50' x 30' in area with a depth of 4ft. on an average. After proper culture a fish grows about 500-800 gm in size in a jhora. DUC to cold climatic condition the growth of fish is slow compared to plain area.[97] Project cost of the scheme is around Rs. 21,800/- for 1500sq.ft. 60% of the project cost is financed by bank and the balance, 40% is paid as subsidy.

Reclamation of all beels, baors and derelict/semi-derelict impounded water areas in the state

Total water area comprised in beels, baors, ponds/tanks is about 3.17 lakh hectare out of which about an area of 2.41 lakh hectare has so far been identified as capable of being utilized for pisciculture. Actual area under culture is around 2.10 lakh hectare. Thus

the water area which is yet be brought under culture is 1.07 lakh hectare out of which an area of about 0.76 lakh hectare is comprised in derelict/semi-derelict impounded water resources and the rest is comprised in beels, baors etc. Intensive reclamation of such vast unutilized water resources for pisciculutre is long overdue. But because of financial constraints such massive reclamation work could not be taken up.[98] However in a small scale the work was taken up in the 10th plan with NCDC- Assistance. In the districts of Nadia, 24 parganas (North), Murshidabad, Malda, Uttardinajpur. Hooghly and 24 parganas (South) 199 beels and baors comprising an area of about 4165 hectare were reclaimed. Because of this work it has been possible to produce 16,227 MT of fish from such water resources. One case is in point. During the current financial year 2006-07 a programme has been taken up for reclamation of chandra beel at Mahanad under Polba-Dadpur Block of Hooghly district.

The Mahanad Matsyajibi Samabaya samiti Ltd. had taken lease of a vested water body of an area of about 100 bigha equivalent to about 33 acre or about 13.36 hectare with adjoining lands measuring about another 43 bigha. The society started the work of reclamation of the beel along with dressing of adjoining land from 20.05.2006. The reclamation work is almost complete and arrangement is now being made for pouring water to start pisciculture. Total investment up to date is about Rs. 30.00 lakh out of which loan component of NCDC is Rs. 20.00 lakh. A minimum of 40 MT of production of fish is expected from the water body whose market price will be around Rs. 15.00 lakh. The society expects to repay the entire loan within two years. The Department aims at doing this type of work under state plan during the 11th plan period for the districts of 24 parganas (North), Nadia, Murshidabad, Uttar Dinajpur and Malda at a cost of around Rs. 128.00 crore.[99]

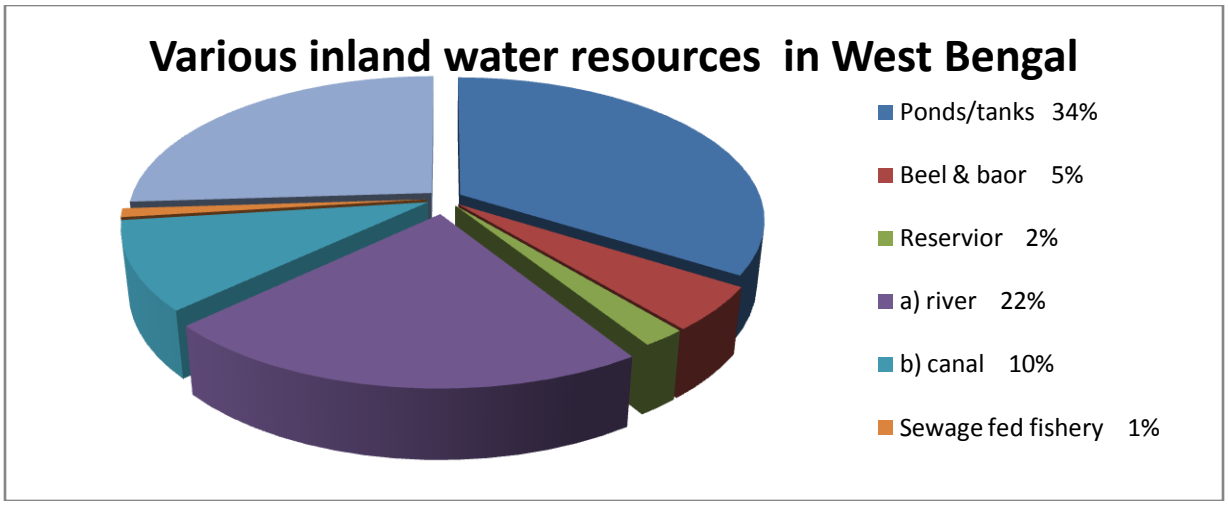


Fig. 12: Various inland water resources in West Bengal

Preservation of Water Bodies

Environmental pollution has reached an alarming proportion endangering thereby animal and plant lives. Indiscriminate filling up of water bodies, particularly in urban areas, have already caused irreparable damage. In order to arrest the growing trend for filling up the water bodies for residential or commercial purposes an amendment of the west Bengal Inland Fisheries Act, 1984 was made in 1997 where the offence for filling up any water body measuring five katha or more was made cognizable and non-bailable. But still the activities are going on. The provisions are proposed to be made more stringent by bringing in an another amendment of the act. But by mere incorporation of penal provisions in any enactment will have little or no impact unless those are strictly enforced by the law enforcing agencies. side by side, it is necessary to create growing awareness amongst the members of the public by organizing ceaseless campaign and publicity by the Govt. functionaries, local bodies, NGOS and social workers about the importance and need for preservation of water bodies not only for maintenance of ecological balance but for generation of income by adopting technologically sound modern integrated pisciculture development practices in those water bodies, which ultimately yields more economic gains in the long run when compared to the gains derived from filling up the water bodies. The Deptt. has taken necessary steps to move to that direction to arrest fatal trend of destruction of water bodies.[100]

Paddy-cum fish Culture

The Culture of fish in paddy fields is of great significant in the economy of rural areas. It can provide a supply of cheap and wholesome protein food, besides affording an additional income. In the global level, this system was prevalent in as many as 107 counries covering 135 million hectare of paddy plots during 1971. But in 1975 only 44 countries continued to have the system.

In India, there is a considerable scope for this practice in states of Assam, Bihar, West Bengal and Orissa where enough water is present in the paddy fields, which otherwise left unused during a certain period of the year. However in recent years, interest in paddy-cum-fish culture has declined because of indiscriminate use of pesticides to protect high yielding varieties of paddy. These pesticides if used properly will in no way harm the fish population around the paddy fields.[101]

Fish farming in paddy fields

Paddy fields are flooded from periods varying from three to eight months in a year and since some growth of fish can be achieved in this period, it appears desirable to use paddy fields for fish culture also. Apart from the fish catch, paddy crop also is said to be benefited. Fish cultural practices in paddy fields are of various types: (i) The simple but widespread practice of retaining and harvesting wild stock which enter the field on flooding. Little cultural practice is involved, there is no regular stocking of fish, whatever fish that enter the field during floods are relained and prevented from escaping by erecting barriers across channels and drains. (ii) Using paddy fields as a temporary pond after paddy has been harvested. There is no cultivation of paddy and fish together, but the fields used for paddy are subsequently used for raising a crop of fish, eg. Prawn culture. (iii) The practice of Stocking the flooded field and managing the field as a kind of pond, one of the most well developed forms of fish culture. attempting to raise a simultaneous crop of paddy and fish in the same water.

Techniques for fish culture in paddy fields vary according to climate and local conditions and according to species of fish available, the variety of paddy, the method of paddy culture and on whether artificial feeding supplements natural food. Actually every

paddy field produces a quantity of wild fish which enters the field as fry. some farmers raise the bunds and protect the inlets and outlets to prevent escape of fish. Some farmers go a step further, and after harvesting the paddy, use the field as a pond for a second crop of fish, by raising the bunds and digging trenches along the bunds. Since paddy production is the primary purpose, fish culture practices are adapted to the paddy cultivation schedule and when ever water has to be removed, fish are withdrawn into trenches and marketable size fish removed there mostly carp and Tilapia are used for culture in paddy fields.

The natural food of carp fry in paddy fields consists of minute crust aceans. Manuring with night soil, stable manure, composit etc. is done to in crease this fish food and thereby ensure fast growth. Green grass is mixed with the manure. The most opportunity time for stocking the fish has to be determined by experiment. Extreme shallowness and seasonal character of the water and fluctuations in water level are peculiar features of this type of fish culture.

Rearing of fish besides yielding protein food and financial gain confers some benefits on the paddy also, fish perform tillage, eat weeds and insects particularly, stem-borers which cause damage to the paddy plants and fertilise the plants. A well planned survey of prevailing conditions with particular reference to depths of water availability of fish seed, with a series of experiments to elucidate various aspects, should be conducted before launching on any lagre scale attempt in paddy cum fish-culture.[102]

Fish Production

In this practice, the fishes are being cultured for a period of 5-6 months in the entire area and 4-5 months in the trenches. The fish production ranges from 500-700 kg/ha/year as obtained by CIFRI. *Cyprinus carpio* grow fast in paddy fields giving an average yield of 6.7 kg/acre, provided that the measures are being taken to prevent high rate of their mortality. Among the other carps the rohu and catla have better survival rate but poor growth in comparison to the common carp (Anonymus, 1962). The average yield of tilapia is reported to about 31.3 kg/acre area of the field (Anonymous, 1959)

Clarias batrachus is in great demand in the north- eastern parts of India, particularly in West Bengal, Assam, Orissa and Bihar for its high nutritional value. It contains higher percentage of protein and iron as compared to other edible fishes. Its fat content is also very low and is therefore easily digestible so that it is very useful during convalescence. Magur is more profitable than that of any other cultivable species of fish. It is an ideal fish for culture in the paddy fields. Due to their omnivorous nature, they can consume a wide variety of insects as food. Moreover, they are hardy, easy to handle and economical to maintain. On the other hand, the high demand of magur, its fast growing nature, short culture period and use of paddy fields for rearing of fishes with selective and limited use of pesticides will commercially make the new system of integrated farming a success.

The Process of Paddy-cum-fish Culture have some Advantages and some disadvantages too. These are 1) Economical utilization of land, 2) Little extra labour, 3) savings on labour cost towards weeding and supplemental feeding. 4) Enhanced rice yield, and 5) Additional income and diversified harvest such as fish and rice from water, and onion and sweet potato through cultivation on bunds. Most common problem faced in paddy-cum-fish culture is the loss of fish during the period of their growth. The loss amounts to about 40 to 60 per cent for the young and 20 to 30 per cent for the large fishes. It is due to birds like herons and others etc. living on the fish. Inadequate oxygen level, abrupt changes in temperature and the poor depth of water also contribute significantly to the loss of fish.

Paddy-cum-fish culture makes multiple use of the paddy field to maximize the utilization of land and water resources and can also increase the production value of paddy fields. Fish as a bio-controller of insects and weed, reduces the input cost of insecticide and herbicide and toxicity accumulation is minimized. This is beneficial to human health and the ecological balance of the environment.

Bheries

Bheries are of the most important fishery resources of West Bengal. This traditional fishery is reported to have developed first in the spill area of the Bidyadhari

river consequent to the Silting up of the river due to discharge of Kolkata city sewage. Later this fishery practice was expanded to the lower deltaic region of the sundarbans. Locally this fishery is known is 'Basa bada', 'now-gheri' or 'bheries'.

Types of Bheries

Bheries are of two types i.e., wastewater bheries and saline bheries. Waste Water bheries are nothing but the sewage- fed bheries. These are located in places like Salt Lake, Jadavpur, Tiljola, Sonarpur and Bhangar areas of West Bengal. These are highly productive. Sewage of Kolkata city is drawn directly into bheries for acquaculture. Saline bheries are mainly located at Barasat. Basirhat, rajarhat, Deganga in low saline area, Minakhan, Haroakulti, Malancha in medium saline area and Nazat, Basanti, Gosaba and Kakdwip in high saline region.

Management of Bheries

During the off season bheries are properly maintained Repairing of earthen dykes all around the bheri and Sluice box, desilting of inside channel and mending of bomboo pattas and traps are done during the offseason. In saline bheries tidal Waters from rivers drawn into bheries during lunar period (new moon and full moon, for 4 to 55 days. Through the sluice with shutter kept open after filling the bheri. In Waste Water bheries sewage is drawn directly from the corporation channel. This Water is highly polluted but rich in nutrients and organic matter. The sewage is drawn into bheri to a depth of about 80 to 90 cm and allowed for setting its suspended organic solids and oxidation of effluents by holding for about 20 to 30 days.

Plankton forms the natural food in bheries. Water and soil are monitored regularly to check natural food status. Generally the chemical fertilizers and artificial feeds are not used in bheries. The entire production system is based on exploitation of natural fertility of bheries. Before stocking in bheries fish and Prawn post larvae are reared in small ponds. It is because they are very weak to survive in large water bodies. The lack of adequate food and presence of carnivorous fishes make their survival poor.

In saline bheries tidal waters form river are drawn into bheries initially to a depth of water about 20-30 cm during December-January and is left as such for about 15 days for the growth of natural food. Immediately after that the water level is raised prawn and fishes are stocked. Prawn is stocked at the rate of 40,000 to 50,000/ha. After about a month, parse, Major carps and tilapia are stocked at the rate of 1000-1500, 4000-5000 and 5000-6000/ha respectively in low saline bheries. In high bheries besides auto stocking of seeds along with tidal water, selective stocking is also followed. Prawn, Parse and Bhangar are stocked at the rate of 30,000 to 40,000/ha, 700-1000/ha and 500-800/ha respectively. During the culture farmers face several problems like prawn mortality algal fouling, red disease, white spot disease, soft shelling etc. The different types of fish diseases such dropsy, finrot, whirling and argulus infection are comnonly recorded from bheries. Bulk of prawn is harvested from April to July and other fishes from April to November. Prawn harvesting from bheries is quite interesting.[103]

Most of the farmers sell their harvested prawn and fish in local 'arat'. It is a common selling place. Some farmers sell their produce to prawn processing companies. Marketting is not free from complications because of the involvement of middlemen and local dalals. For this reason farmers sometimes lose money.

Status of Marine Fisheries

The marine fisheries of West Bengal has rich potential of commercially important variety of marine fisheries and shrimps due to influx of nutrient laden water in the Bay of Bengal through creeks and canals of the Sundarban. The coastline of West Bengal spreads over two maritime districts: South 24-Parganas and East Midnapore. The marine fishery of West Bengal mainly focused on these two districts. About 380,138 people (as per 2010 census) are directly or indirectly related with the marine fishery. The total number of fishing villages and fisherman families are 188 and 76,981, respectively (Table 1.10).

Table 1.10 : General information about the marine fishery of West Bengal

Fishing village	188
Fisherman village	76,981
Traditional fisherman families	52,532
Fisher folk population	380,1

Source: Marine fisheries census 2010, part-II.1, West Bengal CMFRI

The coast line of West Bengal stretches across 158 km and the continental shelf comprises 17,049 km^2. A total of 2590 km2 is covered by inshore and offshore area of West Bengal coast. The marine fishery of West Bengal is flourishing day by day due to massive demand in National and International market. As the demand increases the intensity of capture is also getting increased and that's why the number of mechanized boats is increasing in West Bengal. In 2002-2003 the total number of mechanized boats was I 189, but it increased up to 4618 in 2012-2013. The mesh size of' gill net varies between 30 and 110 mm and its length is 200-500 m for all gill nets that are used for fishing at 6-100 m bathymetry, while trawl net is used to carry out fishing at 30-100 m bathymetry. Small and big bag nets are used to catch fish at 4-6 and 20-30 m bathymetry, respectively.

Table 1.11: Fishing gear details of West Bengal coastal areas

Type of nets	Small bag net	Gill net	Big bag net (for dry fish)	Trawler
Bathymetry (m)	4-6	6-100	20-30	30-100
Mesh size (mm)	below 25-30	30-110	25-35	25-110
Length	7-10(mouth Opening)	200-500	15-20	15-25(mouth Opening)

There are five fishing harbours, viz. Sankarpur, Petuaghat, Sultanpur, Kakdwip and Freserganje and 78 major and minor fish landing centres in the state. In South 24-Parganas district of West Bengal, fish landing centres in estuary zones are eight in number and the marine sector fish landing centres are 29 in number. In East Midnapur district of West Bengal, no estuarine fish landing centres are present. All the 41 fish landing centres are from marine sector. Total landing of 26 types of marine fish, crustacean and molluscan from West Bengal coast are listed in tonnes from 2006 to 2012.

Table 1.12: Marine fish landing (Unit in tonnes) by Species in West Bengal coast

Name of species	2006	2007	2008	2009	2010	2011	2012	% of landing
Arius spp.	30,171	35,115.57	40,145	29,172	18,253	21,072	16,745	15.16
Sciaenidae (croakers)	7239	19,365.86	37,385.4	25,881.5	17,697	27,236	17,876	12.14
Tenualosa ilisha	16,072	9,430.64	11,744	10,560	54,265	16,523	8510	10.10
Harpodon nehereus	32,107	23,410.23	13,704	14,456	9991	11,390	9505	9.11
Other marine fish	14,773	8937.78	8411.35	10,137.8	12,083	13,795	10,500	6.25
Rastrelliger kanagurta	7470	11,29.50	14,262	9949	9279	10,412	8094	5.64
Penaeid prawn	11,001	12,854.91	9600	8532	10,156	8448	7328	5.40
Lates spp. & Lutjanus spp. (snapper & parch)	4480	5396.63	5677	12,853.05	10,121	10,627	10,248	4.72
Stromateidae (Butter fishes)	8694	9622.75	9798.5	8635.45	5964	6800	9924	4.58
Other clupeoides	5055	6506.11	7880	8066	6080	5470	7689	3.72
Carangidae (bangada)	-	4002.75	4869	9719	7115	8100	6167	3.71
Trichiuridae (hair tail ribbon fish)	8195	6439.60	5273	5919	4865	4570	1315	2.91
Mugilidae (mullats)	5914	3470.74	2384	4781.5	4980	5577	9435	2.9
Elasmo branchii(shark rays skates) etc.	123	1988.27	4133	4826.5	7484	8382	6724	2.68
Non penaeid prawns	5527	6329.13	6400	3832	3575	3396	2562	2.51
Indian oil sardine	8505	8823.51	743	1228	1237	6380	3139	2.39
Engraulidae (anchovies)	539	1207.74	2567	4619	5297	6500	8539	2.33
Caranx spp.(kala bangada)	3768	2081.48	2621	2888	2006	2226	1514	1.36
Poiynemidae(Indian salmon)	2205	1600.02	605	2075	1448	1303	321	0.76
Gerreidae(common silver belly)	3650	3159.24	379.85	216.5	475	490	93	0.67
Scombero-morus spp.	659	357.50	79	1125.5	263	240	853	0.28
Marine crust crab	894	389.94	-	400	299	263	163	0.22
Hemiramphus spp.	305	307.10	151.5	366.8	367	330	110	0.15
Upeneus spp.(goat fish)	429	283.40	-	225	299	284	133	0.15
Muraenesox (eels)	98	139.03	400	236.4	199	207	109	0.11
Yellow fin tuna	225	85.65	4	27	158	160	96	0.06
Total	178,098	182,735.07	1,89,217	1,78,928	1,93,956	1,80,181	1,47,692	-

Source: Dept. of fishery, Govt. of West Bengal

The percentage of landing in last 7 years was also depicted on (Table 1.12) Arius spp. has the height percentage (15.16 %) of landing in West Bengal coast in last 7 years, folIowed by Sciaenidae (12.14 %) and T. ilisha (10.10 %). YelIow Fin Tuna (YFT) is the very rear in West Bengal. Only 0.06 % YFT is landed in last 7 years on average. Bombay duck and Hairtail Ribbon fish landing shows a decreasing tendency in these 7 years. Whereas, Snapper and Parch landing getting increased during that time period. But the total landing has been static

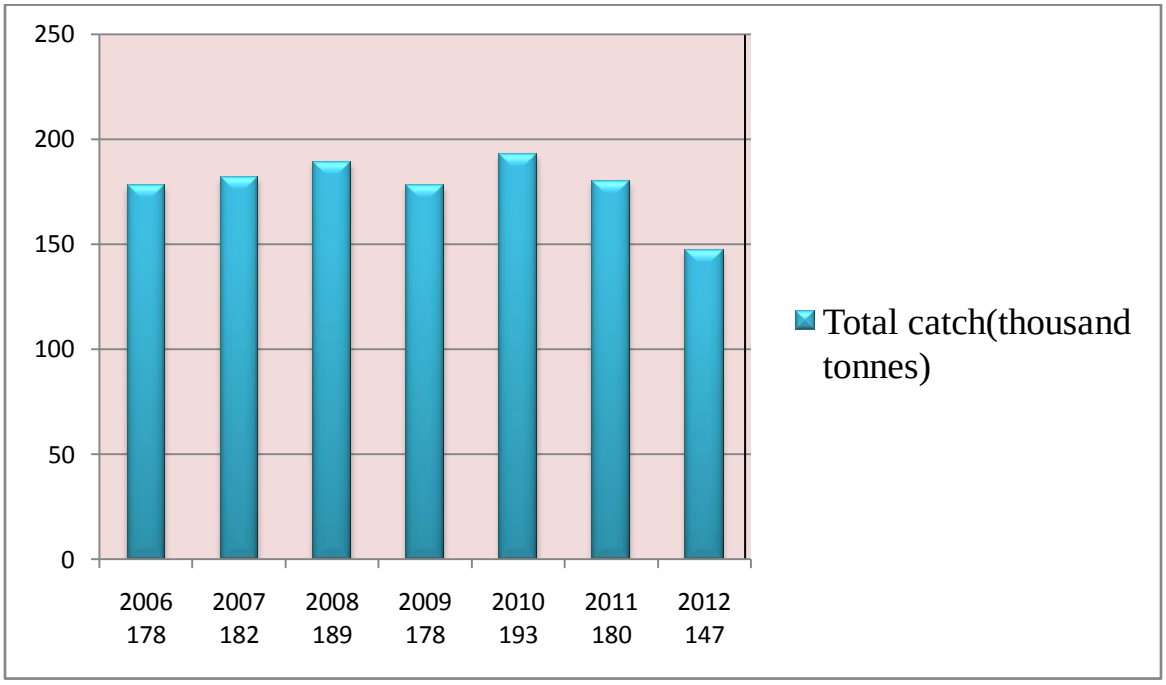


Fig. 13: Total marine fish catch from west Bengal coast between 2006 and 2012

If we look at the efforts, which is, the numbers of mechanized boats has been increasing significantly. For the last 7 years the CPUE of West Bengal coast has been declining significantly (r = 0.77) due to high fishing pressure, low stock and high effort. In this situation it is essential to enhance the stock, which is a potentiality powerful fisheries management tool. The best-way to recover the stock was comprehensively reviewed by Caddy and Agnew (2004). According to them the most successful recoveries occurred in the centre of the species geographical range and/or in favourable regimes and the success seem to depend on non-non-discretionary fishery control laws being applied.

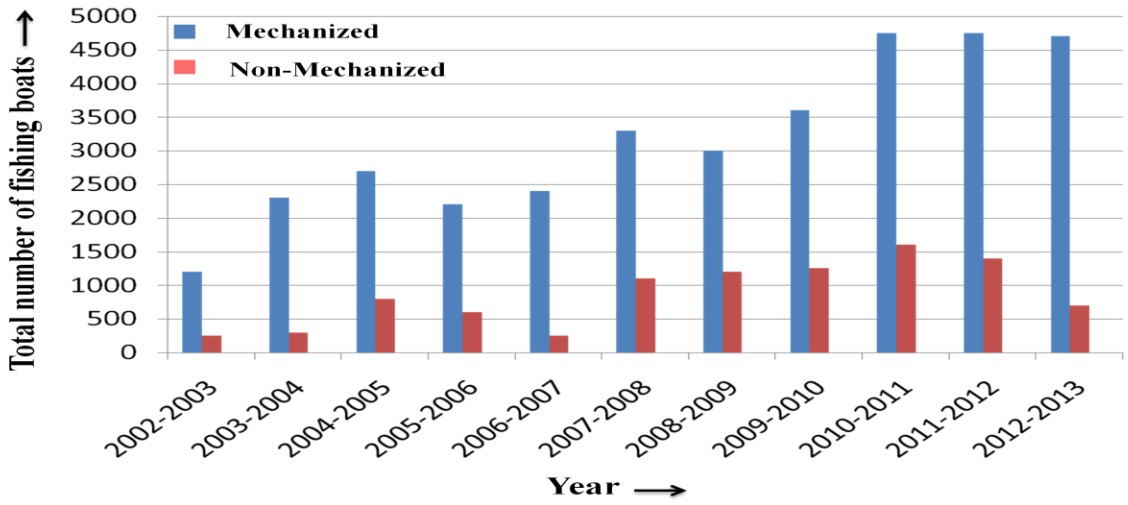


Fig.14: The numbers of mechanised and non mechanised fishing boat operated inWest Bengal coast from 2002-13.

Problems of Marine Fishery in West Bengal

There is a growing problem due to illegal incursion of fishing trawlers from neighbouring countries to fish in West Bengal's rich estuarine waters. Bad weather, frequent cyclones like storm surge heavy rains, and regular attacks by pirates, disrupts the marine fishing in West Bengal. As it is a huge estuary zone, the low depth is a big problem for fishing operations.

In addition to this, bottom trawling destroys the sea bed resulting in ecological devastation. (2009). Sathiadhas and Prathap (2009) did an interesting study on employment pattern and labour migration in marine fishery sector in Indian scenario. They vastly describe the state wise occupation pattern in both primary and secondary sector, and if we consider West Bengal, we find that 54.23 % people are working on primary sector and 44.26 % are working on secondary sector, that is marketing, making and repairing of fishing net, processing, peeling, and 1.51 % in other related sectors.

Management and Policy

Marine fishery is one of the most important natural resources that support both the social and economic development of the area, and, along with it, also partially fulfils the protein requirements. This natural resource has been exploited, without proper management, for a

long time, by humans for their livelihood. Utilization of marine resources is the oldest impact on the ocean environment by humans: With widespread development of fisheries, it has transformed into a major ecological impact. So the proper management of marine fishery is essential for both humans and the ecosystem. The issue of management of the fishery resources is one of the pioneer research topics nowadays. There are a huge amount of literature available for the different management strategies of fishery resources like marine reserves, individual transfer quotas, fishery by-catch, population genetics, life history study, ecosystem based management, community based management, stock assessment. But the key management strategy is the ecosystem based management. Ecosystem-based fishery management is a new direction for fishery management, essentially reversing the order of management priorities to start with the ecosystem rather than the target species. Catch quotas, effort 1imitations, gear restrictions and time/area closures are the traditional practices of fisheries management. The success of a management system is often defined in terms of biological, economic, social, and political objectives.

The marine fishery of West Bengal is heavily overexploited and the CPUE has been declining in recent years. Therefore, immediate management intervention should be made for long term use of fishery resources. Proper assessment of stock is very essential. The management of commercial fisheries clearly requires a good scientific understanding of the behavior of the exploited stock or stocks. The management options for West Bengal marine fishery are:

- Trawling should be allowed only after the monsoon and should be restricted up to 30 m bathymetry.
- The number of registered (and even unregistered) fishing boat should be controlled.
- Monitoring and enforcement should be strong.
- Recovery plan should be implemented.
- As the Sundarbans estuary plays an important role as a breeding and nursing ground, a marine protected area should be declared after proper assessment.
- Adequate scientific data on fishery should be collected regularly.
- Implementation of the rules and regulations should be strong.

- Sustainable ecosystem approach should be implemented towards fishery management.

Rules, regulations and policies are an important factor for management of the renewable resources. West Bengal Marine Fishing Act has been brought into effect in 1980 and it has strong rules and regulations, but the problem is proper implementation and surveillance of the law. The marine fishing act and rules of West Bengal are West Bengal Marine Fishing Regulation Act, 1993 and West Bengal Marine Fishing Regulation Rules, 1995. As the study area, the Sundarban estuary was identified as a breeding and nursing ground of the various fish species, so the conservation and management of this particular ecosystem is very much essential for the sustainability of the fishery.

In Marine Sector there is i) Inshore area (situated near the shore), ii) Offshore area (Situated at sea some distance from the shore), iii) Continental shelf and iv) Coast-line.

Table 1.13: Marine Sector of West Bengal

Marine environment	Area
1. Inshore area (Up to 10 Fathom depth)	777 sq. km
2. Offshore area (10-40 Fathom)	1813 sq. km
3. Continental shelf (up to 100 Fathom)	17049 sq. km
4. Coastline	158 km

Source: Government of West Bengal, Economic Review 2001-2002

The fishery wealth of the state has enormous potential to provide livelihood and nutritional security to people. Sustainable development of marine fisheries requires a sound combination of good management practices and conservation measures. These inter alias include sustainable harvesting of resources following eco-friendly fishing methods, enhancement of over exploited resources through closed season and closed areas, rationalization of existing fishing efforts, improved infrastructure for landing and berthing of fishing vessels, monitoring, control and surveillance, promotion of resource-specific fishing in the deep sea and a safety and security net for the small scale fishermen. While agriculture provides food security, fisheries provide nutritional security to the

country and both of them should be treated at par with each other in all development programmes.

Entry 57 of List I of seventh schedule of the Constitution specifies Fishing and Fisheries beyond territorial waters as Union subject, whereas entry 21 of List II speaks of Fisheries as a state subject. Reading both the entries together, it follows that control and regulation of fishing and fisheries within territorial waters is in the jurisdiction of the state, whereas beyond the territorial waters it is the exclusive domain of the Union. Therefore, management of Fishery exploitation in the EEZ requires close coordination between the Centre and the states. India's EEZ comprises different depth zones: 0-50 metres extending to 0.18 million sq. km; 50-200 metre extending to 0.27 million sq. km and 200 metres and beyond extending up to the limit of the zone, 1.57 million sq. km. Presently, 25% of the production is done by artesenal sector and 74 % is from small-motorized boats. Only about 1% is from the deep-sea fishing vessels in operation. Fish production has increased over the years with the motorization of traditional crafts and introduction of mechanized boats in the traditional sector as well as by diversification of fishing efforts beyond 50 metre depth.

Fishing efforts are currently concentrated in the 0 to 90 metre depth zone. Approximately, 99% of the landings are obtained from this zone. While inshore waters have been almost exploited to the sustainable levels, contribution from the deep-sea has remained insignificant. The fish production from the near-shore waters has reached its optimum yield levels and has been stagnant for some years leading to pressure on coastal fin and shellfish resources and regular conflicts between traditional and mechanized sectors. [104] Although the Marine Fishing Regulation Act promulgated by the coastal Sates provides zones for different categories and sizes of fishing vessels in the demarcated areas, this seldom takes place for the inherent weaknesses in the Act. Remedial measures are, however, being taken with the assistance and guidance of the Central Government.

India faces considerable difficulties in the development and management of its marine fishery resources for a host of reasons. The Indian subcontinent covers a vast region with long coastlines and different ecosystems, both on land and in the sea. The fishery resources are diverse, as are the fishery technologies and systems. Artisenal and small-scale fishermen operate from thousands of landing places dispersed along the coast

and live within socially and culturally disparate communities. Responsibilities and programmes for fisheries management and development are split between the Union government and Sate/ UT governments, which differ in their policies, programmes and approaches. Central Board of Fisheries should meet at least twice a year to sort out these difficulties in the interests of all concerned.

A sizable population of the marine fisher folk living in 346 marine fishing villages in the State are socio-economically backward due to poor literacy, total dependence on fishing, unstable income, extravagant spending on alcohol, health hazards and risky life in the sea without adequate insurance cover for family. They are also victims of cyclone, tsunami and other natural calamities. Several welfare schemes of the Government have helped only a small percentage of the population. Therefore, the programme of poverty alleviation of the families of nearly three lakh marine fishermen has to get top priority in the fisheries development programme.

Rent trends in both artisenal and small-scale fisheries in the country have been disturbing and indicate the need for implementation of sound management programmes. Several fish stocks are being over-fished. The loss in terms of harvest of juveniles is very substantial. Trawlers and Ring seiners cause maximum destruction of juvenile population followed by mini trawlers and purse seiners. In fact, such management for the coastal marine fisheries is long overdue. The catches and earnings of fisher folk have been declining. Resources scarcity and the dearth of new income opportunities have combined to make life difficult for small-scale fisher folk. The Government should take all steps to reduce juvenile harvest through introduction of appropriate fishing gears as developed by CIFT. Considering the large-scale exploitation of juveniles and discards by the trawlers, the cod and mesh size of trawl with square shape should be increased to 90 mm. [105]

Introduction of mechanized boats and motorization of traditional boats have caused extended fishing operations. This has also increased the fishing pressure beyond recovery of certain standing stocks and depletion of resources is noticed in many fisheries. Therefore, restriction and regulation in the operation of mechanized/ motorized fishing vessel are required in phased manner to curb the excess fishing effort.

The open access nature of marine capture fisheries is one of the major reasons for depletion, economic waste and conflict among user groups. Without adequate control

over access, these consequences will become increasingly severe and further impede the sustainable management of fishery and the resources. With an open access, no catch limits have been set on effort or the catch.

The restriction of fishing effort could be in the form of restriction in the number of vessels, number of days or hours at sea, engine power, size of the fishing gear, fish holding capacity, etc. Fishing pressure on over exploited fishery resources such as shrimp in the inshore waters has to be drastically reduced. Restriction in areas for resources specific fishing, prolonged seasonal closure to allow recovery of over-fished species, prevention of fishing juveniles and spawns during breeding/ spawning season should be introduced. Since the monsoons trigger breeding and spawning and monsoon effects vary from place to place and year to year, a close monitoring of resources is required to make a regular uniform closure of fishing in all maritime States and UTs. But the Govt. of India in the ministry of Agriculture mandated uniform fishing ban from 15th April to 31st May each year for the States in the eastern coast which needs be revised from 1st April to 31st July.

To optimize the fishing fleet size, a National-Level Review Committee was constituted in 1997 to study the size of the present marine fishing fleet in India vis-à-vis the harvestable potential and gave recommendations on the fishing effort that need to be deployed. The Committee concluded, after discussion with experts and with coastal states and the union Territories that the mechanized fishing fleet, in the size range of 8.0 to 15.0 m over-all length (OAL), has attained optimum strength and no fresh entry should be allowed. However, 700 new-generation resource-specific vessels, about 18 m OAL, including trawlers and gillnetters-cum-longliners, could be added to the fleet to tap resources in the EEZ beyond the 50 m depth zone. This step also vindicates the recommendation of the committee on Deep sea fishing setup by the union Government in mid-nineties.[106] The recommendation of the Review committee on optimization of fishing fleet need to be implemented at the earliest to sustain the coastal fisheries.

Gear employed for exploitation of demersal resources, particularly the bottom trawl, is being used excessively. The trawlable biomass appears to be over exploited and a reduction in the trawl effort is necessary to sustain the demersal fishery. On the other hand, the gear employed for the exploitation of pelagic resources is either underused or

not used at all. This needs serious consideration by the appropriate authorities. On a fair estimate, 70 percent of the operational cost of a mechanized fishing vessel is accounted for by fuel cost alone. Therefore, one of the prime requirements of the fishing industry is development, demonstration and popularization of fuel saving designs of fishing craft, fishing gear and methods. Studies on the energy efficient hull designs for fishing vessels for reduced power requirements and their effect on vessel motions and maneuverability at sea are required on a continuous basis. [107] Development of deep-sea hull designs in FRP and aluminium for fishing vessels is also essential keeping in view the scarcity of timber.

4. THE WEST BENGAL COAST: ITS NATURE AND EVOLUTION

The coastline of west Bengal extends in an arc, first curving WSW to ENE and then turns west to east round the northwestern corner of the head of Bay of Bengal. About midway along the coastal stretch the Hooghly opens out into the sea. On either side of the Hooghly there is in reality two different types of coasts. To the west of it stretches the alluvial plain coast of Medinipur of similar character as generally found along the western shores of the Bay of Bengal. East of the Hooghly one steps into the Ganga Delta, Which really attains its true character further eastwards. This stretch of coastline therefore, overlaps two different coastal types, each apparently with its true character lying somewhat beyond the limits of west Bengal.

Throughout this coastal stretch several rivers run out to meet the sea, e.g., the Subarnarekha, which empties a few miles west of the Bengal- Orissa border but its influence is locally so important that we shall adapt its mouth as our western limit, the Rasulpur which flows not directly to the open sea but into the Hooghly estuary and then the mighty Hooghly itself. East of the Hooghly mouth the coastal characters change numerous creeks open out to the sea. These are of considerable width but within the environment they are not individually of sufficient importance to merit separate refrence, except the Matla, the very big distributory of the Ganga delta.(Fig. 15)

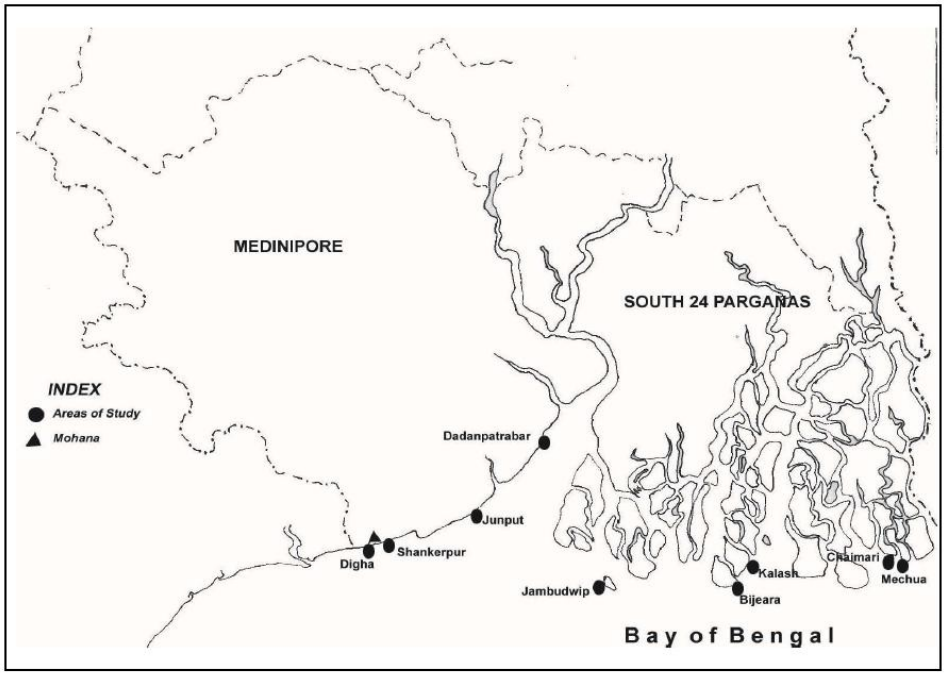


Fig. 15 : The West Bengal Coast

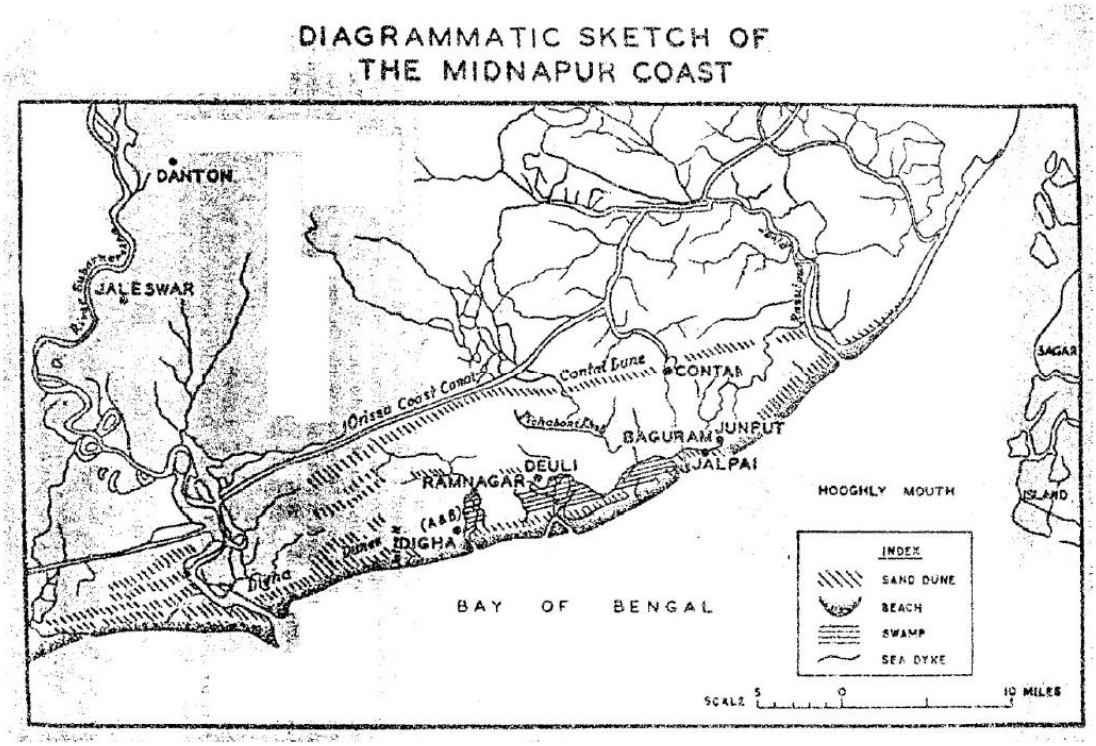


Fig. 16 : Diagrammatic Sketch of the Midnapur Coast

Coming down from the Archaean hilly tracts, of western west Bengal one traverses rolling erosional plains (primarily of lateritic material), and then flatter depositional plains (alluvial in nature) the lower parts of which is tidal, till in the extreme southern part of the Medinipur district one comes on a line of sand dunes-about 7 miles from the sea which marks the inland limit of the coastal tract west of the Hooghly. East of the Hooghly there is no such marked limit for the coastal tract, the vast delta opens out southwards the rivers grow bigger in a flat land and it is difficult to determine the limit of dominance of marine agencies over fluvial ones.

Among all the 9 maritime states of India which have an impressive coastline, the total of them amounts to 7500 km (approximately). The state of West Bengal (W.B.) commands a significant geographical location harbouring the mighty Ganga estuary (Hooghly– Matla estuarine complex), shared with the neighbouring country Bangladesh. Historically and geographically the coastal Medinipur is a contiguous part of deltaic sundarbans of global importance, limiting the Hooghly estuary on the western front. The coastal area of W.B. extends over 0.82 million hactre and extends along 220 km of coastal line. Of the two coastal districts of W.B., the undivided Medinipur district is characterised by sand dunes, long shore currents, high salinity, low turbidity and low vegetative coverage in comparison to its counterpart, (the south 24 Parganas district) supported by Sundarban Mangrove Ecosystem. The Medinipur coast (60 km) covers 27% of the W.B. coastal tract extending along the west bank of Hooghly Estuary from New Digha at the extreme south west point of the Medinipur district and then curving around Junput, Dadanpatrabarh, Khejuri and Haldia on the east to further northeast up to Tamluk or even Kolaghat on the bank of Rupnarayan. Biodiversity of this coastal environment, i.e. floral and faunal diversities are in tune with habitat diversity in this short stretch coastal zone and represents striking features with the regard to ecosystem functioning, commercial bioresource production, coastal zone management and promotion of ecotourism. Biodiversity is dynamic at all three levels, the genes, species and habitats and changes over time in response to natural and human- induced selection pressures. Diversity of habitats in terms of changing physical, chemical and geomorphological parameters impact on genetic composition which leads to the changes of biotic assemblages specially and temporarily.[108](Fig. 16)

Habitat diversity of Medinipur coast

The Medinipur coastal tract (longitudinal extension 87º 20´E to 88º5´E and latitudinal extension 21º30´N to 22º2´N) in between Hooghly and Subarnarekha estuarine confluence with the Bay of Bengal, although very short in length, it displays unique habitat diversities in respect to vegetation composition, occurrence of dunes, mudflats, sandflats and other ecological parameters like variation of salinity, temperature, texture of sediments etc. besides, this coastal tract can be divided into two distinct zones based on the continuous erosion and accretion processes. Different habitats having contrasting ecological features are as follows:

Talsari

This site is located at the confluence of Subarnarekha estuary with the sea. The Subarnarekha estuarine delta is the westernmost unit of the topographic expression in the present coastal plain. A degraded tract of mangrove swamp is still in existence around the estuarine link of Talsari tidal and intertidal flats.

Digha (Old and New)

The history of modern Digha is not very old. In 18th century, the Digha village under Birkul Parganas under the British Rule was a health resort for the British in India and was considered as the most popular weekend beach resort in West Bengal. In the present day, over forty lakhs tourists visit Digha every year.

Shankarpur

Shankarpur, a small village located 180 km. away from Kolkata and 16km West From Digha in the coast of Bay of Bengal. Shankarpur is a well-known fishing harbour and also a tourist spot of West Bengal. This fishing harbour has a capacity of providing facilities for to and fro movement of more than 150 mechanised boats per day. The total employment generation capacity of this area is more than 10.000 people per day.

Dadanpatrabarh

This important fish-landing and processing centre is situated around 10 km away from Kontai sub-divisional town by the side of sea. A total of 85 migrant fishers and

around 200 local fisher families are engaged in fishing. Small patches of degraded mangroves have been thriving for their survival in the area.

Junput

Junput, a small coastal village and an important fish landing centre on Hooghly estuary is located 15 km east of Kontai. People belonging to below poverty line are engaged in fishing, especially for fish drying. A good patch of mangroves comprising namely of *Rhizophora mucronata* and *Avicennia spp* has come up in the intertidal zone.

Khejuri

Khejuri, a small coastal block with historical importance is situated near the Haldi river mouth. This was followed by a mangrove afforestation programme for 4 consecutive years viz. 1999 (10 hectors area), 2000 (10 hectors area), 2001 (10 hectors) and 2002 (15 hectors area) covering a total area of 48 hectors. This has resulted in the development of healthy green patch of mangroves in this coastal tract. Besides others, grazing is the main problem to protect these plants. Small numbers of fishermen are engaged in fishing in the area.

Haldia

Haldia, a newly grown up industrial town in the district of Medinipur, West Bengal possesses a good number of industries like petroleum refineries, fertilisers, pesticides, battery, detergent etc. A large number of industries are located in close proximity of the confluence of the two estuaries, viz. Hooghly and Haldi, which are subjected to severe impact of pollutants discharge.

Nayachar Island

The 46-sq. km Nayachar is a newly emerged Island located (2154′41′′ – 2201′30”N & 88 03′00” – 88 08′52”E) at the middle part of the macro-tidal estuary of Hooghly River within the complex environmental setting of Bengal Delta system. After being raised considerably through continuous accretion of sediments, the surface of Nayachar Islands becomes colonised by salt marshes, the species association of which underwent through various series of succession with the changing bio-tidal environment associated with geomorphological dynamism. This Island, formed out of sediment

deposition during the past several decades, started accretion from 1945. Between 1967 and 1997, the isliand progressively enlarged, yielding an average accretion rate of 0.88 sq. km per year. The Island exhibits very rich biodiversity in terms of the salt marsh grass and swampy mangrove plant species along with various species of birds, fishes, plankton organisms, soil micro-arthropods and benthos.

Kolaghat

The river Rupnarayan, one of the most important tributaries of the Hooghly, has been showing signs of rapid deterioration because of siltation resulting in navigation difficulties. In addition to the navigation difficulties, present trends of eco-degradation is likely to hamper the drainage of freshwater brought down by several freshwater rivers of south West Bengal, resulting in salinity invasion to all the estuarine networks of Medinipur coast. Kolaghat Thermal power plants which have been functioning since mid-eighties produce large amount of fly ash. This fly ash constituting very fine size of suspended particles has posed major ecological threats to adjoining water and soil ecosystem.[109]

Geological and climatic factors of Medinipur coast

Beach

The beaches form linear coastal features, usually developed along the shoreline buffer to absorb or diminish and to reflect or transform the wave energy which is generated over the large areas of the Bay, both driven by winds and tides. Larger and flatter beach profiles of Medinipur coast are associated with beach berm, beach face, ridge and runnel, rip channels, low tide terrace, long shore trough, long shore bar and significant back wash ripples within the limits of back shore, foreshore, inshore and adjacent shallow water area of offshore zones. The beach face is marked by various sedimentological structures and active bioturbatious. The fine sand beaches of Medinipur coast have gentle foreshore slopes and provide a firmly packed hard sand surface for safe walking, playing, bathing and car driving. The beach provided with spits, are usually developed on drift alignment of long shore sediment. The amount of silt and clay fractions has increased in the extensive tidal flats of the lower foreshore region. Reduction of beach volume by attraction in Digha resulted in lowering of the beach

planes. All motions on the sea surface are generated and controlled by a range of forces, viz. tides, waves and currents. Ripples and waves are generated by the wind and controlled by surface tension alone or in conjunction with storm. The waves in turn may generate coastal currents which are responsible for the sediment drifts along the beaches, i.e. long shore or littoral drift. Based on the nature of the tidal range, this coast is designated as Macrotidal to Mesotidal coast.

Dunes

Coastal sand dunes are common geomorphological units in different parts of India. Dunes act as natural barrier to protect the coast from the damaging actions of wind, tide and wave, thus assuming a significant role in environmental protection. Recently, the long-term movement of shoreline obtained from the study of old survey report and new satellite data indicates that there is continued erosion at Digha proper but accretion at its western boundaries of Medinipur coast. Between 1877 and 1965, the beach-front-dune complex retreated landward by about 970 m at the rate of 11 m per year due to frequent marine transgression.

Sea level rise and erosion

Local sea level change and storm surge on seasonal effects or generation of waves of large height contribute to erosion over a time scale of hours to months. Comprising the annual sea level variation, it is observed that the annual mean sea level has risen steadily. In the Ganga-Brahmputra delta, the suspended sediment load is high. If the sea level rise is being considered due to sedimentation load at the rate of 0.1 mm per year, the net rate of sea level rise would be 3.14 mm per year. The causative factors of coastal erosion at Medinipur coast are identified as-(i) strong littoral drift on a fine grained and flat beach bordered by dune in the landward side, (ii) loss of sandy materials inland by wind action, (iii) strong tides during cyclonic storm, (iv) possibility of faulting in the Digha shore-face in recent past and (v) bathymetry of the inner continental shelf and orientation of the ‘ western Brace’ with respect to Digha at its shore-face.

With regard to the coastal erosion along the Digha-Dadanpatrabarh stretch, a general observation is that while the entire coastal stretch from Digha-Dadanpatrabarh to west Dadanpatrabarh is presently under severe coastal erosion, the eastern segment of

Digha-Dadanpatrabarh coast near a small tidal estuary is under stable conditions leading to accreting condition. An acceleration of erosion is also noticed from the year 1994. In the Digha coast, several mouzas, which are still shown on the land use and land holding maps, have been engulfed by the sea during the last 30 years. The seawall was able to arrest the beach retreat but the beach lowering could not be protected. It was also noticed that the beach was steepened considerably after the construction of seawall, as compared to the pre-construction period.[110]

Erosion and accretion

Historical records show that during the period 1877 and 1965, Digha shoreline of Medinipur coast moved inland by 970 m with an average retreat of 11 m per year. However, the rate of shoreline retreat has been increased sufficiently within the short-term period between 1965 and 1995 by 525 m with an average retreat of 17.5 m per year. To prevent such increasing erosion rate, the West Bengal government constructed 4.7 km long sea wall with laterite stones in between 1972 and 1988 in the east west part of Digha. The sloping face of the sea wall touched the upper part of the beach plain and protected the bank line behind the long sea wall from open wave attack. Kolkata Port Trust also constructed a 2.8 km long guard wall on the northern end of Nayachar Island in Hooghly estuary for improvement of the navigation channel of Hooghly River by diverting the eastern bank current to move along the Haldia bank during the ebb tide flow and down flowing river current. Several cross spurs have also been constructed along the northwestern bank of Nayachar Island in the same scheme of river training works.

Natural causes of erosion

It is observed that the normal wave attack produces net loss of sediments by erosion in the lower part of the sandy beach during the southwest monsoon period. During this time, a spring tide level touches the base of beach-fringed dune and produces micro-cliff by erosion or by shoreward transport of unconsolidated dune sands. Even the stratified, grass covered large blocks or chunks of unconsolidated sediments have been observed to roll down after erosion by undercutting of sand bank in Hooghly estuary within a short term period of tidal energy variation and wave activities. However, the enormous discharge of freshwater, carried by Hooghly-Rupnarayan-Kasai-Subarnarekha

system, amplifies the tide and surge situation along with the seasonal high seas in the southwest monsoon brace. Beaches of Digha coast, Talsari, Junput and Shankarpur shoreline generally return to steeper-reflective profile after the high energy wave event is over. Beach and dune erosion are the major thrust of this region due anthropogenic activity, recreational exploitation and unplanned urbanisation.

Tides

The daily water level fluctuations of high tide and low tide and their cycle cause the changing water content of the beach and deposition tends to take place at the top of the beach at high tide and erosion as the tide falls. The mean range of the tide during springs at Haldia and Digha is 4.90 m, 4.20 m respectively**.** Seasonal monsoon winds and maritime actions in the Bay of Bengal influence the tropical dry and wet climate of the region. The rainy season is largely confined to the months of June to October after a long dry spell of hot humid summer.[111]

Floral diversity of Medinipur coastal belt

Fifty seven species of mangroves and their associated plants from the intertidal, supralittoral and backshore zones under 32 families, 28 species of benthicalgae under 4 families and 8 phytoplankton species under 3 families from the intertidal zone, supra-littoral brackish zone from the sub-tidal open estuarine marine zones of different habitats of constructing ecological features have been recorded. Dunes growing plants such as Ipomea, Spinifix, Pandanus, etc. play a major role to stabilise dunes like the mobile dunes or the fore dunes, stabilized or back dunes. These species once established stabilise the shoreline and act as a buffer against erosion.

Faunal diversity of Medinipur coastal belt

Medinipur coastal belt in its extension of 60 km encompasses a diversified habitats and niche which accommodate a galaxy of faunal components in the form of pelagic and benthic forms. Seventeen species of zooplankton mainly comprising of Copepoda, Chaetognatha, Rotifera and some considerable number of nauplii larvae have been recorded. A total number of 48 molluscan species belonging to 3 classes, 15 orders

and 36 families have been reported from the intertidal habitats. A total number of 22 polychaete species belonging to 10 families have been identified. A total number of 12 actinarian species belonging to 2 classes, 3 orders and 6 families have been recorded from different study sites. Besides, sea cucumber (Holothuroida), sea pen (Cnidaria), Lingula sp. (Brachyopoda), were found in the mudflats of Talsari, Shankarpur, Junput, and Nayachar Islands. Of the 68 arthropod species recorded from this coast, 13 brachyuran crabs, 13 species of prawns and shrimps (21), 21 insects belonging to 33 families represent the major groups of fauna. A total number of 51 soil micro arthropods belonging to insect orders, viz. Collembola, Hymenoptera, Diptera and Isoptera, have been recorded from the different parts of this coast and they were found to play considerable role in estuarine-mangrove nutrient cycling. Both the species of horse-shoe crabs, viz. Carcinocorpius rotundicauda and Taphypleus gigas, are also recorded from the Digha-Talsary intertidal flats. A total of 51 fish species under 2 classes, 9 orders and 25 families have been documented from different fish markets and landing centre.

Fish landings at Medinipur Coast

Huge amount of eroded sediments, fly ash along with several other industrial discharges have made this vast sheet of water bodies almost unsuitable for living species. This is reflected by the steady decline of the abundance of fin fish and shell fish seeds, smaller fishes and other nektonic forms. It has been reported that an annual fish landing for 2003-2004 was 14,700.8-kg/yr.

The data collected during the last ten years from the Department of Fishery, Government of West Bengal, relating to fish landings at Digha-ShankarpurMohana, reveals a drastic reduction of total landings of different fishery resources. Operation of increased number fishing trawlers with nylon thread gears may be considered a mojor factor for such condition. Same trend was observed from the Junput fish landing centre and Dadanpatrabarh. The overall species wise analysis of the average catch for the three years showed that the highest contribution was from non-penaeid prawns (15.13%) followed by catfish (14.06%), pomfrets (10.33%), bombayduck (8.86%), croakers (8.2%), other clupeids (7.53%), anchovies (5.36%), hilsa (4.26%), ribbonfishes (6.2%),

penaeid prawn (5.4%), seer fishes (2.33%), marine crabs(1.7%) and miscellaneous group of fin and shell fishes (10.56%).[112]

Status of coastal Pollution: Source and nature of wastes

Because of increasing urbanisation and industrialisation, throughout the Indian Ocean region, the load of sewage and industrial waste is constantly on the increase. Fertiliser, pesticides and insecticides are freely used in most developing countries for agriculture and pest and vector control. The quantities of pesticides and insecticides used every year vary from 45,000 tonnes in India to 3.5 tonnes in Bangladesh. In many countries, however, organochlorine pesticides are either prohibited or are gradually being replaced by organophosphorus and carbamate pesticides. The water quality has deteriorated considerably in this coast because of discharges of untreated or partially treated sewage from the industries, municipalities, coastal towns. Natural habitats of the wetland swamps have also been affected seriously, as they have been used for industrial aquaculture. In many areas, saltmarshes and tidal floodplains of estuarine banks and tidal creeks have been used to develop fish farm in the protective flood banks for sustaining aquaculture. Increased soil salinity, viral infection among the fishes and contribution of pollutants to the sea waters are the adverse consequences of the present rapid growth of fish farming which has been developed without paying heed to coastal zone regulation acts.[113]

It is well known that oil and other related organic products after being discharged from different fishing trawlers, barges, tankers, dredgers, ships and other marine vessels pollute considerably both pelagic and benthic environment. Domestic sewage in small quantities is known to fertilise the sea which leads to an increase in marine productivity because of eutrophication. Kolaghat Thermal Power Plant (KTPP) on the bank of Rupnarayan releases hot effluents and coal-burnt ash into this estuarine system. Waste disposal from the tourist centers of Digha and nearby fishing harbours of Shankarpur contributes pollutants into the nearby estuaries and salt marshes.

Environmental impact of fly-ash disposal in estuary around Kolaghat thermal power plant

In any thermal power station, fossil fuel such as coal is burnt and chemical energy contained therein is released in the form of heat by oxidation reaction. The outcome of such an operation is the contamination of the adjoining environment. Special and temporal variations of environmental factors over a year are considered to be important in generating information and in analysing the changes taking place within a stipulated span due to mixing of effluents with water.[114]

Trend of exploitation of ecologically and economically important finfish and shellfish species

Fishing with small meshed nylon nets reduces considerably the stock of Juveniles, which are present in the fishing zone. It has been a regular feature especially around spring tide that local people in the process of collection of seeds of *Paeneus monodon* in saline stretch and *Macrobrachium sp* in fresh water dominated zone destroy a large amount of juveniles of other fishes like *Mugil sp., Rhinomugil corsula, Gudusia sp., Liza sp., Tenualossa ilisha, Polynemus paradiseus, Lates calcarifer* etc. along this coast. Besides, construction of fishing harbour and non-scientific fishing activities contribute to biodiversity loss.[115]

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CHAPTER-II

Economic viability of pisciculture in Contemporary West Bengal

West Bengal Government had to face many problems immediately after its formation. Due to the partition of India millions of people had migrated to the West Bengal from the then East Pakistan and created a grave situation. Moreover, shortage of food was Chronic. In-order to cope with the situation the Government as well as the general people have come forward to develop the cottage industries, agriculture, pisciculture, etc. The people who adopted pisciculture tried to earn livelihood from sea, river, tank, pond, canal, beel, baor and paddy field by catching fish. In case of crops failure the fish and fisheries had vital role for survival of the life of this peasantry. The Government on the other hand had sanctioned required amount of money through fishermen's cooperatives for the development of pisciculture. With this Government aid fishermen had adopted modern technique in pisciculture especially in rearing, breeding, catching, marketing and processing of fish. So the fishermen of West Bengal had experienced a new taste in the market economy. For achieving more prospect from fish and fishery, the Government has taken Pisciculture with more importance because it has a significant role in the agrarian economy of the State. In this chapter I have dealt with all these aspects of economic viability of Pisciculture in Contemporary West Bengal.

1. Concept of Pisciculture

Pisciculture is culture of fishes relating to its origin and development. It involves breeding, rearing, manufacturing technology related to fishes. Its environment, water system. River, Canals, Ponds, artificial breeding centres hybrid culture that is cross breeding system and its development, Eco friendly sustenance, trade and commerce, marketing and finance are within its sweep. It also requires the large amount of labour compounded by the fishermen of different countries with highly skilled labourers and technological advancement. Computers, televisions and information technology are also deployed for the development of this pisciculture. Economic and social awareness are also two main factors closely related to this culture.

Pisciculture as defined in Oxford Concise Dictionary is the artificial rearing of fish. Another definition comes from Cambridge, Chembers, Mc Graw Hill, etc. and some other books written by different authors. There are other mythological aspects which run thus– Fish has been worshiped as God in India from the very prime of its culture. When religion becomes marred with sin and corruption, Prophet comes to the earth and saves the depressed souls of human being by preaching their doctrine. Similarly when people die of malnutrition and Starvation, fish cultivation can protect them. Half-starved people may find hope for their existence which is going to perish for want of food and nutrition.

There are many folktales on fish and its origin. According to the geologists fishes were originated in the Devonian age (fourth period of the palaeozoic era). At first shark, dog fish and many other cartilaginous came into being. After that rohi, catla, mrigel, shingi, magur, koi, hilsa and other bonyfish presented themselves. Nearly the names of fifty kinds of fish are found in the different papers and documents of sumerian civilization which was three thousand years old. Other Documents of Scandinavian Maglemoshian civilization prove that Megalethic time (10,000 B.C.Z 6,000 B.C.) human beings were acquainted with the art of fish catching. The inhabitants of old greece and Rome would also cultivate fish in their personal pond. An Egyptian caffin, 2000 years B.C. shows the picture of elaborate cultivation of Telapia fish first, from the writings of Telecleids it is known that the people of ancient Greece (in 460 B.C.) would like fish very much as their food. It is also known that from 11,000 B.C. fish were cultivated in the pond in China. Different methods of fish cultivation and the use of different materials as fish food have also been mentioned in the kautilya-Arthashastra (321-300 B.C.). various papers and documents proves that carp like fish were also widely cultivated in china in 475 B.C. Varieties of fish their Characteristics and the method of their cultivations were also found in the essays of susrat in 600 B.C. Fish cultivation and its relevant features are also illuminated in the sholokas of khana. Emperor Asoka (246 B.C.) also passed some prohibitory order regarding fish catching in different seasons. He also patronized fish cultivation in many ways.

Pisciculture deals with aquatic resources like fish which have been highly valued as food and economically rich their shape, Nature, life style, stability, natural growth, breeding, preservation, transport, marketing, diseases and their remedy are

called fish science.[1] Fishes are vertebrates adapted to living in water. The defining concept of fishes has been greatly altered since the jawless fishes have been placed into a special vertebrate super class.[2] As late as 1858 the British zoologist Richard Owen put fishes, amphibians and reptiles together in one class. Aristotle attempted organizing fish's phylogenetically. He divided them into cartilaginous and bony fishes.[3] Fresh water fishes as well as fishes from the ponds have been a general fish culture of the regions in European countries; it is highly developed and remunerative.[4] In our Indian context this culture is highly developed and consumption rate is also very high. Attention of the govt. is drawn to its development. Demand of fishes is so high that the fishermen with the support of the govt. can hardly maintain demand supply ratio.[5]

This culture is also developed in China. The art of rearing of fishes is practised by the Chinese from the ancient period. In the process of planting in Suitable areas is adopted other countries followed the Chinese practice of pisciculture.[6] Fisheries have often been called the agriculture of waters, as if seas, lakes and rivers were in exhaustible store-houses of food, where without fear of ever impoverishing those, man might continue to take and destroy forever bounded only by his wants and his desires.[7] May be this statement is a subject of criticism still; It is an argumentative process through which we have to proceeds.[8] Artificial breeding is also a greater factor for normal catch through hooks and Net. In Japan this technology of artificial breeding is highly developed, challenging. This type of breeding is a healthy sign of an economy. In Norway the journal of the society of arts has given publicity for this culture.[9] Pisciculture has its roots in our physical conditions, Geographical locations, our Philosophy, and religious scriptures, Economic Ventures, Commercial transactions Employment opportunities and foreign trade thus inviting Global trade with great Economic Profit.

In ancient times there were no distinction among the plants, trees and animal life. They were the joined Product of early environment of the earth. Gradually there came up division among plants, trees and animals. Some enjoyed the Privilege of moving from one place to another, some could not. Trees, plants and animal life are two different Pattern of growth. With the first detection of single cell living being we find fishes like jellyfish. Reproduction system has been inherent. Reproduction is done in a single body of beings then came reparation of cells with two distinct types

of fishes (male-Female) both vertebrates breeding their progenies. Later with the evolutionary process different types of fishes in different atmospheric level of water are found. Some fishes survive in extremely cold water. Where as in light degree temperature many types of fishes survive. Soils of different natural region add elements of sustenance for their survival.[10]

Physical environment conducive to rearing, breeding, and developing of fishes in a particular area of the country plays vital role. Different types of fishes are grown in different physical conditions in low temperate zones, fishes reared cannot survive in high temperate zones, fishes grown in high seas cannot be put into any confined water like Ponds, Beel, with shallow water and Canals etc. not only that ecological system largely differs from one region to another. Ecology is the principal factor that determines corporate survival of fishes. Water is the main physical factor for the survival of fishes. This water can be classified under five categories i) saline water of the seas and rivers, ii) non saline water of the hilly regions, iii) frozen water, iv) Stagnant water of the Ponds, Beels, marshy land, and v) water with high current.

Hilsa is special kind of fish found in South Sundarban delta. The confluence of the Ganges, Padma, Meghna, maszad and its adjoining Bay of Bengal region provides high currents and cross currents four times a day that is within 24 hours water level goes up and down due to high turbulent currents. Hilsa Survives only in this type of high currents and cross currents. They are always on the move at a high speed. They swim in a batch and abhor single movement, they move in flocks. This Stream is primary condition of their breeding. Saline water is not conducive to their survival. They usually love to live in non-Saline Water But in this region of Bay of Bengal they survive without any problem only because there is high current both in downstream and upper stream.

Lobster, Prawns, Prawn with eggs e.t.c. also prefer to live in saline water. Pershe, kharsuna type of fishes live in saline water, swimming over the surface area of the water level on the other hand vetki live in deep water. Boal, Aar e.t.c survive in saline water but in different conditions, like that of a dwelling hub or a pit on the sea or canal bed deep into the water specially designed by themselves with their physical movement and body secretions. Oval shaped clean pit measure in 3 f.t. x 2 f.t., 2x2 f.t., 2x1 f.t. etc. are there own make ups. They build their own dwelling place so physical condition of the soil should be of alluvial type.

Soal, taki, Gazal, Koi, etc. prefer to live in Stagnant Clay laden water. They can live inside clay without keeping contact with water. Saline water or non-saline water this type of fishes live in stagnant and muddy confined water casement, pangas, chilinda etc. they live in saline water in different physical condition. They do not prefer high current or low current. They prefer only fruits from “Bain Tree” (available in the Sundarban delta). They swallow this fruits and survive without any problem. Reptile type fishes like Ban, Kuche, etc. they live deep into the clay beneeth the water without which they cannot survive. Carptype fishes like Rohi, Katla, Kalbous, Mrigel etc. Survive in fresh water, stagnant or non stagnant water. Another important fishes imported from Japan survive in darty and diluted water Telapia belongs to this category. Crabs are amphibious; they survive in land and into water

Table 2.1 : SOME COMMERCIAL MARINE/ESTUARINE FISH OF WEST BENGAL

Family Name	Local Name	English Name	Scientific Name
Ambassidae	*Khone Bhetki*	Commerson's glassy perchlet	*Ambassis commersoni*
Apolectidae	*Pomfret/Bahul/ Baoul Firka*	Black pomfret	*Apolec tus niger*
Ariidae	*Tangra/Kaatta/ Samudrik* arr	Catfish	*Arius spp*
Ariommidae		Indian driftfish	*Ariomma indica*
Belonidae	*Samudrik kankley*	Round-tail needlefish	*Strongylura strongylura*
Carangidae	*"Sardine"/Hooroori*	Scad	*Megalaspis cordylal Decapterus spp*
Carcharhinidae	*Kamat*	Baby shark	
Carcharhinidae	*Hangor/shark*	Yellow dog shark	*Scoliodon la ticaudus*
Centropomidae	*Bhekti*	Giant sea perch	*La tes calcarifer*
Chanidae	*Milk fish*	Milk fish	*Chanos chanos*
Chirocentridae	*Samudrik jola/ Samudrik* chela	Wolf herring	Chirocentrus spp.
Ciupeidae	*Koka iiish*	*Kelee* shad	*Hilsa kelee*
Clupeidae	*Khoira*	Chacunda gizzard shad	*Anodontostoma chakunda*
Clupeidae	*Khoira*	Sardine	*Sardine/la spp.*
Clupeidae	*Phansha*	Russel's smooth-back herring	*Raconda russeiiana*
Clupeidae	*Hilsa*	Hilsa shad	*Hilsa iiisha*
Clupeidae	*Khoira*	Bloch's gizzard shad	*Nema talosa nasus*
Clupeidae	*Chandana ilish/ Kajli ilish*	Toli shad	Hilsa *to/i*
Cynoglosidae	*Kukurjibh/Paa ta*	Tongue sole, sole	*Cynogiossus spp.*
Dasyatidae	*Shankush/Shankar mach*	Sting ray	Das *ya tis spp.*
Engraulidae	*Phansha/Tapra/ Tapre/Tapda*	Indian ilisha/Herring	*Ilisha spp.*
Engraulidae	*Phansha/Tapra/Tapre*	Th ryssa	*Thryssa spp.*
Engraulidae	*Phansha/Tapra/ Tapre/Tapda*	Gangetic anchovy	*Setipinna phasa*
Engraulidae	*Amadi*	Korua grenadier anchovy	*Coilia re ynaidi*
Engraulidae	*Phansha/Tapra/ Tapre/Tapda*	Whitebait	*Stolephorus spp.*
Engraulidae	*Ruli*	Grenadier anchovy	*Coilia dussumieri*
Ephippidae	*Samudrik chanda*	Spotted drepane	*Drepane punctata*
Gerreidae	*Samudrik chanda*	Whipfin mojarra	*Gerres filamentosus*
Gerreidae	*Samudrik chanda*	Longfin mojarra	*Pentaprion longimanus*
Harpadontidae	*Lutia, bumaloh, nehare, bambla*	Bombay duck	*Harpadon nehereus*
Leiognathidae	*Samudrik chanda*	Striped ponyfish	*Leiogna* thus *fascia tus*
Lobotidae	*Pa yra chanda*	Brown tripletail	*Lobotes surinamensis*
Loliginidae/Sepiidae	*Dhalla/"Octopus"*	Squid/Cuttlefish	*Loiigo spp., Sepia spp.*
Mugilidae	*Parshe y/Parse*	Goldspot mullet	Liza parsia
Mugilidae	*Ain*	Flathead grey mullet	*Mugil cephalus*
Mugilidae	*Parshey/Parse*	Borneo mullet	*Liza macroiepsis*

Family Name	Local Name	English Name	Scientific Name
Mugilidae	*Corsula/Bhangonl Ingelee*	Corsula mullet	*Rhinomugil corsula*
Mugilidae	*Bhangon*	Tade grey mullet	*Liza tade*
Mullidae		Goatfish	*Upeneus spp.*
Muraenesocidae	Barn	Pike conger	*Muraenesox spp.*
Myliobatidae	*Shankar mach*	Spotted eagle ray	*Ae toba tus spp.*
Nemipteridae		Threadfin bream	*Nemipterus japanicus*
Ophichthidae	*Barn*	Bengal snake-eel	*Pisodonophis boro*
Penaeidae	*Honne chingri*	Speckled prawn	*Metapenaeus monoceros*
Penaeidae	*Chabra*	Prawn	*Penaeus spp.*
Penaeidae	*Channe chingri*	Yellow prawn	*Metapenaeus brevicornis*
Penaeidae	*Bagda*	Giant tiger prawn	*Penaeus monodon*
Penaeidae	*Chapda chingri*	Indian white prawn	*Penaeus indicus*
Penaeidae	*Hende Bagda*	Green tiger prawn	*Penaeus semisulca tus*
Plotosidae	*Kandhia*	Striped catfish-eel	*Plotosus linea tus*
Plotosidae	*Kan-magur*	Canine catfish-eel	*Plo tosus canius*
Polynemidae	*Tapshey mach*	Paradise threadfin	*Polynemus paradiseus*
Polynemidae	*Sahal/Guchial/Gurjali*	Fourfinger threadfinl "Indian salmon"	*Eleutheronema tetradactylum*
Polynemidae	*Gurjali*	Seven-finger threadfin	*Polydactylus heptadactylus*
Polynemidae	*Gurjali*	Blackspot threadfin	*Polydactyius sextarius*
Polynemidae	*Gurjali*	Indian threadfin	*Polydactylus indicus*
Portunidae	*Kakda*	Crab	
Priacanthidae		Bigeye/Bullseye	*Priacanthus sp.*
Pristidae	*Korat mach*	Sawfish	*Pris tis spp.*
Rachycentridae		Black kingfish	*Rach ycentron canadus*
Rhinobatidae	*Shanker mach/Hangor*	Shovelnose rayl Guitarfish	*Rhinobatos spp.*
Scatophagidae	*Paira chanda*	Spotted butterfish	*Sca tophagus argus*
Sciaenidae	*Bhola*	Two-bearded croaker	*Daysciaena albida*
Sciaenidae	*Bhola*	Jewfish/Croaker	*Johnius spp., Otolithus spp., Otolithoides spp.*
Scombridae	*"Mackerel"*	*Indian mackerel*	*Rastrellicer kanagurta*
Scombridae	*Bijram/Mackerel*	Seer fish/Spanish mackerel	*Scomberomorus spp.*
Scyllaridae	*Chingda*	Mud lobster	*Thenus orientalis*
Sergestidae .	*Chingri/Gogua*	Paste shrimp	*Ace tes spp.*
Sillaginidae	*Samudrik belle*	Silver sillago	*Sillago sihama*
Sillaginidae	*Toolmach/Tool-belle*	Gangetic whiting	*Sillaginopsis panijus*
Sphyrnidae	*Magarl/Hangorl Shankar mach*	Hammerhead shark	*Sph yma spp.*
Squillidae	*Polta*	Mantis shrimp	*Ora tosquilla nepa*
Stromateidae	*Chandil/Pom fre t*	Chinese pomfretl White pomfret	*Pampus chinensis*
Stromateidae	*Chandil/Pomfret*	Silver pomfret	*Pampus argen teus*
Teraponidae	*Boorgoonil/Jerrpyel Ka t-koi*	Jarbus terapon	*Terapon jarbua*
Trichuridae	*Rupaba til/Churil/Pa tia*	Ribbonfish/Hairtail	*Lepturacanthus spp., Trichiurus spp.*

Source: Cited in Amullah Bhusan Chakraborty, *Fish science.*

Some typical fish which are vertebrates they have adapted themselves to a wide range of environments. They are found in the icy waters of the Polar Regions on the one hand while they exist miraculously uncooked in the hot desert pools up to a temperature well above 100ºF, On the other hand. They may roam widely over the vast expanses of open sea or spend their entire life in the cramped underground quarters of an artesian well. They thrive in high mountain lakes and also in the abyssal depths of the ocean. They may even leave temporarily the aquatic habitat to scamper mud flats or climb small trees in search of food. If the pools dry up, they may bury themselves in the mud and spend the dry season, breathing air. On the whole, it can be said that where there is water there are fishes and three fourths of the earth's surface is covered with water.[11]

Water system is another important factor. Physical conditions of South 24 Parganas and its adjoining areas offer Suitable grounds for fish breeding. Bengal is a reverine region; it is very important factor to have a natural breeding ground. This rivers and canals are utilised to prepare natural breeding ground for the fishes, abandons of fishes is found throughout the season. Maximum fishes are found in the process of natural breeding system without any human interference. They are grown in plenty without any external help, for the water of this canal etc. is very much essential for their survival. In South Bengal this canals are principal centre of breeding. Fish catch is done without any trouble. Fishes are confined in knee deep water logged areas of the canal bed, from where they are easily caught by the fishermen. Small fishes collected from them are given to the ponds for further rearing or breeding. Big fishes are sending for marketing. Fishes found in this Canal and tributaries are of natural breeding of the saline water. It requires no human effort or technological device. It is a system of natural breeding in a perfect ecological system. Normal breeding technique is the breeders keep open one side that is mouth or entry point of water into the land adjoining the roads and embankment. At high tide different types of fishes or enter into that area and failed to return to sea or canal water because the breeders closes the area with artificial tools called charo (made from bamboo). The fishes are confined in shallow water in low tide and they are also in their normal behavioural patern of breeding in high tide, when the area is filled with water.

In West Bengal there are many artificial fish breeding centres where at the initiative of organise sector plans and programmes and disorganised sector. Seasonal breeding are carried out at a regular interval. Hybrid fishes and its production are of main attraction, for with the growing demand of the fishes of the market. Fish production on a higher scale is a must. In disorganised sector of breeding we can mention the varis, where fish breeding is done on a cooperative basis with indigenous skill and experience the fisherman continue to produce hybrid fishes, sometimes they get regular advice from the Agriculture and fisheries department, Govt. of West Bengal.

Fish breeding and rearing may be divided into two branches i) fish seed from natural sources and ii) artificial breeding or Induced breeding or modern method.

Riverine collection of major carp spawn still remains to primary source of spawn, its contribution to the total production in 1964-65 being as much as 91.67%. Riverine collection has obvious limitations beyond a certain level of exploitation and is very much dependent on several ecological and meteorological factors. The seed of major carps and of some medium carps as well are collected during the monsoon months, when the mature fish ascend the flooded rivers and breed on finding suitable ecological meteorological and climatological conditions, where actual breeding grounds have been located the eggs are scooped out from shallower grounds, by means of rectangular pieces of mosquito netting of varying sizes. However from fast flowing waters they are collected by Benchijal. Carps pawn which emerge out of the eggs in 18 to 24 hours and measure 5-7 mm in length, are collected by means of a specially devised gear the Benchijal (Shootingnet). In Medinipur District of West Bengal the dimensions of Spawn Collection nets are: length of net proper 320 Cm, width at mouth 312 cm. height at mouth 61 cm, ring diameter 23 cm. length of gamcha 168 cm, hight of gamcha 62 cm., and width at rear end 44 cm. Spawn a part fry and finger lings are also collected from the rivers. The fry and fingerlings are collected by fry collection nets, which are fine meshed drag nets. The fingerlings are also collected by cast nets, traps or fine muslin cloth, while them, jump over to cross the irrigation barriers. Basket traps are used for collecting fry and fingerlings in the rivers Godavari, Krishna and Cauvery. In West Bengal spawn area collected at several centres on the rivers Ganga, Padma, Bhagirathi and Damodar. Estimated spawn production in the state from riverine Sources appear to be 11,583 lakhs.

Bundh breeding which is prevalent only in the states of Madhya Pradesh and west Bengal, accounted for 5.38% of the total fish seed production in the country. In west Bengal the soil of Dry bundhs is mostly of red laterite type, hard in dry season but assuming a sticky character during rains. The catchment area, which is about five times the maximum water spread of the bundh consists of barren or agricultural land and covered over with trees such as that of sal, Peasal, Mahua, mango, and tamarind and other miscellaneous bushes. The bundhs are repaired before the commencement of the monsoons, the inlets and outlets checked and provided with a bamboo or velon screen to prevent the escape of breeders and the entry of undesirable species. No sooner sufficient water is accumulated in the bundh, breeders from nearby ponds are introduced with, however no regard as to their total numbers, sex ratio, sizes condition of gonads etc. The fish breeds generally during the early hours of the morning, which continues through the day and almost at any place in the bundh. The eggs are collected by pieces of velon net or Mosquito netting cloth and hatched in earthen hatcheries located nearby. The hatcheries being not very deep and filled up with silt-laden water, the eggs or spawn are also subjected to exposure to high temperatures, particularly when the rains stop and the sky become clear. The percentage of survival and hatching is however, very low. The estimated production of spawn from bundh breeding of West Bengal amounts to 1,500 lakhs. The second important is wet bundh breeding.

Even though the induced breeding of major carps through the administration of Pituitary hormones is being increasingly taken up all over the country over the last few years, yet it accounted for only 1.57% of the country's total Spawn Production of the year 1964-65. A preliminary analysis of the formations furnished from different states indicates that during 1970 carp breeding season in India approximately 5,000 sets of carp breeders of different species have injected and out of these just about 2,000 sets have successfully spawned yielding fertilized eggs and spawn.

Hypophysis is believed to the first link between the receptor organs and the endocrine system. Environmental factors, such as rain, flood, temperature, light etc. probably influence the pituitary gland to release the gonadotropic hormones and precipitate spawning in fishes. The pituitary gland of fish is the main source of hormones usually used in breeding indian carps. Fish pituitary hormones are still considered to be the best and most effective. Selection of suitable donor fish for collection of glands is of prime importance.

Indian major carp breeders are usually raised in fish farms. Ordinarily 2 – 4 years old carps are collected and stocked in broad fish ponds at the rate of 100-2000 kgs per hectare a few months prior to fish breeding season. Utmost care is taken in selecting breeders for injection. When regular monsoon sets in, the fishes become fully ripe and water temperature goes down, the breeding operation is started. Breeders are handled very carefully during operations. The breeders are then ready to receive injections. Determination of proper dosage of hypothysis depends largely on the exact stage of sexual maturity of the breeders and also to some extension the environmental and climatic conditions.[12]

Instramuscular injections of fish Pituitary extract are administered usually in the region of the caudal peduncle a little above or below the lateral line. Immediately after injection the breeders are released inside a breeding happa. In usual practise when two doses are administered to the females the spawning generally occurs 3-6 hours after the second injection. Carp eggs, after fertilisation sweel to the size of a pea and are non adhesive and demersal. The specific gravity of eggs is slightly higher than that of water. Usually the eggs are removed about 8 - 10 hours after fertilization. The eggs are then distributed to a series of hatching happas for hatching.

Table 2.2: Fish Seed Production in West Bengal (Unit in millions)

Year	Target	Achievement
1991-1992	8000	8150
1994-1995	8100	8126
1995-1996	8150	8180
1996-1997	8400	8435
1997-1998	8500	8500
1998-1999	8610	8610
1999-2000	8700	8725
2000-2001	8850	8850
2001-2002	9000	9000
2002-2003	9100	9100
2003-2004	10000	11890
2004-2005	12500	12200
2005-2006	12500	12500
2006-2007	13000	13200

Source: Government of West Bengal Annual Report 2006-2007

In South Bengal or in North Bengal fishes enjoy the facilities of eco friendly Sustenance, for the natural breeding growth of the fish's foods or the nourishing agents are very much essential. A fish usually lives on other fishes, sometimes on the same categories of fishes. A big fish eats smaller fish. A smaller fish consume another smaller fish. A big vetki of four to five feet length makes prey to a fish of one f.t. or so. Carps sometimes consume very big fishes after a kill. Carp and some types of fishes collect food from swampy water and clay alone. Ecological sustenance system is the best breeding and rearing system of fishes in rivers, canals, tributaries and seas, offering best system of pisciculture down the ages. Fishes are remarkable agent between nature and human being. It is a natural process through which sustenance of human being, animal is feasible. Not only that our industry and civilization get appropriate support from the fishes, Petrol Reserves, medicinal products etc. are available from this unique kind of creatures of the world.

Fooder chart

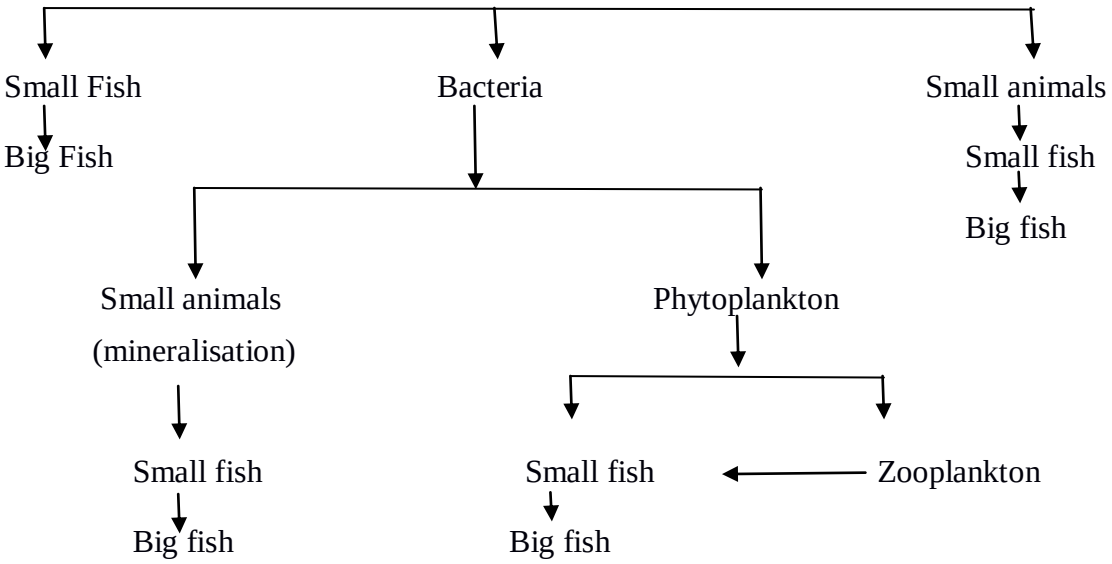


Fig. 1: Fooder chart

Global trade and commerce compels the fish industry to engage very large number of labourers. The atmosphere has forced the Industry to arrange increased production, proper marketing and distribution. The skilled labourers who are expert in catching fish in the pond, river, and canals seas play an important role for the process of the whole system. In west Bengal at present it is the second largest employment opportunity for the labourers throughout the season the fishermen and women are working to support Human-Belts, with different types of necessary supply of fishes.

Festivals, Functions, entertainments, Hotel Business, etc. are keeping a harmonious supply from this food production. So large number of the bengali population skilled or unskilled men or women, adult or children are deployed to maintain this trade. It is a source of livelihood to the habitats of Bengal.

Fishermen need rapid communication when they do fishing in the deep seas. They need to talk with their fellowmen. Weather report is also an important factor to them when they catch fish in the deep seas. Market price of every international market rises and falls frequently. Fishermen and their business organisation cannot do their works smoothly unless they are fully acquainted with the international market price. Computers, televisions and information technology are carrying out this entire worker for the benefit of the pisciculture. Super computer helps the fisherman by forecasting weather report when they catch fish in the troubled seas and rivers. Fishermen of a particular region can talk immediately to any other fishermen of Scandinavian fish market through the Internet channel which works through computer. So there is no doubt that these three Media have brought renaissance in the pisciculture.[13]

Pisiculture is suppliment to Agriculture. Agricultural land and Agro base products that is rice, wheat, Jute etc. occupy our main share of Economy, that too is narrowed now by the thin margin since cultivators depending on Agricultural land are now using their lands to culture fishes. Most of the land of West Bengal generally produce one or two crops in a year. Fish can be cultivated in that piece of land several times, in a year. Moreover Fish cultivation can be done without harming agriculture. It will be more profitable if fish and crops both are cultivated in a particular piece of land. This trend that is crops and fish has been cultivated in a same land under the care of same farmer. Peasents are taking interest to cultivate both fish and crops unitedly in order to solve their economic problem. Trade and commerce on fish is now quite profitable, its demand is also very high from traditional stand point of agro based economy importance is shifted to pisciculture from age worn habit of self complacency on exclusive food production.[14]

2. Technology of pisciculture And Apparatus

Fishing technology

Fishing technology and fish technology comprise very different aspect of primary production industry and commerce of fish and shell fish. fishing technology covers devices and naval equipment that improve fishing performance such as design and shipbuilding, electronic navigational aids, radar, propulsion systems, echo sounder, sonar and other under water equipment for tactical information, nets, lines, traps, accessories and appliances to handle them.

Fishing is considered to be the earliest form of hunting and the world's oldest industry. Engels maintains that the middle stage of the savage stage began when man started catching fish for food and using fire. As a regular occupation fishing began some 50,000 years before our era. The most simple and primitive form of fishing was used-catching the fish with bare hands. The first fishing implements began to appear about 25,000 years before our era.[15] The system of evolution of the equipments of catching fishes has been widely discussed by W. Robinson, James Hornel and Soudarlal Hora.[16] Pisciculture cannot go without women. Their contribution to this field is very important. Their financial inability has forced them to join it. Net weaving mainly done with the threads made of cotton and silk. The whole fishermen family finds job in weaving the nets at home.[17]Nets vary as per the character of watery environment. Hundred kinds of net are found. They are classified into five groups i) Drift and Gil net, ii) Drug and trawl net, iii) Sen. Net, iv) Bag Net, v) Cast Net.[18] James Hornell had mentioned the uses of various kinds of nets in different ponds. Specially "Chhandi and Sangla were used for catching Hilsa Fish.[19]

The scoop nets or dipping nets were used in the Big River like Ganges known as Mahajal. It is 1,000 f.t. in length and 30 ft. in breadth. The holes of the nets were of 1.5 to 2 inches to catch the various types of fish. Same kind of nets was used in different places in different names. A small kind of nets named chotaber is used for catching fish in Dhaka and Faridpur in East Bengal. Chhandi was suitable for big rivers. It is kind of Drift class net. Another type is cast net which is used poor fishermen.[20] Equipments and techniques are the base of pisciculture. The famous novel "Padma Nadir Majhi" by Manik Bandyopadhyay had mentioned clearly the use of small harpoon in the field of catching fish. Polo was also an important trap. Two

kinds of boat were found in the Gangetic delta– one was Raft and other was the wooden boat. Bachari, Mechobachari Balan was fishing boat which was popular among the fishermen.

The adaptation of new technologies could help small scale fisheries increase their catch. Passive gear is stationary. It does not have to be dragged or towed to capture fish. The simplest form of fishing requires only a line and a baited hook. Japanese fishermen use sailing rafts to tow long lines away from their boats. Surface long lines are used to capture tuna, shark, and beel fish. Traditional techniques employing traps and pots have developed in all regions of the world to catch demersal species. Weirs and trap nets have a number of advantages that favour their use in developing countries. Entangling nets are net walls, placed transversely to the path of migrating fish. Trammel Nets is another important Net. Lift nets are lifted from the water at the moment when the sought after fish have gathered over them. Trolling is also an excellent auxiliary method and can be used as the vessel is going to or returning from other fishing grounds. Krill Nets used by the small fishing boats in Japanese waters. It increases the capture capacity and the processing rate of krill. Much marine electronic equipment was initially developed for military use in Communications, navigation, and underwater reconnaissance.

Fish Technology

Catches depend on systems for handling fish, processing and its preservation on board. Fish technology covers pre treatment processing, reprocessing, packaging and quality control. In a restricted sense, fish technology is present during the services and trade stage in landing operations, handling and transport of raw materials and products storage, distribution and exhibition of final products. In a wider sense, marketing and promotion of consumption is technology too. Usually features of frozen, Fish products are closely associated with selling and promotion methods. The purpose of this paper is to examine institutional and socio-economic influences that affect fish technology. Many innovations are directly taken from scientific and technological applications in other fields such as food in general, packaging transport, textile, and electronics. Briefly fish technology is developed within a double context science, technology and the socio-economic circumstances of the world and each country.

Postharvest losses of fish occur during the numerous steps from catch to market. We know some technologically simple preservation and processing methods, which could be adopted at the village level. Fresh fish are highly perishable and start to spoil as soon as they are landed. For high quality fish should be chilled as quickly as possible to 0°c. The purpose of secondary processing is to convert the raw fish into a form that is still acceptable to the consumer and that has a longer shelf life. Salting has no adverse effect on the value of fish protein and it has been used for thousands of year to preserve marine products. Drying and smoking is another traditional preservation technique[21] chittagong, Faridpur and Tripura were famous for salty Hilsa preservation centre.[22]

Fishery cooperative

The very word cooperative has been derived from cooperation. The word cooperative has come to the front. When the strength of an individual had been defeated in all sphere even in the economical field, when a group of people find no way to develop their respective business, like farming, agriculture, fishing, leather industry etc. they then seek an unity among them, and thus they tried to develop their fortune unitedly. In this way in order to develop the pecuniary circumstances of the fishermen when their individual effort failed to bring any progress they, following the foot print of different weak community formed cooperative among themselves in Bengal to drive out the exploitation from the opportunist, Like Mahajans who lend them money with high interest. Thus they tried to grow economically strong and showed their identity to the others being strong by driving poverty from their life.[23]

The cooperative awareness became popular among fishermen both settled and refugees. The state as well as some other organizations likes the Royal commission on Agriculture, The central committee for cooperative training (1953), All India Rural credit Survey committee (1955) and the cooperative planning committee (1946) unconditionally supported the formation of the cooperative societies on fisheries. Five years plan also emphasised the cooperative movement in the fisheries. Thus many cooperative societies such as i) Primary ii) Central and iii) state level fishermen cooperative societies were found in West Bengal.

Table 2.3: Fishermen cooperative Societies of West Bengal 2001-2002

Sl No.	Level of FCS	Number
1.	State level Federation	1
2.	Central	20
3.	Primary	1171
(Inland - 999, brackish water - 41, marine 131)		

Source: Dept. of Fisheries, West Bengal.

The modern generation of the fishermen who were educated had come forward to organize the traditional fishermen for their progress. State and district level preparatory committees were formed to draft the constitution, rules and regulation of the W.B.F.C. The W.B.F.C got its final shape in 1969.[24] The W.B.F.C. had establish constitution and its some objectives such as upliftment of lives, livelihood and Economic status of the fishermen, increasing fish production, spreading education to arouse the self consciousness, to make adequate employment, to organize the Cooperative movement and so on.[25] There is also a Government sponsored cooperative organization launched as a pilot project for rendering assistance to the estuarine fishermen.[26] In Japan most of the fishery co-operatives have their own shop for supply of engines, spare parts, fishing materials. In terms of business turnover the supply business is comparatively small in Japan. In Japan separate cooperatives have been set up to deal with fishing boat and fish catch insurance.[27] The Government gives financial assistance in the form of premium, subsidy and reinsurance, thus spreading the risk of the insurance. Throughout the 1970S and 1980S the W.B.F.C. had been working for the all round development of the fishermen communities through the proper management of the water resources.[28] The primary Fishermen's cooperative societies are the main organ of fisheries development in the state. But most of such co-operative societies are in moribund condition and some are on the liquidation stage. The central or state Government has been proposed to fix outlay at Rs. 5.00 crore in the 11th plan for strengthening the capable co-operative societies to bear the work load for socio-economic upliftment of poor fishermen members of such societies.[29]

Table 2.4: District wise Status of Fisherman Co-Operative Societies in West Bengal

SI. No.	District name	No. of CFCS	Primary Fisherman Co-Operative Society				
			Category-A	Category-B	Category-C	Total	No.of ornamentl Co. op
1.	Darjeeling	1	1	0	1	2	-
2.	Jalpaiguri	1	13	1	2	16	1
3,	Coochbchar	1	61	4	0	65	-
4.	Uttar Dinajpur	1	15	19	0	34	11
5.	Dakshin Dinajpur	1	13	4	0	17	8
6.	Malda	1	88	2	0	90	13
7.	Murshidabad	1	14	64	18	96	9
8.	Nadia	1	27	28	18	73	1
9.	Birbhum	1	3	6	12	21	9
10.	North 24 Parganas	1	41	17	31	89	1
11.	South 24 Parganas	1	36	28	38	102	21
12.	Howrah	1	13	2	7	22	5
13.	Hooghly	1	14	6	15	35	
14.	Burdwan	1	25 .	12	17	54	-
15.	Purba Medinipur	1	54	0	0	54	6
16.	Paschim Medinipur	1	21	0	2	23	
17.	Bankura	1	23	5	34	62	7
18.	Purulia	1	15	10	23	48	-
19.	Purba Medinipur (Marine)	1	25	0	75	100	-
20.	South 24 Parganas (Marine)	1	4	7	39	50	-
Total		20	506	215	332	1053	93

Total No. of P.F.C.S. -1053 Total No. of CF.C.S. - 20 BENFISH- 1

Source: Annual report 2006-07 Dept. of Fisheries, Govt. of West Bengal

Category-A indicates -Functioning Societies, Category-13 indicates-Non Functioning Societies having potential to be revived, Category- C- indicates Nun Finn-Honing & Nun Traceable Societies without having to be revived.

Although the fundamental principles of co-operatives regarding their organisation and functions are the same for any type of co-operatives, the range of activities; and kinds of undertaking in fisheries they cover one or more of the followings– i) Ownership and operation of fishing vessel, ii) Provision of credit for fishermen and encouragement of thrift, iii) Marketing of fish, iv) Warehousing and cold storage, v) Transport, vi) Fish processing, vii) Supply of fishing materials, viii) Maintenance and repair of fishing craft and equipments, ix) Manufacture of fishing materials, x) Technical services, xi) Insurance of fishing craft and equipments, xii) Control of fishery rights, xiii) Insurance of fishermen and xiv) Social and educational services. The relative's importance of fishery co-operatives in terms of volumes of business as compared with companies, merchants and processors varies a great deal from country to country.

Fishermen's co-operatives should meet the needs of fishermen. Marketing and supply co-operatives are largely inspired by the desire of the fishermen to eliminate the monopolistic structure dominated by traders and middlemen prevailing in the fisheries economy. When replacing middlemen by co-operatives it is essential that all the functions performed by the middlemen should be taken care of by the co-operatives that is i) advancing fishermen's working capital before fishing seasons start ii) Supplying fishing gear and other requisites experience shows that, by and large successful cooperatives are most often multipurpose Para cooperatives dealing with all these aspects.

Members of fishermen's cooperatives should have common interests. The interests of traditional small fishermen are often different from those doing mechanised fishing. There is danger of the limited amount of fund of cooperative being used for the benefit of the later even if they are minority members. Sometimes merchants are allowed to be members, hampering the activities of the cooperatives aimed at the benefit of small scale fishermen, because of the conflicting interests. Obvious need to the understanding and support of the members to overcome the opposition from merchants and middlemen with strong economic power. Some Government assistance is necessary, particularly in the initial stages, and special attention is required to educate fishermen in principles of cooperation.[30]

3. Catchment area– Tank and pond fishing, sea fishing, river fishing

Any kind of crop that is paddy, jute, and tea whatever it might be, it thrives well in suitable geographical conditions. Weather, climate are also helped a lot. Paddy grows well in the soils receiving fresh silt every year. Tea grows well in the hilly tracts. Similarly jute grows well in the moist heat. Fish being a valuable natural resource of Bengal had been flourished in full swing as they had got a vast habitat provided by Geomorphological and Geographical features of the Deltaic Bengal. Different writers had given different data regarding the species of fish in Bengalis water bodies.

K.C. De mentioned 250 different species of fish in his report.[31] The location of Bengal had been favoured by the three great river system the Ganga-Bhagirathi, Padma, Brahmaputra, Jamuna, Meghna.[32] Their branches and tributaries had been spread like network through the region. As a result fishing communities found an immense scope to depend on fish for their livelihood. The river system of central West Bengal where main rivers the Ganges, Bhagirathi or Hooghly, Bhairav, Jalangi, Mathabhanga and Churni, are found. They are very rich as natural fisheries the traditional fisherman find an scope for fishing in all this rivers all most all the year round. Because the rivers of this zone are deep and maintain favourable current the fisherman need. More over as they get fishing scope here throughout the year. They also enjoy marketing facilities through the market standing on the banks of all these rivers. The fishermen also get communication facilities through which they can reach Kolkata, Bombay, Madras and many other cities of their liking. Similarly the rivers of extreme of South of West Bengal are very famous for the catching of fish throughout the year. The Hooghly, Kalindi, Ichhamati, Raimangal, Bantala, Saptamukhi, Piyali, Matla, Bidhyadhari, Thakuran, Haribhanga and Garba are the favourable ground where fishermen can fishing for the period they like most. Even in the winter season when all other rivers of the country are dried up and presented themselves as no fishing zone, Southern Bengal System Rivers presented themselves suitable fishing ground maintaining proper current for fishing.[33]

Bengal had got many natural and manmade water reservoir such as beels, Haors, Baors, Jheels, Canals, lakes and ponds, Above all Bay of Bengal, had flowed through a long coast line of about 570 miles from Chittagong to Puri in Orissa. It had many creeks which are the names of the varieties of brackish water fishes. As a result

deltaic Bengal became the homes of different kinds of fisheries. K.G. Gupta has mentioned three Kinds of fisheries. They are (a) Fresh Water, (b) Brackish water c) Sea. The jheels, Canals, ponds and rice fields were the base of the fresh water fisheries. Its area was 7,000 to 8,000 square miles. It produced nearly 960010 maunds of fish of which 90% was exported to Kolkata.[34]

The fresh water fish belonged to the family of carp. Migratory fishes are also found Buchanon Hamiltons list of migratory and non migratory fishes in the freshwater of the district of North Bengal is an authentic document. Next comes brackish fisheries the estuaries of Sundarbans of Khulna and 24 Parganas were very important for fish production and supply. There are so many small rivers, creeks; canals are found in this region. The local people called it khal, upakhal, paskhal and chatra. All khals and canals ran to Chatra, This chatra is the standing place of fish. The extent of water, included creek, canal khal, upakhal, paskhal was 1,355.5 square miles.[35] In South 24 Parganas there are numerous Canals (Khals) excavated for the purpose of irrigation. Bhangar, Katakhal, Diamond Harbour creek., Vishnupur Khal, Mograhat Khal, Joynagar Khal, Hotore Khal, Sangrampur Khal, Krishnapur Khal, Shibkali Khal and Satjali Khal scattered all over the region. T. South wells Report flashed those Sundarban fisheries supplied not less than 2, 00,000 maunds or 7,346 tons of fish to the Calcutta Market. The important fishes that had been caught were hilsa, Bhetki, Pomfrets, Prawn, Katla, Rouhi. Most of the catches would be damaged as the transport facilities were poor. The problem is still continuing.[36] K.G. Gupta mentioned many Bheries under the municipal fisheries of Kolkata at the Saltlake which acted as nurseries and fish of various kind, chiefly prawns, and small bhetkis etc. were caught.[37]

The fisherman who are poor and whose arrangement are not rich they catch fish in the canals and baors for a particular time. During the time of rainy season when catch fish in all these ponds. When the paddy is cut down and the beel become dried up the fish of the Beel take shelter in all those ponds. Some canal and estuaries are also suitable fishing zones. The beels were numerous in 24 Parganas, Murshidabad, Bankura, Medinipur, Jalpaiguri and Maldah districts. A total 1.266 lakh acre had been estimated as the water area consisting with beels and tanks in West Bengal. Big tanks are also found in Coochbehar District. In the dry season, fishermen find difficulties in catching fish in some Beels and haors as they are silted up. But in the rainy season

they become suitable for fishing. Open beels which have connection with the Parent Rivers through narrow channels during the monsoon are the fishing ground, where us which cut up from the parents river, are called closed Beels play a very poor part as a fishing ground.[38]

Table 2.5: District-wise area of River, canal/Khal, Beel and Baor

SI. No.	District	River	Canal / Khal	Beel / Baor	Total Area
1	Coochbehar	13095.82	1664.58	1168.11	15928.51
2	Jalpaiguri	16006.44	562.29	504.38	17073.11
3	Siliguri	3395.63	683.94	683.94	4763.51
4	Uttar Dinajpur/ Dakshin Dinajpur	4032.08	1774.30	3548.59	9354.97
5	Malda	6497.60	2511.42	4551.55	13560.57
6	Murshidabad	36283.23	10013.88	3790.69	50087.80
7	Nadia	4191.28	2771.75	4271.61	11234.64
8	24-Parganas(N)	14299.00	8712.00	8861.19	31872.19
9	24-Parganas(S)	17704.98	13492.47	5749.47	36946.92
10	Howrah	107.36	2019.82	118.28	2245.46
11	Hooghly	4358.74	3784.94	3884.76	11958.44
12	Purba Medinipur/ Paschim Medinipur	12774.12	8766.07	404.01	21944.20
13	Bankura	15960.15	11711.04	1973.00	29644.19
14	Purulia	3707.29	-	-	3707.29
15	Burdwan	11316.64	5991.36	1939.91	19247.91
16	Birbhum	795.63	5695.85	632.16	7123.64
	Total	164525.99	80085.71	42081.65	286693.35

Source: Annual report 2006-07 Dept. of Fisheries, Govt. of West Bengal

A special kind of fishing is found among the jeles of Sundarban regions. They often use Bachari boat when they catch fish in the canals, khals and in the tributaries of Bay of Bengal. They adopt a powerful natural technology. Which is more powerful than scientific modern technology? There are thick bushes grown on the both banks of the khals of the Sundarban regions, adjoining of Bay of Bengal. These thick bushes covered half the portion of the khals and become a resting place of different kind of fishes. Human power fails to go there as a result catching fish remain stopped. So to overcome this difficulty jeles keep civet-cat– A mongoose like animal gifted with a magical power of catching fish. They can dive under water for hours. These civet-cats are very ugly to look at. Their crying is uglier than their body colour. When they become angry, only Jeles can pacify them. When Jele find difficult to catch fish in such thick bushes they let civet-cat go under bushes in the khals and they (civet cat) drive out all the fishes from the bushes and help them to come to the net put outside the bushes. This civet cat technology is very powerful for catching fish in the fishing zones surrounding Sundarbans and its adjacent areas.

The sea fisheries included fore sea and deep sea. The fore sea worked from october to march in calm weather. Balasore and chandipur were the best of them. There were also some substations.[39] During this period fishing was done by fixed nets. The catches were done twice in a day. High tide was not preferable, but in low tide the process could procure good result. Small fishes as well as big like sharks, skates and crabs were found among the catches. Local markets were the suitable place where the fishermen sold their catches and the rest were sent to Kolkata.[40]

Table 2.6: Water resources of West Bengal

Particular	Total Potential Resources in (Hectare
Inland Sector	
Ponds/Tanks–	276202
Beel and Baor–	41782
Reservoir–	16,739
a) River– 1,72,587	
b) Canal– 80,086	
Sewage fed fishery–	4083
Brackish Water fishery–	2,10,100
Marine Sector	
Inshore area(Up to 10 Fathom depth)–	770 Km2
Off shore Area (10-40 fathom)–	1,813 Km2
Continental Shelf (Up to 100 Fathom)–	17,049 Km2
Coast line–	158 km

Source : Government of West Bengal, Economic Review 2001-2002

Water pollution and water hyacinth are harming to fishing zones. The Government of West Bengal has taken steps in marine fishing; the Bengal Govt. thought for marine fishing in the Bay of Bengal and took steps to carry out a number of schemes. But for the lack of modern trawlers and fishing harbours the scheme became unsuccessful. The Scientific Pisciculture is advancing forward day by day. Our fisherman and their organisations are proceeding forward to cope with the enlightend country rich in fishing with scientific apparatus and modern fishing harbours.[41]

4. Economy (Marketing, Middleman, Seasonal fishing)

Fish marketing is making a bridge between production and consumption. Time and distance are required to be overcome. Trading is run through private and public enterprise. Each year huge stocks of fishes are preserved in store houses. Fresh catch fresh marketing and instantaneous business transaction end the entire affair. Only a few Govt. run store houses due to non-preservation and temporary transactions this very promising business of Bengal is suffering setbacks. Certain measures should immediately be taken to put this culture into a national level financial profit rate of price. Entire benefit goes to the brokers and sellers. Pisciculture in West Bengal especially in southern part comprising South 24 Parganas, Medinipur etc. is largely dependent on fishermen, labourers and brokers. Income from this sector is their main source of livelihood. Nexus between brokers and sellers sometimes create unusual situation in which the buyers become worst sufferers. Buyers comprise of high, low and middle income groups and sometimes people without any group that is below poverty line. But in our country Demand and production is increasing in every year. The average consumption of fish in West Bengal is around kg / capita per annum. As per report of the planning commission of India, The average consumption of fish in India is 9 kg / capita per annum. During the year 2006-07 the state has produced 13.59 lakh MT of fish against demand of 12.99 lakh MT. During the year 2007-08 there is a target for production of fish against demand of 12.99 lakh Mt. During the year 2007-08 there is a target for production of 14.48 lakh MT of fish and at the end of 11th plan the target for production of 15.58 lakh MT of fish has been fixed, which is expected to meet the domestic need. District wise Fish production during the year 2006-07 is shown at the table 2.8.

Table 2.7: Year wise demand and production of fish in West Bengal 1995-96 to 2006-07 (in Lakh MT)

Year	Demand	Production	Deficit/Surplus
1995 – 1996	10.20	8.930	(–) 1.27
1996 – 1997	10.60	9.370	(–) 1.23
1997 – 1998	10.70	9.500	(–) 1.20
1998 – 1999	10.93	9.950	(–) 0.98
1999 – 2000	11.15	10.450	(–) 0.70
2000 – 2001	11.35	10.600	(–) 0.75
2002 – 2003	11.68	11.200	(–) 0.48
2003 – 2004	11.80	11.696	(–) 0.104
2004 – 2005	12.80	12.150	(+) 0.06
2005 – 2006	12.31	12.500	(+) 0.190
2006 – 2007	12.99	13.590	(+) 0.600

Source: Collected from Dept. of Fisheries (GOWB).

Table 2.8 : District wise Fish production during the year 2006-07 Unit: MT

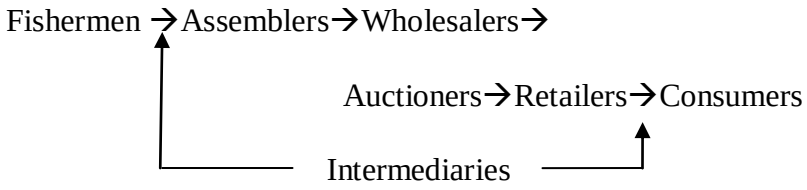
Si. No.	District	Inland fish Production			Marine fish Production		
		Fish	Prawn	Total	Fish	Prawn	Total
1.	Darjeeling(DGHC)	395	0	395	0	0	0
2.	Darjeeling (Siliguri)	1450	0	1450	0	0	0
3.	Jalpaiguri	21724	0	21724	0	0	0
4.	Coochbchar	20426	0	20426	0	0	0
5.	Uttar Dinajpur	16005	0	16005	0	0	0
6.	Dakshin Dinajpur	32992	0	32992	0	0	0
7.	Malda	29288	5	29093	0	0	0
8.	Murshidabad	83582	10	83592	0	0	0
9.	Nadia	68993	20	69013	0	0	0
10.	Birbhum	67518	0	67518	0	0	0
11.	Burdwan	89995	0	89995	0	0	0
12.	Hooghly	67009	60	67069	0	0	0
13.	Howrah	47600	58	47658	0	0	0
14.	North 24 Parganas	130541	40516	171057	0	0	0
15.	South 24 Parganas	180815	9900	190715	46989	6848	53837
16.	Purulia	39135	0	39135	0	0	0
17.	Bankura	52682	0	52682	0	0	0
18.	Paschim Medinipur	58868	0	58868	0	0	0
19.	Purba Medinipur	108547	12871	121418	114581	9680	124261
Total		1117565	63440	1181005	161570	16528	178098

Source: Annual report 2006-07 Dept. of Fisheries, Govt. of West Bengal

In order to increase the fish production / productivity, the fish farmer's development agency of our state is playing a vital role and has been putting sustained efforts on development of pond fisheries, Jhora fisheries and ornamental fisheries. Under the centrally sponsored scheme the FFDA setup was first created in seven districts of the state in 1980-81. Thereafter at different phases all the districts have been covered.

Fish marketing has many stages– this were a) purchase of fish at landing places by fish dealer or middlemen either from fishermen or vessel owner. Often fishermen are in debt and obliged to deliver, b) Assembly of small quantities of fish into large shipments. Sorting, bulk breaking and transport to wholesalers, c) Consignment sale by wholesalers, normally by means of auction. There are several methods of auction such as ascending, descending, whispering, tender, commission 5-10% of proceeds charged and d) Retailing in fish shops, fishmongers, supermarkets.[42]Roughly speaking, producers (fishermen) dealers, other than retailers, and retailers share respectively about 45%, 23% and 32% of the price paid by consumers.

Flow of fish and fish products:



Flow of Money:

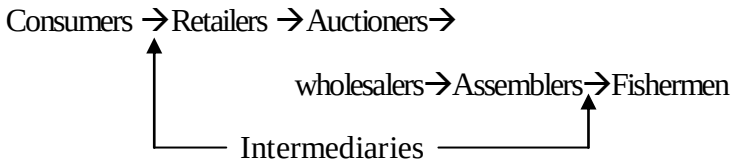


Fig. 2: Flow of fish and fish products and Flow of Money

Each pays necessary expenses and obtains price margins or Commissions.

In Japan- i) Dominance of fishermen's cooperatives as consignees in landing markets. Out of 1400 markets, 88% are owned and operated by fishermen's cooperatives. ii) In consumption centres the channels are-consicongnees→wholesalers→retailers. The complex system is required to deal with large quantities of fish (In Tokyo fish wholesale market more than 2000 tonnes in a shortest possible time). iii) Market practice is supervised by central or local Governments in accordance of laws and regulations.[43] The import of raw fish to Calcutta indicates that 81% of the total imports were carried by the railways, 3.6% by the canals and 13% by the road.[44]

Supply of fish from the internal sources was insufficient. So import of fish from other states and East Pakistan was a regular feature of the fish markets of Calcutta and Howrah, the most prosperous wholesale fish markets of the State from where fish being supplied in other wholesale markets. There are few more towns like Siliguri, Islampur, Ranaghat, Raiganj, Maldah, Durgapur, Asansol, Baharampore, Kharagpur, Alipurduar and Cooch Behar, which have been receiving fish regularly from other States of India. So it is beyond the scope of doubt that the average Supply of fish from different sources had been increased in West Bengal. In the year 1950-1964, shows that the average daily supply of fish from different Sources had been fluctuated. But the whole state average supply and imports from other States of India had been increased.[45]

Table 2.9: Annual Supply of fishes in the fish markets of Calcutta and Howrah

(in metric tonnes)

Year	FROM SOURCE IN W.B	FROM OTHER STATE	FROM EAST PAKISTAN	TOTAL	AVG. DAILY SUPPLY
1950	4621.30	14344.9	5718.02	24782.60	67.85
1951	6112.40	13397.70	3774.00	232.84	63.97
1952	6039.99	12902.71	5886.40	25830.36	70.74
1953	5703.25	10985.30	9260.73	25947.36	51.86
1954	7404.51	14009.68	14455.45	35869.65	98.23
1955	11502.04	12739.47	20553.10	44823.65	122.4
1956	1744.18	13920.76	11883.80	43246.30	118.7
1957	13542.70	14870.30	12848.95	41261.95	113.3
1958	12786.68	19929.38	9263.98	41980.05	115.7
1959	10234.20	21386.00	12409.80	44030.00	122.0
1960	10961.47	19875.29	15023.18	45860.00	125.1
1961	1078.90	20103.50	11743.57	42578.58	126.2
1962	937.76	25963.70	27288.61	62531.07	171.0
1963	8349.50	23038.61	31028.23	62516.49	181.7
1964	8707.50	27747.50	16608,10	53063.10	145.0

Source: Department of Fisheries, Govt. of West Bengal, Master Plan for Fisheries Department (1975)

The import of fish during the period 1962 to 1965 from East Pakistan had been decreased. And last of all it was stopped due to the outbreak of Indo-Pak war. However after the emergence of Bangladesh, during the period from October 1972 to September 1972 West Bengal imported total 3375836.673 Kg of fish from Bangladesh.[46]

Faridpur District was noted for its salted hilsa trade and those were exported to the Calcutta markets. In the cold weather Khulna became a large despatching depot. Hilsa came from Damkundia and Goalundo often packed in ice by train.[47] Hence fish price was always in a hike in the city. The price of fresh fish which had greater demand in the market was to be determined by its quality and the relation of its supply to the demand. Its price naturally varied in different localities and different periods of the year.[48] Fish marketing in the districts and sub divisional towns should be organised by the local cooperative societies under the overall management of the apex society in Calcutta.[49] Fish were also sent by railway to Calcutta from Chandipur in Balasore and occasionally from Puri and Chilka. In the cold weather Khulna became a large despatching depot. Hilsa came from Damkundia and Goalundo, often packed in ice by train.[50]

We also are exporting Marine fish and fish Products through the ports of Kolkata. Shrimp, crab, and hilsa fish have been exported to foreign countries and we are earning a lot. The grand total by exporting item wise marine products through the Kolkata port had been fluctuated.

Table 2.10: Item wise Export of Marine products through the Ports of Kolkata

Q : Quantity in ton V : Value in Rs. Crore

Item Name	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Frozen shrimp	Q: 11901	13030	13970	12960	13600
	V: 449.61	518.90	506.75	492.42	482.25
Frozen Fish	Q: 4890	3024	2644	2220	3624
	V: 36.97	31.29	26.85	19.53	37.28
Fr.Cattle fish	Q: 23	272	558	1102	442
	V: 0.15	2.20	4.26	8.64	3.46

Dried Item	Q: 154	259	233	416	208
	V: 6.8	7.69	9.92	12.12	10.01
Live Items	Q: 462	648	359	440	435
	V: 6.53	9.12	5.49	8.21	6.93
Chilled Items	Q: 217	262	408	418	456
	V: 3.78	5.94	8.45	11.65	9.86
Others	Q: -	7	39	24	14
	V: -	0.07	0.13	0.02	1.41
Grand Total	Q: 17647	17503	18201	17580	18779
	V: 503.91	575.23	560.28	502.11	550.16

Source: Statistics of Marine Export 2005, Govt. of India, MOC & I

A large quantity of fish has been exported from West Bengal through Kolkata and Haldia port. The value has been increased in every year. If fish cultivation is properly done, the fortune of our country will be improved.[51] The yearly quantity (in ton) and value (in Crore Rs.) are shown in the

Table 2.11: Year wise Export of fish from West Bengal through Kolkata & Haldia Port

Year	Quantity(in ton)	Value (in crore Rs.)
1983-1984	4766.00	44.120
1984-1985	4308.00	34.030
1985-1986	3538.59	36.780
1986-1987	4334.78	49.050
1987-1988	4093.31	48.170
1988-1989	4851.37	65.720
1992-1993	9568.00	183.670
1993-1994	121.33	262.290

1994-1995	13023.00	325.650
1995-1996	13361.00	330.060
1996-1997	1611.00	420.440
1997-1998	14450.00	416.690
1998-1999	15060.00	457.910
1999-2000	16348.00	511.700
2000-2001	18553.00	595.400
2001-2002	17647.37	503.909
2002-2003	17502.96	575.228
2003-2004	18201.09	560.282
2004-2005	17580.91	502.108
2005-2006	18778.30	550.166
2006-2007	20560.00	617.000

Source: MPEDA, Kolkata

5. Fishermen's Family life and poverty

Rural life is purely depends on structure of a family, this families mainly are joint families where large number of members, men, women, children are found. In each joint family there is one chief family member or a guide or we can say the Head of the family – supervising the entire affairs. Arena of his activities in the family is varied. He is to look after the welfare of the members; their education, Health and sanitation are also subject to his family programme. Most important of his task is financial support. Managing a family financially is a very responsible job. Every member of a joint family is not an earning member. If number of the family members 20 to 30 task of feeding them amounts to a big amount of money expenditure. The Head of the family has to supply adequate money for their sustenance, not only that education and care of the kids is another sacred duty bestows upon him.

Daily expenditure in a joint family of 20 to 30 members is a great economic burden. Rural people are consumer of rice; pulses, vegetables, milk etc. are very much

fond fishes. They are mostly rice consuming people, naturally supply of rice, fishes are very much essential. These are not always available. Rural people usually depend on domestic economy. There is very little scope of getting things from outside of their villages. Usually poverty is chronic among them. They are sometimes unfed or half fed, we know it very clear that poverty striken people do not maintain family planning. So number of family members goes higher and higher till they are fallen apart.

Fishermen, strictly speaking belong to have no group. They lived below the poverty line. Their main concern is somehow to collect food from any sources; in the process they purchase rice, pulses, from the market. The market is also fragmented. There is no big market place is available in adjoining areas. They can neither sell their goods properly nor can purchase. All their goods remain Ideal for want of Adequate marketing facilities. No buyers are there, sellers only. When buyers are there, no sellable goods are available this ratio between sell and purchase is not comparatively with economic lose of demand and supply. Fishermen cannot rely on sell proceeding on the fishes per day, they are to depend on Agricultural land if there be any. Most fishermen have no land to cultivate, so they cannot grow rice sufficiently. They depend on others mercy. This other group of people who show mercy to them are money lenders, this mahajans or money lenders lend them money at a higher rate of interest. The fishermen cannot pay the interest properly and their debt quantity goes higher and higher. At one stage their income is zero for whatever they earn go to this mahajans or the moneylenders. To support the greedy money lenders one group of middleman comes to exploit the fishermen. Fishermen do not get the actual price of the fishes. They are force to accept minimum amount of money against their catch. This chronic debt invites social contempt on them. Socially they are boycotted. Poverty is not only a curse it out classes caste hierarchy without any problem. This is the way one cannot enjoy social and political recognition. In a sense they are out caste.

All the fishermen castes mentioned earlier had been given a lower social status in the caste hierarchy, an inseparable part of the Indian society.[52] Whatever the social status of the fishermen castes the literature available on their life have illustrated their degraded socio-economic condition. In the Bengali Hindu Society they were treated as ‘outcaste’ or ‘antebashi. Bagdis, Kaibartyas, Malos, Tiyors and other fishing

communities, they were considered impure Social groups.[53] K.C.De reported that fishing was an uncertain calling and all the people engaged in this industry adopted some other occupations, either as a subsidiary or as the principle means of their maintenance.[54] Through the ages fish has been dominant in the bengolis economy, religion and cultural symbolism about which we have ample evidences in the Bengali literature, paintings, epigraphic records and folklores. Sundarlal Hora and Tarak Chandra Das have given descriptions in detail of the social and cultural significance of fish and fishing in the popular lives of Bengal.[55]

Table 2.12: District wise fisher folk population

SI NO	Name of district	No. of fisher folk family		Fisher folk population					
		Inland	Marine	Male Inland	Marine	Female inland	Marine	Total Inland	Marine
1	Darjeeling	956	-	1677	-	1282	-	2959	-
2	Jalpaiguri	26000	-	41125	-	39905	-	81030	-
3	Coochbehar	29542	-	75085	-	61224	-	136309	-
4	Uttar Dinajpur	14210	-	36452	-	33648	-	70100	-
5	Dakshin Dinajpur	10957	-	30600	-	25277	-	55877	-
6	Malda	13857	-	46347	-	42327	-	88674	-
7	Murshidabd	46684	-	121674	-	10036	-	222050	-
8	Nadia	51252	-	146000	-	11000	-	256000	-
9	Birbhum	49751	-	113526	-	87221	-	200747	-
10	Burdwan	35000	-	98000	-	42000	-	140000	-
11	Hooghly	18718	-	41223	-	33650	-	78873	-
12	Howrah	17494	2442	51236	7123	38582	4978	89818	12101

13	North 24 parganas	50897	4103	134877	10873	11967	9643	254484	20156
14	South 24 Parganas	52917	25443	145522	69969	11903	57248	264585	12727
15	Purulia	4528	-	18050	-	16662	-	34712	-
16	Bankura	22860	-	64010	-	50292	-	114302	-
17	Paschim Medinipur	11629	-	35586	-	34190	-	69776	-
18	Purba Medinipur	8620	17081	26378	52267	25345	50217	51723	102484
Total		414872	49069	1227368	140232	980651	122086	2212019	262318

Source: Indian Statistical Institute: A study of fishermen in West Bengal.

It is a curse of our country that its socio economic system does not favour the poor who produce wealth and food grains. Our total distribution process is faulty. The traders who are especially favoured by administration do stock food grains and sell them when they find suitable air. As a result the farmers and labours cannot get food at a retail price when they need. Moreover wealth thrust tendency to create inequality. As a result the rich become richer and the poor poorer. A society thus divided on wealth cannot conducive to maximum welfare. Proper use of wealth is to increase human welfare. But in our country the total system is conducted by five families. So most of the people of our country are poor, they have no purchasing capacity. So they have no other way than to cultivate the fish and they are doing in the small plot adjacent to their house. So there is no doubt that this small scale fish cultivation is helping them to both ends meet. Fishing and Agriculture are correlative. When fishing fails to provide them with food, they go to agriculture for the time being.[56]

Moreover to add salt over injury the fishermen are subjected to exploitation by different classes. Sometimes they are lured by the clever local politicians who exploit money from them with some ulterior motive. Distance between their homes and the market is very long. They use to live away from their family-wives, children kith and keen. A man without family, children and wives cannot be a good labourer in any

way. This separate living is hindrance to work culture. Traditional fishermen of all regions of Bengal are unlucky. Because they cannot enjoy a good family life. They have been forced by the call of their duty to keep themselves away from their family. Most of the fishing zones are far away from their homeland. They have to spend 7 or 8 months in their boats on the surface of the seas and rivers. They cannot meet their wives and children for a long period. Sometimes they have to spend sleepless night for months. Considering high tide and low tide they have to put their net as a result they themselves keep awake for the whole night. By this time they cannot even take care of their health. Local fishermen though poor in number are free from all these anxieties, they can do all normally.[57]

The traditional fishermen of Bengal, in spite of being materially poor had developed a beautiful culture of their own. Their mode of fishing techniques and technologies and the nature of water bodies are the determinant factors of folk-culture of the fishermen. The fishing castes of Bengal used to worship a few special deities for their protection in the natural calamities. The malos worship the "Khala Kumari" The traditional fishermen woreship Trinath, Vishalakshmi, Bhagirath and Manasa. The "Jalapalani" festival is observed by the Tiyors and Jelia Kaibartyas. This festival is started in the first day of Magh and lasts for fifteen days. During this period fishing remains stopped.[58]

Traditional fishermen and Muslim fishermen of Southern district they worship peer shaheb, specially peer khan Jahan Ali of Bagerhat now in Bangladesh is their lord. They take a sacred handkerchief from the darga and freely go to the deep sea for catching fish. If the sacred handkerchief is lost by any means, they consider it bad luck for them. Other tradition Hindu and Buddhist fishermen of the subcontinent also visit Darga for the sacred handkerchief for their smooth Business. Moreover "Bana Bibi" is another deity of the fishermen. Bana Bibi is gifted with magical power. She can make day when it is really night. Perhaps it is a superstitious belief of the fishermen yet they worship her with pomp and Grandeur.[59]

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CHAPTER –III

Habitats and Ethnic Varieties of the Fishermen

1. Ethnic origin and physical environmental variety of fishermen of West Bengal

Fishing is no doubt a prestigious occupation. Their identities have been determined by their profession. The deltaic region of Bengal drew many of these communities to this region by offering immense opportunities for maintaining a prestigious life. K.G. Gupta & K.C. De flashed a report in which they showed 33 fishing castes are engaged in this occupation. Some others though not in many are finding way for their existence doing this practice in the rice fields, ponds, Beels, and haors. They have been scatteredly found throughout the Bengal. The prominant fishing castes have been flourished among many such communities of theirs. They are the Jhalo Malo, Keot, Tiyor, Kaibartya, Nikari, Jelia, Bayale, Gonrhis, Bind, Rajbanshi, The Kadar, The Malo, Bazari, Majhi, Mallah, Pod, Namasudra, etc. The castes and sub castes of these communities have been ignoably identified even the ethnical varieties of their selves have not been immuned from the contempt. Apart from the Hindu castes & sub castes fishermen a section of musalman have come to this profession and have established their identity as Nikari, Bazari, Aratdar, & Bepari. Besides all these sections more identical and ethnical varieties have been found when these fishing castes & sub-castes would have been categorically divided as Dravidian, Aryans, Nordics, Alpines, Proto-Austroloid.[1]

In the prime when the world was very young all the fishermen castes were given a lower social status. According to *Shastra and Smirity* have had been identified as shudra or Antaja, on the other hand *The Brihaddharma Purana* have classified the lower castes into three. They are the (i) uttam sankara (ii) Madhyam Sankara & (iii) The Antaja. Again in the *Brahmabaibartya Purana* they have been classified into (i) Satshudra (ii) Asatshudra and (iii) Antaja, here they have also been considered as untouchables throughout the period of old, ancient, medieval, colonial & post-colonial period. Even today they have been remaining degraded, though they are our friends.[2] It was clearly showed in the Govt. records that fishermen did not accept the Govt. attempts for the improvement of the condition they are remaining in. According to T.

Southwell the nationalist values and culture of the Hindu Society created obstacles on the way of accepting the modern thought. Doctrine of words or action of Hindu Philosophy and complexities among the classes of the fishermen debarred them from changing their lot. They professionally belonged to the lower castes & have been neglected by the upper castes.

It was found that the people of other castes besides the fishermen community were related with this profession. They have contributed much for the gross-up-liftment of the community. In Bangladesh a large section of the fisherman were vaishnavas and believers of other sect. Some Buddhists fishermen are also found in Bangladesh. According to the census report there are a large number of fishermen of Muslim community in that country.[3]

Days have been passed, age old notion has been wiped out regarding untouchable's position in the ethnical varieties of the low castes in the new history of Bengal. Most modern research of Dr. U.N.Biswas has given them their true identity. He has gone deep to seek out the true ethnical identity of the untouchables of Bengals of whom fishermen are a significant part. They are not the lower castes, they are "Bangas". They are the real inhabitants of this region. They are no longer untouchables. What has been discussed in the Introduction will be illuminated broadly in the body of the theme & with the discussion of ethnical varieties of Fishermen, the most modern research of Dr. Biswas will be put side by side & it will definitely show how a false identity of the untouchables fishermen had possessed from the begining & how they have been relieved from the pangs of the degraded life.[4]

Ethnical variety though vague now may be discussed through the communities such as

Malos

By analysing colonial ethnography, it had been found that the Malos are dravidian by race they have come from western India & entered into Bengal in the early twentieth century. Some of them proclaimed their Kshatriya identity while others suppressed it due to the operation of Parsuram in the period when the world was very young. Their western Indian identity was also supported by Buchanan. Dr. Wise also pointed out the Kaibartya, Malo, & Tiyor are the representatives of the fishermen community as a pre-historic dwellers in the Gangetic Delta.

They are mainly a short stature, dark-skinned & thin moustaches. They like to wear good looking Falucin & earrings. They are not highly intelligent & had good temper. Their long curly black hair very often come down to the shoulders both in colonial & pre-colonial period. They are found to establish their identity as fish catching community. Situation forced them to adopt agriculture as their part time profession. They also showed their peculiarity in the art of fishing & net-making.[5]

Jaliya, Jelia, Jele, Jalo

These are the commondesignation which had been broadly adopted by all the fishing communities of Bengal. The designation is surely not a caste's name. But unfortunately have been used by the malos, Tiyors, Kaibartyas, Bagdi and Nikaris. Some argued Jhalo is the synonyms of Malo. Dr. Wise who is famous for his writings on fishing castes of Bengal had highly praised their physical structures of their body. He described them as strong & stout, & pains-taking.

They use different kinds of nets to catch fish such as Kshepla, Sangla, Baoli, Chhandi, Ben, Vesal. Nets are made of hemp & they are steeped in gab (a kind of Jelly like juicy fruit) such a common title among fishing community is absent, all can use it according to their liking. Every fishermen can use this common garment of title according to their will.[6]

Tiyor, Tiar, Tior

Rajbanshi, Machua, though the spelling of the name of the community differ, they are seemed to be same Dravidian boating and fishing caste of Bengal & Behar. According to Mr. Beems the Dhimar & Tiyor show marked differences of complexion & physical type. The Dhimar had got minimum stature of middle class Hindu.

According to Dr. Wise Tiyors are short & muscular, almost black complexion & had got long coarse hair which has often a reddish tinge. They identify themselves as Rajbanshi in Eastern Bengal. In Maimansingh they had got the title of suraj-Bansi. Buchanan divided the Tiyor of Bhagalpur into two (i) Bama-Yaga & (ii) Govariya. Bama-yaga are clean Sudra & the Govariya is impure. The Tiyor widows maintain their lives by selling fish & by manufacturing string & which is largely used by fishermen of Bengal & other states.[7]

Kaibartya

A thrilling emotion is felt as soon as one utter the names of the large fishing and cultivating caste of Bengal. It has been clear that they are the notable fishing castes of deltaic districts of Bengal. The derivation of the word kaibartya are ka or water and brata or livelihood, but the true derivation is Kaibartya means a person taking a low occupation like fishing and boating. The name Kaibartya has been taken in Bengali from sanskrit or prakrit. Kewat is its shorter form and is generally found in Behar. Dr. Wise opined regarding the fishing Kaibarttas of Eastern Bengal that if any Kaibartta family had earned some money, he left the fishing practice & took profession of Nikari.

They also would make fibre, their woman spin it. Thus they would prepare nets twine & ropes. They had been remarkable in Eastern Bengal. They would like to work in November & December by this time they would select a sandy tract near the water & would collect a large quantity of small fish which was dried in the sun. Whatever the occupation may be they are considered low as fishing castes. Their names are found in the Mahabharata, Manu Smiriti and Brahmabaibarta Purana. The king Asoka allowed them to catch fish and very finely recognized them with honour. They also got facilities from the king of the Pala & the Sena. Manu identified them as the decendents of the Nishad father who live by boating.[8]

The Kaibartya who took the profession of cultivation were known as Chashi Kaibartyas and who were engaged in fishing were identified themselves as Jelia Kaibartya. They had been gathered in Burma, Nadia, Midnapur & 24 parganas from the British period, sometimes they would work as paikar & Nikari, who are known as intermediaries in the fish market. The internal divisions of the castes differ in different districts. Child marriage was widely found among them.[9]

Table 3.1 : Distribution of the Malos, Jelia Kaibartyas, Tiyors in different districts of West Bengal-1951

Districts name	Malo	Jelia kaibartya	Tiyor
Burdwan	1209	11043	1081
Birbhum	452	5836	262
Bankura	1536	5062	-
Medinipur	1387	12342	1102
Hooghly	1201	10179	1425
Howrah	155	10008	3699
24 parganas	5079	9455	11895

Districts name	Malo	Jelia kaibartya	Tiyor
Kolkata	509	2828	101
Nadia	18634	5785	394
Murshidabad	11775	3493	475
Malda	11775	4279	20063
W.Dinajpur	1289	1299	1421
Jalpaiguri	2121	509	3
Darjeeling	2121	69	51
Cooch Behar	153	1782	6

Source: Census of India -1951

Kiot, Kewat, Keot

Aboriginal tribe, fishing & cultivating caste of Behar and Bengal. Buchanan described both the Kewat of Behar & the Kaibartya of Bengal belonged to one aboriginal tribe and took the name Kewat.[10] During the reign of Ballal Sen they took the sanskrit name Kaibartya as the mark of purity. Many classical stories have been told about the Kewat & its other sub castes and branches such as Ghibiher, Ghi-eater & Saghar all these classification grew on the basis of food habit. But who adhered to their original profession of Boating were known as Machua- sub castes. They work as a retailer in the fish market like Nikari. They give loan to the fishermen in the season and at the same time establish monopoly business. They buy fish at a low price from the fishermen even cheaper than the market price.[11] Due to their loan the fishermen of the caste are bound to sell fish at a cheaper rate to the Keots Nikari who are known as intermediaries.

Bagdi

A cultivating & fishing caste of western Bengal. Their complexion indicate them to be Dravidians. They are closely related to the tribes, as a result they are considered to be aboriginal. There are so many traditional stories about the origin of the Bagdi. One such story tells that in order to test siva's love for parvati, she disguised herself as a fisherwoman & beged sex & thus shiva was caught in her trap. He angrily cursed that the child to be born from her should be a Bagdi who will take fishing as livelihood. Thus it can be easily imagined that Bagdis are a fishing caste of Bengal from the very ancient time. They are also engaged in cultivation & palanquin bearer.[12]

The Bagdis those who adopted fishing had developed their own techniques and technologies of fishing. They were mainly concentrated in Bankura, Purulia, Midnapur, 24 parganas, Nadia, Burdwan and Birbhum districts. They are divided into so many sub castes in the Bankura district. They are the (i) Tentulia, (ii) Machana (iii) Ujha etc. They have to go through a controversial marriage system. They can neither marry outside the sub castes nor inside the section he belongs to. Infant marriage & adult marriage both are found in their community. Free sexual life is somehow permitted in the case of a adult girl. They follow Brahmanical rituals in their pujas & day to day festivals. In the festivals of marriage ceremony 'sindurdan' is an important event. Exchange of garland is found at the time of marriage ceremony like other hindu communities do.

Widows are allowed to remarry except one sub caste. In the case of divorce they follow the footsteps of higher castes. Siva, Vishnu, Yama, Durga & the saktis are their God & Goddesses. Whatever the theme may be there is no doubt that the women of their community go from door to door bearing a busket of fish on their head with a loud sound and sell fish to the people. They are one of the fishing community of western Bengal.[13]

Chandal

A boating, fishing and cultivating (intelligent in all sphere of life) caste of Eastern Bengal. From the writing of the Sanskrit Pandit it has been found that the chandals are outcaste and servants of the Brahmans, not permitted to live in the city. Different ethnological data regarding their identity has been produced as in the (epic) Mahabharata, they have been described as Assasins. In the Ramayana they have been described as wearing ugly dresses and uncivilized.

But above all what they ultimate are? They are very conscious and have taken several attempts to discard their low status and with a view to do this they had organized themselves in a compact group and went under the influence of the religious principles of Harichand Guruchand Thakur of Faridpur district in East Bengal. Further historical accounts says they tried their best to stop the advance of the Aryans. They fought bravely though had been defeated. They celebrate the sraddha on the eleventh day like Brahmanas. Dacca Chandals claimed themselves as pure as Brahman, but were disputed. Their status become more glorified when they call their

own priest to preside over their social ceremonies. They have got their own purohit, though other community does not call them to their religious festivals specially in Eastern Bengal.

Moreover in order to get the common title "Namas" the Chandal of Faridpur and Bakharganj started a joint movement for the upliftment of their social position but were discouraged by muslim Zamindar. They have got strong caste prejudices. They claim speciality for boating, fishing and boat making.[14] Dr. Wise describes them very highly. According to him they are free-frank, lovable, hard- working etc.[15] On the contrary their physical structure are not handsome. They have the dark complexion, short mascular body and flat chest. They like songs, specially addicted to 'kabigan'. Early & infant marriage is widely practised in their community.

Different pandits have described them in different ways. But their account are not always true. Their ethnical data has brought them very close to the Brahmins.[16] European writers and historians are not always right in their writings. Their sense of prestige very high, their physical complexion is not always dark. They are good 'Bwalis', the term Bwali means who can guide fisherman in the sundarban of East-Bengal as well as in west bengal. They know rivers, creeks, & estuaries of Bay of Bengal very well. They are intelligent, cultivating and fishing caste and now they are doing all kinds of prestigious work for the countrymen.[17]

Pod

A fishing, cultivating, lower caste of Bengal. The census report of 1872 showed them as aboriginal type. They have also been regarded as one of the five chief races of India. Many religious stories of their origin have been illustrated in the Epic like the Ramayana & the Mahabharata. Whatever the story regarding their birth may be, they have been regarded as low castes of Bengal. During the colonial period they advanced forward and became zamindars & some of them bought part of parganas and some areas of particular districts.[18]

They are divided into four sub castes-such as Bagan de, Bangla, Kholta or mouna, Urdiya. Child marriage is found in the caste. Divorce is not always permitted due to economic inferiority. But in the enlightened group divorce is frequently found nowadays. Free-sex has been partly allowed among the poor. Social festivals, like

pujas and marriage completely follow the purohit tantric activity. Dowry giving and accepting are found in the large scale.

They have been considered as low caste. Socially they have been degraded for some of their ugly manner. They ate with Bagdi so the Brahmana are not eating with them. Even they ate the leavings of the Brahmana, with the spread of education they have been doing works as gold smith, Black-smith, tin-smith and carpenter.[19]

Prominent fishing caste have been mentioned differently, but their social status have been remained the same. Everywhere they are low caste whatever the community they belong to be. If we can find out the exact social position of the Bangalee we may get the trace of the social status of the fishermen of the Bangalee. The true social of fisherman status have not yet been discovered. All ways every where they have been considered as low-castes. If exact position of the Bangalee would be exactly flushed out the position of the Bangalee fisherman would clearly come out from the age old rotten thought that they are belong to low caste.

In order to do that the Bagdi of Rajmahal hills, fish catching low caste people of Sundarban, Bashfor of Jessore district are bearing the same physical features. They have deep black, thick overturned lips, short and flat nose, they are generally called Nigrobotu. They spread in different parts of Bengal, but when they fall into the whirl of communal disturbance, they could not save their trace as a community.[20] The mass (people) who played the eminent part among the aborigines, Anthropologist named them as proto-Austroloid. The culture that had been grown up through the ages in Bengal are the result of the combined works of Alpine & porto Austroloid. Later it had been found that a thin layer of culture of Adi Nordic spread over it. But it was confined among higher castes only. They could not touch the lower castes people of Bengal.

Alpine had three branches according to 'Iikestadot' parchim Brakid= western Brakid their decendents are the inhabitants of Maharastra and Kango, long bodied Brakids were found in the Gangetic Valley and the Eastern Brakid lived in Bengal and Orissa. All these three section are called in did. They are the heirs of Indus valley civilization and true representative of Dravidian culture. But those who have changed the old cultural structure and have given a new shape they are quite different from the Alpine group. Anthropologist had named them proto Nordic. They are the creator of

Vedic Civilization. But the Bangalees are quite separate from them. A thin touch may have been found if the strict scrutiny is carried out upon it.[21] Fisher pointed out another section whose name was oriental- but their blood had not reached in Bengal.

By the discussion of the long history of anthropology, it has been clear that long headed, flat nose, who are generally called Adi Austrolio or Kolid. Secondly, long headed, medium flat nose, who are called Melanid, and lastly Round headed, pointed nose, Alpine or Eastern Brakid- These three sections people have unifidely created the Bangalee (as a nation). Nigrobotu Blood found in them very few- Again the touch of pure indid blood is very thin. There is no doubt that the history of the anthropology of the Bangalee have been formed by the blood of these three sections.

District wise variety, wide variety of the anthropological history of Bengal is formed. It is almost the result of crossbreeding among the different section and people of the different parts of the world. It may be deep or thin intermixture of the blood has been broadly happened. So a particular section cannot demand purity of Blood. When such is the condition of Bangalee people, why then a particular section would demand them as higher caste, why other section would be considered as low, they do not know the anthropological variety of their origin in the history of the Bangalee. Bangalee fishermen obviously are not low caste. They are the Bangalee. They are the old habitats of this region. They had got this separate pure identity which is free from Brahmanical thought.[22]

Other Fishing Castes of Bengal

Koch Metch

Tribal communities also have adopted fishing as their subsidiary occupation. The prominent of them were Koch and Mech. Though they have migrated from Jhar-Khand. They have developed their implements and techniques of fishing. Their technique though they have developed still remained in the primary stage.[23]

The Binds

A large non-Aryan caste which adopted fishing and fish related business as the subsidiary occupation. Traditions current among the caste profess to trace their origin to the vindhya Hills of Central India. Mr. Sherring treats the Binds as a branch of the Nunias, others regard the Nunias as a sub-caste of the Binds. The two castes are

probably related in some way. It seems not unlikely that the Binds may be a true aboriginal tribe and the Nunias a functional group differentiated by taking to the manufacture of earth-salt. But this is mainly infer on slight evidence. The Bids of Bihar are divided into two sub-castes-Khariat and Gondh. Among the Scheduled caste communities of colonial Bengal, the Binds had a very small population figure. They were mainly concentrated in Bihar and uttar pradesh. They had and still have little concentration only in Malda district of Bengal. In pabna, Nadia and Murshidabad districts the Binds had some scattered villages.[24]

Binds admit both infant and adult marriage, but the former is deemed more respectable, and all who can afford to do so endeavour to get their daughters married before they attain the age of puberty. Polygamy is permitted, but only to the limited extent that a man may marry a second wife in the event of the first proving barren. A widow is also allowed to marry again by the sagai form, but is expected to marry her deceased husbands younger brother or younger cousin, Should such a relative exist. Divorce is not allowed. If a woman goes wrong with a man of another caste, she is summarily turned adrift and becomes a prostitute, turns Mohamedan, or joins some religious sect of dubious morality. The marriage ceremony of the Binds presents no features of special interest, and has obviously been modelled in most points on the orthodox Hindu ritual. The religion of the Binds, so far at least as it is concerned with the greater gods of the Hindu pantheon, is equally wanting in individual character, and differs in no material particulars from the vulgar Hinduism of the lower castes of Behar. The external observances of Brahmanism have been copied more or less accurately, while the esoteric doctrine on which the whole body of symbolism depends, is entirely unknown to the worshipper of the popular religion. In some of the other objects of the rural worship we may perhaps see survivals of the primitive animism which formed the religion of the aborigines of India before their insensible conversion to Brahmanism. Some of the tribal deities were as we know, promoted to seats in the Hindu pantheon, others, whose position was less prominent and whose hold on the mind of the people was weaker, got thrust into the background as patrons of various rural events.

Fishing, well sinking, building mud wall, mat and basket making, preparing saltpetre, and doing earth work on roads and tanks, are among their chief occupations. Few of them are traders and they visit different places with boat-loads of wheat, pulse,

and gram.[25] In Bengal the Binds were engaged in different occupation like fishing in the river system, earth and agricultural works, cutting tamarisk on the sand banks for selling them as fire wood, making mud brasiers generally used the country boat for cooking. The Binds were also cunning sports man. The Binds were seasonal collectors of rice from the rice field after harvest. They used to dig up the store of rice accumulated by the mud rats.[26] Dr. Wise says that they are considered a pure caste. Binds freely indulge in spirit drinking, eat crocodiles and field rats and are very fond of pork when they can get it. It is indicate that they are impure.

Patni

According to some authorities (patnis) are descended from a Rajaka, or washerman, and a woman of the vaisya caste. The patnis were found to be engaged in boating, fishing, basket making, trading, and cultivating caste of Bengal, whose dark complexion, short and muscular frame, snub nose, and expanded nostrils stamp them as of Dravidian descent. Dr. Wise says that they are very reserved and uncommunicative but there can be little doubt they were originally Doms. In Rangpur, and throughout the Valley of the Brahmaputra, they are still designated Dom-patni, and in Bengal this is applied to them as a term of abuse. Their other titles are Gangaputra, Ghat manjhi or simply Manjhi. The patnis are divided into five sub castes- (1) Jat patni- who are agriculturists and small traders, usually keeping shop as mudis or grocers, (2) Ghat Panti- who work as boatmen and take charge of ferries, (3) Dom Patni- who fish, keep pigs and get casual employment as musicians at weddings and festivals of various kinds. (4) Bansphor and (5) Dagara- who hunt, manufacture sieves and baskets of cane, and tie the frame work of kancha houses. The last two from the nature of their pursuits, are more or less nomadic, making only temporary settlements in huts which they build on the outskirts of villages near rivers. All the sub-castes are endogamous. Some exogamous sections are found. Patnis marry their daughters as infants by the standard ceremony. 'Pan-Protha' was found in their marriage system. A bride-price (pan) is paid by the parents of the bridegroom to those of the bride. Polygamy is recognized in theory, but rarely resorted to in practice. Divorce is not permitted. Widows are not allowed to marry again, Traces of Widow marriage still. Survive among the patnis, but the custom is looked upon as disreputable.

Patnis conform on the whole to the practice of orthodox lowcaste hindus, in religious and ceremonial observances. They employ varna Brahmans who generally assume pompous titles, such as chakravarti. The Gosains, who act as the gurus of the caste, most patnis belong to the saiva sect. Only a few vaishnavas are to be found among them. The dead are burned, and sraddh is performed on the thirty-first day after death. Most Hindu boatmen they invoke the panchpir on embarking or when over taken by a storm. The Ganga puja is main religious festival and patnis never enter upon the work of a ferry without first sacrificing a white kid to the river goddess. Patnis conciliate pavan, the Hidnu ruler of the winds, with offerings of salt, sugar, milk, and ganja.[27]

In social ranking patnis were more or less equal to malos and jelia Kaibartyas. The upper caste hindus had restrictions to take water from their hands. They have barbers and washer men of their own caste, as the regular Napit and Dhoba will not work for them. Widow marriage was heated but in some cases society allowed it.

Doais

The Doai was a low caste community mostly concentrated in the northern part of Eastern Bengal particularly in Rangpur, Dinajpur, Coochbehar, Mymensingh and Dacca districts. In the late nineteenth century they were found in large number especially along the banks of the Lakhya River in Dacca. The Doais according to Mr. Damant have no Brahmans, but employ members of their own caste as purohits, and any stray Bairagi as Guru. They eat pork and drink spirits, Doais were engaged in different professions such as palanquin bearing, load bearing, fishing and piggery. Many of them were found engaged in agriculture. The Doais were also engaged in mat (pati) making for which they were also called patia Das.[28] Dr. Wise described the Doai of Dacca are short, squatmen, with an Indo-Chinese type of features, others are tall and muscular with large black eyes, acquiline noses, and a profusion of hair on the face, while their complexion is of a light brown. At the present day the doais have become 30 thoroughly Hinduised and have so completely lost their original language and customs. They have patit Brahmans of their own, the weddings and funerals are the same as those of other low caste Hindus, the sraddha being like wise celebrated on the thirtieth day.

The Doai will drink from the vessels of the lowest sudras, but even the Bhuinmali is disgraced if he drinks from theirs. They all belong to one gotra, the Aliman, and their sole title is Das. Disputes are settled by a head man, whose office is not hereditary. Socially the Doais had comparatively better position. They placed themselves in the vaishya category of the varna system and did not accept food and water from Mehthor, Muchi and Such others. All varna-Hindus except the Brahmins and Kshatriyas accepted food and water from the Doais. Their religious festivals are Hindu, the majority being vaishnavas. Some of them have lost their ancestral language, and occasionally learn to read and write Bengali, being employed as Tahsildars, or rent collectors by landlords, While the illiterate become watchmen and messengers.[29]

Gonrhis

Gonrhi a fishing and cultivating caste who believed to be the descendents of mythical Nishada boatmen who ferried Ramchandra across the Ganges at Allahabad. They are the non Aryan type. All of the sub-castes are strictly endogamous. Gonrhis are not as a class intelligent enough to be able to explain their own customs very clearly, nor have they a sufficiently strong organization to secure uniformity of practice in different parts of the country. Gonrhis marry their daughters as infants or as adults. Infant marriage is deemed the more respectable. The marriage ceremony is of the standard type. Polygamy is permitted, A widow may also marry again by the sagai form. Divorce is permitted with the consent of the panchayat, on the ground of misconduct or incompatibility of temper. Divorced wives can marry again and it is generally regarded with disfavour by the respectable members of the caste.

Most of the Gonrhis are vaishnava Hindus, but a few members of the saurapatya sect of sun-worshippers are found among them. They employ Maithil Brahmans for the worship of the greater gods, they have also a large number of minor gods. Fisher castes have Barwaria Puja. No Gonrhi will light a pipe or embark on a fishing excursion without first invoking the name of Jaisingh. Once a year in the month of srawan, a flag is set up in honour of Hanuman on a bamboo pole in the courtyard, and offerings of sweet meats and fruits are presented to the god. The dead are burned, usually on the bank of a river, and the ashes thrown into the stream. Sraddh is performed on the thirteenth day after death.[30]

They were basically fish sellers although some of them were engaged in captured fishing. We can get some idea about the occupations of the Gonrhis from their social divisions. They were divided into Kurvin, Manjhi, Chotaha and chobi groups. The Kurvins were engaged in business and service. The Manjhi Gonrhis were basically boatmen. The chotahas were traditional fishermen while the chobis were fishermen of low category. In the colonial period they were largely concentrated in Bihar but they had also concentration in Burdwan, 24 Parganas and Murshidabad districts of Bengal. Their social status varied from place to place. All that can be said is that they rank below Barhis, Kumhars and Laheris, and that although Brahmans do not ordinarily take water from their hands, this rule is not observed everywhere. They eat scaly fish, pork, water tortoises, and field rats, and indulge freely in strong drink. The caste will take water and sweet meats from Kewats, Dhanuks, and Gangotas, but will not eat cooked food prepared by members of those castes. they believe boating and fishing to be their original and characteristic occupation, but many of them are engaged in agriculture as tenure-holders, occupancy or non-occupancy raiyats and landless day labourers.[31]

Table 3.2 : Distribution of the Gonrhis in different districts of West Bengal-1951

Districts name	Gonrhis Population
Burdwan	651
Birbhum	-
Bankura	-
Medinipur	120
Hooghly	169
Howrah	80
24 parganas	384
Kolkata	19
Nadia	95
Murshidabad	672
Malda	11
W.Dinajpur	8
Jalpaiguri	38
Darjeeling	-
Cooch Behar	-

Source: Census of India -1951

Mallahs

Mallahs were basically boatmen a sailor, although a section of them was also engaged in fishing and fish related business. The term was often applied to indicate all fishermen castes of Bengal such as the Binds, chains, Gonrhis, Jelia Kaibartyas, Malos, Keyots and Tiyors. Mallahs divided into many sub-castes. Mr. Sherring pointed out that they are the descended from a common father, by name Nikhad. Nikhad is merely a variant for Nishad or Nishada, a Dravidian tribe mentioned in the Rig-Veda, from which several of the fishing castes may possibly derive their origin. Mr. Sherring pointed out that ten fishing groups once belong to a single tribe. That single tribe had been broken long before the adopting Arabic word Mallah, and it could be a tribe name in India.[32] Some others opined that a certain number of fishing castes formed part of a larger group and was named Mallah which indicated occupation, not caste.

Rajbanshis

Rajbanshis were scattered all over Bengal along with some neighbouring provinces. They (Rajbanshis) were distributed almost in Rangpur, Jalpaiguri, Dinajpur, Maldah and Darjeeling districts. They had highest concentration in coochbehar state and were also in lower Assam. The Rajbanshis of southern Bengal, however, were different than their North Bengal brethrens in terms of occupation and society. In Northern Bengal, the Rajbanshis were a linguistic cum-caste community whereas in southern bengal they were basically a caste community of different character. The Rajbanshis were largest scheduled caste community of Bengal. They were mainly dependent on the agricultural works. The southern Rajbanshis particularly of Nadia, Murshidabad, 24 Parganas and Midnapur were engaged in fishing along with agricultural works. In North Bengal they were agriculturists. Fishing was no way their occupation although they had developed their own techniques and technologies of fishing. They were engaged in agricultural works both as land proprietor and as sharecroppers or as ordinary labourer. There were wide variations in the cultivators-land owner's relationship in northern Bengal and Cooch Behar state. The relation was beginning from zamindar in the top to the agriculutral labourers (halua/kamla) in the bottom. The Zamindars get land directly from the government assured to payment of fixed amount of revenue. The jotedars were intermediary between the zamindars and the chukanidars. Chukanidars could lease their lands to the dar-chukanidars. The dar-

chukanidars could cultivate their land by their own initiative with the help of halua (agricultural labourer) or through their tenants called adhiars (sharecroppers). The supliers of land to the haluas or adhiars were called giri in rural areas of that region.[33] So the haluas position in 'landownership production relations' hierarchy stood in the bottom.

The Rajbanshis of south Bengal are still engaged in fishing in large scale. There were wide variation in the social position of landholders and actual cultivators in the rural areas of sub-Himalayan Bengal. While a big landholder in a village often designated as dewani had prominent position, the adhiars or haluas were inferior in the village society. The zamindars and a big landowners had contact with upper castes what the ordinary had not. However the relationship between the cultivators and the landowners particularly between the Rajbanshi cultivators and the jotedars was quite sympathetic because of common caste origin. From the point of class, most of the Rajbanshis were adhiars who had good terms with the zamindars or jotedars. A few Rajbanshis of Rangpur, Jalpaiguri, Darjeeling, coochbehar state and Dinajpur districts were zamindars and jotedars particularly in the permanently settled areas. The educated section and the landed elites had formed the core section of the Rajbanshis in the late colonial period. In undivided Bengal the Rajbanshis had developed a kind of social integrity through the social reform movement popularly conceptualized as kshatriyaization which led to the growth of self consciousness and formation of a social identity. Kshatriyaization movement of the Rajbanshis was started in 1891from the question of their social status in the decennial census what eventually placed the Rajbanshis as a distinct scheduled caste community in the late colonial rule.[34]

Table 3.3 : Distribution of the fishermen castes population of West Bengal (1961-2001)

Caste	1961	1971	1981	1991	2001
Bagdi	10968851	1291127	1831565	2354609	2740385
Bind	22924	20772	34028	45067	51828
Doai	14191	4770	8054	10232	5089
Gonrhi	13859	12153	14832	2389	1437
Jalia kaibarta	117384	204679	318344	442783	409303
Jhalo malo	68757	89918	150557	220306	293714
Keyot	23174	24397	45282	60704	74078
Koch	3522	17257	9714	14844	12727
Mallah	12366	21596	38103	49415	51501
Namasudra	729057	980524	1692233	2581549	3212393

Caste	1961	1971	1981	1991	2001
Patni	6288	12781	22466	29515	30429
Pod	875525	975352	1536197	1985243	2216513
Rajbanshi	1201717	1353919	2258760	2839481	3386617
Tiyar	39633	79786	82106	159499	195340

Source: Population Census India (1961-2001 years).

The growth rate of the fishermen castes was comparatively higher than the general population growth rates and the Scheduled Caste population of West Bengal. Population of two primary fishing castes like Jelia Kaibartya (39.38%), Malo (47.08%), Gonrhi (507.32%) and Namashudra (124.47 %) had been increased considerably during the period between 1951 and 1961 which prove the migration of the fishermen in West Bengal in large-scale. The decade between 1961 and 1971 also witnessed the high population growth rates of the Jelia Kaibartya (74.37%), Malo (30.77%), Namashudra (34.49%), Tiyor (101.31%) and Patni (103.26%). The period between 1971 and 1981 was more serious for the traditional fishermen communities in terms of population growth rate. The high growth rates of the Rajbanshi (66.83), Namashudra (72.58%), Malo (71.88%), Jelia Kaibartya (55.53%), and Patni were strengthened by the political turmoil in Bangladesh, which caused huge migration to West Bengal. The decade of 1981-1991, had also witnessed the same phenomenon in population growth rate of the fishermen castes of West Bengal.

Table 3.4 : Total population of certain scheduled castes (fishing communities) in West Bengal 1951

Name of caste	1951
WB (SC)	3526651
Jelia Kaibarta	84218
Jhalo Malo	46595
Tiyor	41974
Bagdi	905491
Namasudra	324790
Rajbanshi	742733
Gonrhi	2282
Bindh	18923
Patni	33064

Source: Census of India 1951.

MUGH

There is no doubt that the Bengalees are highly skilled in pisciculture and agriculture. South 24 Parganas, Midnapore, Khulna and Barisal are largely dependent on fishermen labourers and brokers. Muslim, christians and Banga Hindus are majority population here. Muslims and Christians are also taking part with others to survive on fishing.

Another important community is Mugh, they come here from abroad to catch fish. They are different from other community fishermen. They are the inhabitant of Burma, partugal and other countries of that region. Many of them have permanently settled at Gauakhali, North 24 Parganas, and at Beguniar char, and Haldir Char in Khulna and at some other places in chittagong. They are known as "Mugh" a very special community among the fisherman. Most of them come to these region in season that is at the end of October and depart at the begining of March.

There is a rumour behind this Mugh community fisherman. At first when they entered these regions they were docoits and thieves. Gradually they changed their profession and took part in fishing. They were experienced in this art specially their nets may be cited for example Big Vabdi, Dara and Vashal very famous nets. They brought with them. They could use it in two ways. They could place them in deep water. Sometimes they could place in shallow water. The people of 24 parganas, Midnapore, Khulna and Barisal did not know the process of fishing in the deep sea. Even they could not use big boat. Mughs were the first fishermen community who could use their special net, Boat and other things. They are brave. They used Big Mayur Pankhi Boat with sail and ventured to go deep sea and would catch a lot. Their vabdi (Big), Dara net with Big Mayur pankhi boat attracted the notice of the local fishermen and they tried to copy their style but in vain. They were pious and man of less talk. They would stay in these regions for five or six months, and never wasted a single minute. They were skilled in fishing in deep seas. They could row the boat in Rough seas, perfectly even before modern technology signaling of weather come into being. So they ranked 1st in catching the fish. They defeated the locals. Their nets, boats, sincerity and deligence were unparalled. Their matchless technique gave them a good position. They built their temporary shelter on the branches of trees in the Sundarban region beyond the reach of ferocious animals like tigers. They used Big char (usually sandy) as their drying ground. They dried fish in the sun, by placing on

the chot or sand for 3 or 4 days and turning upside down periodically. Another method is hanging rope with Bambo poles. They dried big fish as well as small fish in the Sun. The Mughs are called the father of the "Shutki Fish". The Mughs knew the art first and they gradually introduced it to the locals. At first when the art was first introduced they could not carry drinking water with them. They dug small "kuyo" on the sandy tracts and got sweet drinking water. But when natives tried to get water in this way they could not. Even they could not carry burning oil like kerosine. They used candle like structure and lit them up at night and got emmense light for the purpose of their sewing and mending nets and other things. This art of lightning were unknown among the native fishermen. They worshiped their own kind of God and sacrificed animal. All these manners of theirs arose interest in the locals fishermen and thus they become the boss of the whole community. They were hard working and punctual. Their arrival and departure were so regular that the natives would call them "sun clock". After sawarswati Puja they would depart.[35]

H. H. Risley marked a section of people as Ghashis of Bengal as a fishing community. A section of Binds & Rajbanshi had also been considered as fishing community in the colonial period. Doais are mainly found in the North Bengal.

The Rajbanshis of South Bengal have adopted fishing as their occupation. The other section of Bengal named Kadar have taken fishing as their occupation. The Mals & Mallos have taken fishing as their profession. Besides all these communities Napits have also adopted this occupation in a large Scale, Dhali, Dhaba, Mohaldar, Beldar, Mondal, Naskar are also engaged in fishing, though they have been belonged to a particular so called low-caste. They are doing their economical progress by adopting this profession. Nikari, Bazari, Majhi, Mallah of Muslim community are engaged in fishing.

Some other sub caste of pods & Namasudras are fish catching people. The prominent of them are the Bangal, Goldar, Majumder, Sardar, Choukidar who are belong to Dhani Sudra of East Bengal, and they have taken fishing as their part time occupation. They are the inhabitants of the villages adjoining to the Sundarban. They have developed their own skill of catching fish.[36] Specially in the skill of Bamboo implements. They have also done more development in the case of hook, Thopa (crab catching rope) and pattajal they have shown their mastery. Some Sudra Brahmins

(Patit) who have been identified as choudhuri are also have adopted the fishing as their livelihood.

Naskar, Raptan, Patni, Fakir, Who have been identified them as Dhulepura pod are also expert in catching fish. All these section of Sudra and pods live in the adjoining areas of sundarban and catch fish with their own skill developed by them. Dhulepura pod and Bajetpura Pod are specially expert in crab catching in the interior of the sundarbans which are adjoining to the Bay of Bengal.[37]

According to the professional status and mode of the fishermen's participation in the total process, they have been categorically divided and subdivided too. At first I have been to mention the names of the Aratdar (commission agent) and the Nikaris (fish mongers) though they identify themselves as fisherman, in reality they are always the people of the non fisherman castes. The Aratdars are commission agent. They lend money to the poor fisherman as advance for fishing & in return extract all the from them at a very low price.

The Aratdars are shylock, they understand only their interest. The poor fishermen who are involve in the process they take money from them at the very begining of the season. In order to begin their business, they don't think then the rate of interest and the future activity of the Aratdar, In the middle or end of the season the poor fishermen calculate their fate and became astonished to see how and how much they have been exploited by the Aratdar. They get less than half from the Aratdars. Now the situation have been changed. Cooperative Bank and cooperative society of the fishermen have come forward to save the poor fishermen by giving loans to them at the beginning of the season. So that they may get of rid of the exploitation from the Aratdar.

Nikaris play an important role in the marketing of dry fish. They also play multilateral role in the trade. Sometimes they also play big role in the business. Sometimes they sit in the market & sell fish like the ordinary fishermen. They are very intelligent. They know ins and outs of the business. They are specially valued by the Aratdar & paikars. Paikars try to get opportunity from them of every kinds, so they oiled them very much in order to get benefit from them. The paikars who are known as the fish retailers they are economically weak. Their role is significant in the business.[38]

CONCLUSION

A section of the Muhammedan was specialised in fishing in the district of Eastern Bengal. According to age old notion of 1957 of the Hindu professional fishermen were low castes or untouchables. Though such castes Division is unscientific and the Result of prejudices prevailed in Bengal. Such Division has no base at all.[39]

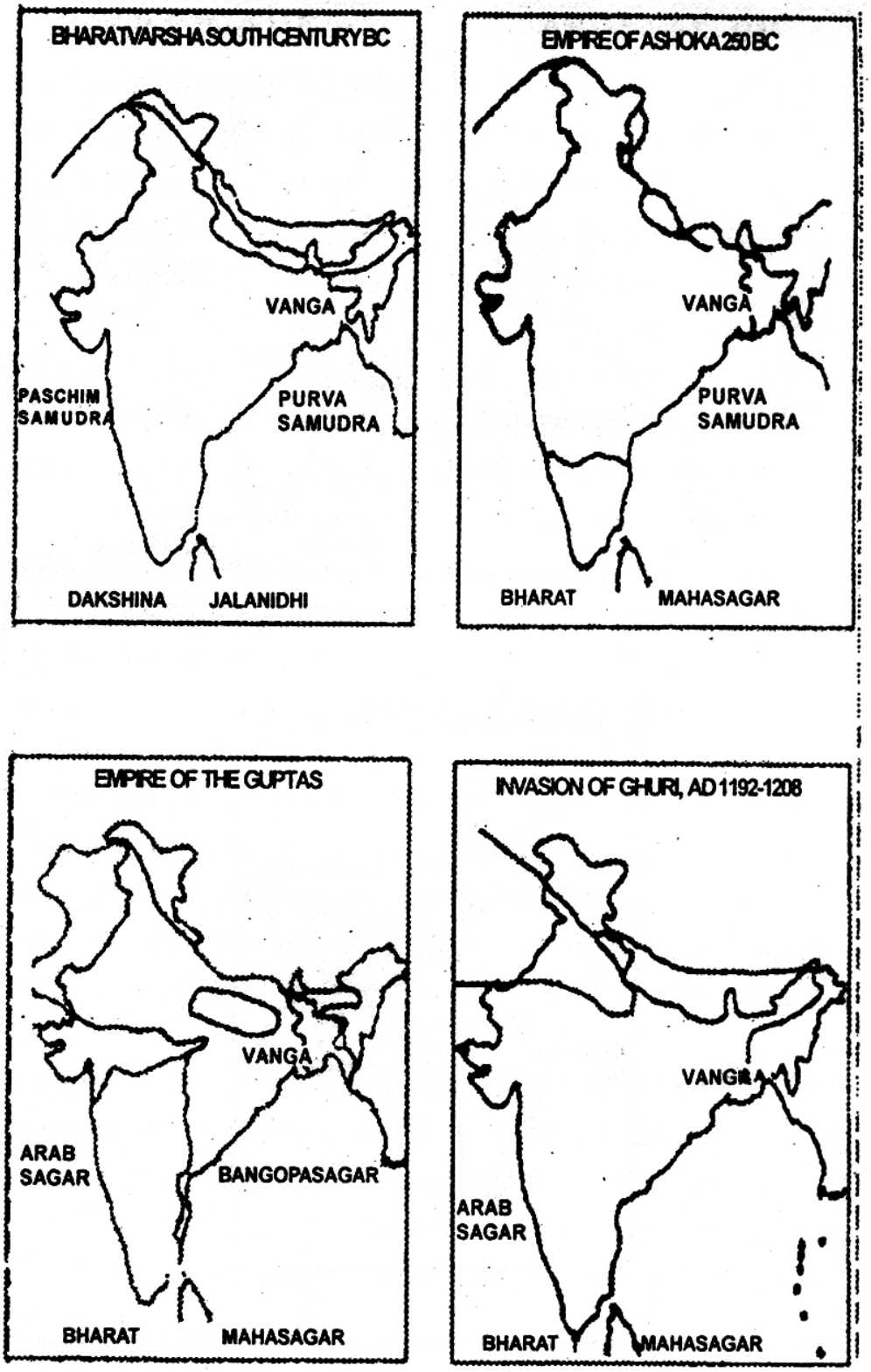
Table 3.5 : The fishermen castes of West Bengal and their occupation.

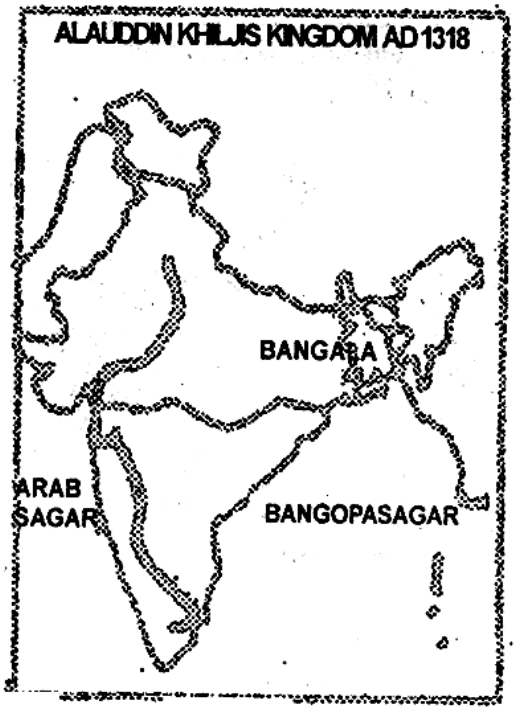
Caste	Their Occupation
Jelia Kaibartya	Fishing, selling fish and making fishing implements.
Bind	Fishing, Earthen Works
Doai	Fishing and making mats
Gangrar	Fishing
Ghashi	Fishing, agricultural works
Tiyor	fishing, selling fish and boating
other Castes Rajbanshi, Mal, Malla, Namasudra, Patni, Poundra, etc	Fishing was their subsidiary occupation
Jhalo Malo, Malo	fishing, selling fish and making fishing implements
Gonrhi	Fishing, Selling fish and agricultural works.
Keot	fishing, selling fish and boating
Bagdi	Agricultural works, fishing, palanquin bearing, making fishing implements and other menial jobs.

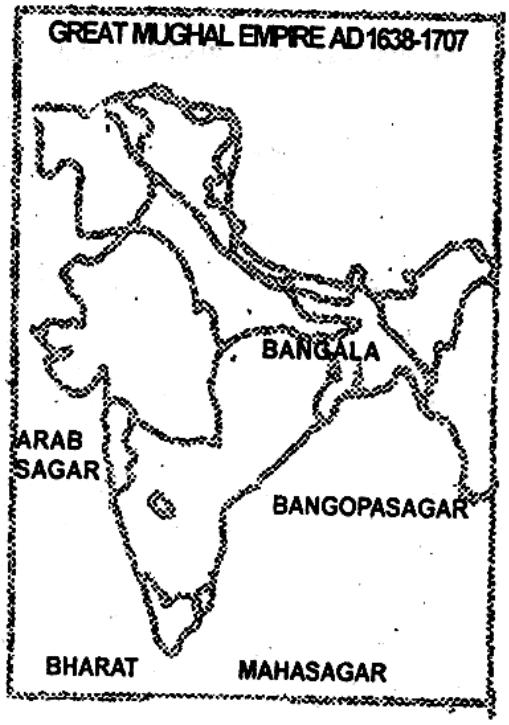
Source : Data compiled by self.

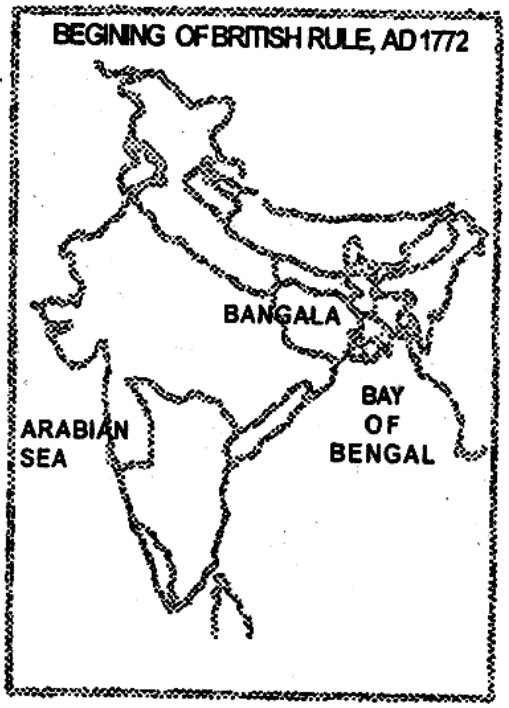
There is a proverb which runs thus "Time and Tide wait for none." The time has come to illuminate the true identity of fishermen of Bengal. They are the "Banga". They are the races of the oldest inhabitants of Bengal. The identity and location of Banga has been showed through the geographical position. (Fig. 1)

Fig.1 : Geographical Location of Banga




ALAUDDIN KHILJIS KINGDOM AD 1318
BANGALA
ARAB
SAGAR
BANGOPASAGAR


GREAT MUGHAL EMPIRE AD 1638-1707
BANGALA
ARAB
SAGAR
BANGOPASAGAR
BHARAT
MAHASAGAR


BEGINING OF BRITISH RULE, AD 1772
BANGALA
BAY
OF
BENGAL
ARABIAN
SEA

The name of the Bangadesh has been derived from its people "Bangas The old and modern historians, Geographist have come to the resolution that Banga people are the main cause to give birth the Banga-desh. Autareyo Arrannoc, Shastri, Maxmullar, Bandopadhyay, Nihar ranjan Roy, all have agreed to this point. Geographical reality is the determination of a group people when they live in a country for a long years. Bangas are non Aryan, aboriginal tribes and they are the Root inhabitants of Bengal. Thye are the outsider of Aryabarta.

Banga History of different ages

India-continent (6^{th} hundred B.C.)	Banga
Empire Asoka- (273-232 B.C.)	Banga
Gupta empire (275 A.D.)	Banga
Invasion of Muhammad Ghuri (1175-1206 A.D.)	Banga
Reign of Allauddin Khilji (1296-1316 A.D.)	Bangala
Mughal Empire- (1526-1707 A.D.)	Bangala
Reign of British empire- (1756 A.D.)	Bengal

Source: NATMO-NATIONAL SCHOOL ATLAS, 1999, The Concise orient longman Atlas, 2004, p. 5-7

Banga- 'ব ' has been used in Bengal, not V. The meaning of 'ব ' : Barun Emperor of the sea/ sagor Raj (Geeta), Samudra Shashak (Rigveda). Bangiya Shabdo Kosh (1978): The meaning of the bengali letter'ব ' means- sea, water, Natural flowing river, storm, paddling the oars, Fishing hook. It can be easily imagined that letter 'ব ' is mainly related with water, river and all other activities related to the seas. Desert and Dry regions are not related with this letter. Fishermen are mainly belong to the Banga group. They are the original habitat of Banga, out of Aryans civilisation. Fishermen are expert in boat making, ship building, wood works, and specially adapt in boat ferrying in the rivers and ocean. They sometimes do participate in Agricultural works and produce large quantity of paddy. Many of them live in the boat most of the time of the year. They use boats in all sphere of the works of their life. They cultivate paddy in a large scale and it is their principal food grain. The Gangetic Delta is the

main living place of this community. The peoples of this region sometimes take part in weaving Nets, Cotton garments and Linengarments. Geographer and the renound historians came to the resolution that they are the permanent habitat of the Middle and East Bengal. A vast area of Tamrolipti of its integral part. During the reign of palas the Banga habitats were very powerful. They were Economically, socially and politically cultured. There is no doubt that Gangetic delta was the original Homeland of this people.[40]

Though the very word 'Banga' has not been mentioned in the Rig-Veda, yet it is found in Autareyo Arrannok. Three major such as- Banga, Vagadha, chera are found in Autareyo Arrannok. Here- jati does not mean caste, it means ethnic race. The races who lived in Bengal were kirat, poundra, Banga, and vagadha. All were Buddhist (Rakhal Das Bandopadhyay 'History of Bengal' 1324 page-15-16). The Aryans also hated Banga, Vagadha and Chera as birds at the time when autareyo Arrannok was composed. It is very significant that when we see the Banga and Poundra Race in Autareyo Brahmana or autareyo arrannok . The Aryans would not live either in Bengal or Magadha at that time.

Besides, Banga had been mentioned as a race in the Boudhayon Dharma Sutra outside the boundary of Aryan Civilisation, But near to the Kolinga. So it had been evidently clear that the name of the Province Banga had been originated from a particular unit of a population.

In gist

Autareyo Arrannok (Rig Veda)	Banga is found
Ramayana	Banga
Mahabharata	Banga
Boudhayan Dharmashastro	Banga
Fa Hien (399-414 A.D.)	Banga
Hiuen Tsang (630-644 A.D.)	Banga
Pala Period (770 A.D.)	Banga
Marcopolo (1250-1323)	Bengala
Abul Fazal (1556)	Bangal
Jayo-Di-Baror (1550)	Bangala
Van-Den-Braker (1660)	Bengala

Rennell (1770)	Bengal
Rakhal Das Bandopadhyay (History of Bengal)	Banga
Nihar ranjan Roy (Bangalir Itithash)	Banga

During the reign of Akbar- Banga had used as suba-Banga. So the word Banga had been derived from a race Banga who had been living here in this deltaic region from the very ancient period.[41]

The prominent fishing community kaibartya as well as other fishing castes have been considered as aborigines. In order to point out aborigines, it is better to depend on the report of the census of 1872. Nationality, Race, aborigines, castes, all have been taken for gradation and thus all have been classified properly. The report says 1. Aboriginal tribe. 2. Half Hindu aborigines. 3. Hindu (A) Developed Caste. (B) Intermediate Caste. This classification is very significant, aboriginal tribe and half Hindu aborigines have been separately classified. They have been expelled from the No-3 category. Moreover fifteen sub classes are found among the Hindus. So original inhabitants refers to aborigines tribe and half Hindu origins. Hunter also expressed the same opinion in his famous work "The statistical Account of Bengal". Now question is who are aborigines of Bengal.[42]

- Aboriginal tribe 3. 87157 (majority santal 1.39761)
- Half Hindu aborigines 51.10989 (majority chandal- 16.20515)

(Census 1872, Govt. of India, General Statement V.B. Statement of Nationalities, Race, Tribes and castes. PPCXIV-CXVII)

Famous Historian Ramesh Chandra Dutta had explained Manu Samhita. There he marked above hundred Kinds of caste in 1 crore, 70 lacs of Hindu. Classification among two crore of people had been showed below. The number given below has been pointed out in per thousand:-

i. Kaibartya-2.006, ii. Chandal-1.564, iii. Koch-1.215, iv. Brahmin-1.077, v. Kaeshtha-1.056, vi. Bagdi-720, vii.Gowala- 613, viii. Satgop-547, ix.Napit-439, x. Baisnab- 439, xi.Chamar-410, xii.Suri- 383, xiii.Teli-383, xiv. Jelia-375, xv.Tanti-330, xvi.Pod- 325, xvii.Benia-318, xviii. Jugi-306, xix.Kamar-286, xx.Kumar-252, xxi. Bauri- 252, xxii.Tiyor- 229, xxiii. Dhobi- 227

Total population 13,760 other castes below two lacs. caste- 3494, total Hindu population 17,254

(Source: Census- Govt. of India, Specially 1911, p. 445)

Kaibartya and Chandal have got the place in the list as mixed castes, served by manu. The total amount of Kaibartya is 20 lacs. Their ratio is 1:8 into total Hindu castes. They are physically strong and stout, persevering, hard working and very polite by nature. Though they live on fishing and hunting yet, they know agriculture a bit. They are one of the prominent fishing communities of Bengal.[43]

According to the census report of 1872 this prominent fishing community has got the place in the list of aborigines. So other fishing castes like koch, Tiyor, Jelia, Malo, Bagdi, pod are considered as aborigines. They are the original and the oldest in habitants of Banga. They had created their own civilization and culture before Hindu culture flourished here. They had been defeated by the Hindu and gradually accepted their religion and culture. Thus they are called the "True Banga". They are native like newgilander. They are indigenous, aboriginals. They had separate culture and different life-style. So on the basis of strict scrutiny entire fish community that we get according to the schedule of the mixed aboriginal castes is the Bangas. They had their own identity, that they are the "true Banga" They are not low castes.[44]

2. Culture and Religious Diversity

Culture flashes the traint of a particular community. Culture shows their nature, religious activities, food habits, language, songs, social festivals, their day to day works. The fishermen live in a hardship of life. They have to work in a adverse situation. They have to go everyday in the seas or rivers which are troubled by gusty wind. They have to carry out their professional works in a life risk situation. So circumstances, have helped them to grow a non-communal & secular disposition among them. They have to fight at every steps of their life. They generally live on the banks of the rivers or on a vacant land where people do not generally live. Most of the fishermen family lives on such lands that are free from rent. They take simple food and wear simple dress. Though their lives are simple, they have to fight with natural evils constantly. The venomous snake, the royal Bengal tigers, Crocodiles and shark

are the dangerous elements they face every time in their daily life. Cyclones, Earthquakes and flood are also their enemies.

In the very prime of their lives the zamindars tortured them very seriously. More over they would become the victim of communal hazards created by priest community of so called caste Hindus. The panchayet councillors and the members of the union parisad harassed them as well as their women. Above all the close observation is that there is a relation between the nature and culture of human civilization. The culture speaks of the collective achievements of human group in different fields of society including social, religious, economic, language and arts. Customs and behaviour of various kinds constitute the culture of a particular community.

Being deceived by the prevailed circumstances the fisherman of West Bengal had developed a fine and smooth culture of their own and naturally it had formed a link with the water i.e. nature. Their habitats, mode of fishing technologies of fishing, language, food habit and the water bodies they use are the determinant factors of folk culture of the fisherman.[45] H.H. Risley wrote in 1891 that "special reverence is paid by them to the great rivers on which they live and these together with their boats and nets have their regular season of worship."

Religion

In order to protect them from natural calamities the fishermen group worship some special deities. They worship Khala Kumari, Bura and Buri, Khaza Khizir, and Pir Badar. For better protection they also worship Trinath, vishalaxmi, Bhagirath, Manasa and sitala. Worshipping of Machandali Saif and Pir-Khijri are still common in the Sundarban delta of West Bengal.[46]

Table 3.6: The Fishermen castes of west Bengal and their folk culture

Castes	Cultural features
Bagdi	They specially worship manasa because it is the deity of snakes in the Hindu pantheon. It is a common belief that manasa protects the fishermen from the snakes in water.
Gonrhi	Worship of the Ganges is the special features of their culture.
Jelia Kaibartya	They worship rivers, nets & boats. They also specially worship the Ganges. Jal palani (Keeping the nets in rest) is their special festival.
Keot	Worship of the Ganges.
Malo or Jhalo Malo	They worship river, boat and net. The Ganges is their special deity as it is the symbol of water. They also specially worship Manasa because Manasa protects the fishermen from the Snakes.
Tiyor	They worship the Ganges. They also specially worship Manasa.

Source :Cited in Rupkumar Barman, (*Fisheries and Fishermen, A Socio-economic History of Fisheriesand fishermen of Colonial Bengal and Post- Colonial west Bengal*).

Fishermen lead a very simple and poor life. They have no religious egotism. They are free from strong communal feelings.

The Hindu, Muslim and other communities celebrate their festivals together. There are some Gods and Goddess whom both the Hindu and muslim community worship. This non communal and collective effort of the fishermen has given them a good position in their society. As they had been very often oppressed by the Pirates, Zamindars and other culprits this collective effort had given them strength to maintain Economic as well as other cultural discipline in their community. The religious festivals in which all community join are the fair of Banabibi, Dakshin Roy, Charok Mella, Durga-Puja, Ganga Puja, and Kali Puja. More over there are other homely pujas for which no fair is held. The fishermen of Southern part of west-Bengal

specially surrounding sundarbans worship and celebrate festivals of their own kind. Though similarity with other parts of the country is found. Fisherman always depend on the nature. Their life is water related and somehow obscure of uncertainty. This fear of obscurity and uncertainty give birth imaginery and customary God and Goddess. In such an atmosphere the worship of Banabibi had come into existence. Later the customary society had accepted her as folk Goddess promoting fisherman welfare. This super natural Goddess is almighty in the Sundarban region. There is none to challenge her right as a Goddess of tiger.[47]

Banabibi

Hindu, Muslim, Jelia, Moule, Baule all worship Banabibi. A strong and powerful Goddess of Sundarban and all most throughout west Bengal. She wears ornaments of leaves and creepers. Crown made of Jari is on her head. Sometimes she puts on shoes. She rides on the back of a hen or a tiger taking a child on her lap. Sometimes Banabibi is found wearing a Sari. Different kind of garlands of wild flowers lay on her neck, her hair is well-combed and often hold a top in her hand. she takes a hen or a tiger as her carrier. Shah Janguli stands by her side holding a mace in his hand. Then Dukhe riding on the back of a crocodile goes under them. The Altar i.e. called than and the Images of Banabibi are found at different places in the adjoining villages and interriors of sundarban.

The worship of Banabibi is celebrated from the 1st Magh in spring and continues till the month of a Jaistha. The wood cutter, fishermen and Honey collector who are the usual visitor of Sundarban perform the worship of Banabibi just at the time of their departure and at the time of their arrival. There was a tale in the Muslim Kitab (Book) 'Banabibi's Johurnama'.[48]

'Banabibi's Johurnama' reveals the class character of Sundarban's culture. The episodes are not only the simple story of preaching the kindness and supremacy of Banabibi over Dakshin Rai but also the feudal character and existing class struggle of the society. It also establishes the fact that in the early stage there was clashes between the two communities, but after long confrontation amicable settlements were made between two communities which is the keynote of Sundarban culture. Dulal Chawdhury in his Article "Banabibir Pala-o-Lok Samaj" reveals the revelation of the class structure in the episodes. It is as follows:

- Banabibi = mother goddess or protector, i.e., good spirit.
- Dakshin Rai = Land lord, or state power-representative or spirit of class society, i.e., oppression.
- Narayani = mother cult and synchronising spirit.
- Dukhe = helpless landless poor person.
- Dhonai and Monai = mouleys or toiling classes of Sundarbans.

Abdul Jalil is not in favour of attributing any historical importance to the episodes of Banabibi. He differs with Satish Chadra Mitra.

There is a common belief of the poor people that sacrificed water on the name of Banabibi can cure the Diarrhoea, small pox and any kind of skin disease of the children. The tigers, crocodiles and robbers these three terrors have got a remarkable place in the folk literature of this area.[49] On the occasion of Jatal puja which is the annual puja (hajot) of Banabibi cake of sugar, cake of molasses, kadma, milk, shirni, and fruits are served on her (Banabibi) as oblation. Moreover alive cock and hen are discharged in the forest. Puja (hajot) is started with the uttering of Hymn from the holy book (kitab or puthi). Narrative opera composed on the life of Dukhe is staged everywhere in the sundarban region. The glory of Banabibi had occupied an wide space in the folk culture and folk literature of sundarban as well as of west Bengal too.[50]

Dakshin Rai

According to prevalent custom the worship of Dakshin Rai had been introduced in the sundarban area by the fisherman and other so called lower caste of Hindu community. They worship him as the God of tiger like Banabibi. This god is seen sitting on the tiger's back. His image is made like a warrior. Both Hindu, Muslim and other community worship him. The wood cutter, fisherman and Moule community do worship him with great respect and gratitude. His worship does not need gorgeous oblation. Simple offering is enough for his satisfaction. Someone do sacrifice hen on his alter as oblation. He is not only worshiped as the God of tiger but as the God of crops he is much respected. He also protects crops from the massacre of natural calamity like cyclone, flood etc.

Dakshin Rai has been addressed as Baro Thakur in the Mongal Kabbo (epic) written by Hari Deb. Another opinion runs thus-the king of Vatir-Desh (southern region). The modern opinion about Dakshin Rai is that he is a outrageous zamindar, oppressive Jotdar and a wicked king famous for his tyranny.[51]

His images are found in various shapes, sometimes he bears Buckler and sword, sometimes he carries bow and arrow in his hand. There is a beautiful temple of Dakshin Rai at the village of DhopDhopi in P.S. Baruipur in South 24 parganas. Weekly puja of Dakshin Rai is held here on every Friday with pomp and grandeur. In the 'Mongal Kabbo' of Rudra Deb, It is found that his army is consisted of tigers, crocodile and hornet. Big Fairs on the eve of the worship of Dakshin Rai are held at different places in South Bengal Such as Hasnabad, DhopDhopi, Bhangor, Canning, Gosaba, Satjelia, etc.[52]

Pir-Gazi

Much influence of Pir Gazi is found in the vast area of sundarban and its neighbouring locality. Many people of lower caste Hindu were converted into Islam in the 14th and 15th century. All these Pir Gazis took important role in this hinous act of convert. They had love and sympathy for the poor people. They would help poor people in their day to day problem. As they were Ayurvedic practitioner, they would stand by their side at the time of their illness. On the other hand the oppression of Zamindar and caste Hindu had forced the poor people to go under the Umbrella of Islam where Pir Gazis gave them shelter. By adopting this process of convert, they took the help of religion in economic and political fight against caste Hindu. Pir-Gorachand of Harowa, Mubarek Ali of Ghotiar Sharif and the Baro Kha Gazi of Khajuria came forward and tried to take bold steps against the oppression of Hindu Zamindar to poor people. Every week on Friday many followers of Pir-Gazis attend the mosque. Gorgeous festivals and fairs of Pir Hazrat Sahander is exhibited at the village of Bakra under P.S. Hingolganj on the 1st Magh every year. People of different community attend the festival. The Devotees offer (shirni) to the mosque with a view to full fills their desire. According to Hindu religion the cake of molacess and sweetmeats are thrown as offering. Flowers tied with brick-bat and holy water taking are considered as helpful for the full-fillment of the desire of receiving new born baby and cure of cronic diseases.[53]

The famous pir Gazis are Pir Aedil Sha, Pir Gorachand, Badar Pir, and Manik Pir. Manik-Pir-Gazis have got much familiarity in the sundarban as well as in other parganas too.[54] Daria pirs are specially remembered just at the begin of boat journey in the rivers for the sailors safety. The sailors and fishermen remember the names of pancha Pir and shouted the very peculiar sound on their name which runs thus.

"Daria Panch Pir, Bador, Bador".[55]

BaroKhan Gazi

The worship of BaroKhan-Gazi is well known to the people of sundarban area. This festival known as Gazir Mela has been celebrated by the people every year. The man who has been victorious against wrong doers is known as Gazi. A trace of an inhuman battle was fought between Dakshin Rai and Barokha gazi. The battle has been elaborately illustrated in the Ray mongal Kabbo. Though a peace treaty was signed after wards. Hindu and Muslim both the community worship him as God.[56] His clay made images are found almost everywhere in the villages. The God wears turban on his head. Keeps long beard on the mouth and generally bears sword in the hand. Such an image is placed on the Alter. Then shirni prepared from Batasha, Kadma, and other sweetmeats are offered as offerings. There is also a custom to let hen or cock in the forest. People believe that BaroKhan Gazi can save the children from different critical child disease. There is mosque of BaroKhan Gazi at Ghutiari sharif. People go there and pray for expectation. A Big fair has been being held since 7th Ashar every year on the eve of the occasion of Gazi's death but the Biggest fair is held on 17th shraban. Thousands of people attend the fair and pray for obtaining his grace.[57] Once he saved the people from drought and since then the fair sits on the day of Ambubachi every year.

Kalu Rai

Kalu Rai a formal god is worshiped throughout west Bengal like Dakshin Rai Narayani, Bana bibi and BaroKhan Gazi. People believe Kalu Rai Chotto Mia saves people from the clutches of crocodiles. The statue of this God is human like. He holds hatchet, shield and wears belt, adorned with different kinds of arms.[58] Sometimes he takes bow and arrow on the back. 'Shirni' liquid offering prepared from sugar, Batasha is given as oblation before the idol.

Manasa –Goddess of Snake

Ma- Manasa the Goddess of snake is worshiped everywhere in west Bengal specially in the Sundarban region. Manasa gets respect from every corner of the Bengal. Both Hindu and Muslim community worship Manasa. It is found in the novel 'Arjan sardar' written by shib Shankar Mitra that the Fatima wife of Arjan sardar was very submissive to the Goddess of snake. She spoke in favour of the Goddess Manasa for the sake of her family's safety. Once her husband killed a king- kobra. She became very sorry for this and she rebuked her husband. Yearly festivals of the Manasa are held two times in the Sundarban area. Not only this her worship is celebrated throughout west Bengal every time of the year.[59] The first important puja is held on the last day of the Bengali month Shrabon. The puja is commonly celebrated by all. The 2nd puja is celebrated on the last day of the Bengali month Bhadra. This time the puja is widely celebrated in the every house of the farmers of West Bengal.

In order to satisfy eight snakes of Manasa there is a custom for offering garland of shapla and eight leaves of shapla on the mud made altar of the Goddess as oblation.

'Manasa jatra' and other folk songs composed on the life of Behula and Lakshindar are displayed everywhere in West Bengal through the year. Many places as well as villages have been named after Manasa. Village fairs are held on the eve of the puja and handmade Goods (cottage industry) are sold.[60]

Shitala Puja (Worship of Shitala)

Shitala Puja has been specially introduced in the Sundarban area like other parts of West Bengal. There is a general belief that Shitala Puja brings remedy from different kinds of skin disease and measles. Her conveyance is ass. She takes fan in one hand and broom in the other. She is worshiped from temple to temple throughout the year. There is no need of priest to conduct everyday puja affair. Chaste woman of every house worship the Goddess respectfully with devotion at noon or in the evening. Remarkable puja of shitala is held in the month of Baishak and Jaistha. The famous fair of Shitala is held at Bharatgor under P.S. Basanti in 24 parganas. Non cooking day is strictly observed on the puja day. Boiled rice steeped in cold water is eaten as

'Prosad of Shitala'. Many narrative opera and panchali of shitala have been composed illuminating the glory of shitala and is sing on the occasions.[61]

Sati Ma

Some community of West Bengal is the follower of the ideology of Satima. They call meetting to get immunity from hard disease. The meeting is generally presided by a fakir of the village. It is supposed that the fakir has been specially favoured by the Goddess for somedays, as he has been blessed by the Divine Power he gets right to give prescription of medicine to the patients, of the village. Such gatherings of satima are held at different places under P.S. Hingolganj. Many people attend the gathering; Both Hindu and Muslim community believe that such medicine blessed by God can cure all types of diseases.[62]

Kali Puja

Kali Puja is widely celebrated in West Bengal. But it gets special dimension in the Sundarban region. At first it was celebrated at the cutchery Bari of Each Zamindari estate with pomp and grandeur. But now it is organized by the effort of the people of two or three villages unitedly. They collect subscription and organize the puja on the day of the new-moon in the Bengali month of poush. Sometimes it has been held since poush to Jaistha. In many places the puja, idol making and immersion are done within the period of day of the new moon. Huge quantity of Batasha (cake of molasses), fruits, and male goat are sacrificed on the altar of the Goddess. Women do starve for the sake of the welfare of their sons and daughter.[63] They bathe in the pond 200-500 metre or even 1 k.m. away and return in a peculiar manner to the temple. This peculiar attitude is called Dandi Kata.

Some other folk deities were also worshipped through folk rituals or without a composed textuality. The following Gods and goddesses are remembered in times of ailments with or without the texts or panchalis, in away of collective appreciation:

Basanta Roy/Sitala	Pox
Ghentu	Skin disease
Panchu thakur/Panchananda	For child birth,Children’s disease
Sasthi	For child birth,Children’s disease

Harijhi/Manasa	snake Bite
Jorasur	Fever
Ateswar	For cattle fever
Ola bibi	cholera
Bana bibi,Dakshin Ray	Tiger bites/ailment
Kalu Gazi	from forest
Satya pir/Mangalchandi	Manat/Hajot/recovery

Gajon Festival

Gajon is a favourite festival to the people of Sundarban. The Devotee who have vow to the god 'shiva' wear sacred thread and beg alms on the name of God Shiva from door to door in the village on the first day of the Bengali month Chaitra. They have been remained vegetarian for a month. They do not use oil or soap of any kind by this time. Carrying water in a jar from the "Nimai tirther Ghat" of the Ganges, they directly go to the Tarokeshwar and pour it (water) down to the head of the God 'Shiva'. On returning home they attend to the temporary 'Shiva temple' and do worship the God 'Shiva' and discard sacred thread. Thus they come back to the normal life. They believe if they can do the God Shiva pleased, the whole family would live in safety without any disease or trouble and at the same time the family would get an economic lift which will bring prosperity to all.[64]

This festival is not always publicly arranged in the village. There are endowed properties in the village and from that property the total expenditure is maintained according to the custom. A party consisting of 10 or 12 members from the village takes active part in the festival. Such members are called 'Gajon Sanyashi'. The head of the party is known as 'main sanyashi' and the last one who continue the end of the period is known as 'pat sanyashi'. In order to keep themselves pure and holly they let 'Shiva lingo' bathe (placing in a parthor bati) with Ghee, Honey, milk, sacred water of the Ganges and move from door to door in the village shouting a peculiar sound on the name of the God Shiva. At noon they take rest for a while and eat slight fruits and remain full vegetarian at night. They maintain a routine up to the puja days. They are accompanied by a party of clown dancer consisting of 5 or 6 members. In their demonstration a band party of large drum, flute, bel metal plate are found on play.

The singer who leads the party is known as Balader. He recites different kinds of rhymes and expresses the glory of Ma-Durga. Wearing mask this party (clown) perform the fight of Demon, the scene of Mohishashur Mardini the matricide of Paroshuram and prollad charittra like clown-dance of Purulia. The Gajon is held consecutively on the last three days of the Bangla month chaitra. This worship of 'Shiva' is known as "Del-puja"[65]. Gajan festival is held at Howrir-Hat at Mandir Bazar. Another puja is held at Deul-Temple on the banks of the river Moni of Sundarban (116 No. lat). It has been known from an inscription of 975 A.D. The king Jayanta Chandra built this temple during the reign of Pala. The Gajon festival is gorgeously celebrated to this temple. Sanyashis Jump on the iron blade strung together on a board of wood kept in the water of the pond. The 2nd day is the day of the Blue candle (Nil), on this day women go from temple to temple and offer the blue candle to the god and the Sanyashis standing on the dried mud jump on the iron blade painted with the blue colours. All the Sanyashis gather under a date tree. The leader climb up the tree and enter into its thorny top to smash the green date. This process is known as the custom of the breaking of date tree. The Del-Puja comes to an end on the last day of the Bangla month Chaitra.[66]

Makal Thakur (The Fish God)

Fish has been considered as incarnation and sign of prosperity in the Hindu religion. Incarnation comes to the Earth for the salvation of sinners. They protect the creation of the god. They guide people to the right path. They act as the savour of the animals. Similarly fish supply us with protein, fat, iron, calcium, Phosphorus and save people from mal-nutrition. Men had relation with fish from the period when the world was very young. Men eat fish; the animals, birds and all other insects eat fish. Even the royal Bengal tigers of Sundarban like to eat fish. There is a proverb that even the Ghost of Bengal eat fish. The fish has gained super priority as food from the Bangalees. It has a long historical background too. Fish remains with us in all the social festivals. During the period of the Purana, we see there is fish everywhere and plays an important role in every festival.

Many instances of love for fish in the Bangalees are found in the writings of the poets (Bengali) like Bijoy-Gupta, Mukunda Ram and Raygunakar Bharat Chandra in the medieval age. Fish have influenced us much. So existence of the God and

Goddess of fish are found but they are wordly. The name of the God of fish is Makal Thakur. The worship or puja of this fish god is mainly celebrated in 24 parganas (both), Medinipur and Howrah districts. The Makal Thakur is seemed to be the god of Marshy land. The people specially the fishermen community of West Bengal worship this god before going to catch fish in the deep sea. Anthromorphic images of Makal Thakur are not found. Makal Thakur is familiar with the fisherman in many places in West Bengal. There is no permanent temple or than of this fish god (makal). Making an alter by the side of a marshy land or a river fisherman worship the god before going to catch fish. Mud heap or lump of Earth are placed on the alter and are worshiped as god.[67]

The images of Makal Thakur recalls the period of (FETICHISM). This puja is celebrated by the side of a marshy land or on the banks of a river. At first a clean and plain plot of land is chosen, then an alter is made with mud. This altar has three stacks which are like steps. After that a heap of mud or a lump of earth is placed on it. Next four sticks which are joined by red thread are implanted at each of the corner of the altar. Then image is painted with vermilion. At last keeping flowers, water pot, sacred basil leaves and bell-pata on the altar. Puja is done by lightening the candle and incense.

The arrangement of the puja is very humble. A plate of unboiled rice, with ripe banana and a few molacess cake is offered as oblation to the idol. Some sweets, rice, sacred grass, sacred leaves of basil, new bowl of hooka and some Gonjika are offered on the name of the god. Some flowers are also kept on the head of the images. The Devotee believes that if the flowers fall naturally they will be fully successful in the art of their catching fish.

No priest or Brahman is needed for this puja. Those who are the Deyashi category of Brahman, they only utter the very word three times "Guru Satto", otherwise most of the time a senior fisherman takes the responsibility of a Brahman & Carry out the puja. They believe that if Baba Makal gives shelter for the fish in the water no power can catch them. And only for that reason they try to satisfy the Makal Thakur by offering oblation. Not only has that if had any one thrown hook in the water by remembering his name the fish must be caught. Those who are young they utter his name before catching fish by hook.[68]

There is no fixed date for the puja in the calendar. The fishermen perform this puja according to their need. The farmers do the puja before planting the paddy and after harvesting. At the time of festival, they become very conscious. Because the ultimate aim of the Puja is to satisfy Makal Thakur. This puja is mainly celebrated among the community of kaora, Bagdi, Tiyor, Rajbanshi, and Pod. Most of the fishermen of Howrah district call Makal Thakur as 'Makal Chong'. They worship chandi but they do not follow the rules of the Puja of formal chandi. They call both the heaps placed on the altar as "Makal Debota" the male only. There is no room for the Goddess. This festival is only found in the Sundarban region. The fishermen of this area worship some other Goddess too before going to catch fish. They are the vishalaxmi and Khala Kumari.

The worship of this formal god is no longer widely celebrated nowadays. Once the fishermen would celebrate the puja gorgeously. The existence of Makal Thakur has been illustrated in the religious book of Hindu Dharmo Kabbo. The name of Makal Thakur is also found in the religious book named "Tarokeshwar Shivatatto." The name has also been explained with other Gods and Goddess in the "Kalikamongal". Many villages of west Bengal have been named after the name of Makal Thakur. Similarly some surnames have been determined according to the very name 'Makal'.[69]

Fishermen also worship Narayani, Ateswar, Vishalaxmi, Ganga, Panchananda, Sasthi, Jorasur, Olabibi, Mangalchandi etc. Their cultural life flourishes more brightly when they participate in folk songs like- Jhumur Gan, Rupban Pala, Ramlila and Vasanjatra. The Tribes have separate culture. They sometimes catch fish and worship local gods and goddesses with other people. They also participate in Tusu festival which is very significant in their life.

Pir, fakirs, ojahs & Bedias are powerful men of the forest. People go to then when they become sick. They treat people with two types of knowledge. i. Magical ii. Medicinal. They use herbal treatment too. The healers took recourse to 'dust' (dhulopoda), 'water' (jalpoda), ‘oil’ (telpoda) and ‘herbs’ (sekor bakor) along with hymns (mantras) to propitiate the people. They offer holy water to the people when they are in troubles. If their manot is fulfilled they give reward to the pir and fakir. With all these customs and manners their culture has been attractive.[70]

3. Fishermen's life style and Economy

The formation of Fishermen families is (mostly) basically same in west Bengal. But according to their functions and other characteristics some classifications are done among them. They are mainly the joint or nuclear, matrilineal, patrilineal, matrilocal or patrilocal and so one. Several researches have been done on the family style during the last few decades. Following the clue of the researches we have got messages about the relation among the families in India. We have also known their occupation. Caste and life style moulded by Economic factors related to their life.

Structure of the Family

According to the structure of fishermen families are mainly two types (i) The nuclear & (ii) The Joint. The nuclear families are composed of husband, wife and their unmarried sons and daughters. Joint families are big and construction with broad membership. This type is called patrilineal. More than 50% families are nuclear type in nature. Most of the family in the village consists of the head, his wife and unmarried sons and daughters. Nuclear type is liked by all though joint family system include social security and financial ability to all the members of the family. Joint family comprises the head, living with parents, unmarried brothers and sisters are found living together with other. Though the fishermen like to live in the joint family, the inadequancy of income had forced then to live separately. Whatever the situation of their living may be, they attend ceremonies festivals together and take food with their relatives.

Separation between the parents and sons takes place after the marriage of the sons and as a result married son cannot get share from father's fishing gear. Though Hindu Act has give equal shares of parental property to both sons and daughters, the women are not getting their share in reality. According to the custom paternal property have been equally shared among the sons after the death of the father. Only the unmarried daughter may claim the ornaments of the mother if any. Fishing gear is kept for the livelihood of the old parents. Only the land property is divided among the sons and they are finally liable to pay of the debts of their guardian. They are so poor that they cannot buy a separate plot of land. They build their home on the existing land as a result they live in a congested village.[71]

Family members both adult and minor work for economic support

All the members work together for economic upliftment. Male and Female all do works. Fishing and net weaving are the primary work of the family. Grown up male members catch fish in the river or sea. Women and their children fish in the river by means of hand nets. Children also catch fish by rod and line. In some areas women are engaged in net weaving and children are found engaged in the processing of shrims. They also do work in the brick-fields. They collect fuel for domestic use. Women collect fuel. They sell fish in the market. Thus children and women take part in the work for the economic well being of the family.

Fishing, net mending, boat painting, drying fish in the sun, and other out-door works are mainly done by the male members. Female members take active part in the work related to fish. At the same time they do cooking and child-care. Thus all the family members take active part in the work for the all round economic prosperity of the family and they become an unit.

For example in Tamil Nadu region the details of population, size of family, literacy, educational status and occupational pattern are given in (Table 3.7)

Table3.7: The distribution of fisher population, size of family, literacy & occupational pattern.

Item	T.Kuppam	P.Kuppam	K.kuppam	Mallipattinam	Alanthalai	Total
1. No. of households	137	601	441	220	275	1674
2. Population details						
Adults						
Male	256	1016	679	346	630	2927
Female	249	1059	657	344	623	2932
Children						
Male	117	650	382	179	230	1558
Female	125	498	335	195	217	1370
Total	749	3223	2053	1064	1700	8787

Item	T.Kuppam	P.Kuppam	K.kuppam	Mallipattinam	Alanthalai	Total
3. Average size of family	5.5	5.4	4.7	4.8	6.2	5
4. Literacy rate (%)	60	33	15	23	28	29
5. Educational status of Literates (%)						
Primary	48	38	72	72	88	57
Secondary	45	38	18	14	8	29
Higher Secondary	7	24	10	14	4	14
6. Major occupation of households (%)						
Active fishing	70	60	69	74	90	70
Fishery related activities	18	25	22	24	7	21
Other activities	12	15	9	2	3	9

Source: Cited in R. Sathiadhas, *Production and Marketing Management of Marine fisheries in India.*

The sex ratio of fisher population works out to 959 females for 1000 males. Average size of family ranges from 4.7 at Keechankuppam to 6.2 at Alanthalai. The literacy rate ranges from 15 percent at Keechankuppam to 60 per cent at Thiruvottiyoorkuppam. Due to the overall poverty of marine fishermen families, many children of school going age are also involved in fishing or infishery related activities. Among the literates maximum people (38 to 88 percent) studied only upto primary level and the drop outs are more afterwards. The fishermen believe that the ideal time for getting training for the labourous catamaran fishing is around the age of ten. Hence, many of the children in the age group of 10-14 get the basic training in swimming. Floating, assisting in fishing etc. with the result that are uable to attend the school.

Children naturally acquainted with their father's profession

From the very prime the children begin to gather knowledge about fishing and fishing equipments. Such as Nets, Oars, Sails and boats etc. The children observe the works of their elders when they are engaged in mending nets not or painting boats. Thus they gradually gain idea about boat building and boat repairing. The juniors hear the adventurous stories of the seniors and acquire knowledge of the order of tide and try to reach at the summit at a very early age. They visit hooghly, Kakdwip, Dimondharbour and many other important fishing harbours with their parents and acquire knowledge.[72]

Ranks vary in respect of men & women

Men members of the fishing community get lion's share of their father's property but women's right are not considered judiciously. They do household duties. Sometimes they sell fish in the market and take part in weaving nets. They also catch fish in a creek or Beel with hand nets. Thus with their small earning they try to buy household article. When male members remain absent from the family for some days, they do necessary purchases for the period of their absence. Though women always try to help the family with their small earning their rank is still remain very poor in comparison with their husbands and sons.

Remarriage of widow has not been approved. Though divorce has been permited, if any women go to astray due to unavoidable reason, they lose their social status and be severly criticised but men remain free from such situation. Male members take decision about all important matters of the family but women are consulted only in domestic matters. The heads talks with their wives regarding marriage affairs, puja-parban and many other domestic crisis. Senior male member exercise his authority on the family. He welcomes the guest and relatives but women covering their face with veil speak little. They only serve food to them. Women do not take their meal earlier than that of their husband. They feed the mates first and then eat at last. They get less honour in comparison with the mates. The fishermen play cards in the leisure. They go to the ghat and enjoy gossiping with their fellowmen. They are habituated into smoking and taking tea.[73]

Standard of Living

Food habits, mode of dresses and the condition of the houses indicate the standard of living of a perticular community. A few well-to-do families of the fishermen community get food according to their need. One fourth remain half fed or under fed and another one fourth do part time starvation. The members of the well-to-do families eat rice, fish and vegetables. Other group who are comperatively poor eat fish and the last group eat poor meal without fish. Fishermen who are migrate do not take egg and meat.

They use cheap garments. Most of the time one gamchha is found on their shoulder. Men wear dhuti and woman wear saree. Shirts and blouses are rarely used. shirts are worn when they go to the festivals. The children below 5 years remain naked. They wear good dress when they go to fair with their parents. Grownup children both male and female wear shirts and frocks. They seldom wear special winter garments. They wear sandals and slippers on a few occasions. Very few have pucca houses. Wooden box and steel trunks are found in their houses. They use aluminum utensils. Very few uses gold ornaments. Sanitary arrangements are very poor. Male members use the bank of the river and nearby fields. Female member and children use kancha latrine in their housing complex.[74]

Marriage system

The Hindu community is divided into a number of castes. This caste is again divided into a number of sections. Next sections are divided into sub-sections. And these several sections have created obstacles in the smooth flow of marriage system in the Hindu community and its sections and subsections are not freed from these evils. But they mostly maintain a general rule which is prevalence from the age old days.

As a member of the Hindu community the fishermen must marry with the caste. They must maintain caste and Gotra. i.e. they must marry within the same tribe. Violation of caste endogamy is severly condemned. It was considered severe offence in ancient time. But now, with the spread of modern outlook and education caste endogamy is losing its popularity and mass support. Yet the news of inter-caste marriage is rarely heard. In some places the rule of exogamy prevalent among the fishermen community. But marriage with near kin is strictly prohibited.

In some cases it is generally found that the dead husband's unmarried brother marries the widow. On the contrary a man is allowed to marry his dead wife's sister. Love marriage and alliance making marriage are getting support with the spread of education. Both Pre-marital and extra-marital sexual intercourse among the fishing communities are not allowed. Sexual relations between relatives are not permitted. They highly regard the status of a family. So any kind of violation of family rules they do not tolerate. In short it may be further explained that sexual relation between brothers or sisters or any person belonging to parent's generation is not allowed in the fishing community. Marriage between two relatives (near or far) is not approved among fishing community. Those who violate are severely punished. Elopement is found nowadays.

Attitude towards widow's marriage

The widow marriage brings a very fine message for the fishing community as they live a life full of risks. They do not give free license to the widow marriage but widows can do. The young widow can re-marry if she has got no child. The whole fishing society has considered the matter of young widows, she marry but not a single instance can be cited.[75]

Latest generation

Both the rate of child birth and child mortality is high in the fishing community. They do not go under family planning due to poverty. Their children generally suffer from malnutrition. The baby does not get nutritious food. Mothers work hard but remain frequently under fed. They are not in a position to call qualified doctor. They rely on kabaj, tabij, maduli and dore although they have got hospital at the distance of stones throw, they do not take helps at a first sight. They believe in the works of Gunin and evil spirits. In some cases, they realise the importance of good doctors, they cannot afford money to buy medicines and fees of the doctors. Sometimes they seek help from Govt. hospital. Very few people get the opportunity to take such help. Most of the children die from diarrhoea, dysentery and malnutrition. Parents do not get much time to see their children, they remain busy for their food.

Education

Illiteracy is deep-rooted. Their children do not get primary education. Their children remain so busy for meals that they ignore to attend school. They like to accompany their parents to catch fish and sell them in the market.

The children do not know even the Bengali alphabet. None was found to have read up to class six. Only less than 20 to 40 percent were found enrolled in a primary school adjacent of their village, but they did not attend it regularly. The main reason for the poor attendance in their poverty. But formal education being an important input for socio-cultural development made little head way among the population. Due to lack of proper communication and proper state initiative education could not spring up in the villages.

Table 3.8: Educational qualification of the fishermen of different communities of the sample survey conducted by the IIM, 1972

SI. NO	Community	Illiterate	I to VII or can read & write	VII to X	Passed school final / H.S	Graduate
1	kaibartya	68.76	24.81	5.31	1.11	-
2	Rajbanshi	77.24	19.13	3.15	0.48	-
3	Malo	76.92	19.84	2.83	0.40	-
4	Namashudra	84.75	11.86	2.54	-	0.85
5	Bagdi(Dule)	75.83	21.67	2.50	-	-
6	Bazari(Muslim)	91.43	8.57	-	-	-
7	Nikari(Muslim)	79.83	18.52	1.85	-	-
8	Jhalo	84.49	13.51	-	-	-
9	Average	74.68	20.95	3.70	o.62	0.05

Source: govt. of West Bengal: report of the Master Plan Committee, part I, p.145

They help their family by collecting fire wood and cowdung, which are very important in the rainy season for cooking. They also help their parents at the "Ghat" where various workers are performed relating to fish and fishing industry. The children remain dirty because the family cannot provide them with oil, or soap, child marriage is found at a high degree in the society due to age old, rotten culture. Most of the male children smoke Bidi specially half-burnt Bidi thrown away by their elders. They suffer from constant want, they do not get nutrition, clothing, education and treatment. They become perish due to strong poverty they face from the very morn of their life.[76]

4. Economic Conditions related to occupation

The matter of increasing income of fishermen, improving their living conditions, organizing fishery co-operatives comes under social science. Development of fishery to increase fishery production by introduction of new fishing gears, motorization is one side of the development. But the real development and the role of Government to increase income of fishermen for betterment of their living conditions particularly for small scale fishery, where fishermen engaged are poor and their living conditions are miserable. It is difficult to assess the actual economic position of the fishermen. Neither do they maintain regular accounts of their income and expenditure, nor are they able to supply information regarding the quality and quantity of their catch. Some of the owners of the fishing boats were also reluctant to furnish information in this regard out of fear of income tax. An idea has been made about the economic conditions of the fishermen on the basis of information collected through questionnaires. The Economic condition based on the expenditure from each household on items such as food, dress, education, medical, indebtedness etc.[77] The employees at some of the arats where these fishermen sell their fish, who's information were also valuable.

Fishing is obviously the only primary source of income of these fishermen. The possession of fishing implements such as fishing boats, nets and other accessories by a household is indicative of its economic position. Further the possession of landed property also indicates the economic position of a household. The native fishermen did possess agricultural land in the past. But gradually due to successive failure of catch, they were forced either to sell the whole or a part of their agricultural land or to mortgage it to the money lenders. It was also observed that some of the fishermen families purchased agricultural land to counter the highly uncertain income from fishing. They never dreamt of investing cash in purchasing agricultural land in the past. But the prevailing circumstances compelled them to change their attitude. They now turn to this source of stable income. This change of attitude due to economic uncertainty was also found among the fishermen. Some of the fishermen were engaged on fishing trawlers owned by private persons belonging to other district or state. They were engaged by the owners on a fixed monthly remuneration. Despite the inadequate remuneration they preferred it to the uncertainties in the fishing

occupation. Fixed income at least keeps their households above starvation.[78] They had some secondary source of income. Such as cultivation, small business, and other jobs. The income from agriculture and agricultural land was somewhere better, some were not.

The standard of living and employment opportunity of fishermen depend on their occupation. Majority of the wage earners (58 per cent) have an annual income in the range of Rs. 10,000 to 30,000. Most of the families (51 per cent) depending on fish trading earn Rs. 5,000 to 20,000 per annum. Families depending on fishery related activities other than fish trading as their major occupation earn the lowest income since 78 per cent of them have an annual income of less than Rs. 10,000. The average annual and per capita income of fishermen household on the basis of the survey carried out in five sample villages of Tamil Nadu Coast are given in Table 3.9.

Table 3.9: Average annual and per capita income of fishermen household based on major occupation.

Major occupation	Annual income	Per Capita Income
1. Owner operators		
a. Mechanized units	43230	8646
b. Motorized units	34660	6932
c. Non-mechanized units	29306	5861
2. Wage earners		
a. Mechanized units	18340	3668
b. Motorized units	15205	3041
c. Non-mechanized units	9384	1877
3. Fish Traders	11552	2310
4. Other Fishery related activities	5846	1169
5. Other activities	22873	4574
Overall	19713	3943

Source: Cited in R. Sathiadhas, *Production and Marketing Management of Marine fisheries in India.*

The expenditure also indicates the economic position of the people. In the case of the fishing community, variability both in income and expenditure exists due to the nature of their occupation. The extent of expenditure incurred by each household on the basis of the quantity of items consumed by them in terms of the prevailing market price. A major portion of the total expenditure is incurred on food only. Among the fishing communities, expenses on other items are negligible. Expenditure on

education and medical facilities are poor enough. Spending on ceremonies includes expenses on recreation, social function, community worship etc. Miscellaneous expenditure covers investment on fishing gear, repayment of loan etc. Expenditure on clothing is also insufficient.

Rice is the principal food. As regards food, meals are generally composed of cereals, pulses, vegetables, fish, eggs and meat. It is really a tragedy that despite being engaged fully in the fishing trade, most fishermen cannot afford to purchase fish. Fishermen catch fish almost daily but their poverty compels them to sell in the market, though sometimes they keep some portion of it for domestic consumption.[79] For example (table no 3.10) showing the total expenditure of the of the two villages Hara and Sultanpur close to diamond Harbour in the districts of South 24 Parganas, along with the breakup of the amounts spent on different items, is given for a clearer understanding of their economic position

Table 3.10 : Itemwise Monthly Expenditure

(in Rs.)

	Hara		**Sultanpur**	
Items	**Amount**	**Per cent**	**Amount**	**Per cent**
Food	21275	76.86	5970	69.88
Clothing	1085	3.92	565	4.21
Education	240	0.87	670	1.80
Medical expenses	755	2.73	1210	3.25
Ceremonies	1035	3.74	1835	4.94
Miscellaneous	3290	11.88	5915	15.92
Total	27680	100.00	37165	100.00

Source: Cited in S.K.Parmanik, Forward by Prof. S. C. Dube, Fishermen community of coastal villages in West Bengal.

Before the beginning of the fishing season, the owners of the boats are generally compelled to take (advance) dadan from the aratders (godown owners) to meet their requirements. Locally one fishing unit during the rainy season requires approximately Rs. 3000 and during the winter season approximately Rs. 5,500. But none of the boat owners is capable of providing necessary cash for running the

business, only a few are able to do so. Since the owners take dadan from the aratders, they are thereby obliged to store the catches in their arats for auction. The fishermen store their catch some times in the arats when they have to wait for four to five hours for sale. The aratders provide the necessary ice, when sufficient ice is not available locally, the aratders purchase it from Kolkata at their own cost. Moreover, when there is insufficient catches in successive years, the aratders continue to advance money to the owners. This however is sometimes in adequate. There is no substitute for this mahajani system at present.[80] Thus fishermen are tied to their mahajans though they are aware of being exploited.

Auction is held in the presence of the fishermen and the amount is paid by the aratders with several deductions. Fishermen have to add 50 grams to every kilogram of fish sold. This is the usual practice of the Sundarbans. But at some Bazaar, the aratders take no share of it. The extra grams are entirely taken by the buyers. For each sale, the aratders deduct subscription (britti) of 13 paise, accounting (hisabana) 20 paise, porter charge (Koyali) 25 paise and gift (dan) 50 paise, plus a commission of eight paise per rupee from sale proceeds. The amount of commission varies with the variation of sale proceeds but other deductions are fixed for each sale (challan). The aratders profit from this mode of sale from both the buyers and the sellers. From the buyers they charge two paise per kilogram of fish. These profits induce the aratders to invest their capital among the fishermen. While at other centres in the sundarbans the price of fish is fixed by the aratders, at Nagendra Bazaar it is determined by auction. Most of the fish purchased are taken to calcutta by trucks and train. Some of the aratders own lorries which are hired for quick transport. During the rainy season, fishing is done in the rivers and fishermen return to the landing ghat daily. one of the crew members carries the catch in a wicker basket to the arat at Bazaar. He stores the catch for auction at the arat whose owner advanced them money. Thus their catches are hypothecated to him. There are occasions when fishermen do not return to their own landing ghat. In those cases they sell the fish elsewhere. The aratders donot mind if there are sufficient reasons for such sales. Sometimes, the person who carries the fish obtains an advance from the aratder before the auction of the fish and then returns to the unit. At the end of the trip some of the members visit the aratder and receive the actual auction money minus the amount taken as advance. The fishermen rely on the aratders in this respect and the aratders, in turn, never cheat them.[81]

The fishermen go in the Bay of Bengal for fishing in winter, for about ten days at a stretch including upward and down ward journeys. They do not carry ice with them. They sell their fish to paikars (wholesalers) who, with carrier boats, hover about the fishing grounds. They have with them sufficient ice for the preservation of fish. When any fishing unit hauls a catch a flag is in hoisted on the boat. This is a signal to the paikars. Fish is sold in batches of twenty and the price determined by the size of the fish. Scales are not used. Sometimes, the fishermen are also in a position to bargain, particularly when several paikars approach them. Otherwise, fishermen are generally compelled to sell their catch at the rate fixed by the paikars. Which is much lower than the market price. Fishermen are not paid cash at the fishing ground. One of the members of the unit is sent back with the paikar who purchases the catch from them. The paikar makes full payment to that person at the arat at Diamond Harbour. No person is sent with the paikar who is not well known to the fishermen and cannot be relied upon, though the paikar gives a receipt. Wholesalers at Diamond Harbour send their agents who are locally called charandars on motor launches for direct deliveries at the sea shore. Fishermen sell their catch to them who give them a printed receipt. They do not hesitate to sell on credit.[82] They receive the payment at Diamond Harbour when they return home at the end of the trip.

The system of sale on credit at the fishing ground is advantageous both to the buyers and the sellers. To move in the open sea with liquid cash is not safe either to the paikars or to the fishermen. Fishermen have no use of cash on the fishing ground. They have not any safe place on their boats to store the cash, though they keep small amounts of money received from the paikars/ charandars, in advance at the time of sale of their catch. Some of the fishermen go to sea with hired carrier boats for purchasing fish at the fishing ground. Each of them is the owner of several fishing boats. This trade requires a large capital. Very few fishermen can afford it. Besides, there is great uncertainty in it. During the auction it was observed that the persons employed by the aratders try to make the bid higher, for higher the price greater will be the profit of the aratders. The fishermen usually present some fish to the aratder and his employees. The quantity is not fixed but the gift has become a rule. These gifts are often sold by them and thus become a part of their income. However, the buyers get some benefits from the aratders. They purchase the fish at the auction but sometimes can not pay the entire amount at once to the aratders. This amount is paid

next day after selling the fish. Thus the amenities offered by the aratders to those who sell to them and buy from them attract business.[83]

The Economy was partly depended upon agriculture. Sundarban was popular for fish and agriculture. About 88.53% of the total workers of this area were engaged in agriculture. The cropped area was 975 sq.miles, of which 967 of the area covered under "Amon" paddy cultivation. Cultivation was spreading very rapidly in the sundarbans and all over the district, the swamps were being gradually drained and reclaimed. In rainny season paddy field also a interesting fishing ground. In this time most of the ponds were overflowed so fish took shelter in paddy ground.[84]

Sundarbans was considered as goldmine for fishing. Fish and fishery related trade was the most flourishing trade of sundarbans. There was various rivers and creeks, having tidal saline water with flushing of sweet water provided a unique ecological ground for the propagation of fish. The rivers and khals were abound with all kinds of fish and support a large fishing population. Their economic condition remained very poor. The maximum population in sundarbans directly or indirectly depended on fishing for their livelihood. Fish near Calcutta or large towns was carried there but the greater quantity was consumed locally. Vast water resources of this area had a great potentiality for fisheries. Fishes were sometimes carried out to long distance by enclosing them in a larger wicker-cage which was towed behind the boat, but this was not common. There was fishery and fish drying business near the mouth of Meghna. There was also a vast demand for fishes in Calcutta. It is evident from the note on fisheries of Sundarbans, 1958, published by the Deptt. of land and land revenue, Govt. of West Bengal that there are 86 salt water fisheries, big and small, biggest being the Garberia fishery in P.S. Haroa with an area of 2469.31 acres and the smallest being Harispur fishery in P.S. Sandeshkhali area being 50 acres. Just on the border of this area there are 60 other salt water fisheries in villages Bansra. There are 86 fisheries lying in the Sundarbans area proper.[85] Some fisheries could broadly be classified- i. Fisheries created in the marshy areas, Khals, Beels, Dhals etc. and unculturable waste lands. there are 14 such fisheries, ii. Fisheries created partly in marshy areas and partly in agricultural lands subsequently inundated due to breaches in embankments. There are 9 such fisheries. iii. Fisheries created partly in non-agricultural lands and partly in agricultural lands subsequently inundated due to breaches in embankments. There are 26 such fisheries. iv. Fisheries created

exclusively in agricultural land, subsequently inundated due to breaches in embankments.There are 31 such fisheries. v. Fisheries created exclusively in non-agricultural lands, subsequently inundated due to breaches in embankments. There are 6 such fisheries. vi. Fisheries created by constructing embankments in the low lying areas, accreted from the rivers.[86] Dept. of fisheries however, had found 13.7 lakh acres water area as possible sweet water fisheries in 1970. Moreover, West Bengal had good possibility in marine fishing.

Table 3.11: Fisheries of West Bengal estimated by the Department of Fishery, Govt. of West Bengal in 1970

Category	Sub-category	Area
1. Sweet water fisheries	a) Tanks	6 lakh acres
	b) Beels & Baors	2 lakh acres
	c) Rivers & Canals	5 lakh acres
	d) Dams & Reservoir	0.70 lakhs
	e) Total	13.7 lakhs acres
2. Sewage-fed fisheries		0.22 lakh acres
3. Brakish water fisheries	a) Estuarine fisheries	4.30 lakh acre
	b) Bhasa-Bada fisheries	0.20 lakh acre
4. Marine fisheries	a) Fore-shore	280 sq.miles
	b) Off-shore	520 sq.miles
	c) Deep sea	39000 sq.miles
5. Hill-stream fisheries		0.38 lakh acres

Source: Department of Fishery, 1970.

In 1980 West Bengal Fisheries corporation Ltd. Has been founded to supply the high quality fish seeds in West Bengal and other states. Under its direct supervision with the financial assistance of the World Bank three hatcheries were opened in Medinipur, Burdwan and Murshidabad districts, which are successful attempts of the state. This corporation successfully completed the construction of the small fish port at Sankarpur, Frejerganj and Sultanpur (Diamond Harbour) and fish landing jetty at Namkhana. The brakish water farmers development Agencies (BFDA) is supervising the prawn culture in 24 parganas (north and south) and Medinipur districts. The directorate of fisheries, the fisheries corporation Ltd. and West Bengal state fishermen co-operative federation Ltd. (BENFISH) are also supervising the pisciculture in the beels and baors.

As rivers and their tributaries are the suppliers of a significant portion of the total supply of fish, the Dept. of fisheries is distributing fish seed in the Bhagirathi and its

tributaries. This scheme has been introduced in 1992-93. however, the pollution of river water has diminished the rate of fish captured from the rivers. All the schemes for the development of fisheries under taken by the Left front Govt. are not successful but the state got considerable success in the production of fish seeds and west Bengal is producing 60-70% of the total fish seeds of India. The rate of production of fish seeds is first growing. West Bengal had produced 2300 million fish seed in 1980-81 which reached to the 8850 million in 2000-01. (Table 3.12)

Table3.12 :Progress of fisheries in west Bengal (1980-81, 1990-91, 1995-96, 1998-99, 1999-2000, 2000-2001)

Production of fish (in thousand tonne)	1980-81	1990-91	1995-96	1998-99	1999-2000	2000-01
(a) Inland	340	555	740	824	857	879
(b)marine	30	125	153	171	188	181
Total	370	680	893	995	1045	1060
Production of fish seed(in million numbers)	2300	7552	8180	8610	8725	8850
Production of mechanization of boats(number cumulative)	___	2100	2584	2974	3762	4229

Source: Govt. of West Bengal: Economic Review 2001 – 02

Sundarbans estuaries supplied an extensive natural fishery, calling only for harvesting without any expense of effort on breeding, rearing or stocking. The fishing was carried on in the month from November to February. But in the month of March the fishing was practically stopped because of the non-navigable character of the waterways for country fishing craft. Mr. Westland had given us a vivid description of mode of fishing in the sundarbans.[87]

Various rivers, creeks and estuaries were valuable fisheries. The fisheries consists of several enclosures formed by throwing mud embankments round a shallow area along the side of drainage channel each of them was called 'bheri' and water was let into it at flood time by a regulated wooden sluice, through which fry and small fish could go but could not come out again. Numerous fishes like chiefly prawns, small bhetkis, mugils and macrones were caught from the bheries and it acted as nurseries.

O'Malley is of opinion that owing to the existence of annual leases the whole place was completely drained by February and all the fishes caught so that any large growth was not possible. Some people stocked their private tanks with fry obtained from the rivers. Such stocking was done as a commercial investment in the neighbourhood of Calcutta and hundreds of people of sundarbans earned their livelihood by selling their catches to the tank stockers. At the increase of the heavy demand of fish in Calcutta market, fish farm or "Bhasa bada-Bheries" as they are called, is becoming popular. It meant the stocking of fry in a private tank and protected tank and then to discharge it into large tanks and to the fishing merchants. The list of fish caught for sale was long one. The most valuable fish caught in the estuaries and estuarine rivers were different. Kinds of mugils and polynemus and the well known bhetkis are available. Besides, tapsia, hilsa, rui, magur, Singhi, Katla, mirgal, Kalabaus were also available for business. Fishing in Sundarbans was carried on throughout the year. But in the estuaries and the larger channels of sundarbans it took place only from October to March, after which a strong South West wind sets in. The busiest season was from November to February when the fishermen ventured to go to sea for fishing. The marine fishing zone of West Bengal has rich potential of commercially important variety of marine fishes due to inflush of nutrient laden water in the Bay of Bengal through creeks and canals of the sundarbans. Earlier, the major portion of marine catch was landed by traditional craft through artisanal fishing gears placing an obvious limitation on the quantity of the catch. Due to growing demand of fish and with people gradually developing a taste for marine fish, it was felt necessary to improve fishing techniques which called for mechanisation of the fishing vessels and modernisation of the fishing gears, a programme which has been continuing since 1981-82.[88]

Fishing was permitted in sundarbans free of charge. Boats entering the reserved forest were however required to pay an annual registration fee which varied according to a sliding scale from 3 annas for boats of 25 mounds load to Rs. 2 for over 1,000 maunds. The forest department charged a weekly fuel permit fee of 2 annas per head. Pisciculture was developing in sundarbans rapidly. A large number of population of Sundarbans were dependent on the fishing. Kolkata and the neighbouring areas were greatly dependent on the supply of fishes from sundarbans. But lack of quick transport system with cold-storage facility, poor organisation of

fishermen, which enabled middlemen to intercept most of the profit and the primitive equipment, ruling out operation in rough weather, was the main obstacles to progress. The fishermen community who flourished on this trade wonderfully adapted themselves with the environment of this area. But the sundarban commissioner could not ascertain what portion of sundarbans population live by fishing.[89]

The fishermen has not only taken the fishing as their livelihood but other communities like Malo, Jele, Rajbanshi, Namasudra, Poundra are also involve in this profession. Sometimes they do cultivation. The land less labour are not less in number as a result due to poverty they go to sundarban, cut the wood, collect the wood and honey, and catch fish. Through catching fish is the important profession among others. The most interesting profession of the poors of Sundarban is to catch Prawn. Prawn lives in the sea. During the period of laying eggs the prawn come to the less saline tracts and are scattered in the different rivers of sundarban.

The people are catching prawn from the estuary of Bhagirathi, Ichamoti, Raimangal, Kalindi which has been extended to vidya, Matla, Piyali, Moni, Gosaba, Saptamukhi, Hetania, Doania, and adjoining rivers, khari, varani and doani. Men women and children of all ages are engaged in this profession whole year and earned their livelihood. The big owners of the fishery and the fish embankment collect the light maroon coloured prawn from Basanti, Gosaba, Hasnabad and Hingalganj. By collecting the prawn from the prawn fishing (catcher), cultivation of prawn and processing factory bas been built up. Thus shrimp (different kinds) cultivation has been progressing in 30-40 hecter saline marshy land.

Rivers, canals and estuary become full of prawn when the sea roars due to the effect of the gusty southern wind. Prawn, catcher with their naked children get down into the water of the rivers with nets of nilon fixed on the frame of the bamboo. Tiger shrimps are very fine to look at, so they are called the Tiger of the water of the sundarban regions.[90]

Crocodile and Shark are a great threat to the life of the shrimp catcher, yet they go to catch prawn over looking their Frown. The men of the different Island of the Sundarban become engaged in catching crab from the begining of Kartik to the end of Magh. A large number crab catcher in group or gang goes out to catch crab. On the mouth of Matla, Haria, Vanga, Vidya and raymongal. They have to over look the

fear of tiger and crocodile for a handfull of rice. The crab catcher starts their adventure on 12th or 13th of Lunar (tithi). By this time when the river over flows the crab comes upper surface of the water. Crab catcher enjoy this opportunity and they use the rope line called Don (thopa) in the river to catch the crab. This rope line is a peculiar aparatus. It is 3 or 4 hundred hands long. Fish or char of shark are tied with this rope at a gap of 1f.t. or more. When Don (thopa) is thrown into the river the weight of brick is gene rally use to keep it sunk. Crab Catcher Party often comes from Jogger Hut, Koikhali, Dongajora of Sundarban area. They float their boat on the river and bring rice and dal with them so that they can maintain their purpose for the fifteen days or more collecting crabs they very often come to the canning town. They sell their crabs to the Arat of the distinguished businessman. Thus crab supply are despatched to Kolkata and many other big markets from Canning.[91]

Nowadays fishermen carry out their fishing expedition in the country or jungles but also in the deep seas for the economic reasons. The demand on the sea fish has been increased a lot and fishing in a large quantity in the sea is possible by the help of mechanised boats. It has been estimated that 150 lakhs to 2 lakhs worth quantity of fish can be obtained by going to catch fish in the sea at a time. Whereas Country boat fishing can earn thousands to 6 thousands at a time. Various Economic benefits have been flourished among the fishermen through the co-operatives among them.[92] Govt. loans have been sanctioned to co-operatives for buying mechanical boats and other necessary things for their profession. The number of the fish catcher has been increased more than before. But fish have been decreased. It is no doubt a pressure on the Economic life of the fishermen of the Sundarban.

Some Development schemes for the upliftment of the fishermen of south and north 24 parganas have been adopted by the assistant Director of fisheries of West Bengal Govt. and were realised. Gradually the schemes are the 1) Net making and repair for the scheduled caste women. 2) Repair and training for the use of Mechanical boats related to fishing. 3) Collection and Relief scheme for the fishermen who catch fish in the deep sea 4) Accidental Insurance for the fishermen. 5) Some civil Amenities like roads drinking water, community Hall, were arranged for them. 6) Grant and Aid for buying fishing Implements. 7) Identity card with photos. and 8) lastly Licence for fishing and Registration for mechanical and non-mechanical boats related to fishing.[93] Moreover state Govt. has emphasised on meeting, discussion and

workshop for the development of the fishermen. 3 other important schemes have been taken up for the schedule caste fishermen through RSVY (in this field NCDC, IFAD are) also co-operate with them. BPL card should have to be bagged for 99%. The 3 schemes were A. Net making and fitting B. Mending food from fish and C. Dry fish processing of Dry fish through machines with the help of Modern Machines. Though a large number of fishermen depend on the fishing for their livelihood. They are still living in the dark due to economic inability.[94] They can not form co-operative among them due to the want of money. Broker, Mahajan, Middleman, Aratdar all are exploiting the fishermen. Fish industry can be developed by progressing the Economic life of fishermen and by adopting Modern fishing technology.

5. Indebtedness has become chronic in their life

Fishermen's complex indebtedness shows the deapth of their poverty. It is the saddest thought that they born in poverty, live in poverty and die in poverty. Poverty takes away all the comfort of their life. Their free life cannot be expected so long they are woe to moneylenders. They take loans consecutively from the village Aratdar, Bank and cooperative society of their own. And thus they have to pay variety rate of interest to different Bank and cooperatives, as a result mental peace has been destroyed and they fall in the hazards of life. In the villages most of the fishermen are indebted for economic reasons. The owners of the fishing boats require loans for the repair of their boats, purchase of accessories and preparing of new nets. Losing nets during the expedition are rampant. Moreover, hilsa fishing in the Hoogly during the rainy season and also fishing in the Bay of Bengal during winter require substantial investment. Therefore most of the owners have to seek financial help from the aratdars on hypothecation of their future catch. During the fishing season owners take loans from professional money-lenders to meet the running expenses, while are not properly covered by the dadan taken from the aratdars. The fishermen who accompany the fishing units with or without nets also need advance from their mahajans (owners of fishing boats) to meet their household expenses while they are away for fishing. But the advance given by the owners is never adequate to meet their domestic requirements during their absence. Thus, they are also forced to contract further loans from the money lenders. Some of the households are indebted due to social reasons such as marriage and shradh which they observe befittingly. Sofar, no household has

incurred loans for religious purposes. It is clear that most of the fishermen are indebted to the mahajans. Next the main source of loans is the money lenders. Sometimes they took loans from friends and kinsmen.[95] For example the sources of indebtedness if the fisherfolk are varied and are shown in table no3.13.

Table 3.13. sources of Indebtedness

Village	Indebted households	Friends	Kinsmen	Mahajans	Money-lenders	Mahajan and money-lenders
Hara (N=89)	63	8 (12.70)	1 (1.58)	35 (55.56)	10 (15.87)	9 (14.29)
Sultanpur (N=78)	65	4 (6.16)	6 (9.23)	33 (50.77)	11 (16.92)	11 (16.92)

Figures in brackets indicate percentages
Source: Cited in S.K. Pramanik, Foreword by Prof. S.C.Dube, *Fisheries community of coastal villages in West Bengal.*

Fishing mainly depends on the caprices of nature. Whenever the catch is poor, the owners of boats are unable to repay the advance to the aratdars. The members of the crew also remain indebted to the owners. As a result, both owners and crew resort to loans. The fall of income is the main reason for the indebtedness of the fishermen. owners require large loans for the investment of their business whereas the crew require smaller loans to meet the household necessities. Loans whether large or small, are not available from money-lenders, professional or non-professional, without any security. Some of the boat owners possess landed property. They contract loans by mortgaging their land. Some fishermen sold their lands when they realized that they would not be able to recover the land afterwards if mortgaged.

Sometimes the fishermen pawn their valuables to money-lenders for loans. Professional money-lenders at Diamond Harbour give them loans either against gold ornaments or brass utensils at 36 to 40 percent interest rate. Those who do not have gold ornaments or brass utensils, pawn their fishing nets to some of the rich fishermen if inside the village or outside at the interest rate of 120 percent. They sometimes take loans against security from the non-professional money lenders in the village or outside at 120 to 144 percent interest. The fishermen who have no security to offer are denied any loan by the money lenders. The indebtedness of some of the households passes from generation to generation. The extent of indebtedness of the fishermen and their consequent misery can also be apparent from personal observations. It was great

sad that whenever fishermen sustain loss in their business or fail to get adequate catch, they are forced to sell their fishing boats, nets, ornaments and utensils either in their village or outside it. In this way they become poor. The same process of pauperisation is also noticed in the agrarian economy. Economic power is being gradually concentrated in the hands of a few landowners. They control the means of production land. This tendency also effects the social structure of the village.[96] A majority of fishermen constitute the labour force. They like the landless agricultural labourers, are subject to exploitation.

The fishermen of the most of villages somehow survived by means of fishing. But their earnings for the last few years have been too meagre to provide their families with even one meal a day. As a result they are heavily indebted to the owners, money lenders, relatives and local shop-keepers. It's a matter have come to such a pass that their traditional occupation seems to be no longer capable of ensuring their survival. Most of them have lost their fishing boats and nets and hire themselves out to the mahajans. They have now left with nothing except their labour power for survival. They are, therefore forced to work as labourers in the construction of village roads, nearby brick-fields and loading and unloading of paddy in the arat. The income from fishing was utterly inadequate to meet their minimum domestic requirements. So unless they are ensured of their daily bread, some fishermen may be compelled to give up their traditional caste-occupation. Some of the migrant fishermen have purchased agricultural land to ensure their livelihood; they do not know anything about agriculture and get their land cultivated by labourers hired from the neighbourhood. As the economic situation of the fishermen is characterized by chronic insecurity and scarcity, they are forced to contract loans for a living. When they are in dire necessity, they are ready to stake anything for mere survival. They then depend to a great extent on the mercy of the money lenders, both professional and non-professional, and those villages are happy hunting grounds for them.[97]

It is an important question wheather the masters of all the fishermen family have an alternative income. Above all forty percent family have that opportunity. It is supposed that if they had got such opportunity that is alternative source of income they would have dropped fishing. They are engaged in this profession for the fear of starvation. They have other professions like cord making, trading in fish, paddy business and grocery shop as secondary sources of income to supplement fishing

income. If the situation permitted they would give up fishing altogether. There are some reasons for desiring alternative sources of income.[98] Uncertainty of catch and gradual decrease of income from fishing, increasing risks involved in an expedition; obsolete fishing implements and physical incapacity due to old age were some of the reasons. (Table no.3.14) discloses that up majority of respondence prefered small business to others.

Table 3.14. Alternative Sources of Income

Village	Persons desiring alternative sources	Category of alternative sources				
		Fish trade	Small Business	Agriculture land	Service	Misc. jobs
Hara (N=89)	26	4 (15.39)	11 (42.30)	4 (15.39)	4 (15.39)	3 (11.53)
Sultanpur (N=78)	42	6 (14.29)	30 (71.43)	1 (2.38)	3 (7.14)	2 (4.76)

Figures in brackets indicate percentages

Source: Cited in S.K. Pramanik, Foreword by Prof. S.C.Dube, *Fisheries community of coastal villages in West Bengal.*

Due to the catch in the Hooghly was gradually dwindling so their economic condition was deteriorating and they were involving more into debts. During the field work, the fishermen gave several reasons for the scarcity of fish in the river. Their knowledge of the habitat and habits of fish is gained from the experience of past generations. The fishermen believe that shoals of Hilsa migrate upstream to spawn. They fish Hilsa in the Hooghly during the monsoon and continue the operation so long as this species is available in the river. The sweet water of the river is suitable for the Hilsa to breed during the rainy season. But their natural home is the seas. After spawning the fish return home. The fishermen catch Hilsa during their upward and downward journey. Dinobandhu Das (65) from Kakdwip said that the Hilsa run starts in the month of Asar (June-July). The another reasons behind the poor catch is the construction of the Farakka Barrage. Inadequate discharge of fresh water from the Barrage prevents the shoals of Hilsa from ascending upstream and is responsible for heavy siltation in the river-bed.[99] The formation of sand-bars at the mouth of the Bay of Bengal is a further obstacle to the upward migration of the Hilsa. The number of fishermen has increased day by day in the same-fishing area. The constant plying of a

large number of mechanised boats scatters the shoals of fish in the area where the net are set. Mechanised boats capture the Hilsa before they enter the Hooghly estuary.

The hand operated boats have lost its importance in comparison with the mechanised boats on the fishing grounds in the sea. Prawn's eggs have been captured in large quatity in the estuary of the sundarbans for the last four or six years. Small fry and other species have also been destroyed by the fine-nylon made bag nets when fishermen catch prawn eggs. This unscientific catching of prawn eggs has had a bad effect on the variety of species in the Hooghly river. Scientifically it has been stated that clean drinking water is an essential human requisite for sustenance of fish life. Clean water is also for the development of fishery resources. Polluted water is one of the main causes of the decrease of fish in the Hooghly.[100] Industrial effluents are being discharged into the river without any pre-treatment. There are about 159 factories located on the bank of the Hooghly. These include 12 textile, five paper, 78 Jute, Seven leather, four wine and 53 others, the effluents of which contribute to the pollution of the Ganga water. The textile wine, pulp and paper, sugar, and petrochemical industries severely affect the aquatic organisms. The effluents reduce the acidity of the water required for the survival of the fish and increases the ammonia, caustic soda which is harmful to them. The pollutants in the river destroy fish food such as phytoplankton, zooplankton and benthic algae, and fish spawns and larvae. It was detected that water, to the extent of 1.5 km at Bhadrakali and 3.5 km at Risra, was quite unsuitable for the habitation of fishes. Waste matter covers the bottom of the water body with a coating where algae grow and as result the supply of food for the fish is considerably reduced.[101]

Some expert thinks that the Hilsa is a long distance migratory fish, this species is adversely affected by the highly localised pollution near-Calcutta in the Hooghly. The large extent use of agricultural pesticides and insecticides like aldrine, endrine and folidol etc poses a great danger to the aquatic life. Some of the experts opine that the Hilsa resources in the Indian rivers are dwindling and the fishery as a whole is on the decline. They advocate the prohibition of indiscriminate and premature destruction of the Hilsa. They support the observance of the ancient socio-religious injunction which prohibited the Hindus from eating Hilsa from Bijaya Dasami to Sripanchami. This coincides with the period when shoals of spent fish return to the sea and the swarms of young ones come down to the estuaries. But these religious

customs are no longer observed due to the influx of migrant fishermen from Bangladesh, increasing demand on fish and the general apathy to this ancient customs.[102] The Hilsa fishery is subject to tremendous fluctuation. Thus the reports of poor catch in particular areas may not be an index to the stock of that species.

Hilsa and Hilsa fishery have been decreasing since 1952. It is not known why such scarcity happends whether the scarcity was due to over fishing or Biological cycle. Further information is needed for the protection of the Hilsa fish. Table no.show that there is tremendous decline of the Hilsa fish in Alahabad, Buxar and Bhagalpur in the post Farakka period. The CICFRI has marked the decline upto 98.12 %.

Table3.15: Average landing of Hilsa in the river Ganges

Centre	Pre-Farakka	Post-Farakka
Alahabad	19.30	1.04 (94.6%)
Buxar	31.97	0.60 (98.12%)
Bhagalpur	3.95	0.68 (83.05%)

Note: Parenthesis denote % decline.

Source: CICFRI, 1997.

The fluctuations of fish in the Hooghly matlah estuary, not only for Hilsa but also for many other species, appear to be related more to environmental causes than to plunder by man. The environmental causes like smaller water-discharge, loss of spawning ground, elevation of river-bed, less flushing, greater pollutional load etc. appear to make the habitat less suitable for the commercial species. It was suggested that attempts should be made to elevate those causes which tend to make the estuary an improved habitat for fish. Certain measures should be taken for preservation. These are raising of minimum size limits and prohibition of very small meshed nets in the upper areas of the estuaries where young fry of many species are found to inhabit.[103] It is also need for an increased discharge of fresh water is stressed which will prevent siltation in the river and increase tidal penetration.

The fishermen have got knowledge of the movement of Hilsa. Hilsa runs in the month of Asar (june-july) in the Hooghly. It has a link with the Hindu festival of

Jagannath's Rathajatra. Scientific investigation has confirmed upward and seaward migration of Hilsa. In 1983 Hilsa appeared in the Hooghly from June-July to November-December so most of the fishermen fished Hilsa in the river instead of going out to sea for fishing. This is an exception. Through the study of the life history of Hilsa it reveals that the fish breeds mostly during the rainy season.[104] fishermen pointed out valid reason for the decrease of fish. They did not mention pollution of water of the Ganges. But the scientific investigation has mentioned a great threat to the stock of fish in the Hooghly. Pesticides and insecticides used extensively in modern agriculture have aggravated the problem of pollution through drainage to ponds, lakes and streams all over the country. Whatever be the reasons for the poor catch of fish, there is no doubt that preservation and destruction should go side by side. A balance should be maintain between the two.[105]

Indebtedness has been part and percel in the life of the fishermen. Their occupation is mainly responsible to their indebtedness. Fishing boats, hired labours, Nets of different kinds require large capital so they cannot avoid indebtedness for continuing their business.

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CHAPTER -IV

Trade, Stocks and Markets of Fishes in this Region

1. FISH MARKET/ FISH MARKETING

Fish market is a place inside or outside the country where the fishes and fish products of commercial importance are sold. These systematic production and consumption of fish is known as fish marketing. The marketing is integrated part of fish industry. In short it has been stated that the process direct or indirect by which fish reaches to the consumer from the hand of the producer is called fish marketing. The effective marketing systems in identified areas are the key requirements for the development of this sector. This would ensure higher profit margins to the producers enabling faster fisheries development. This apart it is worthwhile to mention that fish is subject to rapid deterioration in quality in view of the generally hot climate in the state and thus it is necessary to take quality literacy measures amongst fishers in order to ensure appropriate value realization for them and also to protect the health of the consumers. The term fish marketing was used to mention simply buying and selling of fish at a landing centre or the beach side. At present, the fishermen used to sell fish according to whatever demand that was existing either in the quay or nearby place. Fisheries have become highly industrialized and profitable in all advanced fishing nations. The recent system of marketing not only thinks of meeting the effective demand for products but also creating demand in the market. The advance marketing techniques have been adopted so as to sell more fish not only in local areas but also in distant and interior markets. Modern fish marketing system in meeting the existing demand for fish, besides tapping the potential demand in the important markets. Changing the fish form according to the taste and needs of the consumers would result in mere sales, thus the market has to design the new product features developing, packing and brand name pricing the product to get a better result on investment.[1]Constant advertising is also a good method for the awareness about new products. Following this system we can get highest amount of output.

Fish market is a link between the trader and the consumer. It is a place inside or outside the country where the fishes and fish products which are of commercial

importance are subjected to sale. A good market always serves to safeguard the interest of the trader and the consumer. A trader also cares for maximum production, best possible quality of commodity and their timely, supply to consumers at, reasonable cost. Fishes are directly connected with the economy of the country. It earn foreign exchange also by the distribution of the commodities in the international market. The fishermen in West Bengal experienced with the networks of the market economy. They could control fish production and determine its market price. But fish markets of many places are controlled by middlemen or powerful rings of businessmen with the result that the fishermen get very low price for their product even when the consumers pay highly for it. The adoption of the modern technological methods in the fish marketing managements which means more sales of fish and reducing further the wastage of fish, more fish there by will be available for human consumption. Fish marketing system based on modern lines has to be developed in all developing countries, like India, Japan and others.

Fish marketing have some characteristics such as

1. Perishability of the commodity
2. Seasonal concentration of landing (glut)
3. Scattered landing places (long distance of transportation).
4. Small quantity produced by each fisherman is to be assembled, sorted and transported.
5. Large number of intermediaries involved.
6. Non-Uniformity of landings, quantity, freshness and size. Lastly
7. Handling and treatment, icing, freezing, curing, packing.

As spoilage of fish starts right from the time it is caught, the proper storage, preservation and prompt disposal or transport services are essential. Various studies have made from time to time which pointed out to the high level of wastage in the fishery due to spoilage. This is a vital area to be addressed and may result in increased economic returns to those dependent on the fishery without any increase in fishing effort. Therefore, strengthening of post-harvest infrastructure such as storage facilities, ice plants, cold chains, roads and transportation etc. as well as effective marketing system are very essential for the development of fishery sector. From the nutritional point of view only fresh fish should be provided. These works engage more labours. Each agency must be happy in the interest of producer and consumers.

Limited transport facilities indicate the present status of fish marketing. The distribution of fishes is greatly distractor from land centre. Fish marketing should be fairly localized and loosely linked in different areas. Relatively for human beings, fishes are short product. Physical distribution, adverse geographical conditions and climatic conditions fluctuate the qualities of fishes. Middlemen provide help to fishermen in transportation and given financial add also but because of financial riser, retailers and wholesalers get more advantages, so that as there is less production and supply of fishery and fishes, therefore fisherman gets low price and buyer get fish in "high price."Fish marketing should be negligently linked with different parts of the areas.[2] Fishes are brief product for human being. Physical distribution, adverse geographical conditions and climate have great influence on the qualities of fishes. Middlemen help fishermen by giving transport and financial aid. Retailers and wholesalers get more advantages. Due to less production and supply of fishes, fishermen get low price and buyers have to buy fish in high price.

The fishing industry has often been considered as being isolated from fish marketing with which fishermen had little or nothing to do. This has caused numerous problems. But now gradually, it is being realised that marketing must be an integrated of the fisheries industry. From the nutritional point of view the best use, that can be made of the fish, is to consume it fresh. From the overall national point of view also, it is much more economical if the catch, where possible is consumed fresh, instead of being subjected to processing, requiring more labour and capital. But as fresh fish is a rather perishable commodity, transport over considerable distance is costly and involves risk of wastage through spoilage. The margins charged by retailers, therefore incorporate this risk. Considerable saving can be effected by eliminating this distribution. All improvement of the fresh fish market requires rather thorough knowledge of the peculiarities of the market, its preference to species and presentation, its responsiveness to price changes, its seasonal fluctuations etc.[3]

Because of the great distances over which the product would have to travel, it is often impossible to market the fish as fresh. The most common processing form in such cases is curing. The great advantage is that their manufacture does not require extensive plants, that they keep fairly well and that transport and marketing are cheap compared even with fresh fish. The functions of processing and marketing may be listed as follows.

1. To enhance the products ability to keep, so that it may be stored for the purpose of evening out the supply of goods to the consumers market.
2. To treat the product, so that it may with - stand transport strains and thus give it bigger range.
3. To improve the products ability to carry greater cost, (this has bearing on quality, weight and case of handling.)
4. To provide the greatest possible variety of commodities, thus being in a position to satisfy the greatest possible range of demand in the consumer's market.
5. To stimulate demand, by means of publicity, guidance to the consumers and sales promotion.

To achieve these objectives, costs must be incurred labour is spent, and transport facilities are used. The consumer and the consumers demand constitute the basic foundation of the entire economy. It is the guide to intelligent primary production, processing and marketing. No business enterprise in fisheries has any reason for its existence, but for its service directly or indirectly to the consumers. The interests of producers and consumers are often in open conflict. The consumer is interested in securing lower prices or a greater quantity. The producer is interested in higher experiences and higher earning in production.

Two types of fish marketing

There are two types of fish marketing one istraditional and the other is Modern fish marketing. In **Traditional system** – some practices in trade dealing are based on some old customers that remain unchanged. It is generally seen that a fisher woman tries to sell spoiled fish first, then gradually she takes out fresh ones. The fish is usually sold as a whole piece as traditional practice. There is no free entrance for the new traders in the fish market. Old merchants maintain a complete secrecy for the new with a view to monopolistic control over fish supplied.

Modern System –In order to enhance marketability of fish product .It has to preserve properly as soon as possible because longevity of fresh fish is very short. For example ocean perch fish finds a good demand after frozen in the U.S.A. The in marine products processing centre, college of fisheries Mangalore, fish sausages which were processed with fresh fishes like Sciaenids and Sharks were demanded

highly from unhabituated classes who never ate such fish before. CIFE, Mumbai had developed technology to manufacture fish wafers.

Fish marketing have some stages

1. Purchase of fish at landing places by fish dealer or middlemen either from fisherman or vessel owner often fishermen are in debt and obliged to deliver.
2. Assembly of small quantities of fish into large shipments shorting bulk breaking and transport to wholesalers.
3. Consignment sale by whole salaries normally by means of auction. There are several methods of auction, such as ascending, descending, whispering, tender commission 5-10% of proceeds charged.
4. Retailing in fish shops, fish managers, super markets.[4]

Channels and different fish market

Fish does not go to the hand of buyers from the hand of the producer directly. There are some middlemen between the two. These middlemen are Aratdar, Foria, wholesalers and retailers. They are all called middleman. Whatever the situation may be on the whole the Aratdars dominate over fishmarket. In order to take advance payment (Dadan) fishermen are bound to sell their fish to the aratdars, From the total amount of his sell 6% commission or interest is given to the aratdars. From the Discussion with the aratdars of kakdwip. It has been known that 6% or 7% commission which they get are including with all other things. Separately nothing is taken. But there are some different opinions too, 6% or 7% is not the matter. If the catches are flourished in the net.

Most of the time, supply is not up to the expectation of demand. As a result the prices of the fish raise high for all these middlemen. Many middlemen get lion's share of the profit without labour in many such sectors. There are many khal, beel, jhil, dam, embankment, pond, river, estuary and seas in our country. Some of them contain saline water and some are sweet water. Slight portions of the caught fish are sold in the local market. The large portions are sending to Calcutta and to many other big markets.

Table 4.1: FLOW OF FRESH FISH TO MARKETS IN WEST BENGAL

Market	Supply from	Type of fish	Consumption
1. Bantala	Cultured from producers	Carp & other fresh water fish	Kolkata retail
2. B.K Pal	As above	As above	As above
3. Canning	Producers from coastal belt of 24 Parganas	Marine & estuarine fish	Kolkata retail
4. Raidighi	As above	As above	As above
5. Diamond Harbour	Cultured fish from 24 Parganas & from Diamond Harbour agents	Freshwater, marine & estuarine	Kolkata port
6. Sealdah	Marine / estuarine fish From 24 Parganas & from Diamond Harbour agents	Freshwater, marine & estuarine	Kolkata retail
7. Howrah	Capurted fish from 24 Parganas, Medinipur, Orissa, Andhra Pradesh Tamilnadu, Bombay	Marine & estuarine	Kolkata retail-Assam, Nagaland, Bihar traders

Source : CMFRI SPL Pub No 31.

This transportation of fish is done in many ways. A large quantity of fish is imported to Calcutta. Howrah and many other big towns from Bangladesh, Bihar, Orissa, Chilka Lake, TamilNadu, Uttar Pradesh, Panjub, and Rajasthan, through the transport of train, truck, boat and bus etc.

There are many big Arat and permanent fish market in Kolkata and Howrah. There are many small Arat and fish markets are found in the sub division and district town. Many permanent fish markets have been built up in the remote corner of the villages, because some factors work behind it. They are the increase of the demand of the fish, large scale production for scientific process, Govt grant and they develop transport system.[5] Even whole Sundarban area has been developed in all this respect. Kolemarket of Kolkata, Baithakkhana Bazar of Sealdah, Patipukur, Kasba, Howrah market, are the notable permanent Arat of fish.

Most of the fish are imported to Kolemarket of Sealdah from Bangladesh, Canning and Diamond Harbour fish comes to Howrah market from Bihar, Orrisa, Chilka, Rajasthan and UttarPradesh. Arat is also called the wholesale market of fish.

Table 4.2: shows marketing costs margins and price spread in the marketing of different spices of marine fishes in the market channel having one middleman* during first week of October 1996 in the landing centre of Paradeep of undivided district with consumers price at Paradeep. (Price in Rupees/ kg)

Items/fishes	Hilsa	Sahala	Paniakhia	Kantia	Borei	Small shrimp
1. Price at fishermen's level	32 (91.43)	16 (84.21)	11 (78.57)	10 (80)	8 (80)	20 (83.33)
2. Cost of retailer/vendor	0.50 (1.43)	0.50 (2.63)	0.50 (3.57)	0.40 (3.20)	0.30 (3)	0.50 (2.08)
3. Margin of retailer/vendor	2.50 (7.14)	2.50 (13.16)	2.50 (17.86)	2.10 (16.80)	1.70 (17)	3.50 (17.59)
4. Consumer's price	35 (100)	19 (100)	14 (100)	12.50 (100)	10 (100)	24 (100)
Marketing costs	0.50 (1.43)	0.50 (2.63)	0.50 (3.57)	0.40 (3.20)	0.30 (3)	0.50 (2.08)
Marketing margins	2.5 (7.14)	2.50 (13.16)	2.50 (17.86)	2.10 (16.80)	1.70 (17)	3.50 (14.59)
Price spread	3 (8.57)	3 (15.79)	3 (21.43)	2.50 (20)	2 (20)	4 (16.67)

Figures in the parentheses indicate percentages to the consumer's price

*Fishermen- Retailers/ Vendor – Consumer

Fish is sold on Auction at Arat or wholesale market at late hours of night or very early of the morning. Fish is sold by offering "Dhalta'' at Arat, the process "Dhalta" means two and half k.g. Fish is offered without any price per 40 k.g. of buying. Retailers buy Bata, Singhi, Tangra, Khaira, Chingri and Puti from the big Arats of the cities and they separate them to each of the kind and sell at different prices. This process is known as -"Thaoka". Buying fish from the Arat the Retailers sell them in the small markets in the town. They are sold intact or cut. By these processes they get maximum benefit and at the same time Aratdars get a commission as a middle man. Sometimes many Hawkers buy fish directly from the producer and sell them into the small local market and gain much profit.[6] some sell fish of the fisheries to fish traders through contact. The fish traders gradually or at a time catch fish and sell them in the market. It is also found that seating at hut or bazar some fish traders sell fish at a retail price or sometimes they made the retailers selling fish at a commission. There are other processes too. Aratdars bookedfishermen, Bepari and Chalandar, by giving advance money and other facilities to control the fish market through which they keep open to gain the lion's share of the profit.

West Bengal Govt. has opened many fixed price shops of fish in Calcutta and adjoining areas. By showing card the buyers can buy fish at a considerable price. Even fish can be obtained by showing permit at a considerable price to the social occasion like Wedding, Pujas, Sraddha.[7]

Methods of selling of fish

A. In the primary fish markets, the fisher folk diretly sell fish to the buyers without having any intermediary between fishermen and buyers. In many places the buyers may be wholesalers, dry fish merchants or middlemen.

B. The fishermen send fish to the commission agents as consignments. The commission agents or "Aratdars" auction the fish and the gross sale proceeds are remitted to the fishermen after deducting the various marketing charges. This system of selling is known as auction system. In this system the fishermen is obviously at a disadvantage since he will not be available at the time of auction. A few cooperative societies have come up in the place of agents for marketing the catches in the fish markets. So as to strength the bargaining position of the fishermen.

C. Selling is also done by contract method. The prices fixed before the fishing season starts. The traders make some agreement for the delivery of catches by fishermen at stipulated prices. All the fish caught is disposed of at the fixed price. Roughly speaking, producers, dealers other than retailers and retailers share respectively about 45%, 23% and 32% of the price paid by consumers. [8]

Table 4.3: Market Functionaries

Marine Fish	Inland Fish
Auctioneers	Wholesalers; Commission agent-cum-Wholesalers; Pre-harvest Contractors
Commission agents (Purchase)	Commission agents (sales)
Wholesalers	Co-operative society
Commission agents (sale)	Retailer; wholesaler-cum-retailer
Retailers	Vendor; workers-cum-vendors
Vendors	

Source: Data compiled by self.

Some causes that affecting fish marketing patterns

i. Landing facilities, increased maneuver ability of boats in the course of fishery development.

ii. Increased size of capital requirements for fishing activities often with outside investors coming to fisheries. Increased scale of operation resulting from economic growth.

iii. Increase of processed fish.

iv. Above all fish marketing organisation, State Fishing Corporation, Govt. Loan Scheme and Fishermen's Cooperative, affect fish marketing patterns.

The core fish marketing system is classified the three types

- **Intensive growth** – Intensive growth is possible when the firm seeks to expand its efforts which are within the premises of the firm. Some opportunities which are not latent in its present marketing efforts have to be explored, it can adopt product market expansion matrix.

Market penetration

a. It consists of attempting to have increased sales, for its commodities in those markets through more aggressive marketing effort. Example price incentives and explaining nutritional values of fish communication may be made by way of advertisements to the public about the high protein value of fish.

b. Samples of prepared fish food in most palatable form can be distributed to the public.

- **Market development** – Efforts of present fish sales from those markets can be diverted to new market, where new sales centres can be opened in different areas. According to consumer tastes, it is necessary so that new segmented markets may be approached for further marketing of fish products. And products development consists of increased sales by developing new products or getting new types of fishes for those markets which we are attempting improved products like fish bournvita, fish biscuits etc.
- **Integrative Growth** –Integrative growth comes when it takes integration. Some Economic advantages from the other firms which have already established their markets in some phases. The basis unit may combine with another concern by making backward, forward or horizontal integration.

a. **Backward Integration**- A firm selling fish may seek ownership in other firms who are supplying fish or its products; this is known as backward integration.

b. **Horizontal integration –** It may combine hands with its competitors. It may join with some distributing firms who have better control of distribution of fish. Sometimes they may seek the help of middlemen who have a well-organized network for distribution of fish in the country.

c. **Forward integration –**It means combining with other firms for distribution of fish for instance, the Amul, a cooperative concern had given its distribution of dairy products to the voltas. A fishery co-operative producing fish can combine hands with MAFCO a co-operative for distribution of fish.

- **Diversification of growth** - If a core marketing system does not show development and there are opportunities that the laying outside the core marketing, the firm may take up diversified products for marketing. These diversified products, however should be related to the product marketed.

i. **Concentric diversification –** These products that have technological and marketing synergies with the existing fish commodities sales is known as concentric diversification. For instance ‘‘fish ham’’ and ‘‘fish sausages’’ may create an appeal to the customers. These changes will appeal to intermediate customers also.

ii. **Horizontal diversification –**This is adding new products that will bring some appeal to the present customers eg. frozen fish kheema may be supplied along with chilled fish.

iii. **Conglomerate diversification –** It consists in a firm seeking to add new commodities to new classes of customers because this will offset some of the deficiencies of old products.[9] For example, we can substitute some fishes with other fishes whose properties are near or similar to the one that is marketed by the firm when Rohu is not available it can be substituted with common carp or silver carp.

Organization of marketing

Agents and retailers are not suitable for fish exportation, storage and purchase. There is an organization of fish market.

1. **Local Assembled market –** This market is found near the fish production centres of the coastal villages.
2. **Primary market –** This is also a small market but here some brokers also take part in it.
3. **Central market –** This type of markets are in cities that have larger building for storage, preservation and attractive shops.
4. **Future market –** This market is being planned by the Government. Such markets shall be regulated by co-operative societies. Suitable facilities for stocking exporting and transporting will be provided by the societies, financial helps shall also be available to poor fisherman to survive. They shall also be trained by the trainees of these societies for better fish production. [10]

This organisation has some functions

1. Competitive situation of market.
2. Willing of sale product to fishermen.
3. Transport whole selling processing drying to provide salting facilities. This society works on common risk. Only trained person works in society, trainers suggest the fishermen.
4. Local cooperative is made for solving money problems. This cooperative provides money to fishermen in low interest.

Progress of Marketing

Improvement in fish marketing system and distribution can remove the poverty of the poor people, who live on subsistence level, by supplying fish at reasonable prices. In remote areas it can be marketed after collecting it from surplus coastal landing centres. A processing and marketing specialist produce new products from fish and finally induce them to take fish consumption by explaining its nutritional values. The poor fishermen are exploited by the middlemen in this trade. These middlemen lend money to the fishermen on very high interest, at the time when there is fall in catches. But now credit facilities have changed their fortune. Cooperative societies have given them such facilities. Not only that the fishermen

now can get education and training under rural integration programmes through cooperative societies. They can be benefited by adopting several ways –

1. Facilities for processing and preservation of fishes.
2. Facilities for credit, finance and loan.
3. Facilities for distribution, transport and marketing.
4. Facilities for equipments (crafts and gears)
5. Facilities for making them aware of the socio-economic facts for the welfare of the fishermen and their family members. The socio-economic facts include rights of fishing lease of water, insurance against risk of life and property, Unprecedented poor catches etc. The traditional marketing prevails. It is easy for the producer or any member of his family to approach a consumer and sell the product directly. Certainly this is advantageous for the producer but producer has no time, as he is mostly concerned with fishing to market his catches is distant markets. In such circumstances the distributive machinery has to be tackled by someone else, particularly by any other bigger commercial organization which can invest bigger capital outlay. There is possibility in improving the economic conditions of fishermen. The involvement of middlemen in the trade is much necessary in the big network of distribution of fish. It may be replaced in the long run when better and progressive machinery and proper institutional frame work are developed.

The fish marketing is not an easy task as it has to face many peculiar and special problems at different stages of production and marketing management with greater uncertainties in fish production. The high perishability of fish assembling of fish from too many scattered coastal landing places, too many species and too many demand patterns, wide fluctuations in prices, lack of quick transportation system are the main problems. There is need to reform the markets by moderning the traditional fish marketing methods by introducing new management techniques. For improving fish marketing the major segments of study should be a) Demand b) Supply e) Attractive marketing d) Economics.[11]

The names of some wholesale fish market and other multipurpose markets which I have visited in Kolkata and both 24 Parganas are given below-

Table 4.4. Markets in brief-Kolkata

Market	Location	Owner ship	Area yard in Acre	Nature of market	Principle agri. Commodities dealt in
1.Azadgarh Market	7 R.G kar road P.o.Azadgarh, P.S-Jadavpur Kol-40	Bazar samity	0.82	(R)	Veg, fruits, fish, egg, meat, betel leaf e.t.c
2.Ashu Babur Bazar	20 Raja manindra road, P.O.Belgachia, P.s.Chitpore, kol-37	Private	1.15	(R)	Veg, fruits, betel leaf, flower, fish, meat, egg, e.t.c
3. Baghajatin Bazar	68B,Baghajatin Bazar, P.O.Naktala,P.S.Jadavpur,kol-47	Bazar samity	1.33	(W) & (R)	Veg, fruits, betel leaf, road side grocery, flower, fish, meat, egg, e.t.c
4.Bijoygarh Bazar	Bijoygarh Bazar,P.O. Jadavpur , P.S Jadavpur,kol-32	Do	0.33	(R)	As above
5.Behala Puratan	1 Netaji Subhas road, P.O.+P.S.Behala,kol-34	Do	0.66	(W) & (R)	As above
6. Bantala	Bantala road, P.O.+P.S.Tiljala,kol-39	Private	20 Mtr Both side of the road	(W)	Fish Matsha Arat
7.Bagbazar	1/1 Bagbazar street, P.O.Bagbazar, P.S.Shyampukur,kol-3	Do	0.50	(R)	Veg, fruits, fish, egg e.t.c
8. Baithakkhana	15/16, Baithakkhana road, P.O. Amherst street, P.S-Munchipara, kol- 9	Do	2.0	(W)	Veg, fruits, betel leaf, grocery, flower, fish, meat, egg, e.t.c
9.Bowbazar Market	84/A,84/1A,84/3A B.B Ganguly street, P.O.Bowbazar, P.S-Munchipara, kol-12	Do	0.82	(R)	As above
10. Charu Chandra Market	54/1 Charu Ch. P.O+P.S. Tollygunge, kol-33	Private place east	0.66 roadside	(R)	As above

11. Chingrighata Fish Market	Chingrighata Canal south road, P.O. Nowabhanga, P.S. Tiljala, kol-39	Private	---	(W) & (R)	Fish
12. College street market	77 to 85,college st. , P.O-bowbazar, P.S. Jorasnko	Kol. Corpon.	7.66	(W) & (R)	Veg, fruits, betel leaf, coconut, fish, meat, egg, e.t.c
13.Dhakuria Bazar	46, Ashutosh Chatterjee road,P.O.Dhakuria, P.S-Kashba, kol-31.	Private	1.33	(R)	Veg, fruits, betel leaf, flower, fish, meat, egg, e.t.c
14. Garia Market	152,S.C mallick road,P.O. Naktala, P.S-Jadavpur, kol-47.	---	1.0	(R)	As above
15.Jadavpur Market	Jadavpur Central road, P.O-J.U, P.S-Jadavpur, kol-32	K.I.T	1.0	(W) & (R)	As above
16.Jadavpur Sandhya Bazar	Adjacent to Jadavpur station, P.O. Santoshpur, P.S-Jadavpur East, kol-75.	Babsayi Samity	1.0	(R)	As above
17. Lake Garden Super Market	114, Lake Market, P.O-Lake gardens, P.S-Lake Thana, kol-45.	K.I.T	1.0	(R)	Veg, fruits, betel leaf, flower, fish, meat, egg, grocery, e.t.c.
18.Mandir Bazar	P.O.Jadavpur, P.S-Jadavpur , kol-32	Private	0.21	(R)	As above
19.Netaji Nagar Sandhya Bazar	Netaji Nagar, P.s-Jadavpur, kol-40.	Babsayi Samity	90 Mtr. Both side of the road	(R)	As above
20. New Baithakkhana Market (Chhagal kata fish market)	155 -158, B.B Ganguly street, P.O-Bowbazar, P.S-Munchipara, kol-12	Kolkata Universi ty	5.0	(W) & (R)	Fish
21.Sri Colony Bazar	Sri Colony Bazar, P.O. Regent Estate, P.S-Jadavpur, kol-32	Bazar Samity	1.66	(R)	Veg, fruits, betel leaf, flower, fish, meat, egg, grocery, e.t.c.
22.Santoshpur Municipal Market	58 Santoshpur Avenue, P.S-Jadavpur East, kol-75	Kol. Corp.& private	0.41	(R)	As above

23. Sarshuna Bazar	P.O. Sarkar hat, P.S-Thakurpukur, kol-61	Private	0.82	(R)	As above
24. Paler Bazar	P.O-Santoshpur, P.S-Jadavpur East, kol-75	Bazar Samity	3.0	(R)	As above
25. S.S Hogg Market (New Market)	19, Lindsey street, P.O-New Market, P.S-Taltala, kol-87	Kol. Corp.	12.33	(W) & (R)	As above

Source: Data compiled by self

Some of few big wholesale fish market are:

- Howrah fish market, near to Howrah station, largest fish market in eastern India.
- Diamond Harbour market, biggest sea fish market in West Bengal.
- Wholesale Markets in Kolkata- Baithakkhana Market, B.K. Pal Market, Bantala fish market, Bagha Jatin Bazar, Chingri Ghata fish market & Orphangunj Market.
- Wholesale Market in 24 Parganas (South): Malancha Market especially for shrimp.
- Wholesale Market in 24 Parganas (North): Patipukur Market for a variety of fishes.

Howrah Fish Market

Howrah wholesale fish market is the largest fish market and the second largest in Asia. The Tokyo Central wholesale fish market, Tokyo in Japan is the largest wholesale fish market in Asia-handling about 80,00,000 tonnes of fishery products annually.

Howrah wholesale fish market is situated in the vicinity of Howrah railway station. The building in which the market is housed is an old enclosed type with it's many interior sub-divisions. It is connected by two main gates with the Maulana Abul Kalam Azad Road. The market occupies about an area of 0.4 hectare. There are 180 stalls and each one is having an area of about 14 sq.m. Every stall is having a raised platform which serves as the sales counter of the wholesaler.

Picture 1: Howrah Fish Market

In front of the stall there is a pucca brick and concrete flooring for keeping the fish lots at the time of auction. Transactions in the market generally start taking place at 0600hrs and continued late in the night up to 2100 hrs. The peak period of business now days is from 0800 to 1800 hrs. The market remains open for all the week except Sundays. The market is visited and about 10,000 to 17,000 persons who are engaged in the retail business of fish attend auctions. The number of visitors goes as high as 20,000 during the festival and marriage periods when the fish is in huge demands.

The fish from various states starts arriving at the market right from 0400 hours by rail and lorries. The fish is carried to the stalls of various wholesalers who also function as commission agents for auctioneers. The fish is sorted out variety wise and graded size wise and then put to auction by open bidding.[12]

Market functionaries

The wholesalers are also the commission agents. They dispose of the fishes to the retailers or to other fish merchant's whole bids are highest in the auction. The number of bidders is increased in this market at the time of marriage and festivals and on special occasions. Generally it's proprietor or his representative manages the business of one stall. An account clerk known as "Munim'' a cashier and an auction clerk who auctions the fish assists him. All these members of staff are called "gaddi staff." Every stall has its own fish sorters and labourers who are collectively called as mutia. The members of the gaddi staff are paid salary on monthly basis. The number of staff working under a wholesaler depends upon the turnover of his business. Some stall owners are receiving an ample supply of fishes from morning till evening and naturally they have got more number of staff to handle the business smoothly. The labourers or the mutias of every stall get Rs 7 for clearance of one basket of fish.

The fish consignments are brought in two ways in the market. A person known as "Munshi" is hired by 15-25 wholesalers. He is authorised by the wholesalers to take delivery of fish on their behalf. The Munshi gets the consigns cleared from the Howrah railway station and makes necessary arrangements for its transportation to the stalls of his client wholesalers. The munshi also prepares the reports regarding the daily train wise arrival of fish consignments and supplies these reports to all his client wholesalers. From these reports the wholesalers get the information regarding fish supply received by other colleagues. In this way the wholesalers receiving fish from a

single supplier try to sell it at the highest possible rate so the sender may in future supply him more quantities in comparison to others. For unloading of the fish consignment from the train and to bring it in the market, the labour gets Rs.6.50 per basket. The labourers engaged for unloading the fish consignments from the trucks carrying it in their carts to the stalls of the wholesalers are paid Rs 5 per basket.[13]

Apart from above specialized labour there are other labourers doing some odd jobs. They are called 'Jhalliwalas.' They are generally engaged by retail merchants and by other wholesale fish purchasers who send fish outside Kolkata & Howrah. The 'Jhalliwallas' take the fishes from the side of the stall to that spot where these retailers keep their purchase at one place under the supervision of another person 'Jhalliwallas' are paid at the rate of two or three rupees per trip.

Preparation of fish for Auction

The fishes received late during the preceding night are packed in fresh ice for keeping their quality and are kept for auction on the next day. Just from early morning, the fishes are unloaded from the trains and trucks and brought to the respective stalls. Major carps and catfishes are graded size wise. There are four grades according to size.

1. Small, below 1 kg. 2. Medium, 1 kg to 2.5 kg. 3. Large, 2.5 kg to 5.0 kg and 4. super large, 5 kg and above.

Bata, Khaira, and Ban are auctioned in auctioned without sorting. Other quality fishes, which are graded and auctioned, are Hilsa and Bhetki. Hilsa has got two grades, one small and one large. Live fishes are received in drums. Koi (Anabus testudineus) is kept in separate drums and singhi (Heteropneustes fossilis) and Magur (Clarias batrachus) are put together in the same drum. They are auctioned drum wise, but all the rates of the fishes either sale unit is 'kg'.[14]

Pricing of fishes through open auction system: Open auction at stalls of the wholesalers starts from six in the morning. As by this time the fish consignments reach the market. On every stall, quality fishes are sorted and graded species wise and are displayed in very attractive lots for auction. The small fish dealers and other interested buyers attended the auction at the stalls and bid for the available fish of their choice.

Picture 2: Process of Drying Fish for Marketing

Dry Fish Market

Indiais the second largest fish producing country with the contribution of 5.43% in global fish production and West Bengal hasbeen able to secure the second position among all the states of India (FAO, 2012).West Bengal has a coastline of 157.5 km. and covers mainly the districts of South and North 24 Parganas and Purba Medinipur. Fish is an important part of the regular diet and is a cheap source of protein for the peoples of West Bengal.About 78% of total fish catch is consumed in fresh condition, 6% is used as dry fish and rest is used as frozen fish. Indian dry fish export contributes 8% of all form of fish exports and earned 754 crores during 2012-2013 (MPEDA, 2013). The nutritional quality of dried fish remains intact. Sometimes retains higher quality standards compared to fresh fish.

Marine fish drying is very common in the entire coastal zones of India. In West Bengal this practice is restricted to 24 Parganas and Purba Medinipur. These dried fishes have demand both in domestic and international market and plays an important role in employment generation of coastal poor people.

Table 4. 5: flow of marine dried fish from West Bengal

Market	Supply from	Consumption
1. Territy Bazaar	Behundi operators in 24 Parganas	Andhra, Tripura, Nagaland
2. Kerala traders	As above	Kerala
3. Uluberia	Behundi operators in Medinipur	Local & Kolkata retail
4. Local traders	Medinipur district	Kerala, Orissa, Assam, Nagaland

Source: CMFRI spl. Pub. no. 31.

In this dry fish marketing channel people involved early in the production chain (fishing and drying) add relatively more value and make little profit due to smallscale production, poor product quality, lack of market access and high transportation cost/toll/taxation etc.

Egra regulated dry fish market, Purba Medinipur; West Bengal is the largest regulated dry fish market of India. Different kinds of dried fish from all dry fish processing area of coastal West Bengal (Digha Mohona, Sankarpur,Jaldakhoti, Saula veri Junput, Sagar Island) and Orissa usually come to this market. These dried fish later supplied to differentmarkets such as Assam, Siliguri, Orissa,Bihar and some other parts of India and abroad. The most common dry fish traded in this market are patia, lahra, tapra, vola, ruli, tauri-boi, kagja, mourla, chanda etc.The dry fish

marketing involve a long marketing channel system starting from the fish processors, Beparis, Aratdars, andWholesalers to Retailers andconsumers.[15]

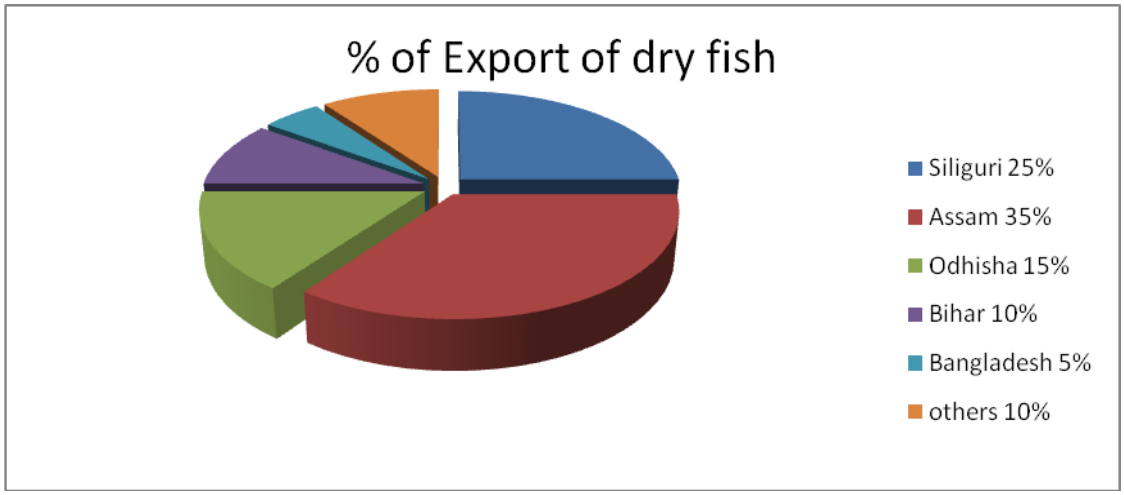


Fig. 1: Percentage of export of dry fish

Traders

Egra regulated dry fish market is the largest dry fish market in West Bengal. Several Aratdars and Wholesalers operate here. It is estimated that 14000 to 18000 tons of dried fish move through Egra regulated market per annum. The market remains most active during the winter season (October to January) as the supply and climate remains most consistent. Rest of the season the supply of the fish falls.The dry fish trading system in West Bengal depends on several stakeholders like fish processor, Beparis, Aratdars, Wholesalers and Retailers.

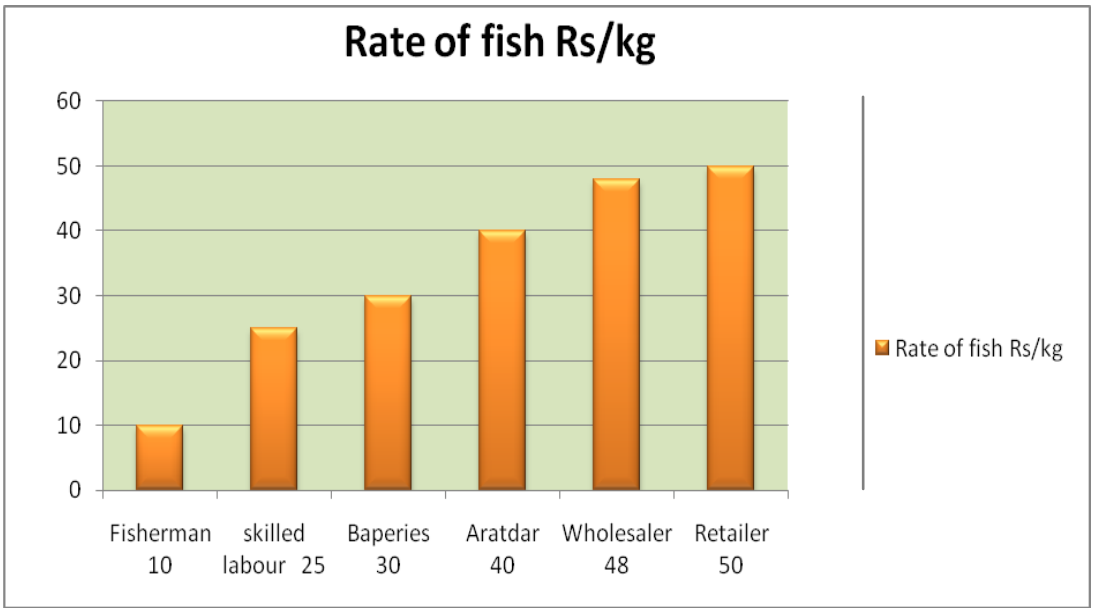


Fig.2 : Rate of fish Rs/kg

Means of Transport

In general the fish drying farms are located in the coastal areas. After drying they are purchased by Beparis and Aratdars. Here the means of transport is either mechanized vans or small trucks. Aratdars sale the collected dried fishes to wholesalers in the market. Here big trucks are used for the transportation system.

In some areas where the road transportation system is not well developed as in South 24parganas, the Aratdars use ferry system (from Sagar Island to Petuaghat) as best alternative transport system. The Egra Regulated market operates weekly at every Saturday. Retails and different types of consumers purchase fish as per their requirement. Fish are sorted/graded and repacked either inside or nearby the market. Manual labours work here for loading and unloading. Now a significant amount of dried fish like patia, lahara, gogua, tapra is exported to Bangladesh.

Comparative rate of dried fish at Egra regulated dry fish market

The price of different dried marine fish depends on the size, availability, quality of the species, transport, labour and season. During winter season the rate of all the available fish increases as the quality of fish drying enhances.[16] The comparative rates of available fish are given below.

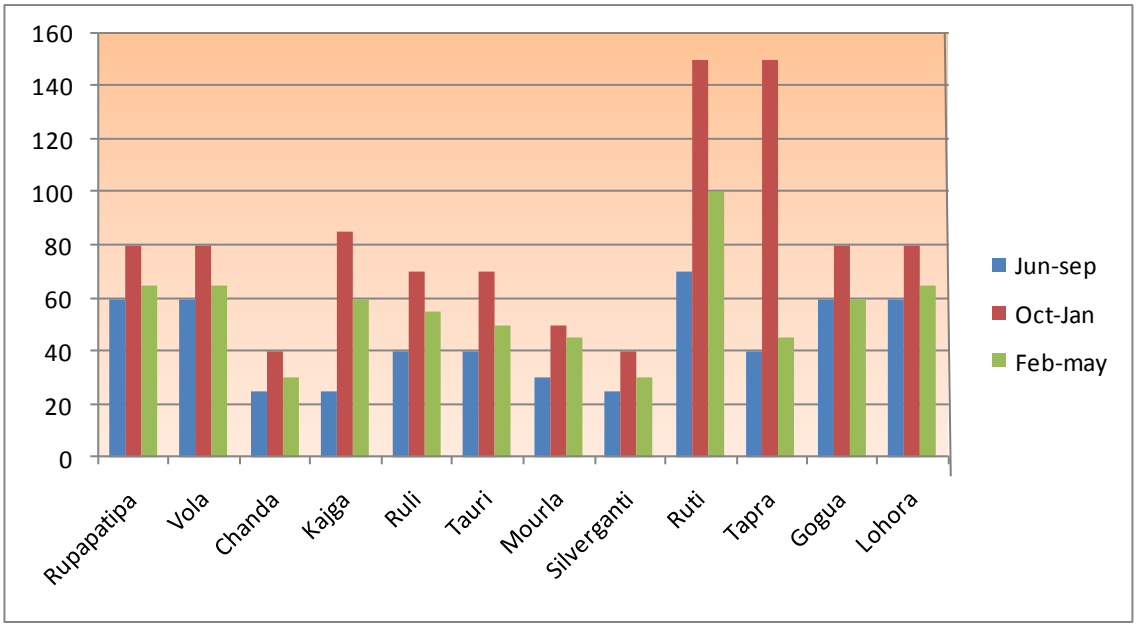


Fig. 3: Seasonal Fluctuation of rate of fish rupee/kg

Marketing costs

Marketing costs dried fish include expenses such as transport, levy and market fees, purchasing of polypropylene bags, ice, electricity, hired labour, storage etc. The costs of fish marketing depend on the volume of fish, distance from the market and mode of transportation etc. Maintaining the hygienic condition of the fish market is very essential.

Marine dried fish marketing plays an important role in the economy of West Bengal as well as in India. Fish processors depend on the climatic condition for drying of fish as advanced fish drying chambers are unavailable. Furthermore poor road and transport facilities, lack of credit facilities, lesser Govt. interestappears as barrier for the long termsustainability of the system. However the Egra regulated market is located adjacent tothe Contai- Egra State High Way which is well connected with all the coastal areas of coastal Purba Medinipur. This provides a good opportunity to both the fish importers and exporters to establish a sustainable marketing system.[17]

2. Fish Trade & Stocks

West Bengal has been able to secure the leading position in fish production for seven successive years and has been rewarded accordingly by the Central Government as best productivity award. West Bengal is the only state in India, where fishes have been cultivated in every kind of water bodies' i.e. brackish water, sweet water, sewage water and marine water as well.

Total production and demand in the state

The total production of inland fish was 15.30 Lac ton and marine fish was 2 Lac Ton. Apart from the fact that they are mainly consumed in the state, a large amount of inland and fish is exported to Delhi, Uttar Pradesh, Madhya Pradesh, Bihar and other adjoining states. Export of Marine Fish beyond boundaries of the country earned a handsome revenue of Rs.700 crore in the year 2009-10.West Bengal occupies the 4^{th} position in the country in terms of export of sea food products. Fishes are exported primarily through Kolkata and Haldia Port to Japan followed by Vietnam and China. Exports to Japan only aggregates to total annual revenue of Rs.650 crore;

Out of the total exports 90% areshrimps and the rest includes ornamental fish, crab, fresh water prawns.

About 78% of the fish catch in the state is marketed as fresh or chilled and forms staple food for the population and inland landing centres. About 6% of the catch is used for drying and curing. Frozen fish production accounts for 12% and about 4% is used for reduction to fish meal. In the wake of changing lifestyles, value added fishery products of different descriptions as 'convenience food' is also gaining popularity in the markets. The range of value added fishery products processed in the country include extruded products, battered and breaded products, surimi and derivatives, pickles and curried products in restorable packing.

Major production areas in the state

South 24 Parganas accords the highest production of inland as well as marine fish aggregating to a total value of 3.3 Lac Tons in the year 2009-10 followed by Purba Medinipur, North 24 Parganas. Burdwan and Nadia. However Marine fish ispredominantly available in South 24 parganas and Purba Medinipur only.The current availability of fish and per capita consumption at 9 kg the State is facing a shortage of over 90 thousand ton. The fish requirement of the state by the end of 2010-11 had been estimated at over 14.71 LT assuming the total population. The demand will be more in view of the increasing fish consumption.[18] Production of fish from inland water resources is also increasing considerably. It reached to 879000 tonnes in 2000-2001 from 340000 tonnes in 1980-81. Similarly marine fishing is also increasing in West Bengal (Table 4.6).

Table . 4.6: Marine fish landings in West Bengal (1998 to 2000)

(Quantity in Tonnes)

Fishes	1998	1999	2000
Clupieds-Oil Sardines	5145	5120	5600
Clupieds-Hilsa Shad	37730	30726	32070
Clupieds-other Shads	10290	0	0
Clupieds-other Clupieds	0	10240	11201
Bombay Duck	34010	33560	34135
Ribbon Fish	0	6500	7467
Carangid-Horse Mackerel	0	3760	0
Mackerel-Indian Mackerel	3944	0	4294
Mackerel-other Mackerel	1715	0	0
Seer fishes-S Guttatus	0	1536	0
Seer fishes-Acanthocybium -spp	0	0	1867
Mullets	1715	1710	1867
Elasmobranchs-Sharks	8575	0	4480
Elasmobranchs-skates	4116	3930	0
Eels	343	340	373
Cat Fishes	20870	29433	33602
Perches-threadfin Breams	0	308	0
Perches-other Perches	343	1246	0
Goat fishes	1200	0	1307
Thread Fins	1200	13670	0
Croakers	13720	341	14934
Silver Bellies	343	0	373
Big Jawed Jumber	0	0	9334

Pomfrets-Black Pomfrets	1888	8000	0
Pomfrets Silver Pomfrets	8575	0	0
Crustaceans-Penaeid Prawns	11319	11387	11760
Crustaceans-non Penaeid Prawns	3946	3950	5900
Crustaceans –Crabs	1886	1853	1867
Crustaceans-Others	0	0	141
Cephalopods	0	0	3734
Miscellaneous	10290	3090	374
Total	183163	170700	186680

Source: Statistics of Marine Products Exports 2001, The Marine products export Development Authority, India

With the advent of processing technique like freezing and storage coupled with tremendous demand for prawns in several European Countries. The export marketing of marine fish recorded phenomenal growth in recent and previous years.

Table 4.7: Export of marine products through Kolkata Port from 1976 To 1988

Year	Quantity (Tonnes)	Value Crores* Rs/-	Share of West Bengal in all India Export in %	
			Quantity	Value
1976	2,943	14.32	4.73	7.96
1977	3,081	16.45	4.75	9.15
1978	2,853	16.68	3.66	7.86
1979	1,266	7.77	1.37	2.96
1980	3,029	20.14	4.06	9.20
1981	3,308	32.19	4.39	11.33
1982	4,807	42.12	6.40	12.30
1983	4,638	43.29	5.38	11.95
1984	4,290	35.22	4.77	9.15
1985	3,710	37.43	4.64	9.91
1986	4,157	48.72	4.76	10.54
1987	4,441	52.73	4.98	10.77
1988	6,232	64.92	-	-

Source: MPEDA *1 Crore=10 million

Frozen prawns earned substantial foreign exchange in marine fish export and paved the way for the growth of an organized sea food export industry. Product diversification in the export front has also been initiated to sustain the growth rate in

the export front. Now, not only shrimps, but also cattle fish, shark fins, crabs, seerfish etc. are exported substantially. The economy of subsidiary industry of the marine fishery sector of the state, to a large extent is highly depending on the demand of our marine products in the external markets.It must be remembered that apart from earning foreign exchange, exports were singularly responsible for increasing the earnings of the fishermen. [19] Price is determined by the interaction of demand and supply at both producing centre and consumer markets.

Table 4.8: country wise distributions of marine products exports from India (in %)

Country	1970-71	1975-76	1980-81	1985-90
Australia	2.66	1.97	0.72	0.27
France	1.67	3.13	2.58	2.47
Hongkong	1.46	0.45	0.83	0.76
Japan	34.95	64.55	68.73	68.69
kuwait	-	0.19	2.22	0.96
Netherlands	0.50	0.14	3.19	0.90
Singapore	2.01	0.81	1.04	1.30
Srilanka	4.58	0.42	0.57	0.68
Thailand	-	-	0.21	0.09
U.k.	3.68	0.33	3.41	6.24
U.S.A.	42.69	25.30	12.04	10.99
Others	5.81	2.70	4.46	5.60
Total	100	100	100	100

Source: Reserve Bank of India Currency and Finance Reports, Several Issue

The Marine fish market in west Bengal

The domestic fish marketing system in India is neither efficient nor modern and is mainly carried out by private traders with a large number of intermediaries between producer and consumer, thereby reducing the fisherman's share in consumer's rupee. The marine fish market in West Bengal is also inefficient, unregulated and unorganized. The type of market is value chain marketing system. The fish reaches the consumer from the fisherman via two to three types of intermediaries. So that's why the price received by the fishermen is very low as compared to the price paid by the consumers. The key intermediaries in fish marketing are: auctioneer, wholesaler, and retailer. The main marine fish markets are Sealdah, Howrah, Diamond Harbour market in Sundarban area and the Digha-Mohana market in Digha-Sankarpur area.

Picture 3: Digha-Mohana Fish market

The structure of fish marketing has changed considerably due to technological improvements in the fishing industry. The transportation sector plays an important role in connecting the marine fish landing centers to the markets and consumers. But the fish market of West Bengal is not hygienic and does not have good sanitation facilities. Some attempts have been made to minimize the pathogenic bacteria in sea food at kolkata fish market recently. While the demand of fish and fishery products is steadily growing and is fairly uniform across the country, the supply of fish is highly seasonal and it comes from diverse production environments, leading to price fluctuations across regions and seasons, and even within the day, and this is exploited by the middlemen, resulting in reduced welfare of fishermen. Marine fish is not popular in Bengali cuisine; in West Bengal people like fresh water fish rather than marine fish. Among the marine fish, only Hilsa Shad (T. *ilisha*) and Silver Pomfret (Pampus argenteus) are popular. So the marine fish production from West Bengal coast gets transported to other parts of India, or, exported to International markets. The total export of Marine Products during April 2010-March 2011 from India has crossed the US$ 2.84 billion mark by registering a growth of 18.96 % in quantity, 27.64 % in rupee value and 33.17 % in US$ realisation compared to the same period of the previous year, which according to the provisional export figures, is the for first time in the history of Marine Products Industry (MPEDA 2011). The marine product export from the West Bengal coast during 2009-2010 was 32,625 MT whose export value was about Rs. 700.00 crore (Annual Report 2009-2010, Department of Fisheries, Government of West Bengal).

Table 4.9: State/ Union Territory wise marine fish production

Sl. No.	State/ Union Territory	2003-2004		2004-2005		2005-2006	
		Marine fish product-ion	%	Marine fish produ-ction	%	Marine fish produ-ction	%
1.	Andhra Pradesh	297.26	10.06	210.73	5.97	218.84	7.35
2.	Goa	90.00	3.04	91.61	2.60	100.91	3.39
3.	Gujarat	609.10	20.59	538.46	15.26	663.88	22.31
4.	Karnataka	187.00	6.32	171.23	4.85	176.97	5.95
5.	Kerala	608.53	20.57	601.86	17.06	558.91	18.78
6.	Maharastra	400.00	13.52	417.85	11.84	445.34	14.97
7.	Orissa	116.90	3.95	121.93	3.46	122.21	4.11

8.	Tamil Nadu	373.00	12.61	307.69	8.72	307.99	10.35
9.	West Bengal	181.60	6.14	179.50	5.09	160.00	5.38
10.	Andaman & Nicobar Islands	31.06	1.05	177.65	5.04	12.053	0.41
11.	Daman & Diu	10.80	0.37	186.55	5.29	177.19	5.95
12.	Lakshadweep	10.00	0.34	207.91	5.89	11.964	0.40
13.	Pondicherry	42.80	1.44	315.00	8.93	19.272	0.65
Total		2958.05	100.00	3527.98	100.00	2975.5	100.00

Source: extracted from the Agenda note of TMC meeting (December 7-8, 2006) for centrally sponsored scheme on 'strengthening of database and information networking for the fisheries sector', DAHD, Ministry of Agriculture, GOI.

Special features of marine fish marketing

i. Greater uncertainties in fish production and hence in the supply of fish

ii. High perishability of fish.

iii. Assembling of fish from too many coastal landing centers.

iv. Too many species and therefore too many demand patterns.

v. Wide seasonal and special variations in prices (place and time).

vi. Disequilibrium of demand and supply.

vii. Difficulty in maintaining the quality of fish.

viii. Lack of preservation and storage.

ix. Lack of transportation facilities.

x. Lack of minimum facilities at marketing centre.

xi. Seasonal abundance and scarcity of different varieties.

xii. Lack of information on price and production.

Price determination of marine fish

The price behavior of fish in internal markets is mainly characterized by wide fluctuations at all stages of transactions which is resulted from the highly perishable nature of fish and the high variation in its short run supply. Price is determined by the interaction of demand and supply at both producing centres (primary markets) and

consumer markets. At landing centres the market demand is the aggregate demand from wholesalers which is indicated by the number of purchasers. There will not be much variation in the day-to-day volume of transaction by these purchases or in other words the short run demand in more or less-stable. However, the level of supply on any day is completely unpredictable and short run supply is highly inelastic.

Market channels

Since the marine fish is consumed all over the country, it has to be carried to a long way from the coast to interior parts of the country. Marine fishes thus pass through the following prominent channels to reach the ultimate consumers.

a. Fishermen - Auctioneer - Agents of freezing plants -Exporter - Retailer - Consumer.
b. Fishermen - Auctioneer- Processor (Dry fish)-Wholesaler -Retailer - Consumer.
c. Fishermen - Auctioneer - Wholesaler (Primary markets) -wholesaler (Retail Markets) - Retailers -consumers.
d. Fishermen – Auctioneer- Commission agents - Wholesaler - Retailer - Consumer.
e. Fishermen - Auctioneer - Retailer - Consumer.

f. Fishermen - Auctioneer - Consumer.

The major portion of fish trading in internal marketing is practiced through 3rd, 4th and 5th channels. The auctioneers in the primary market and commission agents in secondary markets are also involved in the process without involving themselves in direct possession of the fish.

Picture 4: Disposal of fish at large volumes through Auction in Mohana Market

Auction sale

The prevalent practice of disposal of fish at large volumes is through auction where buyers participate in bidding. Normally auction is carried out after sorting of the catch. The open bidding is done simply by verbally declaring the bids of all the perspective buyers for a particular fish lot. As a rule, fish lots are awarded to the highest bidder.

In general, each fishing boat operator directs his catch to a particular auctioneer regularly. As producer's representative, the auctioneers perform the selling function for which they are paid a commission of about 5 per cent of the gross sales. Because fish is generally sold on credit, the auctioneer sometimes makes payments by himself to the suppliers promptly and fully to maintain their goodwill and confidence. As producer's representative, the auctioneers are free to negotiate with any buyer. Generally, the auctioneers sell their products on credit payable before the next purchase. In these cases the credit-worthiness of the buyer is the most important factor considered by auctioneers. There are also transactions that involve cash and installment payments.

Price behaviour

The price behaviour of fish is mainly characterised by wide fluctuations at all stages of transactions in the marketing chain, which resulted from the highly perishable nature of fish and the high variation in its short run supply. Price is determined by the interaction of demand and supply at both producing centres (Primary markets) and consumer markets. At landing centres the market demand is the aggregate demand from wholesalers which is indicated by the number of trucks arriving at the centre and also from cycle vendors, retailers and individual purchasers. There will be much variation in the day-to-day volume of transaction by these purchasers or in other words, the short run demand is more or less stable. However, the level of supply on any day is completely unpredictable and short run supply is highly inelastic. Hence, on any day, a bumper catch at a landing centre will slash down the fish prices and a small catch will boost the prices to very high levels.

The fishermen received maximum price for seerfish (Rs. 28 per kg) and minimum for silverbellies (Rs. 3 per kg). Barring few varieties like seerfish, sharks, etc. the price of many varieties are found to be more than double of the landing centre

prices. Among the consumer markets studied, the average retail prices of different varieties of fish were comparatively lower at Monday market of channel II and higher at Vadasery retail market of channel I. There is considerable seasonal variation in the average primary, wholesale and retail prices of marine fish. For example the average primary, wholesale and retail prices of fish during july-september 1989 are given in table 4.10.

Table4.10: average prices at primary, wholesale and retail markets in Kanyakumari region during Jul-Sept. 1989(Rs./kg)

	Channel-I*			Channel-II*	
	LP	WP	RP 1	RP 2	RP 3
Group-I					
Seerfish	23.70	28.40	36.85	34.40	35.80
Rainbow runne	19	24	33	28	29
Pomfret	20	25	31	29	29
Peeg-face bream	12	16	24	21	22
Red snapper	9	12	18	19	21
Barracudas	11	15	22	19	21
Group-II					
Reef cod	8	12	17	18	20
Tuna	8.14	12.20	16.40	17.25	17.50
Sharks	10.14	12.95	18.05	15.05	14.95
Cat fish	9.10	13.35	17.65	16.50	15.80
Wolf herring	6.30	8.30	11.70	10.50	11.10
Mackerel	6.60	7.60	11.45	9.90	9.90
Scads	3.45	5.75	10.30	10.75	13
Group-III					
Goat fish	3.20	4.75	8.15	6.75	8.85
Ribbon fish	4	6	10	8.50	9.85
Thread fin bream	3.75	5.45	8.45	7.30	9.25
Rays	4.3	6.35	10.65	8.15	9
Lizard fish	2.25	3.85	5.05	4.40	5.15
Indian pellona	3	5.05	9.15	7.70	9.40

Gold striped sardine	3.55	5.60	10.25	8.25	7.60
Whitebaits	2.70	4.45	9	7.05	7.55
Silverbellies	2	3.05	6.35	5.40	5.60

** channel II : fishermen-retailer chain
LP-landing centre price
WP-wholesale price
RP 1-RP 3 : retail price

Fish Export

During 2006-07, 1,78,000 MT of marine fish and fish food products were exported whose export value was about Rs. 600.00 crore .It has already been pointed out that in the year 1987-88 amount of foreign exchange earned by exporting marine products was only 50.00 crore. Within a span of less than 20 years it has been possible for this department to increase export by 11 times in spite of so many limitations, the most important of which is that amongst the maritime States West Bengal coastal region is very small, measuring approximately 150 km. only. Still then West Bengal occupies the 4th position in the country in terms of export of sea food products. Out of the total export 90% was shrimp and rest includes ornamental fish, crab, fresh water prawns etc. [20]

On the other hand huge quantities of fish are required daily for consumption as about 95.00% of the population consumes it. In order to satisfy the internal demand, large quantities of fish are imported from adjoining states like Bihar, AndhraPradesh, Orissa, Uttar Pradesh, Madhya Pradesh. Also fish is imported from distant states like Gujarat. The Calcutta metropolis alone consumes more than 10.00% of the country's fresh water fish production and about 30.00 % of the reservoir fish production especially carps. Like fresh water fish, the state only consumes 0.83% of country's total marine fish production; large quantities of fresh fish are consumed at other cities of the state which are situated within a distance of 200 kms from the place of production. [21]

Table 4.11: supplies of table fish to Kolkata/Howrah fish markets from outside West Bengal

Year	Quantity in Tonnes	Supplying states
1976	20,815.9	Uttar Pradesh, Andhra Pradesh, Madhya Pradesh, Bihar, Delhi, Punjab, Orissa, Tamil Nadu, Maharashtra, Rajasthan & Gujarat
1977	21,616.5	
1978	22,788.3	
1979	25,959.5	
1980	27,021.5	
981	27,076.1	
1982	28,803.3	
1983	29,871.7	
1984	30,196.1	
1985	30,131.0	

Source: MPEDA

Market and trade

Freshwater carp and shrimp from brackish water are the principal aquaculture species produce in India, almost the total quantity of fin fish produced by aquaculture is consumed on the domestic market, while shrimps and fresh prawns are mainly exported. While people of Eastern India prefer fresh water fish, people from southern Indian prefer marine fish and thus depend on the capture fisheries. As second most important producer of fresh water fish after West Bengal, Andhra Pradesh Markets the bulk of its produce in the eastern and north eastern states of India through an organized and established marketing network. Insulated trucks carrying ice are the principal means of transport over longer distances which can be over 2000 kms. The post-harvest processing of aquaculture produce other than for shrimp and fresh water prawn is almost nonexistent in the country. The Govt. has know regulatory control over the domestic marketing system for aquaculture produce and the price is influenced by supply and demand, furthermore, no certification system is available for the sale of the fish on the domestic market. During 2002-2003, cultured shrimp and prawn contributed 65.7% of the total shrimp and prawn export, mainly in frozen form and with a value of over US$ 0.80 billion. The USA has emerged as the single largest

importer during 2002-03 relegating Japan to second position; the marine products export development authority since its inception has played a key role in formulating guideline as well as periodically modifying and implementing the development plan for export promotion.

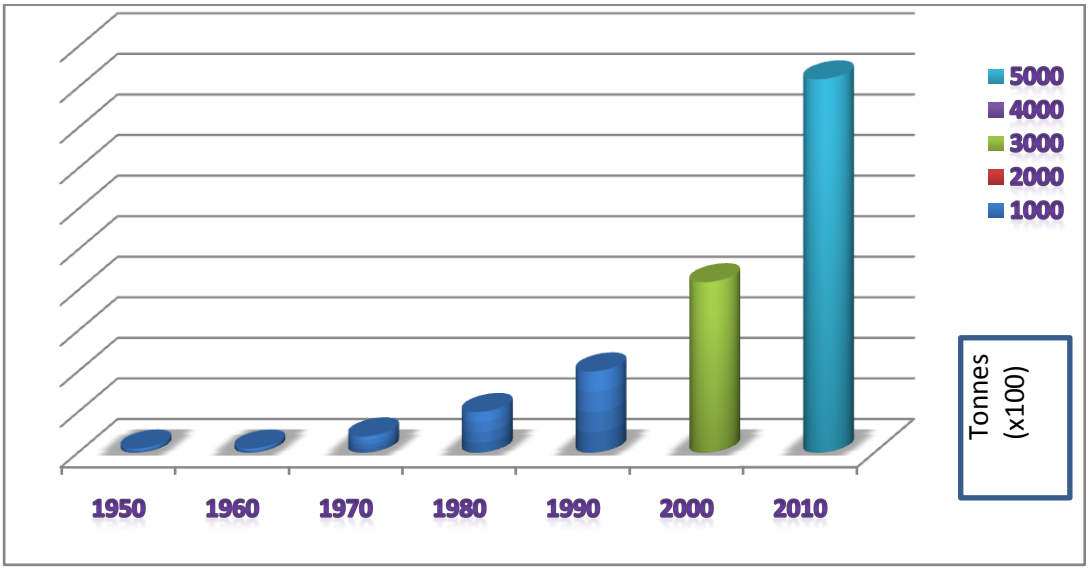


Fig. 4: Reported Fish production in India from 1950 to 2010 (FAO fishery statistic)

Fish Centre

Canning is a major market for supply of fish to Kolkata. The fishermen of the area bring their catch to the all-night fish market at Canning. Here the commission agents receive the fish and auction them. It is bought by the wholesalers and transported to Kolkata for sale to retailers, who sell it in the different markets. As greater part of Kolkata's fish now come from South India and Madhya Pradesh, local wholesale trade at Canning and Bagnan has lost out in the competition.

Picture 5: Canning Wholesale Fish Market

The entire supply chain of fishery product in coastal districts is over-whelming geared towards supplying the fish to one distinct destination (that is Kolkata). Among these, a smaller portion of catch goes for exports. Prawn, pomfret, crab, and certain other sea-fish, catfish, ribbon fish, etc. belong to this category. Mainly two types of fish come in the market i) Freshwater cultured fish, ii) Brackish water cultured fish, prawn and iii) Catch from the capture fisheries either from river, or sea. In south and North 24 pgs the produce from brackish water aquaculture ponds goes to nearby auction markets. A significant portion of the catch goes to distant places within the state via Kolkata. Fresh water fish culture in ponds goes to the urban marketing centres in districts surrounding Kolkata and Howrah, Barasat, Basirhat, Hasnabad, Hooghly, etc. and in distant districts like Murshidabad and districts in North Bengal (most important centre is Siliguri.

Produce from capture fisheries, small portion of the total catch goes for local consumption. Such fish travel from auction market to retail centres without ice and goes to places that can be covered within 2 hours in whatever means of transport engaged. After reaching the retailing point (which is usually a nearby town, where price and availability of ice is better than at the auction centre like Digha Mohana), ice is applied to the fish to preserve the fish for the period until which the stock is not sold out. For example, from Digha Mohana auction centre, such fish are carried by head –load on foot (15 %), tricycle van or bicycle (80%), Tata Ace 2 toner vehicle (5% or 1 by number- used by five retailers jointly-going to Ramnagar a place around 12 km away) to nearby retail markets in Ramnagar, Digha , Choddo Mile, Kanthi, etc. The fish is auctioned for the second time in these urban centres before reaching the retailers. [22] Such fish are carried in vehicles like 107 (2-toner vehicle), 207(2 toner pick-up truck), 407(4-toner truck), after proper packing with ice. Of the total landing in Digha Mohana, less than 1% by weight travels this route. This is not surprising, because the purchasing power of the consumers is very low in the surrounding area. The type of fish involved is primarily low-value sea fish (for domestic consumption), some quantities of high-value sea fish like pomfret (for premium consumers in Kolkata, Howrah and N24PGS), aquaculture fish like Parshe, Bhetki, prawn (usually smaller ones than are exported) and pond fish like carps (Rui, Katla), etc.

There are auction marketing outlets in some prominent places like Canning, Raidighi, Kakdwip, Namkhana, Sagar, Malancha, Basanti in South and North 24

Parganas. Apart from thsese auction markets some small auction markets are also managed by some local aratdars in remote island of Sundarban. Aratdar charges a fixed commission to the seller on the value of fish atuctioned. Aratdars takes 5% -7% commission from the "Jeunis" (Fish producer). Generally fish producer's sale their produce to a specific aratdar (this is because they take loans from them). Malancha market deals with majority of prawns therefore, here the commission varies between 5.8 % depending upon the loan amount given to the producers. Diamond Harbour has a big auction market which mainly markets the capture fishery products of the trawlers. Primarily Auction held at Landing Station than 1) Local Retail 2) Secondary Auction in Districts 3) Secondary Auction in Kolkata 4) Third Auction in districts 5) Local Retail. Paikars buy the fish from the aratdars in primary auction centres. (Fish landing centres) and supply the same to the secondary auction markets and or retailers in Kolkata. Chalandars buy fish from the primary auction centres and deliver the same to the processing units in Kolkata through the intermediation of commission agents. Major role played by paikars and chalandars is to aggregate quantity (by buying from a number auctioneers in the same or different auction markets) and Delivering in bulk to secondary auction markets in Kolkata and to the processing units. From the above description it is evident that in the existing system of marketing of fish there are 3 to 4 intermediaries doing business between the producer and the consumer / Exporters. If a farmer harvest 1 Kg prawn (head on) he will get Rs 200/- from the middleman, Middleman will get 200/- for 990 gm from aratdars, aratdars will get same price for 900 gm from the retailer /exporter. So farmer is losing 20% from the ultimate selling price (source : Personal communication).[23]

For small and marginal fishermen, credit is required not just for catching or producing fish, they take credit for running other day to expenditure.

Auction market in Basirhat (N. 24 pgs.) 12 seafish (70%) and inland fish mostly carps from Andhra Pradesh (30%) (dadan is less prevalent here) Very close to the belt (Nazat, Sandeshkhali–I & II, Haroa) producing aquaculture prawn and bhetki, parshe, but these fish go to Kolkata (exporter & retail market through intermediaries) and do not come to this auction market.

Canning (S. 24 Pgs) Tiger prawn, Parshe, Bhetki, Inland fish like Scampi, Carps, (Rui, Mrigel) sea fish (during season) could not be ascertained 6% with dadan and 4% without dadan (there is another cut called Jholta). Sea fish from Basanti- Gosaba sector does not come here due to want of a bridge across Canning river, which is under construction now.

Picture 6: Canning Auction Fish market

Diamond Harbour (S 24 pgs) 96 (about 25 operates in off season as well) Mostly sea fish, inland water fish and aquaculture fish like prawn could not ascertained 6% +Rs. 0.175/kg for loading and unloading each one of the largest primary auction markets in West Bengal, Other being Digha Mohana)

Raidighi (S24pgs) 32 Variety of inland and reverine fish, sea fish about 125 in season 7% with dadan, 5% without dadan. A reverine centre for whole sale trade of fish.[24]

Some important measures for the success of the trade

A. The demand position of the consumer market should always be assessed.
B. All precautions should be taken to prevent fish and fish products due to wastage.
C. Quality control is essential at various levels as per requirements of the local and foreign markets.
D. Sudden price rise and also fall of price should be prevented. Prices should be stabilized for abundant or poor landing of fish and fish products. Creating of artificial scarcity leads of dangerous consequences.
E. There is need to be alternative to even small points of conscience against the harmful activities and functioning of the middlemen, money lenders, hoarders, retailers and even co-operative societies are involved in this trade.
F. A preliminary statistics on catches should be collected prior to diversion of the fish to various agencies dealing with storage, preservation, canning industries and manufacturing units of various products and by products. Statistics of fresh consumption should also be collected.
G. That the fishes have very high food value being rich in protein, carbohydrates, vitamins and minerals, should be given wide publicity.[25]

Francis Buchanan Hamilton witnessed a brisk fishing and fish trade in the districts of Northern Bengal and some parts of Bihar in the early decades of the 19th century. It is evident from his report that the fishermen were then more directly linked with the market economy. The main problem of perish ability of fish they would overcome by drying, curing and salting it by the application of their indigenous methods of technology for export to the distant markets. West Bengal's dried fish has profitable demand in Bhutan, Burma, Garo hill areas, Nepal and even in Britain for consumption and use for medicine and manure in cultivation. There has been inter

districts dried fish trade. The fresh fish is more lucrative and palatable to the consumers. Its trade is subject to the inadequate technology for preservation and means for transportation.[26] The number of fish consumers of West Bengal has been estimated to have risen from 80% to 95%, while the demand side stimulated the expansion of fish trade. The development of communications is possible through the rail, roads, water ways and sometimes in airways. The Kaibartas, Nikaris and jele malo fishing communities through their enterprise play a key role in marketing and curing fish.[27] Some of the fishermen have fleets and fast boats located near the hilsa fisheries which they use to transport fish to steamers and trains for the Calcutta markets. The import of raw fish to Calcutta indicates that 84% of the total imports are carried by the railways 3.6 % by the canals and 13% by the road. The rail transport was largely done in the winter season. Along the Ganga in Bihar there was a chain of stations such as Arrah, Patna, Monghyr, Bhagalpur, Sahebgaung and Rajmahal which sent carp packed in open baskets to Calcutta, Hooghly and Burdwan . From various places on the Hooghly fish was distributed to Calcutta by rail throughout the year. Fish was also sent by railway to Calcutta from Chandipur in Balasore and occasionally from Puri and Chilka. The boats were used in the conveyance of fish both fresh and dried and the Calcutta market was supplied in this way. In the cold weather special fast carry boats were employed by the parties of the Sundarban fishermen to carry the catches to the nearest railway stations.[28]

The official report suggest that dried fish and its by-products had lucrative foreign markets, in Cylone, UK , Burma, Fizziland straits settlement through the Calcutta Port. In some of the places where fish caught locally and was sold in the local markets and huts. The smaller vendors and fisher women sometimes carried fish from house to house for sale both in towns and villages. Women fish vendors largely do retail marketing in the marine sector. Over the years, the supply of fish to women vendors is on the decline and they face several other hard ship in selling fish, which is a highly perishable commodity. Schemes to promote retail marketing of fish in hygienic condition should aim at providing assistance to women fish vendors, especially with regard to containers for carrying fish, transportation facilities etc. Self help Groups comprising women fish vendors should also be assisted in setting up of hygienic retail outlets with facilities for keeping the product in chilled or refrigerated

conditions. Such schemes will be helpful in sustaining their livelihood and ensuring quality fish to the consumers.

There is a vast trading network of fish. However 26% of the demand of Calcutta markets is met by the import. Fish price is always high rate in the city. The price of fresh fish which have greater demand in the market is to be determined by its quality and the relation of its supply to the demand. Its price naturally vary in different localities and different periods of the year.[29] T. Southwell expressed that the existing intermediary system both in the fishery organization and marketing of fish. But the excess profit accured from the increase of prices was to be appropriated by the middlemen. It has been stated that the development of fish trade in Bengal but the actual position of the fishermen had always been suffering in it. What was the reason? K.C. De pointed out in his report the fish was extremely perishable article and was sure to become useless- unless quickly conveyed to the market or at once preserved. The catcher of the fish was therefore entirely dependent upon the middlemen who had means of transport at their disposal. They kept information about demand and supply and with the help of a modest capital they could always secure a good trade.[30]

The state has already constructed five minor fishing harbours and forty three fish landing centres with due regard to the hygiene and sanitation conditions. Also steps are being taken for opening aqua shops for catering to the requirement of the fisher folk in terms of fishing gears / boats etc. along with repair to earn revenues as well as providing employment opportunities to the local people. Two other fishing harbours are under construction. The state has taken up an ambitious programme to construct more number of fishing harbours and fish landing centres in near future which would directly benefit the marine fishers through better handling of fish and safer landing leading to better realization besides improving the prospects of export through compliance with the requirements of the importing countries .This should be included under the central sector scheme because the present scheme involving NABARD has had limited success because of its insistence on 50% state share. Full attention is required to be paid to the existing minor fishing harbours and fish landing centres which have since been constructed over the years and are now becoming difficult to use because of heavy siltation. To overcome this problem it is necessary to carry out periodical dredging operations. There should also be a central sector scheme in this regard. It is high time to set up a Central Fishing Harbour Development

Authority which could comprehensively manage the minor fishing harbours and fish landing centres in terms of construction , management, maintenance dredging etc in consultation with the states and stakeholders. The Department of Animal Husbandry, Dairying and fisheries should prepare a proposal for a law on the subject after consulting the states so that the harbours and landing centres could be managed more professionally.[31]

Table 4.12: Important fishing centers in West Bengal

District	Centre	Nearest Town	Distance(Km)	Access
24 Parganas	Diamond Harbour	Kolkata	47	Road & rail
	Kakdwip	Diamond Harbour	41	Road
	Namkhana	Kakdwip	13	Road
	Raidighi	Kolkata	70	Road
	Frazerganje	Namkhana	20	Road or River
	Jambu Island	Namkhana	20	River
Medinipur	Junput	Contai *	11	Road
	Saulaghat	Contai *	16	Road
	Jaldah	Contai *	35	Road
	Sankarpur	Contai *	35	Road
	Digha	Contai *	45	Road

- Contai is 150 K.M from Kolkata by road

Source: collected from Dept. of Fisheries, GOWB.

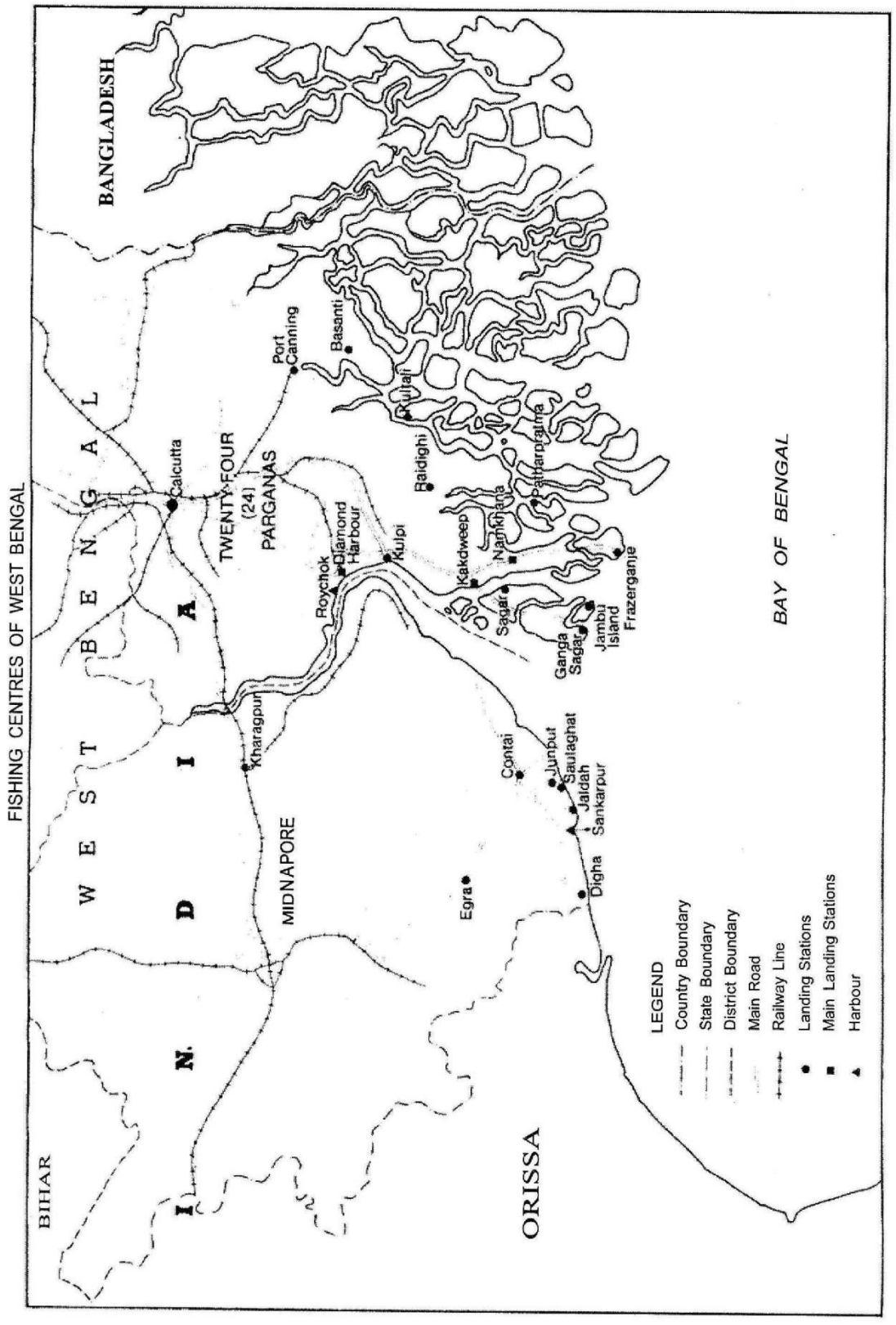
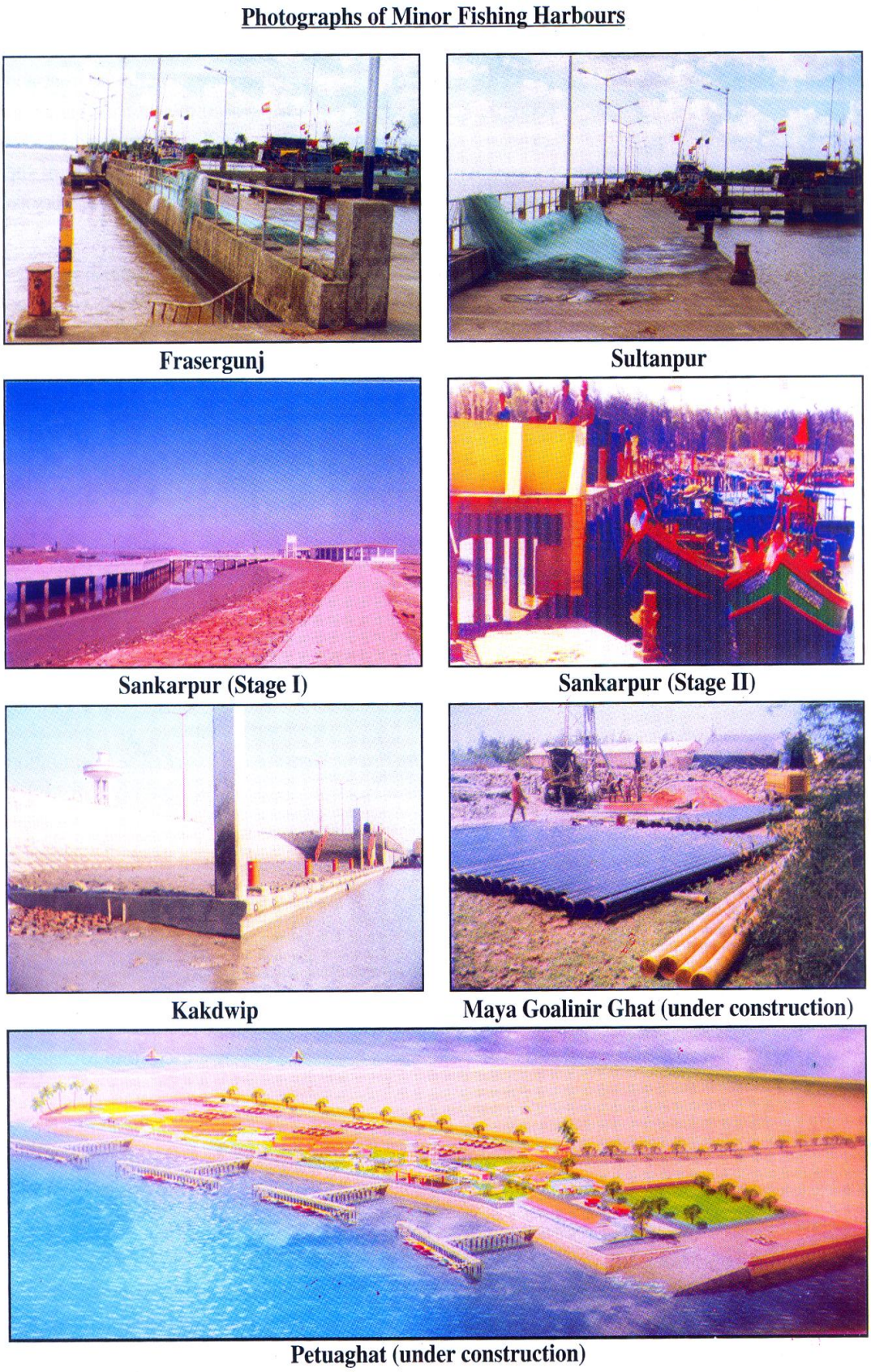


Fig.5: Important Fishing Centers in West Bengal

The construction of fishing harbour at petuaghat in Purba Medinipur district at an estimated cost of Rs. 32.00 crore. Its proximity to the sea and navigability it has been proposed to convert it into a deep sea fishing harbour. The work for construction of another fishing harbour at Mayagoalinirghat in the Sagar P.S. of South 24 Parganas district is being taken up during the financial year 2006-07. This apart the Department proposes to set up five more fishing harbours during the 11th plan period at various locations in the coastal areas. The estimated cost will be around Rs. 95.00 crore. Frasergunj minor fishing harbour, Kakdwip, Sultanpur, Shankarpur (Stage –I & II), Minor fishing harbours at Petuaghat in the district of Purba Medinipur, Mayagoalinirghat, fish landing and Berthing jetty at Namkhana are the famous.[32]

The products exported contribute aquaculture as well as capture fisheries. The brackish water aquaculture products account for 80% of total export while the rest is contributed by capture fisheries. West Bengal possesses the richest resources for brackish water aquaculture in India. The export marketing of marine fish recorded phenomenal growth in recent years. Frozen prawns earned substantial foreign exchange in marine fish export and paved the way for the growth of an organized sea food export industry. Now, not only shrimps but also cattle fish, shark fins, crabs, seer fish etc. are exported substantially. Price is determined by the interaction of demand and supply at both producing centre and consumer markets.

West Bengal produced 3008 tons of exportable prawns during 1980-81, which was 52.27% of the country production. The exportable prawns changed maximum of two heads between farmers and processors. In the state 23.62 % of the production was directly supplied by farmers to the processors and the balance 76.38 % was sold through commission agents cum –auctioneers. The commission agents (sale) cum auctioneers in West Bengal handled both domestic fresh as well as exportable prawns. They handled 2297.46 tons of prawns during 1980-81. Bulk of this 76.22% was sold to wholesalers, who operated for prawns exclusively. The balance of 23.78% was sold directly to processors. Usually the staff knows the processors visited the commission agents (sale) cum auctioneers' shops for collecting prawns.[33]



Picture 7: Minor Fishing Harbours

The state could have achieved phenomenal progress in this regard resulting thereby earning of huge amount of foreign exchange. Because of the imposition of a lot of restriction by the Govt. of India under the coastal Aquaculture Authority Act and imposition steep rate of land revenue on brackish water aquaculture by the state Govt. the Progress in the field of shrimp culture has somewhat been thwarted. However, in spite of the impediments the inland shrimp production has been raised from 28785 MT. in 1990-91 to 80000 MT (approx.) at the end of year 2006-07. A table showing the progress of development of shrimp culture is appended below:

Table 4.13: Shrimp production in west Bengal (in ton)

Year	Inland		Marine		Total
	Penaeid	Non-Penaeid	Penaeid	Non-Penaeid	
1990-91	12370	6220	7350	2845	28785
1992-93	14608	7850	8497	3450	34405
1994-95	14893	8122	8657	4128	35800
1996-97	16261	8958	9039	4242	38500
1998-99	18357	6442	11319	3947	40065
2000-01	16610	6075	11320	6015	40020
2002-03	21150	6510	12730	6110	46500
2004-05	35000	16000	13000	7000	71000
2006-07	41000	22400	11001	5527	79968

Source: Dept. of fisheries, Govt. of west Bengal (Annual report2006-07)

Marketing of processed fish

In West Bengal processed fish are available in two forms

- Frozen fish which are mainly prepared for export purpose
  - More than 90% contributed by shrimp
  - 10% contributed by Pomfret, Cat fish, Hilsa
- Ready to eat, ready to cook & ready to fry items from

BENFISH: It has mobile and stationary counters to sell various ready to eat products. However it only depends markets of Kolkata.

IFB: The Company with its different marketing strategy from BENFISH is able to serve greater market. It prepared ready to cook products and these products are available in sub urban areas also. It supplies product to local restaurant, interest kirani shops with frozen facilities. However the market is limited by geographical boundary of south Bengal.

TRIVENI: The Company supplies variety of fishes to hotels and restaurants on contract basis. Their products are not likely available in stores. They prepare itemized value added fish product for specific consumption.[34]

Fish Trade and Marketing through Cooperatives

Co-operative movements have also gained importance in fishery trade. It can safe guard the interest of the small entrepreneurs and stops their exploitation by the middlemen. The fishery trade is also promoted by this movement. There is need for collective efforts by the fishermen, consumers, industrialists and government authorities. In several countries there is much more modernization and sophistication in fishery operations at all stages right from capture to marketing.[35] Fishery trade can solve many socio-economic problems as poverty hit fishermen. They can be provided many credit facilities for improvement.

In many foreign countries (Canada) loans are granted to the poor fishermen, under "fisheries improvement loan Act". The methods of marketing are like this-

a) By supply a good quality of fish.

b) By maintaining the nutritional value of the fish.

c) By exporting fish to other countries to get foreign currency.

d) By supplying fish to the fish agencies so that consumers may get fresh fish.

e) By organization – Balance between producer and consumer play an important role in the production of fish. To increase fish production a cooperative organization being formed by Government which is the association of producer.[36]

There has been conscious effort by the state government to develop the poor fishermen, who are generally either landless or does not possess any water body, as they mainly belong to the scheduled castes community. A number of institutions are working at the villages, district and State level for development of the poor fishermen. At the state level, West Bengal Fisheries Development Corporation and state fisheries Development Corporation are the two institutions engaged in infrastructure development, establishment of modern fish breeding farms and fish production in inland and marine sectors. At the district level fish farmer's Development Agencies (FFDA) have been set up for all round development of fishermen[37]. Financial assistances are also provided to the people below the poverty line for pisciculture through integrated Rural Development Programme (IRDP) by the district Rural Development Agencies (DRDA) and from commercial banks. In view of the vast potential for development marine sector, development, assistance has also been provided by various national level institutions. Such as Marine Products Export Development Agency (MPEDA), National Cooperative Development Corporation (NCDC) and National Agricultural and Rural Development Bank (NABARD)[38].

Fish marketing through cooperatives-there is three different channels of marketing.

1. Cooperative - consumer channel

2. Cooperative - retailer-consumer channel and

3. Co-operative –Auctioneer-wholesaler (purchases)-wholesaler (sales)-retailer/ vendor-consumer channel.

Fish Marketing Through Cooperatives:

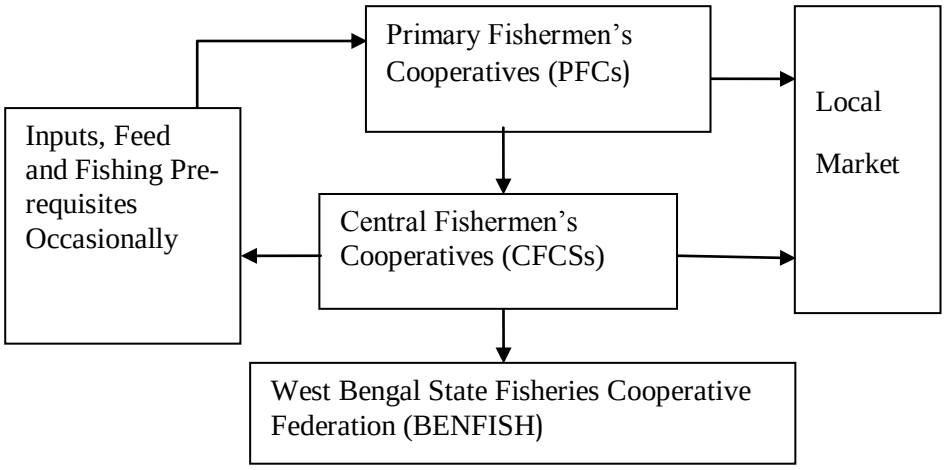


Fig. 6: Structure of Inland Fishermen's Cooperatives

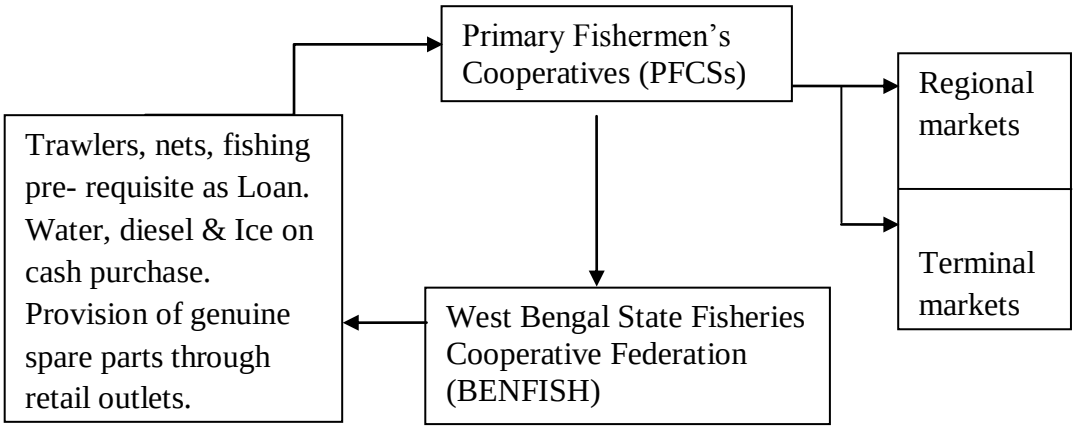


Fig. 7: Structure of Marine Fishermen's Cooperatives

For assuring remunerative fish at reasonable price to consumers the fishermen's primary cooperative societies (PFCSs) and Fishermen's Central Cooperative Societies (CFCSs) have constructed retail outlets at the nearby markets. For construction of these retail outlets loans were provided to the societies[39]. With the help of Union Ministry of Food in the Eighth Five Year Plan, the BENFISH has started an innovative method in fish marketing in Calcutta city. Fish stalls known as 'Kiosks' have been set up at identified places under the Calcutta Municipal Corporation for sale of cut and processed fish. Under this Scheme, initially the BENFISH with buy fish from wholesale markets for sale through the Kiosks. Initially the BENFISH intends to utilize their knowledge and develop expertise in marketing of fish. As the Scheme will make some success, the CFCSs will be asked to supply fish directly.

Total numbers of member of PFCSs are 71,850 of which only 120.3(1.67%) are women. Of the total number members 60 and 5 percent are from the scheduled caste and scheduled tribes community respectively. Paid up spare capital of the PFCSs are Rs/- 261 lakhs, of which the government share is Rs/- 210 lakhs (77.78%). Cumulatively, for all PFCSs total reserve fund and working capital are Rs/- 220.05 and 116 lakhs respectively. Total capital borrowed by the societies is Rs/- 723 lakhs. The societies have fixed assets worth Rs/- 507 lakhs. Of the total number of PFCS only 21.71 percent are running with profit. Rest 47.45 and 30.84% of them are running in loss and without any profit or loss respectively. It has also been estimated

that of the total amount of inland fish production in the state about one third is from the cooperative sector.

Various govt. schemes through which the PFCS financially helped are :

i) Govt.'s contribution to share capital.

ii) Sanctioning of loan and subsidy for purchase of crafts and gears, establishment of fish stall in markets and purchase of fisheries requisites.

iii) For development of infrastructural facilities, community halls and making provisions for drinking water facilities.

In addition to the above schemes, in marine sector, fishing harbours are being set up with electricity, drinking water facility, ice factory and diesel dumps for cooperatives as well as private trawlers.

Table 4.14: Number of Primary Fishermen's Cooperative Societies- in Marine Sector

SI. NO	District	No of registered societies
1.	Medinipur	21
2.	24 Parganas (South)	30
	Total	51

Source: Assistant Registrar of Cooperative Societies, West Bengal.

Table 4.15: District wise number of Fishermen's primary co-Operative Societies inland sector

SI.no.	Name of the district	No. of registered societies	No. of societies in working condition	
1.	Hooghly	42	15	(35.17)
2.	Murshidabad	85	32	(39.02)
3.	Dinajpur	29	18	(62.07)
4.	Cooch bihar	71	43	(60.56)
5.	Jalpaiguri	12	12	(100)
6.	Birbhum	30	17	(56.67)
7.	Bankura	57	20	(35.09)
8.	Purulia	40	-	
9.	Nadia	82	32	(39.02)
10.	Medinipur	144	-	
11.	Howrah	34	8	(23.53)
12.	North 24 Parganas	61	37	(60.55)
13.	South 24 Parganas	110	17	(14.28)
14.	Darjeeling	2	-	
15.	Burdwan	39	-	
16.	Malda	52	-	
17.	Kolkata	3	-	
Total		**902**	**252**	

Figures in parentheses indicate percentage of working societies to total number of registered societies.

Source:Asst. Registrar of Co-operative societies, Directorate of Fisheries, Kolkata.

Only those PFCS which have business, have been taken into account. In consultation with district and state level officials four inland sector PFCS and six marine sector PFCS have been selected for study.

Table 4.16: Name of the sample Inland PFCSs.

SL. No.	District Name	Name of the PFCSs
1	Medinipur	a. Mukshedpur fishermen's co-operative society b. Ballabhpur Dhibar Samabay Samiti c. Dantan Sarasanka unemployed fishermen's co-operative society
2	24 Parganas (South)	a. Captain Bheri Samabay Samiti Ltd.
3	24 Parganas (Noth)	a. Chamta fishermen's co-operative society
4	Kolkata	a. Mudiali fishermen's co-operative society

Inland PFCS

Cooperative- consumer channel: Problem of price for fish disposed through this channel are:

i. In most of the societies due to small quantity of catch sales are also less. At present fish are sold only during religious and festival occasions.
ii. Prices of fish at retail outlet situated in towns are always more than existing market prices. As a result, fish at retail outlets remain unsold.
iii. Whereas, at the retail outlet situated in the markets prices have been found always to be less by Rs.5 to 10 per kg. than the existing market price thus entire quantity of fish brought to these retail outlets are sold.

Cooperatives- Auctioneer-Wholesaler (purchase) -Wholesaler(sales)/vendors-Consumer channel:

i. Bulks of the fish are disposed through this channel.
ii. The cooperatives cannot assure any steady remunerative price to the fishermen in this channel. Because they have to depend entirely on the Wholesaler (purchases) and Wholesaler (sales).

Cooperative- Retailer-consumer channel:

Cooperative societies like Mudiali Fishermen's cooperative society sell daily about 1000 kgs. of fish through this channel. Apart from it, Carps up to 50 gms size are sold

to about 30 identified retailers at fixed price. By this method the society is able to by-pass the wholesalers.

Marine PFCS

i. For the entire fishing and trawling season spread over 6-7 month in a year quantity of fish catch is enormous. The catch also consists of a variety fish, to be consumed as fresh, certain varieties are to be processed and other varieties either small or purified are to be sun dried. Of the sun dried varieties some are consumed and the rest which are unfit for human consumption used to manufacture poultry feed mainly.

Table 4.17: Number of Sample Marine PFCS

Sl.No.	District / Location	No. of PFCS
1.	Medinipur – Sankarpur Fishing Harbour	3
2.	24 Parganas (South) Namkhana Fishing Harbour	3
Total		6

ii) For marine fish, the auctioneer-cooperative-wholesaler (purchase)-wholesaler (sales)-retailers/vendors-channel is utilised solely. The reason for utilising the channel by the PFCSs is that working capital as lone is available from the auctioneers at the beginning of the fishing season. At Namkhana, working capital loan ranging from Rs. 10,000-12,000 is required for purchase of diesel, ice etc. In turn the PFCSs are morally bound to sell the entire produce through the auctioneers deduct 5% of the value of the catch in each occasion. The loan remains as outstanding throughout the fishing season. At Digha coast, just before beginning of the season for repair of boats the PFCSs obtain loan from the auctioneer ranging from Rs. 25,000-30,000 each year. The principal is deducted gradually through sale of fish.

iii) As a result the producer PFCSs don't have any control over prices.

iv) Instead of marketing fish by assuring better prices the BENFISH is found to be more interested in realisation of loans. Generally about 35% of the total value of each fish are realised as loan. Alternatively, also Rs. 6,5000 are required to be deposited every month by the PFCSs for recoupment of the loan.[40]

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CHAPTER-V

Labourers and Brokers

1. Function of the labourers

Pisciculture in West Bengal especially in Southern part comprising South 24-Parganas, Medinipur etc. is largely dependent on fishermen, labourers and brokers. Income from this sector is their main source of livelihood. Labours are involved in fisheries. They do part time work in this sector. There are some full time workers too. They help in catching, salting and drying which is an important livelihood activity for a large number of labour throughout the coastal West Bengal. When a large number of catch are heaped up on the banks they come forward and help the master to carry out the quantity to the nearest suitable market and lift them to the conveyance that go to the comparatively big market. Sometimes they also go to the market with the fish and help to sell them. A significant proportion of labours either independently process fish meal by the sun drying or work as labour in by product units. The seafood export sector utilizes the marine fish catch and employs large number of women workers for grading, packing and freezing seafoods for export. Thus the contribution of different types of labour in very aspect of post harvest handling, preservation and processing of fish is substantial in the overall development of fisheries sector. The information on socio-economic issues and nutritional status of fishermen and women (labour) in West Bengal is inadequate to suggest appropriate intervention to improve income generation, the standards of sanitation and hygiene, product quality and address the specific problems confronting the labours in post harvest fisheries. [1]

Fish is a highly perishable commodity. Right from the time of taking out the species from water spoilage starts. On an average about 30% of the catch is destroyed due to spoilage. The percentage is more in respect of marine catch. As such immediate preservative measures are called for after the time of catch so that commodities reach the market without any substantive deterioration of quantitative value. With that in view it is of paramount importance to develop necessary infrastructure for creation of cold-chain

system, storage and marketing facilities with proper hygienic standard, processing, communication and transport.[2] Training to fishermen and fisherwomen is one of the most important components in post harvest activities in order to equip them with knowledge in drying of fish maintaining the nutritive and qualitative value and for preparation of various value added products like fish pickle, fish pappad, fish dust, fish meal etc. Such training programmes are organized on a regular basis in both the inland and marine sectors of the state. To minimise exploitation by middlemen and ensuring good returns to fishers and fish farmers the feasibility for marketing of fish through co-op Societies or by back agreements by the big export entrepreneurs is being examined. This may yield better returns to the farmers with price stability in the domestic market and availability of fish to the consumers. [3]

Fisheries sector has a significant role in employment generation, poverty alleviation and socio-economic upliftment in rural areas of the state

Table 5.1: Employment generation in fisheries sector (Plan schemes only)

Man days – Unit: in '000s

Si no.	Name of sector	2005-06	2006-07
1.	Inland fisheries	2688380	2827740
2.	Brackish water	518490	541200
3.	Marine fisheries	10458000	10548000
4.	Extension wing	368000	384000
5.	Welfare scheme	1240700	1240700
6.	Co-op society	1634140	1654140
7	Others	128000	159500
	Total man days	17035710	17355280
	Total man year	70982	72313

Source: Annual report, Dept of fisheries, Govt. of West Bengal.

During the last twenty three years since 1982 about twenty lakhs fisher families and fish farmers have been directly benefited and about twice the numbers have been indirectly benefited from the various activities undertaken by the Dept. Fisheries represent a vital sector in the thrust programme of West Bengal Government for rural development through production of fish and other ancillary activities thereby generating rural employment and improvement of socio-economic status of the fishers who are the prime contributors of fisheries production. Fisheries sector has a significant role in

employment generation, poverty alleviation and socio- economic upliftment of rural areas in the state.

Fisheries sector embraces a large population of scheduled castes and scheduled tribes. A good no. of income generation schemes was formulated for benefit of those down-trodden sections of the society. Rehabilitation of scheduled castes and scheduled tribes families through fishery activities has become a major boon for upliftment of their economic status above poverty line. Keeping this in view, fishery cooperative societies, fish production groups specially for Scs and Sts were revamped. Welfare activities for this downtrodden fisher folk have been taken up with a great zeal to improve the socio-economic status by constructing community halls, dwelling houses, model fishers, villagers, approach roads and various programmes on training of fishermen and fisherwomen, introduction schemes like old age pension and group insurance, savings-cum-relief schemes for the fishers etc are running. In addition, under the guidance and active help from the department a good no. of carp hatchery, macro brachium hatchery, fish-meal plant, Ice plant and demonstration centres have been set up at different places in the state. [4]

Table 5.2: fish based industries in West Bengal

SI. No.	Name of the District	Ice Plant		Feed Plant		Fish Meal Plant		Net making centre	Fish drying centre	
		No.	Capacity	No	Capacity	No	Capacity / day	No.	No.	Capacity
1.	Darjeeling	5	380.8	-	-	-	-	-	-	-
2.	Jalpaiguri	4	22.2	-	-	-	-	-	-	-
3.	Coochbehar	-	-	-	-	-	-	-	-	-
4.	Uttar Dinajpur	20	16.5	1	27.5	-	-	-	-	-
5.	Dakshin Dinajpur	13	20.7	-	-	-	-	-	-	-
6.	Maldah	4	37	-	-	-	-	-	15	131.1
7.	Murshidabad	8	30	-	-	-	-	-	-	-
8.	Birbhum	-	-	-	-	-	-	-	-	-

9.	Barddhaman	3	16	-	-	-	-	-	-	-
10.	Nadia	33	217	-	-	-	-	-	-	-
11.	North Parganas (24)	14	100	.	*	-	-	1	-	-
12.	Hooghly	4	40	2	-	-	-	3	-	-
13.	Bankura	4	1703	-	-	-	-		-	
14.	Purulia	9	11	-	-	-	-	-	-	-
15.	Paschim Medinipur	8	61	1	50	-	-	-	-	-
16.	Purba Medinipur	73	989.5	6	21.5	29	257	2	41	12191
17.	Howrah	15	25.3	2	-	2	-	-	-	-
18.	South Parganas(24)	71	1571	-	-	3	32	-	296	601.6
Total		288	524	12	99	34	289	6	352	12923.7

Source: Annual report, Dept of fisheries, Govt. of West Bengal. (in Ton)

Such steps taken by the Department helped in generation of employment for many persons. Two types of Hatcheries belongs in our state- one is private and other is Govt. Hatcheries, where there is need of many labours. They work there and are benefitted much.

Table 5.3: number of Hatcheries in West Bengal

SI. No.	District	Private Hatcheries	Govt. Hatcheries
1.	Coochbehar	12	1
2.	Jalpaiguri	8	-
3.	Darjeeling (Karshiang)	0	1
4.	Daijeeling(Siliguri)	0	-
5.	Uttar Dinajpur	6	1 (CADC)
6.	Dakshin Dinajpur	9	-
7.	Malda	1	1

SI. No.	District	Private Hatcheries	Govt. Hatcheries
8.	Murshidabad	22	-
9.	Nadia	7	1
10.	24-Parganas (N)	200	-
11.	24-Parganas (S)	-	-
12.	Howrah	8	-
13.	Hooghly	51	-
14.	Purba Medinipur	7	2
15.	Paschim Medinipur	4	1
16.	Bankura	200	-
17.	Purulia.	5	-
18.	Burdwan	19	1
19.	Birbhum	5	-
Total		564	9

Source: Annual report, Dept of fisheries, Govt. of West Bengal.

A large number of different types labours are involved in the fisheries related activity. It is clear that the fresh fish marketing and traditional fish processing are the more preferred activity of maximum labours, specially for women. The other activities are such as the clam collection and processing, Fish processing plants and aquaculture, the prawn seed collection, Fish and shrimp farms and hatcheries. Labour at landing centres, by products units and plants provide work and income for large number of poor people. The Marketing of fresh is relatively easy with access to fish for labours, Facilitating flexibility of operation, financial security and occupational sustain ability. But the venders have range of problems with fish supplies becoming increasingly scarce, due to depletion of fish catches, increased competition from processing and export sector. Most of the labour prefers this activity mainly due to the light demand for fresh fish and quick return of the investment. The small scale men and women processors in the traditional sectors have more problems. The profit margins are low, fluctuations in the product supply, lack of storage facilities, insect infestation present them with risks and uncertainties.[5] The frequently occurring occupational health hazard of labours are mainly

related to physical exhaustion due to long standing, long sitting, working in hot sun, untimely food, long working hours, long distance working with head load, Back ache, headache, chest pain, shoulder, joint, muscular pain, skin infection, burning sensation of eyes, Breathlessness are the common problems of fishermen and women associated with post harvest fisheries activity in all the centres. Some scholars have stated that by adopting systematic cost effective approach, it is possible to bring improvement in the traditional fish processing sector.

It is clear that there is a need to improve the general situation of women and fishermen on a long term basis. But as a priority interventions in creating awareness among the labour on food, health, sanitation and childcare, to educate men & women formally as well as informally in improvement of the quality of the product. Effort is to be made to have trained female extension workers. Women friendly technologies need to tested, evaluated and proper techno economic reports prepared to facilitate their use through entrepreneurship development programmes.[6]

The fishermen of West Bengal are the 'sons of the water'. The whole economic status of the fishermen of West Bengal is very much deplorable. Majority of them are internal capture fishers who are dependent to the whims of the nature. Capture fishing as profession hardly fulfills the minimum needs of the fishermen through the year. Still they are engaged in this profession, as they do not have other sector to be engaged in. In North Bengal, fishing now a seasonal profession because of shortage of water and fish scarcity in river system of Northern Bengal. In rest of the year the fishermen of North Bengal earn their livelihood from other sources particularly by rickshaw pulling, selling vegetables, breaking stones and as agricultural labourers.

In case of sundarban and the coastal belt of Digha condition of fishermen have no different feature. They are engage in marine fishing as small share holders as they do not have sufficient capital. Modern technology, essential to cope with the situation in the modern fishing industries, requires huge capital, which generally supplied by the non-fishermen traders and big fish farmers, the fishermen worked in the advanced mechanised fishing boats as labourer or as very small shareholders of the total earning in marine

fishing. The children of the fishermen instead of going to the school are engaged in min collection in Sundarban. The woman folk of the fishermen lost their traditional jobs of net knitting and basket making and are trying to earned livelihood as maidservant in urban and suburban areas and as Bidi binders and seasonal agricultural labourers in the rural areas.

Table 5.4: Population by Category of Workers (1981 & 1991)

Category	1981				1991		
	% of total population		Total workers		West Bengal		
	W.B	India	Total no. % in million		Total	Male	female
			W.B	India			
Total main workers	28.3	33.8	100 15.4	100 222.5			
1. Agriculture							
a)Cultivators	8.4	14.0	29.8 25.3	41.6 24.9	1372616	1289350	83266
b)Agricultural labourers	7.2	8.4			2054552	1633528	421024
2.Livestock, Forestry, Fishing, Hunting, Plantations, Orchards	0.9	0.8	3.3	2.2	144970	126641	18329

Source: Census of India, 1981 and Cultural Research Institute-short note on the Scheduled caste of West Bengal (Kolkata, 2005).

Labours also help in catching fish; specially they do it when they have no agricultural work. It may be said they help in catching fish in offseason. Fishermen engage them in fishing boat both in Indigenous and Mechanical. They work in the boat as a helping hand. They performed different types of work. Sometimes they help to ferry the boats when they go to the deep sea. When they remain near the coast, they help to put the net into the water of the rivers. They also help in lifting and sorting the fish even they carry the amount to the market where aratdar and mahajan open their shop, as they are hired labour they have no routine work. They have to do hard mannual work in the whole operation. Generally labours are engaged in fishing, marketing, and processing. Fish catching and fish selling in the market are an integral part of their profession. In the

coastal areas of the country a section of the Muslim labours are associated with the fishing profession. A large section of the Muslim society used to catch fish without any fishing net during the summer and rainy season with the application of their age-old techniques. This is also a part of their alternative profession to procure more food for their livelihood. This age-old fish industry is one of the significant centre of rural employment. The leader of the team of the fishermen is called 'Bahardar' who is the owner of the boats and nets. Seagoer Malo fishermen are known as 'Saidar'. In the fishing boat earnings through production is distributed among all the labours of the team. But the leader gets 2 percent more than the others. There are more or less 2000 boats in 24 Parganas are found in the rivers. In the river Hooghly 250 fishermen in 100 boats in average used to catch fish. In every season the fishermen use to go on fish hunting as it is their chief livelihood. Yet the high time for fish hunting is from December to June. In the rainy season the hilsa fishes are caught as they come to lay eggs in the mouth of the estuaries. All the labours are become very busy in the rainy season when the hilsa fishes are caught. [7] They earn from their ancestors the knowledge of fish hunting, movements and nature of the fishes.

Labours are also engaged in fish rearing. Fishes are used to rear in the irrigation canals, big lakes, reservoirs' etc. K.G. Gupta mention that the old system of pisciculture is prevalent in the rivers of Bankura, Midnapur in the rainy season. Fishes laid eggs in the reservoirs in the rainy season and the fishermen take these to the nearby ponds, covered by the cloth nets specially manufactured by the weavers.[8] These ponds are called 'Nursery ponds'. When the eggs turned to fry or become small fishes then they are brought to another big tank for rearing up or bringing up. Such system of upbringing of the small fishes is prevalent in Hooghly, Damodar, Padma and Meghna rivers. Young fishes are sold in the markets of Amta of Howrah and other places. Artisanal fishermen used to carry them in a big urn-shaped clay pot and travel from one spot to another by roads for selling. This system of export of young fishes is prevalent by roads from Birbhum to Murshidabad. In Sundarbans, the golden Mines of the pisiciculture is the swamps known as fishery dams . The important young fishes like parse, Bhetki and prawn used to flow to the embankments by the tidal saline water. Some embankments or dams are two hundred to thousand meters long. The fishes produced in the dams or

fisheries used to satisfy the demand of fishes in the Calcutta market. Thus the labours are busy whole year in this sector. [9]

PRIMARY PROCESSING

Post harvest losses of fish occur during the numerous steps from catch to market. The lack of appropriate methods to preserve the catch on board results in heavy losses. Additional losses occur in the period after docking and before marketing. During this period exposure, inadequate processing and insect infestation take their toll. The catch is further reduced by poor transport to market, unsatisfactory preservation, and further exposure during the marketing process. Fresh fish are highly perishable and start to spoil as soon as they are landed. Concern for quality should begin on board the vessel. The first consideration should be to bring the fish aboard alive and in good condition. This is more likely for example, if gill nets are set for six hours or less and the trolling runs are two hours or less. The number and type of bacteria found at time of capture of the fish vary with season, locality, species, water temperature, and method of capture. The heaviest bacterial population in the ocean is usually found in the bottom mud. Bottom-feeding species will, therefore, often have a large bacterial load. Fish should be handled with care. Kicking, trampling or dumping the fish will increase the rate of spoilage. For high quality fish should be chilled as quickly or possible to 0^0C. Before fish are landed hot decks should be cooled with clean sea water. Because high temperature is the single biggest cause of quality loss, fish should be moved promptly from the deck to cool storage. It is most efficient to put the ice and fish together in a covered box or hold area. Flakes or small pieces of ice provide the most effective cooling. Large irregular pieces can damage the fish. Fish and ice should be packed in alternate layers. Dumping ice on a pile of fish will not give good results. [10] The sanitary quality of the water used for producing the ice is also important. Both disease and spoilage-causing microbes can survive in ice and contaminate the catch when the ice melts. Similarly ice should not be reused. Once used for storing fish, it should not be recycled for cooling freshly caught fish.

Fish can be kept cool by other methods. If possible, the fish can be kept in water in live wells until the boat lands. Water temperature is usually lower than ambient

temperature. Fish kept shaded will be cooler than if they are exposed to the sun. Keeping the surface of the fish wet will help bring the temperature down. It is bring the temperature down. It is easier to keep the fish damp if materials such as wet seaweed, leaves, sacking or sawdust are used as a light covering to increase the amount of water available for evaporation. Whether the fish are stowed with ice or without, over filling of containers should be avoided to prevent crushing them. Cool conditions and careful storage should continue through landing and marketing. Spoilage can never be prevented through chilling or cooling, but the cooler the fish are, the greater the reduction in bacterial and enzymatic degradation. For each 5^0c increment in storage temperature above 0^0c, there is a significant reduction in shelf life. Fish that can be stored for two weeks at 0^0c may only last a day or two at 10^0c. In some areas, work has been done on ice-making machines that do not require gasoline, diesel oil or electricity as an energy source.[11] There are gradual changes, than the old system of preservation of fishes from rotting, which the fishermen inherited from their ancestors, due to the evolution of the technicalities, as per demand in the market.

There are two kinds of fishes in the market-fresh and dried. Before establishing the ice-factory the problem of supplying fresh fishes to the market was solved by old system of preservation by the fishermen. Geography and environment played an important role in case of fish preservation and technical development. In summer, like West Bengal, main problem is rottenness of fishes because a chemical reaction took place which spoiled the food value of the fishes. There is an old and native method of preservation to dry fishes in the sunshine. Jalpaiguri, Bankura and Sundarbans are famous for dried fishes.[12] It is found in the writings of Francis Buchanon and W.W. Hunter that the system of drying of fresh fishes in the sunshine on the sand on the bank of the river Ganges and Brahmaputra was prevalent. The fishes which are caught used to be dried in the place of fishing. This place of fish drying is called 'Khola or Kuthi' i.e. an open place for manufacturing dried fish. In the novel 'Titas' we find a vivid description of drying of fishes in Tripura with salt by the side of tanks by the Malo male and female fishermen. The system of processing dried fishes is different in case of big and small fishes.[13] Regional differences are also noticed in case of production. In Jalpaiguri an artificial system of drying fishes in prevalent. In summer the dried fishes are kept in open air at

night. In Sundarbans and Jalpaiguri dried fishes are kept in an earthen pot under the ground to increase the quality of the dried fishes. Later on the dried fishes are supplied to the market for sale. Its profitable markets are in Nepal, Bhutan, Burma, Srilanka and England. The food value of the dried fishes remained intact for a year. Winter season is the ideal season for fish drying. In some places fishes are preserved by boiling. It takes two to three hours. There are some prawn drying centre which is established by the local fishermen. Small and big prawns are laid on a platform of bamboo under which heat is given to boil the prawns. This system is locally known as 'boiled dried fishes' or 'Aulo Shutki' or 'Alo Shutki'. Through businessman of Calcutta these fishes are exported to Burma, Karachi and Cochin. Dried pabda and prawn are of great demand in local market.[14] A paste of pulverized dried fishes mixed with some herbal products are prepared in Jalpaiguri. To make the paste tasty the powder of black pepper and cooking soda is mixed with it. The Mughs of Arakan used to make a paste of dried fishes which is known as 'Nagapee'. Another famous process is salty hilsa, salt is put on the abdomen of the hilsa to protect it from rotting. Same system of preservation of prawn is followed in Sundarbans. No other technique of preservation of fishes, other than the use of salt, is known to the fishermen.[15] The traditional fishermen of West Bengal had also developed different techniques of preservation and processing of fish. Drying and preservation of fish with adding salt is also a common practice among the fishermen of West Bengal. These special kind of dried up and preserved fish called chepa sidal.[16] Processing of fishes and its trade are also a part of the fish industries.

The works of the labour like the fish processing , preservation and making fish products will be discussed below :-

SORTING AND WASHING

In line fisheries, sorting out is continuous as the fish come over the rail. In the trawl fishery, however, sorting is often a problem, as the fish are caught in large quantities and are dumped all at one time on the deck. Market fish of different species and sizes should be separated for icing. Small fish are more difficult to keep in good condition than large ones and should be iced separately. Some species of trawl fish are soft fish and spoil more readily than do other species of comparable size and thus should be iced separately.

Mud and debris on the fishes should be washed with clean water, preferably drawn by pump, while the vessel is running. Harbour water should never be used for washing since it is contaminated with oil, sewage or garbage. The fish should not be stepped upon or thrown bodily to prevent crushing or tearing of the flesh. If practical, it is better to sort market fish by hand.

REFRIGERATION

If a delay between the time the fish are landed and the time they are iced is unavoidable, care should be taken to see that the fish are protected from spoilage. If the sun is shining and the deck is hot, the fish should either be covered with a tarpaulin or kept cool and wet with clean sea water. When the fish are iced, small fish and more perishable species should be handled first.

Large size, in comparison with small ones requires less time to eviscerate per unit of weight and is usually eviscerated. Large fish cool slowly in ice, and evisceration exposes more area to the cooling effect. Eviscerating, is therefore, a matter of cooling efficiency as well as one of eliminating bacteria and enzymes from the intestines. Small fishes are iced without being eviscerated as this is impractical and uneconomic due to the great number in the catch.

FISH PRESERVATION AND FISH PRODUCTS

Fresh fish are preserved for short periods of time by being packed in ice, but this is only a temporary means and the quality of such products will be lowered after a few days. The chief means of preserving fish for longer periods of time are freezing, canning, salting, smoking and drying. Sometimes two or more of the above methods are combined. Freezing is in many respects an inhibition process, with the microorganisms causing spoilages although usually lowered in numbers, are far from being eliminated. When the product is returned to higher temperatures, very definite deteriorative changes will occur, and some may even take place at storage temperatures lower than the freezing point of water. Enzyme (inherent of fish tissue) changes are slower in freezing temperature, but apparent after a number of months even at 10° F storage.

Drying is used to preserve fish because it is possible to lower the moisture content sufficiently so that microorganisms are inhibited. With the return of favourable moisture conditions, deteriorative changes again progress. Salting is often combined with drying for water removal from the fish tissues. Salting is combined with smoking for the preservation of important fish products. Smoking is accompanied by drying as it is difficult to separate the desired smoke from the heat simultaneously generated in burning wood. The canning of fish is a means of preservation depending on the heat treatment of the product in hermetically sealed containers. It may also be used as a means of preservation of fish products, which have been previously salted or smoked.[17]

i) METHODS OF FREEZING

To prolong storage life raw fish must be processed in such a way as to preserve its natural freshness for as long as possible. In refrigeration practice this is done by freezing. Perishable fish may be kept much longer by freezing provided (a) the product must be frozen to as low a temperature possible, and (b) most of the fluid in the product must be converted into ice specially significant in fish.

Freezing is a process by which the temperature of the raw fish is reduced from the initial Level to between 16° C and 18° C and most of the fluid in it is converted into ice. The storage time and quality of frozen fish depend mainly on the quality of raw fish, the method and speed with which it is frozen and the conditions under which it is stored. Only live and perfectly fresh fish should be taken for freezing. It is essential that they are graded by species and size. In modern freezers, the fish are frozen very quickly and the final temperature inside them reaches -20° C to 30° C or even lower. Quick freezing has been found to result in a minimal change in the initial properties of the fish and to allow maximum reversibility of the process.[18]

SECONDARY PROCESSING

ii) Drying

Micro organisms require plenty of water for their growth and multiplication. Lack of water, or less' of it, can bring to a standstill the activities of the bacteria and moulds that spoil food stuffs and hence drying can be used as means of preservation. Primitive

methods of drying fish merely by hanging them either in sun and wind or over wood fires, have been used by man for thousand years. The process is slow and may take up to several weeks to complete, depending on the size and thickness of the piece of fish and on the climate.

Drying is involved in various ways in processes used by the fish trade. In many processes drying is an essential part of the operation. The evaporation of moisture from the product is a complementary part of the smoking process and is in the production of dried salted fish and fish meal. The term drying usually implies the removal of water vapour by evaporation, but water can also be removed from by pressure or by salt.

The rate of drying depends on:

a) the surface area of the fish
b) the velocity of the air
c) the thickness of the flesh
d) the fat content
e) the temperature of the air and fish
f) the relative humidity of the air;
g) the initial water content.[19]

iii) Salting

Salting is both *a* method of preserving fish and a preliminary operation to smoking, drying and marinading. Broadly speaking, salting is a combination of operation aimed at preserving fish in common salt, beginning with the preliminary work of washing and gutting and ending with packing the salted fish in containers.

The main features of salting are removal of some water from fish flesh and its partial replacement by salt. The passage of water from fish into the salt is an example of osmosis, the skin and cell membranes act as semi permeable membranes, which permit outgo of the water and the entrance of some salt. When sufficient salt has penetrated in the fish, the inner flesh of the fish loses much of its translucent appearance, and is called "struck through". The preservation effect of salt is due to removal of moisture from the flesh. Salt itself reduces or prevents the activity of the bacteria if more than 6% is present. Salt uptake and water loss are influenced by the fattiness of the fish, the thickness of flesh, temperature, chemical purity of the curing salt and other factors.

COMMERCIAL METHODS OF SALTING FISH

Drying salting

The round beheaded, eviscerated or split fish are washed and then packed in water tight containers with an excess of dry salt. The proportion of salt to fish varies from 10% to 35% of the weight of fish depending upon the kind of fish, the weather and the- local custom. The fish is usually rubbed in salt just before packing and each layer is sprinkled with salt.

Brine salting

Brine salting is of little importance commercially as compared with dry-salting. The cleaned fish are placed in large vats, partially filled with concentrated salt solution. A small amount-of salt is put on top of the fish floating in brine. The fish are sometimes stirred to prevent the brine from becoming too dilute at any one point.[20]

iv) Canning

Processing perishable food which has been hermetically sealed in a container, as practised in canning, is one of the best ways to preserve fish. During canning heat processing alters the nature of the material and new products are formed, whose nature - may be change further by various treatments of the fish before Canning or by addition of substances, such as, sauces to the can. The main object of fish canning is to yield a product that may be stored in any climate for a considerable time, at the end of which it will still be interesting and safe to eat. Both enzymes and bacteria can be permanently inactivated by heat and the heat-processed fish should be kept indefinitely.[21]

Sequence of operation for canning fish

Raw fish→Dressing→Portioned out to pack size→Washing→
Packing into cans→Adding of spices and salt→Exhausting→Seaming→Sterilizing

v) Smoking

A finely smoked fish is yellow amber to light brown in colour having a smoke aroma. The fish are washed in fresh water to remove slime. The head and entrails are removed and cleaned in freshwater to remove blood. The flesh is dressed into fillets, each fillet is

again cut into 3 to 4 flat pieces. The piece of flesh are soaked in 15 percent salt solution for 7 minutes in order to give the smoked fish its tastes, appearance, texture and affects its shelf life. The fish are arranged in the smoking trays (made of wire netting) for drying in sun or in artificial dryer for one hour, in order to evaporate surface moisture. The fish are transferred to a smoke-house, where saw dust, coconut husks are used for production of smoke. During smoking the temperature in the smoke house should be maintained between 50°-70° C and smoking to continue for 2 hours. After smoking, the product should be cooled before it is packed otherwise it will turn flabby and sour. Smoked fish is packed in plastic bag.[22]

Fish sauces

Nam-pla is used as staple table condiment in Thailand, prepared put of Stolephorus sp. Rastrelliger sp. and anchovies. It is clear liquid ranging from yellow amber to dark brown in colour. Nam pla has a salty with characteristic cheesy flavour and odour.

Shrimp or fish paste

A fine paste, known as 'Kapi', of pale purple to dark brown in colour with a salty taste and characteristic flavour is prepared out of planktonic and semi-planktonic crustaceans (Acetes sp., Myses and small shrimps and prawns) and fish (Stole -phorus sp., Rastrelliger sp.) are prepared in Thailand)

Boiled Fish

Boiling of fish is a method of short term preservation under tropical condition and practised on a commercial scale in the Indo-Pacific region, Boiling of fish result in loss of moisture, water-soluble vitamins, minerals and other substances and oil. The product is generally stored in room temperatures. Under these conditions the keeping quality as compared with that of a fresh fish in a tropical climate can be extended to as much as 3 days for boiled fish and 5-7 days for twice boiled fish. Storage at 0^{0C} extend the keeping time to 3 weeks.[23]

2. BROKERS (DIFFERENT CHANNELS)

A large number of intermediaries are involved in the process of fish marketing. They render their services in transferring the catch from the landing centre to the ultimate

consumers. In the process, the intermediaries incurr some expenses for grading, packing, processing and finally making available the fish among the consumers. They appropriate a share in the consumer's price for their services as marketing margins. The following intermediaries are indentified in the West Bengal fish markets who render their services in the process of marketing of fishes.

AUCTIONERS

Auctioners play a major role in marketing of fish in Kolkata and other districts. They perform auctioning on behalf of the fishermen. Often they provide loan to the fishermen to ensure a volume of the catch. People involved in auctioning are generally in groups of three to five, belonging to local fishermen communities. They collect 2-3 per cent from the catch value of each auction bid which differs with the species.

COMMISSION AGENTS (PURCHASE)

Commission agents purchase on behalf of the wholesalers and they play a crucial role in primary markets. They buy either through auctioners or directly from the fishermen. They receive commission on the purchase price from the wholesalers/ traders. They also work as money lenders being refinanced by wholesalers.

WHOLESALERS

Wholesalers almost do all the services towards protecting the fish from decay and despatching the same to the urban consuming centres by taking proper care. They also assume the risk associated with fish marketing in the urban consuming centers. They procure fish either directly from the fishermen in through the commission agents (Purchase). Also, they often provide financial assistance to the fishermen either directly or through the commission agents. Financing the fishermen is considered as a necessary condition in order to ensure an adequate volume of trade.[24]

TRADERS

They do the same functions as wholesalers. But their volume of business is less than that of the wholesalers. They mostly despatch the procured fish to the wholesalers/traders which are within the state. They procure fish either directly from the fishermen or through commission agents (purchase) .They also provide loan to the fishermen both for production and consumption purposes.

COMMISSION AGENTS (SALES)

In the terminal markets, commission agents receive the fish and sell it either to the wholesalers for export or to the retailers in the urban consuming centers within the state. The commission varies from 6 to 8 per cent depending upon the species as well as between destination points.

RETAILERS

Retailers form the final link between fishermen and the consumers. They purchase fish either directly from the fishermen or from auctioner/ wholesalers/ traders / commission agents (sales). Being perishable in nature, the volumes of purchases made by retailers are relatively lower.

VENDERS

The operation of the venders/cycle traders is similar to that of retailers excepting that they are engaged in door to door selling and deliver fresh fish. They obtain their supplies either from wholesalers/ traders/ commission agents (sales) or directly from the fishermen at the landing centres. They do not have permanent shop like retailers.

Marketing channels (or trade channel or chanel of distribution) means a set of interrelated intermediaries who direct products to consumers. These intermediaries co-operate each other and work together for mutual advantage although their relationship is symbolic and they perform dissimilar work. If there is a set of intermediaries naturally a set of marketing channels would be evolved. In Kolkata and Adjoining areas a long chain of middlemen have created a number of market channels or distribution paths for the movement of fish from fishermen to consumers. A number of marketing channels have been identified for each landing center selected for the study in different maritime districts of West Bengal.[25]

3. CONTRIBUTION OF WOMEN IN FISHERIES SECTOR AND THEIR LABOUR

Fisher women not only do their household duties, they also work hard in the development of fisheries sector. Their role is insignificant in capture fisheries but their help in active fishing has increased with the advent of mechanisation and enhancement of multi day fishing in marine and Inland fisheries. Their active participation as labour in fishery

sector has done its all round development of aquaculture and increased in the exports of marine products. Their old occupational activity has also been changed with the shift from net mending to fish marketing and processing. In order to save the family from irregular earning pattern of their men, they have been forced to earn from a variety of fishery related works.

The geographic distribution of fresh and brackish water areas suitable for aquaculture. The fisherwomen are engaged in different segments and earning. The fresh water resources of rivers, canals, reservoirs, ponds, tanks, beels, oxbow lakes and Swamps also offer immense scope for fisheries development and enormous employment opportunities to women. The seasonal nature of employment in the fisheries sector displays a distorted picture about the per capita earnings of fisher folk and this is quite correlative with their poverty status. The problem is more acute for the women stake holders mainly due to the prevalence of wage disparities favouring men. It is widely accepted fact that poverty has a gender bias. [26] Women contribute in all spheres of development both at micro and macro level, it is not appropriately quantified or recognized.

In marine fisheries women are involved in seaweed collection, collection of bivalves and seeds with seasonal and regional peculiarities. Full time involvement of women in the primary sector of captures fisheries is negligible; rather it is more of a seasonal nature in certain activities in marine, brackish and fresh water segments. Women are also actively involved in the collection of bivalves and their marketing to ornament dealers and lime collectors. In capture fisheries brackish water sector also, the involvement of women is observed to be passive except their engagement in the collection of fish and shrimps. It is more or less remains as an involvement for basic subsistence. Fresh water fisheries provides larger opportunities to women as they engage mainly in fishing, using scoop nets, traps and fish vessels in addition to the hand picking methods almost throughout the year. A large majority of women are involved in the fisheries related activity. It is clear that the fresh fish marketing and traditional fish.

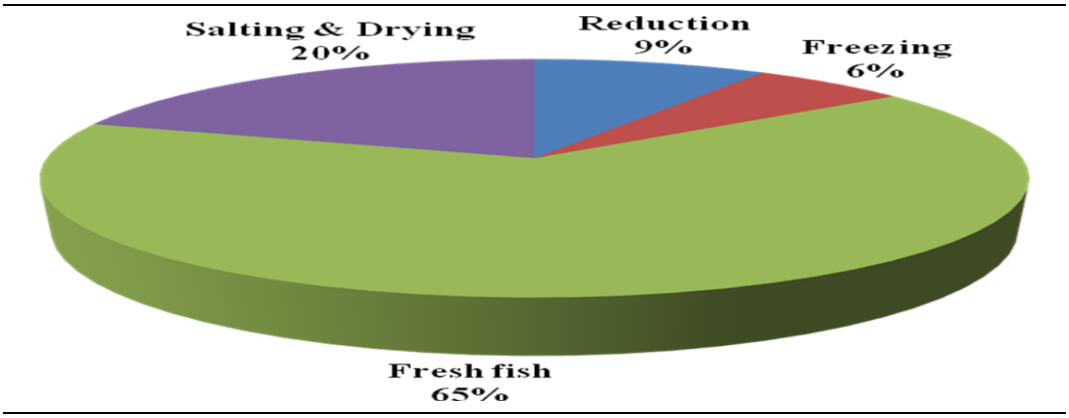

Fig.1: Fish utilization trend in India

Culture fisheries are a widely growing area providing huge labour days to the fisher folk. In the two major types of aquaculture systems such as pump-fed and tide-fed, women have enough places to perform their roles. Women are increasingly independent and devoid men's involvement in the collection of wild seeds, segregation and stocking, construction and maintenance of ponds feeding and harvesting.[27] The expansion of diversified aquaculture practices utilizing more of the potential water bodies, women can be largely absorbed into the sector. In West Bengal women get employment in shrimp farms for 4 to 6 months in a year for activities like pond construction, seed collection and segregation, de-weeding of pond and hand picking of shrimp during harvest. Some of the small scale coastal aquaculture technologies tested and proved as economically viable and could be adopted in a commercial scale are backyard hatchery technology for seed production. And other activities like scientific shrimp culture practices, mud crab culture and fattening technology, seed production technology of pearl spot, different finfish culture practices, polyculture of sea bass lates calcarifer and tilapia, mussel culture technology, pearl culture technology, Edible oyster culture technology, ornamental fish culture practices and carp culture practices. [28]

Table 5.5: Activities of women in fisheries

Activities of women in fisheries	• Clam collection • Prawn seed collection • Sorting • Marketing
	Fresh fish marketing
	Dressing of fish • surimi units
	Aquaculture • Fish farms • Shrimp firms • Shrimp hatcheries
	Processing plants • Peelers • Graders • Packers
	Labour at landing centres • Loading • Ice to boat • Unloading fish from boat • Loading fish to tempos • Sorting of fish
	Traditional fish processing • Salting and drying of fish
	By products units • Fish meal • Oil • Liver oil units • Manure

Source: Data compiled by self.

Post harvest fisheries sector could supply maximum employment to women. The involvement of women in different post harvest activities with a broad indicative. Picture of nature, employment pattern and wage structure. Information from the villages reveal that, the common occupation in which women engaged are beach work, small scale fish trading, fish curing, drying, net making, peeling and processing plant work . Women are involved in different activities. 28% women are engaged in small scale fish trading. Fish curers, dryers, net makers, constitute 21% of the total women work force. The 2nd largest category of occupation is that of peeling work 19% followed by processing plant work 17%.

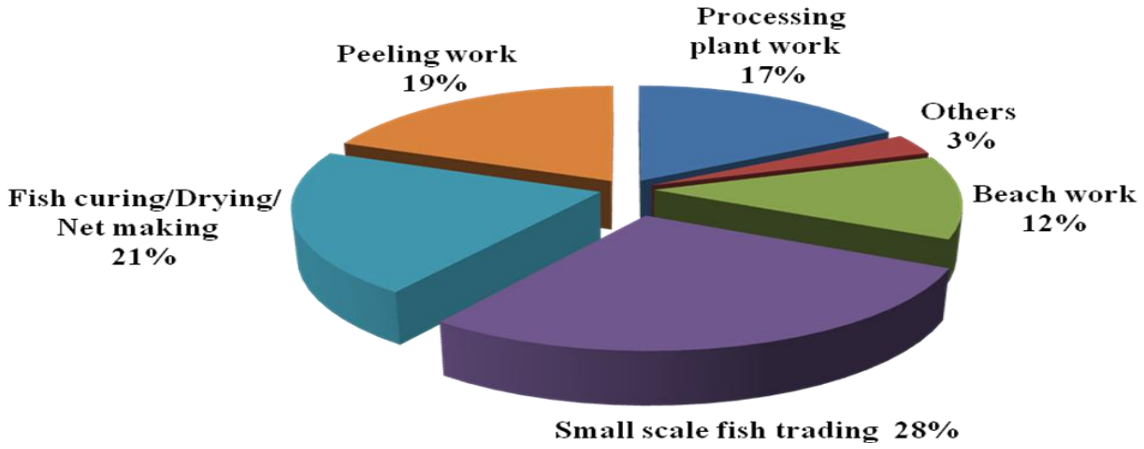

Fig. 2: Occupational pattern of fisherwomen (Average)

Peeling work as well as processing plant work are mostly institution-based and more likely to be in the formal sector of employment. Such types of jobs are comparatively more restrictive than other engagements. It could be assumed that the increase in the production figures of fisheries sector would have its immediate accelerator effect upon the informal employment sector such as beach work, fish trading, fish curing, drying, net making.[29] West Bengal is yet makes its fisheries more potential institution based fish processing for women.

Table 5.6: Nature and pattern of post harvest engagement of Women in Fisheries

Si No	Occupation	Place/type/ nature	Employment and wages
1.	Sorting and Grading	1. All major mechanised centers 2. Throughout the year but intense work during peak seasons 3. Flexible working hours	1.Mostly contact employment 2. Monthly earnings ranges from Rs 300/- to Rs 3500/-
2.	Curing and Drying	1.All fish landing centers 2. Highly seasonal 3. Market surplus is mostly used for curing and drying	1. Self employed/contract 2. Monthly income varies from nil to Rs 1500/-
3.	Peeling work	1.Major trawl/export centers 2.Throughout the year 3.Working hours flexible as per seasonality	1.Mostly contract labours/daily workers 2.Monthly earnings varies from Rs 300/- to Rs 2000/-
4.	Processing plant work	1.Export companies 2.Freezing / grading and packing / quality assurance 3.Fixed work hours throughout the season	1.Regular employment 2.Monthly salary ranges from Rs. 1500/- to Rs 3000/-
5.	Fish meal work	1.All major centers 2.Throughout the year but intense during peak seasons 3.Utilization of fish waste and surplus	1.Self employment /contract labourers 2.Monthly wages ranges from Rs. 500/- to Rs. 3000/-
6.	Fish trading	1.All landing centers /marketing centers 2.Throughout the year 3.Perform all roles from that of auctioneers to retail vendors.	1. Self employment 2. Average income monthly ranges from Rs. 500/- to Rs. 3000/-

Si No	Occupation	Place/type/ nature	Employment and wages
		4.Long working hours	
7.	Value addition	1. All major centers 2.Fish , varieties used will depend on availability 3.Catering both domestic and international demand	1.Mostly a competitive venture 2.Good opportunity for self help groups 3.Monthly earnings ranges from Rs. 750/- to Rs 2000/-

Source: Cited in Vijaya khader, *Empowerment of fisher women.*

The fishing community earns their livelihood from fishery resources; women are also play an important role in this respect. They do different post harvest activities and earn from it. Fish vending offers the best opportunity to earn higher annual income. Shrimp peeling is a seasonal activity depending on prawn fishery season, the peak period being June- September. Shrimp peeling is mostly carried out either in peeling sheds, houses rented/ owned by agents or in homesteads of workers. Usually in a peeling shed; women are employed depending on the quantity of prawns they peel in a day. On an average, a woman gets Rs. 50 to 60 per day during the peak season. The average annual income of a prawn peeler is Rs. 9720, which varies from Rs. 500 for occasional part time worker to Rs. 20000 for a full-time worker.

Table 5.7: Average working hours & earnings of women in different sectors

S. No.	Activity	Average annual working hours	Average Income per hour (Rs.)	Average annual Income (Rs.)
1.	Peeling	1620 (4)	6.00 (4)	9720 (5)
2.	Curing	19944 (3)	12.00 (3)	23328 (3)
3.	drying	729 (6)	4.40 (5)	32076 (2)
4.	Sorting	1960 (2)	4.20 (6)	8232 (6)
5.	Vending	3600 (1)	16.60 (2)	59760 (1)
6.	Value addition	900 (5)	20.00 (1)	18000 (4)

Note. Fig. in parenthesis are the ranks based on the relative position of activity.

The income of a prawn peeler is varies for occasional part time worker and for a full time worker. When the catch is landed, most of the women are engaged for the post

harvest operations including curing and drying. The average number of hours spent by a woman labourer in a year in curing work is 1944 and for sorting, the hours spent in a year is 1960. Sorting is done for separating different varieties of fishes into separate lots. There are three grades of sorting based on the uniformity in size and a quality identified in first, Second and third grades. The procured fishes are sorted out an trash fishes are taken to fish meal plants. The exportable varieties are graded, cleaned, packed in ice and sent to processing centers. It is found that the average income obtained per hour from sorting is Rs. 4.20. It is also observed that the women sorters sell some edible prawns and small fishes discarded from the lot. This earning either becomes an additional source of income or if not sold, the fish is used for household consumption. On an average, 729 hours a year is spent for drying activities. In fish drying, some of the women labourers working on contract basis earn Rs. 100 for each lot. They require about 3 days of time for drying each lot. The time spent of fish drying ranged from 8 to 12 hours a day. In general, fish worth Rs. 6000-7000 is bought for house-based drying. [30]

The women fish vendors operate as an important link between producers and final consumers. They purchase fish either from the fishermen at landing centres through auctioneer from traders through bargaining. Fish vendors mostly undertake the distribution of fishes at the retail market. Female vendors carry baskets of fish as head loads where as male vendors use cycles to carry fish for marketing. These fisher women borrow rupees 500 to 2000 daily from middlemen to buy fish. After selling fish they return the money to the lenders with interest. They buy ice; no wastage of fish is recorded as the fisher women take the fish remaining either for house hold consumption or for drying. The average income per day for their labour comes about Rs. 200 to 300. Per day and this works out to an average annual income of Rs. 59760.[31] Age wise distribution of women engaged in different post harvest activities. Majority of the women involved in activities like peeling, curing and value addition work belong to 20-40 years age group and those in activities like sorting, drying, marketing, majority are between 40-60 age group. In the case of drying and sorting, 5% of fisher women are above 60 years in age. Activities like drying and sorting entail comparatively less physical strain and this might be the reason for the involvement of age –old women in it. Maximum number (80%) of women are engaged in value addition works, this being skill oriented and only youngsters

and middle aged women opt for this work. Young and unmarried girls are usually not allowed to go for vending purpose, and the few in this activity take up the job due to poverty and unemployment. Accordingly, 70 percent of fish vendors belonged to 40-60 years age group and only 30 percent belonged to 20-40 years age group.[32]

Table 5.8: Age wise distribution of women by activity (%)

Age group (years)	ACTIVITY					
	Peeling	Curing	Drying	Sorting	Value	Fish vendors
<20	8	-	-	-	5	-
20-40	57	75	40	25	80	30
40-60	30	25	55	70	10	70
>60	5	-	5	5	5	-
Total	100	100	100	100	100	100

Constraints in the Development of fisherwomen

i) Lack of access to leadership positions and voice in decision making.

ii) Limited access to resources.

iii) High disparity in ownership of productive assets and wage structure.

iv) Inadequate training and formal education.

v) Exploitation by middlemen and contractors.

vi) Lack of interest in occupations other than fisheries.

vii) Intensive labour and long working hours.

viii) Lack of credit facilities.

ix) Socio economic frame work with traditional customs and conventions.

x) Lack of knowledge in latest technologies of aquaculture and post harvest management.

xi) In adequate health care for occupational hazards.

Table 5.9: Constraints of Women in post harvests fisheries

Constraints of Women in post harvests fisheries	
General	• Low income • Lack of transportation facilities • Long distances • Inadequate facilities for women at markets & landing centre • Declining fish catches • Have to support facilities • No alternate income source

	• Use of inappropriate tools & accessories • High interest rates
Raw material	• Seasonal availability • Uncertainities of catch / scarce supply of fish • High perishability • Intense competition • Long waiting • Non availability of ice • Losses due to spoilage • Poor quality • Lack of cold storage facilities at market
Health & nutrition	• Lack of knowledge on food & health • Poor general hygiene • Inadequate food consumption • Nutritional deficiency-low intake of macro & micro nutrients • Lack of awareness of child care
Traditional processing	• Labour intensive • Non availability of good quality salt • Lack of knowledge on hygiene • Scarcity of potable water • Lack of space for drying • Adverse climate • Inadequate drying • Losses in drying on roadside • Losses during storage by insects infestation, browning • Drying at floor level • Lack of facilities in drying yards • Informal trading-large number of intermediaries • Lack of storage facilities • Low profit margins • Risks & uncertainties • Inappropriate use of insecticides • Low quality product

Needs

- Increase income
- Reduces losses
- Provide appropriate tools & accessories
- Education & training
- Increase savings
- Generate alternate income sources

Advantages to be in post harvest

- Flexibility in working hours
- Immediate returns skilled & expertise
- Strong demand for fresh & dry/ salted fish
- Low investment
- Low working cost
- Support from the family

Fisher women's role in household system and Empowerment of rural women through fish culture

Women play a key role in the development of the household, society and hence the country. Mostly her contributions were not quantified and also not recognized. The role of women in the economy and their contribution there on has been receiving attention in a much lesser pace than what they deserve. Presently women continue to excel men in many fields. For the educated employed women there have been some reliefs by virtue of their position in society, but who cares much about the women who are illiterates, living in rural and coastal areas and strive hard to earn their bread? The answer will be silent no. Among the different sectors of the economy where women contribute significantly fishery sector is an important one. Fisherwomen involve themselves in different fishery and fishery related business. About 25 % of the labour force in pre-harvest activities of fish, 60% in export marketing of this sector. A few studies have brought out their differential wage rates they experience in these activities. However, the fisherwomen were not given their due because of some handicaps they experience like poverty, illiteracy, insecure nature in the society and related aspects. In some of the place of marine fishing villages, fisher women have to spend a major part of their time in fetching drinking water from roadside public hydrants. They take decision on the expenditure on food and also decide on the household activities. In spite of taking such responsibilities on both domestic and income earning activities for the improvement of the home, they are not recognized properly. In such a circumstances there is a need for a regular assessment of the socio-economic status of the fishers in general and that of the fisherwomen in particular to advocate to the policy makers to formulate suitable plans for their welfare and development. This in turn will result in the ultimate development of the

society only. The socio-economic status & their nutritional status all depend upon the capacity of the individual to work. Their earning activities strengthen their ability to improve family, health, nutrition and sanitation. The socio-economic status of the fisherwomen household was assessed by their literacy level housing pattern, electricity facilities, Occupation pattern, income level, Income and expenditure and level of indebtedness.[33] Globally the east Kolkata wetlands constitute the largest area managed for peri urban aquaculture, fishponds currently occupy 3,500 ha, with most managed for waste water aquaculture. In some peri urban villages fisherwomen were engaged in other works to maintain their family.

In Chowbaga, women working as vegetable vendors, in Sardarpara, a tribal village women and girls from farming families participated, and in Udayrampur, where ornamental fish breeding is practised widely. The Department of fisheries, Government of West Bengal has initiated some gender focused initiatives. These include establishing fish farming co-operatives controlled by women, assisting female community members develop ornamental fish culture by helping them access loans through the FFDA, and with financial and technical assistance from TIFAC Government of India, providing women with training in fish processing for income generation. [34]

Project on ornamental Fish Culture through Fisherwomen's Co-operative Societies

Benfish took up the project on ornamental fish culture through fisherwomen's co-operative societies in the districts of Howrah and South 24 Parganas in the year 2002-03 with the assistance from the fisheries Department and NCDC. West Bengal has the enormous potential for indigenous fresh water and marine colour fishes, popularly known as "ornamental fish'' for developing aquarium fish industry business. The project has the potential of not only generating employment opportunities for the rural as well as the urban people in large number with proper guidance and scientific training but also fetching a good amount of foreign exchange through export because of high demand of such fishes in the global market. Subsequently Uttar Dinajpur district was included under the project. Benfish has plans covered seven more districts in the phase –II of the project. 83 women's co-operative societies with 1650 members have already been formed. A hatchery for production of seeds of ornamental fish has been recently established at

Haridevpur near Diamond Harbour in the district of South 24-parganas by Benfish with the financial assistance from the fisheries Department and NCDC. [35]

Fisher women play a significant role in general livelihood of fishermen family. They not only maintain all day –to-day family and domestic activities but also contribute significantly towards the most of fisheries and aquaculture activities. The importance of fisheries sector is well known as a provider of livelihood to several million fishers, prime mover of coastal economy and a major foreign exchange earner. It is essential to develop their capacity by improving their knowledge, skills and attitudes. Training helps to improve knowledge, skills and attitudes of the people in a society. Knowledge brings desirable changes in human behaviour. As most of the fisherwomen are illiterate they require need based aquaculture training to enhance their efficiencies, effectiveness and excellence- the triple 'E' concept towards the sustainable fisheries, the precursor of dreamed "Blue Revolution".[36] It is needed to provide them need based training of the following areas:- (i) Management of beel fisheries viz. pre-stocking, stocking and post-stocking including fish health management, i, e, on common fish diseases and their treatment and control. (ii) Development of beel fisheries for upliftment of socio-economic status of the fisherwomen. (iii) Management of aquarium fish for self employment. (iv) Training on quality fish seed raising so that they can be self employed through it. (v) Making and repairing of craft and gear with the help of cheap and easily available local materials for sustainable catching and harvesting. (vi) Training on preparation of indigenous fish smoking and salting products. (vii) Training on proper conservation of endangered fish species.

Such kind of training model for fisherwomen is suggested

Proposed Training Model

Selection of fisherwomen

↓

Setting well defined realistic training objectives

↓

Grouping of women for training

↓

Choosing of appropriate training strategies

↓

Development of well defined course curriculum

↓

Starting the training programme.
↓
Evaluation of the training programme
↓
Follow-up-action

Involvement of women in fishery sector

For instances – Fisher women were involved directly or indirectly in fish and aquaculture activities at Bhomra Fisherman's Co-operative Society Ltd., Kastadanga Nadia and Kanchrapara Fishermen's Co-operative Society Ltd, Dhankal, North 24 Parganas. As the socio-economic condition of fisher women play a vital role in the overall economic status of fishermen family as well as general livelihood. The study shows that the annual income, land holding caste, occupation of the fisherwomen.

i) Majority of the fisherwomen belonged to lower income group. The annual income of fisherwomen varied from Rs 3,500, Rs. 4,000

ii) The average land holding ranged from 25-30 kathas and almost all houses were found made up of mud and other local materials barring a few.[37]

iii) Majority of the respondent's i.e. 95 % were belonged to scheduled caste followed by 5 % from other backward classes.

iv) Most of the fisherwomen were engaged in agricultural and other household activities besides aquaculture activities. Their socio-cultural aspects like education and adoption of technology were too poor. It is important to mention that due to lack of information about scientific pisciculture, and did not have exposure about latest communication technologies. Such as television, interactive multimedia and print media, which may help immensely in broadening their outlook towards the sustained fisheries and aquaculture activities.[38] Some socio cultural barriers were faced by the fisherwomen such as – a) Illiteracy b) Non-availability of critical inputs for adoption of improved aquaculture practices c) Resistance from the family members with

respect to free mixing with the male counterpart at community hall/ Cooperative meeting. d) Lack of exposure regarding latest communication technologies. e) Lack of time to spent for watching and listening T.V. and Radio due to heavy domestic work burden of the fisherwomen.

Another thing is important the decision making patterns of fisherwomen. Male members of the family mainly took decision regarding adoption of improved aquaculture practices. But sometimes female counterparts also took decision independently in some aspects like net weaving, pickle making, minnows catching for household consumption. It was also found that the elder female members of the family played an active role in taking decision independently. The study also revealed that the degree of decision making capacity is increased to those fisherwomen who are more independent economically, than the financially dependent female counterparts. Considering these views it is judicious to provide ample opportunity to earn more by taking up different fish and fisheries activities by the fisherwomen. So that they can become financially sound and create innovativeness in decision making for sustainable fishery development. It can be said that without induction of some well planned programme, The fisheries development by empowering the fisherwomen is not possible. [39] For widen up the outlook of the fisherwomen, formation of 'Matsya Mahila Mandal', 'Women Fish Club', may be established which will enhance the knowledge and skills of the clientele for adoption of improved fishery practices and aquaculture environment in the near future.

WOMEN'S WELFARE PROGRAMME

The department has been pursuing the programme for women's welfare for the last 25 years. The Focus for development has been shifted to involve womenfolk from mere net making and other indigenous fishery related activities to the development of ornamental fishery units and various post harvesting schemes like preparation of value added products, fish drying and processing, marketing of fish and food products etc. An innovative scheme has been formulated for vending of fish by wayside. Women retailers in various municipal areas of the State by mobile vans. They are also being trained to get acquainted with various modern fishery related activities under FFDA and NCDC programmes. In the 11th plan an amount of Rs 5,000 crores has been specifically marked

for implementation of schemes only by women. Such schemes will go a long way in the attainment of financial self- sufficiency by women folk in rural and urban areas. For socio-economic upliftment of the poor fisher-families with special attention to the needy fisherwomen for their self-sufficiency, different programme viz. ornamental fish farming, crab culture, dry fish, value added products etc. have been taken up by forming women co-operative societies. [40]

In the districts of Purba Medinipur, 24-parganas (south and north) and Kolkata training has been imparted by the microbiology and parasitology division of this department to 5 groups consisting of 250 fisherwomen on preparation of value added product like pickles, Papad, cheeps etc. and socio-economic development of the poor fisher families with special attention to the needy fisher women for their self sufficiency. Ornamental fish or commonly called aquarium fish has a high export value. Considering this aspect rural women are being trained by forming co-operative societies in the districts of 24 parganas (South), Uttar Dinajpur and Howrah about the breeding practice of ornamental fishes. 10 such societies have been formed during the year 2004-05. There is a proposal to set up women's co-operative Societies in each block of the State for ornamental fish culture. Besides this, the department has engaged such rural women for mass cultivation of algae required as fish food. In the districts of Howrah and 24-parganas (North and south) 7 such groups have been trained in this job consisting of 40 women.[41]

Till the year 1989 to 1990, about 1,40,725 fishermen and 4,620 fisherwomen have been trained in West Bengal. The state plays an important role in fulfilling the demand of fish fingerlings in the country. About 75% of the total demand of the country is met by the state.

Table 5.10: Production of fish Fingerlings in West Bengal (in crores)

Year	Quantity
1980-81	2300
1981-82	3200
1982-83	3150
1983-84	3910
1984-85	4200
1985-86	5000
1986-87	6100
1987-88	7005
1988-89	7250
1989-90	7400
1990-91 (Target)	7500

Source: Collected from Dept. of Fisheries, GOWB.

Similarly, 124 fishermen engaged in marine fisheries were trained in 1980-81 and at the end of 1989-90 a total number of 2074 fishermen (marine) were trained. The state has introduced a programme on social fisheries with an area of 199.30 ha. in the year 1987-88. The area under social fishery programme has increased to 1890 ha. in 1989-90.

Table 5.11: Training programme of fish farmers over different year in West Bengal

Year	Training given to					
	Inland				Marine	
	Fishermen		Fisherwomen		No of fishermen	Cumulative total
	No	Cumulative total	No	Cumulative total		
1980-81	1190	1190	200	200	124	124
1981-82	1278	2468	200	400	111	235
1982-83	4728	7196	200	600	120	355
1983-84	7896	15092	200	800	160	515
1984-85	22180	37272	200	1000	180	695
1985-86	23085	60357	200	1200	259	954
1986-87	22033	82390	400	1600	280	1234
1987-88	21212	103602	1000	2600	280	1514
1988-89	20957	124559	1000	3600	280	1794
1989-90	16166	14725	1020	4620	280	2074

Source: Collected from Dept. of fisheries, Govt. west Bengal

Besides, fisheries in the sewage-fed water have brought a new dimension in this field. About 4000 ha. area in the outskirt of kolkata is being used for sewage–fed fisheries. Brackish water fisheries, in the state, have got a great scope. The govt. of West Bengal (GOWB) has taken several measures to increase the production under brackish water fisheries and also to improve the socio-economic condition of the fishermen engaged in this type of fisheries in collaboration with UNDP, MPEDA and BFDA. Pisciculture in the hilly watershed has also got due attention since 1986. About 450 watersheds in the hilly areas of the state have been brought under fisheries development programme in the year 1989-90. GOWB has formulated project for pisciculture in the Kangsabati reservoir. The GOWB is also planning for spawning in different rivers of the state to increase fish production.

TRAINING AND EDUCATION

Training, extension and research are important components of fisheries sector. 2,05,846 fishermen/ fish farmers and 5540 fisherwomen have been trained at Block and district level till date under FFDA and BFDA Schemes. A State level training centre at Kalyani and West Bengal University of Animal and Fishery Sciences has been set up for training and education in pisciculture.

Table 5.12: details of training imparted to the fishers

A. Upto 2005-2006

Men	222116	Gen	153390
Women	12906	Sc	74569
Total	235022	St	7063

B. during the year 2006-07

Si. No.	Name of the training course	No. of fish farmers trained				
1. Grass-root level training for FFDA farmers		682	Men ——— Women	638 ——— 44	Gen Sc St	337 331 14
2.	Ornamental training programme for fisherwomen under RSVY	500				
3.	Ornamental training programme for	300				

	fisher women under NCDC					
4.	6 months ornamental training course in collaboration with NSU(paying fees)	65				
5.	Training course on cold water fisheries	60				
6.	Training for hygienic Dry fish production	60				
7.Macro brachium rosenbergi Hatchery operation training(paying fees)		33				
8.Fisheries training and under central sponsored scheme for fish farmers		660	Men ——— Women	596 —— 64	Gen Sc St	323 321 16
Total		2360				

Source: Fish farmer's development agency (FFDA).

Each-district has one training centre for fishers and entrepreneurs located at Meen Bhavan. Training to the fish farmers and entrepreneurs is also provided at regular intervals at Pailan Research centre at Pailan in the district of South 24-parganas, Marine training centre at Namkhana in South 24-Parganas, Digha fishery training centre in Purba Medinipur and fishery Training centre at Kalimpong, Darjeeling. This a part, short term courses on fish and fisheries for the farmers are also arranged in collaboration with Netaji Subhas Open University.[42]

4. CHILD LABOUR IN FISHERY AND AQUACULTURE

Children are the greatest gift to humanity and childhood is an important and impressionable stage of human development as it holds the potential to the future development of any society. Children who are brought up in an environment, which is conducive to their intellectual, physical and social health, grow up to be responsible and productive members of society. Every nation links its future with the present status of its children. By performing work when they are too young for the task, children unduly reduce their present welfare or their future income earning capabilities, either by shrinking their future external choice sets or by reducing their own future individual productive capabilities. Under extreme economic distress children are forced to forego educational opportunities and take up jobs which are mostly exploitative as they are usually underpaid and engaged in hazardous conditions. Parents decide to send their child for engaging in a job as a desperate measure due to poor economic conditions. It is

therefore, no wonder that the poor households predominantly send their children to work in early ages of their life. One of the disconcerting aspects of child labour is that children are sent to work at the expense of education. There is a strong effect of child labour on school attendance rates and the length of a Childs work day is negatively associated with his or her capacity to attend school. Child labour restricts the right of children to access and benefit from education and denies the fundamental opportunity to attend school. Child labour, thus prejudices children's education and adversely affects their health and safety.[43]

Table 5.13: the school enrolment as %

School Enrolment as % of the age group population			
Level	Age group	West Bengal(1981)	All India(1981)
Primary School	5-9	86.5	79.4
Secondary School	10-14	26.6	32.3
Higher Education	15-24	5.2	5.5

Source: Data compiled by self.

Child labour is work that is damaging to a child's physical, social, mental, psychological and spiritual development because it is work performed at too early an age. It deprives children of their childhood, their dignity and rights. Children who do not complete their primary education are likely to remain illiterate and never acquire the skills needed to get a decent employment and contribute to the development of a modern economy and agriculture. When children are forced to work long hours in the fields, their ability to attend school or skills training is limited, preventing them from gaining education that could help lift them out of poverty in the future.

The problem of child labour continues to pose a challenge before the world and it is much more intensified in poor and developing nations. More than 150 million children (5-14 years) are engaged in child labour all over the world (UNICEF 2009). International institutions (MLIs) & Governments in almost all countries have taken pro-active measures to tackle this problem. The Convention on the Rights of the Child was adopted and opened for signature, ratification and accession by UN General Assembly resolution 44/25 of 20 November 1989. It came into force 2 September 1990, in accordance with article 49. It has been ratified by 193 countries. Optional Protocol of this convention entered into force, 12 February 2002. The States Parties to the present protocol,

acknowledged ILO convention 182. Article 32 of this convention has particularly highlighted the issue of child labour and the need for their protection.

Governments are trying to enforce strict legislative provisions along with simultaneous rehabilitative measures with varied degree of successes. Despite all existing efforts, child labour remains a sad reality in our countries and considering the magnitude and extent of the problem it has been strongly felt that, a holistic understanding of the problem is imperative towards addressing the same. Child labour in fishery and aquaculture is essentially a socio-economic problem inextricably linked to poverty and illiteracy; it requires concerted efforts from all sections of the society to address the problem. According to available statistics (FAO, ILO, UNICEF) worldwide, agriculture which also partly includes subsistence fishing) absorbs the largest share of working children. As per recent FAO data nearly 70 percent of the world's child labourers are agricultural workers, many of them work in hazardous occupations. Over 132 million girls and boys aged between 5 and 14 years, work in crop and livestock production, as well as forestry and fisheries.

Table 5.14: Data on child labour based on Employment unemployment survey during NSS 66th Round (2009-10)

State	Age group 5-14			
West Bengal	Rural		Urban	
	Male	Female	Male	Female
	357265	134657	31946	27716

Apart from agriculture, fishery and aquaculture alone engage big numbers of child labours. However, it is difficult to get sector-wise disaggregated data in this regard as often children engaged in fisheries and aquaculture belong to small scale fisheries and the figures are combined with agriculture related data. Apart from small scale and artisanal fisheries, children are also working in large scale fisheries and in particular fish processing industries. A significant challenge is to make these children visible in statistics as often official records do not provide any information on child labour in organised and unorganised fishery sector.[44]

Fishery including aquaculture is an important source of livelihood for millions of people across the globe. In 1998, an estimated 36 million people were engaged in capture fishing and aquaculture production worldwide, comprising 15 million full-time, 13 million part-time and 8 million occasional workers. In 2000, an estimated 27 million persons were working solely in capture fishing worldwide (including full-time, part-time and occasional fishers). Asia accounts for 83 percent of fishermen in the world. In Asia, China and India are two big actors in fishery but many other South Asian and South East Asian countries have also significantly contributed in fishery and aquaculture. In India more than 14 million fishermen and fish farmers, living mainly in 3937 coastal villages and in hundreds of hamlets along major river basins and reservoirs, depend on fisheries and aquaculture for their livelihood. As per FAO data of 2003 0.93 million fishers were full time fishermen, 1.07 million were part-time fishermen and 3.96 million were occasional/Ancillary fishermen including fish workers in processing units. According to a study conducted by the National Labour Institute, Government of India (GOI), around 40 percent of fisher populations are children. Fishery and aquaculture sector is becoming increasingly important in India's economy in terms of foreign exchange earnings through exports and according to NFSO (2003) data it contributed 1.07 percent of the total GDP, which has increased considerably in the recent years.

The nature incidence and causes of child labour in fishery sector in India & West Bengal.

As mentioned before 40 percent of fisher population constitute of minors. Experiences reveal that many children belonging to fishers' families work in fishery sector as child labour. Before trying to analyse the nature incidence and causes of child labour in fishery sector in the country let us have a quick look at the status of child labour as a whole in the country.

According to the Census 2001 there were 12.7 million economically active children in the age group of 5-14 years. The number was 11.3 million during 1991 (Population Census) thus showing an increase in the number of child labourers. Workers in general are classified into main and marginal workers by the population census. Census data shows that there is a decline in the absolute number as well as the percentage

of children (5-14) to total population in that age group classified as main workers from 4.3 percent in 1991 to 2.3 percent in 2001. But it is noteworthy that there was a substantial increase in marginal workers in every category of worker irrespective of sex and residence. As a result, despite the number of main workers declining from 9.08 million in 1991 to 5.78 million in 2001, the total number of children in the work force increased significantly. A large part of the increase was accounted for by the increase in marginal workers, which increased from 2.2 million in 1991 to 6.89 million in 2001 (NCPCR 2007). When Main and Marginal workers are put together, it shows that the Work Participation Rate (WPR) of children in the 5-14 age groups has declined from 5.4 percent during 1991 to 5 percent in 2001, which is a marginal decrease only. The trends between 1991 and 2001 of declining main child workers along with increasing marginal workers indicate the changing nature of work done by children, which is perhaps becoming more seasonal and part-time. This is also to be seen in the context of reducing employment growth in general in the country during the last decade (NCPCR 2007).

Table 5.15: The child labour in India

Distribution of children	2001 Population Census	2006 Population Projection & estimates	Percentage of child population	
			2001	2006
Child population (5-14)				
Male	132367710	125485000		
Female	120795938	116274000		
Total	253163648	241759000		
Child labour (10-14)				
Male	6804336	4276744	8.8	6.7
Female	5862041	3894131	8.5	6.3
Total	12666377	8082954	8.7	6.6
Children out of school(5-14)				
Male	36428634	19199205	27.5	15.3
Female	45878836	24184992	38.0	20.8
Total	87126075	43274861	34.4	17.9

Sources: Census of India 1991 and 2001 and NCPCR 2007

The magnitude of the problem is manifested in the total number of children who are out of school. Despite declining trend in the incidence of child labour in the country, many

children failed to access education. There were 87 million children (5-14) who were out of school during 2001. NSSO (61st Round) estimates show that the magnitude of out of school children has declined to 43 million by 2004-05. However, the NSSO estimates illustrate clear gender discrimination as about one fifth of the girl children in the 5 to 14 age group are not in school. The main activities in fishery sector apart from active fishing are sorting and grading, curing and drying, peeling work, processing work fish meal work, fish trading and value addition. The children working in the fishery sector and engaged in some of the above works are mostly from poor and vulnerable households in terms of their economic and social status.

These households are largely dependent on subsistence fishing as small scale fishers or fish workers. The children belonging to these households seldom afford to go to schools and they are forced to work for earning an extra income for the family, however meager that might be. From our experiences we have seen that in fishery and aquaculture the children are working mainly in sorting, peeling and fish trading works. However, children belonging to higher age group 12-14 also work at fish processing centres. The children who are working in factories, processing units, peeling sheds etc. could be termed as child labour as per The Ministry of Labour, GOI as they are associated with 'hazardous' work as defined in The Child Labour (Prohibition and Regulation) Act, 1986 and Rules (Act No. 61 of 1986), Part B 59-60. However a large number of children in fishery, particularly in shrimp aquaculture are involved in collection of shrimp seeds from local water bodies, which they sell to the middlemen in their villages. This particular work is very hazardous and full of risks. But due to narrow definition of child labour it is difficult to include these children in this category. Thus ministry's definition only includes a very small percentage of children who are in the work-force in fishery and aquaculture particularly in the unorganised sector and leaves out millions of children who require support from the government both in terms of developing adequate policy framework and implementation of relevant programmes. In the fishery sector the single largest category of child labour is termed as ‘Working Children’. These children are working as a part of family labour in fishery approximately 12-14 Hours a day. This is the largest category of children among fisher communities

who are out of school and are working full time. Girls dominate this category and work as child labour at the cost of their education.[45]

Perpetual Poverty and socio-economic exploitations are driving factors behind child labour in fishery aquaculture in West Bengal. Widespread and entrenched exploitation, gender discrimination, caste bias and other social problems in W.B. as well as in other states are obstacles for elimination of child labour. These obstacles cannot be overcome in one instance as these are issues intrinsically associated with the fundamental questions of rights and socio-economic equity and justice. Moreover, changing world scenario e.g. world food price crisis, climate change concerns, land grabbing and grabbing of sea and water-bodies have made it very difficult to predict the fate of the poor and underprivileged in the nation and it is also very difficult to foresee how far the efforts for elimination of child labour in the country would be successful in coming years. There is a grave risk that the share of people living in absolute poverty will increase, possibly slowing or even stalling recent moderate gains in struggle against child labour in the country. Such a situation will no doubt be detrimental for the child labour in fishery sector in India too. As mentioned above most of the working children in the fishery sector come from the poorest of poor households and belong to so called low castes, the table below illustrates this claim.

Table 5.16:Caste structure of fisher population in West Bengal and in other selected states.

	West Bengal	Orissa	Karnataka
Scheduled castes	76.7	6.25	100
Other backward castes	3.33	51.56	
General	20	42.19	

Source: Training Programme on enhancing leadership skills for fish workers, V.V. Giri NLI 2006

The inland fishers and fish workers including a significant number of child labourers are economically disadvantaged and traditionally they do not possess much resources or assets of their own. They are deprived of many basic human rights like right to food and adequate housing, right to health etc. Given their economic and social status they find it difficult to have access to education facilities. These poor fishers including

children working in this sector have least access to skill development trainings and institutional credit. Therefore, it becomes difficult for them to break the barriers of perpetual poverty. Due to lack of proper policy frame work and complex bureaucracy, these poor fishers are often denied of their ownership rights and they become victims of chronic evictions.

Majority of marine fish workers and small fishers (part time) are engaged in different sectors of marine fishery but primarily in fishing in the sea. They are extremely vulnerable. According to an estimate of the GOI around one million active fishermen are engaged in marine fishing in India of which 0.2 million are engaged in mechanised sector, 0.17 million in the motorized sector and the rest in the artisanal sector. In the artisanal sector, of the total 0.63 million active fishermen 41% are engaged in the operation of catamarans, 31% in plank built boats, and the rest in dug-out canoes and other crafts. Among those engaged in mechanised sector, 75% work in trawl fisheries. Only 30 percent of the fisher folk possess ownership of fishing implements while the rest work as labour force. The annual income of a labourer working in a mechanised boat was estimated as Rs. 34200, motorized boat Rs. 15,200 and artisanal unit Rs. 8000 during late 90s. their pattern of income itself is a strong indicator of their poverty. The fish workers are ill paid and are mainly paid in kind on share basis. The children working as labourers in this sector receive even much lower wages. The boat owners take 70-75% of the catch while the fish workers get the rest in a fishing trip. Rapid depletion of fish catch due to use of destructive gears and increase in numbers of motorised/ mechanised vessels as well as high level of sea pollution (From industrial wastes and sewage), has worsened the economic situation of the fish workers (V.V.G.NLI 2007). The fishers and fish workers, particularly child labourers are further exploited by middlemen and in absence of any alternative employment, despite worsening economic situation, they remain highly dependent on fish harvesting in the coastal regions. In such extreme conditions, the poor fisher households do not have many alternatives than to send their children to work for mere survival of the family. In some cases the local culture, attitude, bias etc. also influence the prevalence of child labour. However, the single most prominent nature of the child labour in fishery sector is poverty of fishing households followed by their poor access to education, health, housing and other basic amenities.[46] As mentioned above that

in fishery the children are working mainly in sorting, peeling and fish trading works. In aquaculture a large number of children are engaged in collection of shrimp seeds from local water bodies, which they sell to the middlemen at a meagre price. The children belonging to higher age group 12-14 also work at fish processing centres. No official data is available to determine the exact number of children who are collecting shrimp seeds, working in factories, processing units, peeling sheds etc. There is absolutely no effort made by the GOI to capture the numbers of the children working in aquaculture directly or indirectly. They remain invisible. The health standards and safety or hazards etc. of fishing and aquaculture work depends largely on the nature of the work.

i) Children engaged in fish related work brings misfortune.

Collection of shrimp seeds in brackish water is highly hazardous as children work in local water bodies which are highly contaminated due to discharges of polluted effluences from nearby aquaculture farms. Many girls are engaged in this practice. The crude way of collection of seeds (sucking the water with the seed and spitting the same in a container) results into serious health hazards among the children (Halim 2003). The most common complains are irritations in eyes, skin diseases of various natures, stomach problems and in some cases even cancers were reported. Shrimp seeds are also collected in delta areas (estuaries) and seas, children are engaged in this work for 8-12 hours a day during high season and they do not use gumboots or gloves while doing this work. In Sundarban region of West Bengal, many children suffered from severe injuries due to attacks of crocodiles and Kamaths (a species of shark) while collecting seeds in the estuaries. The price of the seed varies as per demand; the highest price could go up to INR One per seed while at the lowest end it can drop to fifty-paisa per seed only. It is needless to mention that the middlemen always keep a good margin for themselves while selling the same seeds to the aquaculture farms, thereby exploiting these poor children intensively. There is no alternative than to ban this practice altogether, in order to ensure the safety of the children who are engaged in seed collection. The government should acknowledge this occupation as 'Hazardous' and should immediately ban this practice. There should be legal provisions for stopping shrimp farms from buying wild caught shrimp seeds and buying seeds from hatcheries should be made compulsory for all farms. Adequate

awareness generation among the poor fisher households is essential to stop this harmful practice.

ii) **Children involve in sorting and peeling in the unorganised sector**

Sorting & Peeling works are done mainly in local sheds, where children (age group 12-16) get engaged. As these sheds operate in small-scale and in unorganised sector, it is often difficult for the government departments to regulate the conditions of work in these sheds. The working environment is very hazardous, with narrow space for work, lack of proper infrastructure, lack of hygienic environment etc. Peeling is done mostly in sitting posture which gives rise to severe discomfort and postural problems. Mostly the sorting and peeling are done with bare hands. The peeling shed owners normally do not provide sufficient and reasonable medical arrangements for treating such conditions as may be created by constant contact of hands, mainly fingers with wet and icy fish. Such cleaning and peeling works cause skin corrosion, particularly on the inner palms and fingers of children working in this sector. The most common ailments are allergies, infections, scabies, eye irritation nausea etc. The poor sanitary conditions, both at the shop floor and the lodgings lead to various health complications like urinary tract infections etc. The payment is based on piece rate system and the average earning varies from INR 30-40 per worker per day.[47]

iii) Girls doing work in fish processing units (Age group 12-16)

In a study done by The Centre for Education and Communication (As cited by V.V. Giri National Labour Institute) it has been claimed that many girls aged between 12 and 16 are engaged as workers in fish processing units in various coastal areas. The fish processing units are a varied lot. Some units are fully integrated while others rely heavily on sub contracting for fish procuring, cleaning, peeling, freezing and packing. The bigger units (big investments) generally have a standardised infrastructure. But the medium and small processing units generally lack standard infrastructure for ensuring safe and healthy working conditions for the work force. The nature of employment is seasonal, though nowadays in many processing units work goes on throughout the year. The working conditions vary from one unit to other. Generally the workers are kept within the boundaries of the processing units and they are provided with dormitory type residential accommodation. The workers have to live in a captive environment throughout the day

and night, which often works to the advantage of the managements as the management then have 24-hour availability of captive labour in the factory. The lodgings are generally poorly built, ill ventilated and have insufficient lighting. The dormitories are overcrowded and in some cases the workers are not even provided with a bedstead, they have given only bed rolls to be used for sleeping on the floor. The sanitation facility and availability of adequate fresh drinking water are poor. The food is also supplied by the managements and is poor in quality and variety. There are various laws to protect the interest of workers in the fish processing units and also to protect the minors. For example Factories Act 1948 states that a child below 14 years of age is not allowed working in any factory.

Children aged between 12 and 16 are also engaged in micro fish trading as a part of their family work. They have to work for several hours and in a poor working environment i.e. in local markets. Sometime they also go for door to door selling of fishes. Thus these children do not get the opportunity to attend school. Many children in fisher families do small works for the family like mending nets, cleaning and peeling fish catches which is mainly for their household consumption. Boys occasionally go for near shore fishing with the adult members of the families. It should be clarified that such occasional engagements in family occupation is not necessarily harmful for children and sometime such engagements give them practical knowledge about the profession, which are beneficial for their skill development. Therefore the Child Labour Act in India does not prohibit such works done by children occasionally. But the Act's weakness is that it completely ignores intensive work done by children for subsistence (of the households) and does not recognise such intensive work as hazardous or children engaged in such work as child labour. A standard and simple category of defining child labour could be considering all children out of school as child labour, irrespective of their nature of engagements.[48]

Researches on child labour in fishery & aquaculture

Lack of accurate data on the incidence of child labour in fishery and aquaculture is a major problem and affects efforts to come up with a systematic strategy and plan. It is therefore necessary that the national governments should commission research and

surveys on different aspects of child labour in fishery and aquaculture in the countries. To this end a coordinated research could be initiated by of FAO and ILO in collaboration with leading expert INGOs in fishery/ aquaculture in various countries/continents where child labour in fishery is a pressing problem. This will help developing effective global policy frameworks related to child labour in fishery and aquaculture. The time is ripe for such coordinated researches, as at the initiative of FAO a discussion is going on regarding adoption of a guideline/chapter on small scale subsistence fisheries. In India the last countrywide enumeration of the working children was held in 2001 Census and then the fishery and aquaculture sector was not adequately incorporated in that process. There is an immediate requirement for child labour survey with a focus on fishery and aquaculture. The same applies to other countries also where the situation is similar.[49]

Review the policies and programmes related to the work of children in fishery and aquaculture

The child labour acts should be inclusive and should be able to address the new emerging problems of child labour in fishery and aquaculture. For instance, in fishery and aquaculture more and more sectors are using the sub-contract modality and the work is being given to workers at home or in a local shed (unorganized sector). Large numbers of children are working at piece rate from home or in a nearby shed and generally they go unnoticed by many child labour Acts. An appropriate child labour act should recognize all sorts of child labour and must be non-negotiable and the word "Regulation" (If exist like in India) should be removed from its title.

It has been observed with concern that some children who are rescued from work have no security in terms of their family or community and are, therefore, in a highly vulnerable position of exploitation and require temporary shelters. To tackle this problem NCPCR in India recommended to develop Transitional Education Centre both residential and non residential, this recommendation could be considered for implementation in India and in other countries where applicable.

Number of child labours rescued, during the last 3 years in West Bengal

2009-10	13187
2010-11	2215
2011-12	7456
2013-14	3117

Need for adequate funds to eliminate child labour in fishery and aquaculture

lt goes beyond saying that there should be genuine political will of the governments to implement programmes for addressing the child labour problem in fishery and aquaculture to its fullest extent. The genuine political will would be reflected in budgetary allocations for carrying out various envisaged programmes to rescue, rehabilitate and mainstream child labour and to prevent the incidence of child labour. In other words the nation states should allocate sufficient funds for addressing child labour problems in their respective countries. INGOs should play key role in advocacy and lobby work in this regard.[50]

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CHAPTER -VI

Fishing Technology and Its Transfer

Fishing is the process or activity of catching the not only fish but also aquatic animals such as molluscs, cephalopods, crustaceans, and echinoderms. The term is not normally applied to catching farmed fish, or to aquatic mammals, such as whales, where the term whaling is more appropriate or to farmed fish. Fishing activities takes place in the wild environment. It is an ancient practice that dates back to at least the beginning of the Paleolithic period about 40,000 years ago.[1] Isotopic analysis of the skeletal remains of Tianyuan man, a 40,000-year-old modern human from eastern Asia, has shown that he regularly consumed freshwater fish.[2,3] Archaeology features such as shell middens,[4] discarded fish bones, and cave paintings show that sea foods were important for survival and consumed in significant quantities.

During this period, most people lived a hunter-gatherer lifestyle and were, of necessity, constantly on the move. However, where there are early examples of permanent settlements (though not necessarily permanently occupied) such as those at Lepenski Vir, they are almost always associated with fishing as a major source of food.

Spearfishing with barbed poles (harpoons) was widespread in palaeolithic times.[5] Cosquer cave in Southern France contains cave art over 16,000 years old, including drawings of seals which appear to have been harpooned. The Neolithic culture and technology spread worldwide between 4,000 and 8,000 years ago. With the new technologies of farming and pottery came basic forms of the main fishing methods that are still used today. From 7500 to 3000 years ago, Native Americans of the California coast were known to engage in fishing with gorge hook and line tackle.[6] In addition, some tribes are known to have used plant toxins to induce torpor in stream fish to enable their capture.[7] Copper harpoons were known to the seafaring Harappans[8] well into antiquity.[9] Early hunters in India include the Mincopie people, aboriginal inhabitants of India's Andaman and Nicobar islands, who have used harpoons with long cords for fishing since early times.[10]

Not only fishing, but culturing of fishes in India also has long history. Kautilya's Arthashastra (321–300 B.C.) and King Someswara's Manasottara (1127 A.D.) each refer to fish culture.[11] For centuries, India has had a traditional practice of fish culture in small ponds in Eastern India. Significant advances in productivity were made in the state of West Bengal in the early nineteenth century with the controlled breeding of carp in *Bundhs* (tanks or impoundments where river conditions are simulated). Fish culture received notable attention in Tamil Nadu (formerly the state of Madras) as early as 1911, subsequently, states such as West Bengal, Punjab, Uttar Pradesh, Gujarat, Karnataka and Andhra Pradesh initiated fish culture through the establishment of Fisheries Departments. In 2006, Indian central government initiated a dedicated organization focused on fisheries, under its Ministry of Agriculture, Brackish water farming in India is also an age-old system confined mainly to the *Bheries* (manmade impoundments in coastal wetlands) of West Bengal and *pokkali* (salt resistant deep-water paddy) fields along the Kerala coast. With no additional knowledge and technology input, except that of trapping the naturally bred juvenile fish and shrimp seed, these systems have been sustaining production levels of between 500 and 750 kg/ha/year with shrimp contributing 20 to 25 percent of the total Indian production. [12]

Fishing in the earlier half of the last century mainly comprised artisanal inshore capture fishery using sailboats and catamarans and culture of Bengal carps (catla, rohu and mrigal). The Indian Fisheries Act of 1857 defined the powers and responsibilities of the erstwhile presidencies and princely states. Immediately after India's independence for a few decades, the erstwhile Madras and Bombay States led the country in fisheries surveys and research activities. With I.A.S. officers at the helm of state fisheries departments, these aspects have been relegated to the background and replaced by central governmental agencies.[13]

As fishing is an ancient occupation, it contributes significantly to the foreign exchange earning of India. Fish harvesting systems include the components of fishing vessel and fishing gear. A wide array of fishing gears and practices ranging from small-scale artisanal to large-scale industrial systems are used for fish capture. Over the years, traditional fishing gears have been upgraded and newer more efficient fishing systems have been introduced. Most important among these fish harvesting systems are trawls,

purse seines, lines, gillnets and entangling nets and traps. The basic criterion used for the classification of fishery vessels is the gear used for catching fish or other aquatic organisms. The characteristics used to distinguish the various types and classes of fishing vessels are the general arrangement and deck layout, position of the bridge or wheelhouse, the fishing equipment used and the method of fish preservation and processing used in the vessel. [14]

Fishing techniques include hand gathering, spearfishing, netting, angling and trapping. Recreational, commercial and artisanal fishers use different techniques, and also, sometimes, the same techniques. Recreational fishers fish for pleasure or sport, while commercial fishers fish for profit. Artisanal fishers use traditional, low-tech methods, for survival in third-world countries, and as a cultural heritage in other countries. Mostly, recreational fishers use angling methods and commercial fishers use netting methods.

There is an intricate link between various fishing techniques and knowledge about the fish and their behaviour including migration, foraging and habitat. The effective use of fishing techniques often depends on this additional knowledge.[15] Which techniques are appropriate is dictated mainly by the target species and by its habitat.[16]

Fishing techniques can be contrasted with fishing gear or tackle. Fishing gear or tackle refers to the physical equipment that is used when fishing, whereas fishing techniques refers to the manner in which the tackle is used when fishing. In early times man hunted fish to supply food for his family and himself, fishing from the sea shore or river bank, using spears, crude hooks and lines and simple traps. When he took to the water in the first rough dugouts, his field of operations was substantially extended. As the pattern of community living developed and preservation techniques such as drying and curing became established fish became not only food for the catcher but also a staple commodity of trade. Competition and technological advances slowly brought about improvements in fishing gear and new methods of capture appropriate to the target species sought were evolved by trial and error down through the centuries. Today there is a wide range of towed fishing gear for catching fish on the seabed, just off the bottom and in mid-water suitable for all sizes of vessel working singly or in pairs. There are various

types of seines used for surrounding large shoals of fish in open water or small shoals near the coast, static nets that catch fish by enmeshing them, traps for lobsters, crabs, salmon and sea trout, lines set to catch fish on baited hooks and dredges for scallops and queens. For those who for professional reasons need to know something about fishing gear and methods used today, or those who simply would like to know about the gear and methods used to catch the fish they eat.

India, with its long sea-coast and extensive riverine and estuarine waters, has a big wealth of fish fauna. In fact, the success of fisheries in a country depends on proper catch of its fish fauna, for which the use of modernised crafts and gears. In India, a large variety of crafts (boats) have been designed for marine and inland fishing. The nets or gears and other devices for catching fishes are also numerous and ingenious. But both crafts and gears were invented centuries ago and probably have remained static and have shown little or no change or improvement in India, unlike in other maritime countries. This has hindered or restricted the exploitation for our seas and Inland waters i.e. river, lakes, etc. It is only in the last decade or two of 20th century that some attempts have been made to use motor boats and modern steam vessels for the purpose. Actually the capture of fishes is as important as pisciculture methods. Basing upon the usage of materials and construction, the fishing gears are categorized into

1. Net fishing gear, where fishing gears are predominantly constructed of netting eg. gill net, seines, trawls:
2. Tackles in which hooks are an important part and miscellaneous gear covering all the other gears such as traps, wounding gear etc.

The main types of fishing gear and methods used by fishermen and their development are listed in the below those are presently being in operation in Indian marine fisheries and other states of this country like West Bengal.

6.1 Trawl Fishing Techniques and Its Development

History of the trawl fishery cannot be isolated from the history of fishery. Naturally, one who desires to discuss the history of trawl fishery has to start with the history of fishery.

6.1.1 Fishery in the early years

The history of taming fish and its use by man is as old as the history of human race. From the dawn of history fishing was the major occupation of the people inhabiting the sea coast[17]. In the Stone Age, people living by the sea endeavoured to satisfy their hunger by catching fish that was left behind by the receding tide with their hands bare or clad in their skins and firs. In the next stage, pronged spears or harpoons were introduced. With the passage of time, man learned to fish with bait holding gorges of wood, bone or horn with pointed tips. In the Stone Age real nets were devised and went fishing in rough boats, which was hallowed out of tree trunks.[18]

A good illustration of catching fish and angling is found in the Old Testament of the Bible and Hindu Mythology. In the book of 'Job' one of the forty-six books of the Old Testament of the Bible, written presumably in 1500 B.C, there are many passages referring to the use of hooks, harps, iron etc for fishing. The use of fish in India dates back to the third millennium B.C. Fish remains with cut marks and signs of the use have been obtained from excavations at Mohanjadaro and Harappa of the Indus valley civilizations (B.C 2500- B.C.1500). Aristotle is said to be the father of Fishery science too.[19]

Coming to the Indian Scenario King SomaSekhara (A.D 1127) was the first writer who recorded the common sport fish of India, grouping them in to marine and 8 Aristotle is considered as the father of Philosophy, Political Science and Biology besides Fishery Science fresh water-riverine forms. In medieval India, good illustrations of catching fish are found in Akbarnama, indicating the system of catching fish in state water. The first modern writer on Indian Fishes was Bloch whose splendid work 'Auslandiche Fishe' was published in 1785.

This work along with its ichthylogy and its further extension by Schneider in 1801, contain many Indian marine forms. Later Lacepede wrote 'Historide Poisons' (1798-1803). In 1803 Russel described 200 species of fish from Vishakapattnam. In 1822, there appeared Hamilton's pioneer work 'Fishes of Ganges' which contains the description of 269 species of fish. Cuvier and Callenoinnie's 'Historic Naturally Depoisons' published in 1849, provided more impetus to the study of ichthyology.[20]

In states like Kerala, the earliest reference about fishing activities is found in 'Sangham Literature'. The society of the Sangham period (The first five centuries of the Christian Era) had developed hunting, fishing, cattle rearing and agriculture. The fishing population at that time was known as 'Paravathas', sale of fish was done by women folk while men did the fishing. The cultural and trade relations developed in Kerala, over the years, with the partners like, the Arabs, the Chinese, the Africans the Egyptians and the Europeans had its impacts on the fisheries of Kerala by way of improvement in crafts and gear used for fishing.[21] The Arabs remodeled the indigenous dung out canoes, unique to Kerala, into a high board canoe by stitching planks on their side. The Egyptians introduced Kattamaram (a type of raft). The long snake boat used in Kerala is of Phoenician in origin. The three most popular conventional vessels used in Kerala are the Kattamaram, Plank canoes (Kettuvallam) and Dugout canoes.

The use of conventional fishing crafts is limited to the use of human stamina and skill such as towing or paddling. Dependence on manual labour and wind power are easily overcome by mechanized crafts. Mechanised crafts are of two types.[22]

a. In Board Engine (IBE) with engines inside the hull of the Boat

b. Out Board Engine (OBE), engines fastened to the boat from outside.

A dugout canoe is made by scooping of wood from a single log of soft mango or jungle jack of suitable size. The keel portion of left, thicker than the sides, which are hallowed out so as to form internal stiffening ribs.

6.1.2 Introduction of the Trawlers into the history of fishery

"A review of history shows how Sailing trawlers, Stern trawlers and currently both Motor and Otter trawlers and Twin beam trawlers have in turn dominated the trawler fishery. Fishing power has sometimes leapt forward within a few years but at times has also stagnated for decades. Fishing has not become a profitable sector because increases in catch rates have lagged far behind those in fishing power and everything points in the direction of over capacity of the sea".[23] A short history of the evolution of trawlers into fishing fleet is given below.

6.1.3 Era 1-14th to 19th century

References to some form of trawl fishing in the world date back to the 14th century. In 1376/77 A.D, a royal commission under King Edward III, prohibited the use of a controversial new fishing gear called the "Wondyrchym" that had been in use in the 'Thames Estuary' for about seven years. This early ten feet-wide beam trawl was already accused by traditional line and net fishers of catching large quantities small fish in the Estuary.[24and 25] Opposition against trawl continued throughout the history, but never halted its development.

During the 17th century, Britain developed the 'Dogger' an early type of sailing trawler commonly operated in the North Sea. The 'Dogger' takes its name from the Dutch word dodger, meaning a fish vessel which tows a trawl. Dodgers were sturdy, capable of fishing in the rough conditions of the sea. The trawlers in the early years were known as "the mother of Deep sea fishing" The design of the elegant wooden boats spread across Great Britain and the whole world, influencing fishing fleets everywhere. During the middle ages, Brixham was an important fishing port, where the trawling vessels were improved to a great extent and, in 1890s, there were about 300 trawling vessels in Brixham, England. Until the late 18th century, sailing vessels were only capable of towing small trawls. However, in closing years of that century, a type of vessel emerged that was capable of towing a large trawl in deep waters.

British sailing trawling industry in the North Sea expanded greatly during much of the 19th century.[25] By the end of the 19th century, there were more than 3000 sailing trawlers in commission in U.K waters and the practice had spread to neighbouring European countries.[26]

6.1.4. Era II - 20th Century

Around the turn of the 20th century steam trawlers were being built rapidly in Great Britain and by 1990 their combined number in English and Scottish east coast ports was no less than 1251, according to official statistics of the time. There was also a continued expansion of the fishing grounds worked by British steam trawlers which by 1990, included the entire southern, central North Sea.[27] The trawler design adapted as the way they were powered changed from sail to coal fired steam by World War I to diesel and

turbines, by the end of World War II. During World War I & II many fishing trawlers were commissioned as naval vessels to be used as minesweepers. From the 1930s to the early 1950s there was little change in the average fishing power of British steam trawlers fishing in North Sea.[28] From 1950 onwards, the technological improvements of the trawl fishing were widely used all over the world. From 1960 to 1980, was the period for the rise of modern twin beam trawling. Since World War II, commercial fishing vessels have been increasingly equipped with electronic aids such as radio navigation aids and fish finders. The largest fishing port in Europe from 1970s has been Peterhead, situated in the North east corner of Scotland. In its prime in the 1980s, Peterhead had over 500 trawlers staying at sea for a week on each trip.[29]

6.1.5. Modern Trawlers and use of electronics

Modern trawlers are decked vessels. Their superstructure (wheel house and accommodation) can be forward, amidships or afterward. Motorised winches, electronic navigation and sonar systems are usually installed. Fishing equipment varies in sophistication depending on the size of the vessel and on the technology used. Modern trawlers make extensive use of contemporary electronics including navigation and communication equipment, fish detection devices and equipment to control and monitor gear. Which equipment will be installed depends on the size, and type of trawler. Navigational instruments such as two pilot and GPS are used for maneuvering the vessel in harbour and at sea.

Radar can be used for example when pair trawling to keep correct the distance between two wheels. Communication instruments range from basic radio devices to maritime distress systems as well as device for communicating with the crew. Fish detection devices such as echo sounders and sonar are used to locate fish. Net sounders (trawl eyes) give information about the concentration of fish around the opening to the trawl as well as the clearances around the opening and the bottom of the trawl. Catch sensors give information about the rate at which the code end is filling. Symmetry sensors give information about the optimal Geometry of the trawlers. Tension sensors give information about how much tension is in the warps and sweeps.[30]

6.1.5 Fish Storage and Processing

Modern trawlers store the fish they catch in some form of chilled condition. At least fish will be stored in boxes covered with ice or stored with ice in the fish hold. In general, the fish are kept fresh by chilling them with ice or refrigerated with sea water or freezing them in blocks. Many trawlers carry some measure of onboard fish processing and the larger the vessel more likely it is to include fish processing facilities.[31]

6.1.6. Trawl Gear

Trawler is a fishing boat provided with engines of sufficient power to tow the net at the appropriate trawling speed. They are fitted with trawl winches and equipment necessary to haul the net on board and lift the 'cod end' over the deck[32]. The trawl is a conical shaped net towed over the sea bed. On the wings of the trawl net rectangular boards called otter boards are attached to weigh the whole net down to the bottom and maintain lateral opening [33]. The trawl is primarily a bag net and is believed to be evolved from the dredge nets used in the calm oyster of fisheries. The trawls, in its earlier form had a rigid rectangular frame to which the bag was attached at one side and towing ropes on the other [34].The design requirements of trawl are relatively simple, a mechanism for keeping the mouth of the net open in horizontal and vertical dimensions. There is a body of the net which guides fish inwards and a "cod-end" of a suitable mesh size, where the fish are collected. The size and design of the net used is determined by the species being targeted, the engine power and locally enforced regulations.

This gear is a bag shaped gear dragged with in the water with the help of a towing boat. Its mouth is kept open by otter-boards and towed on seabed or at the desired water depth. Generally, the trawl gear has larger size of the mesh at its towing end and the mesh size reduces gradually towards the cod end. The larger size of the mesh at its towing end is for the screening of unwanted fish species of certain size and the smaller mesh size at the cod end for retaining shrimp varieties. As such, the mesh sizes of the cod end webbing influence largely the size of fish caught by the trawl net.

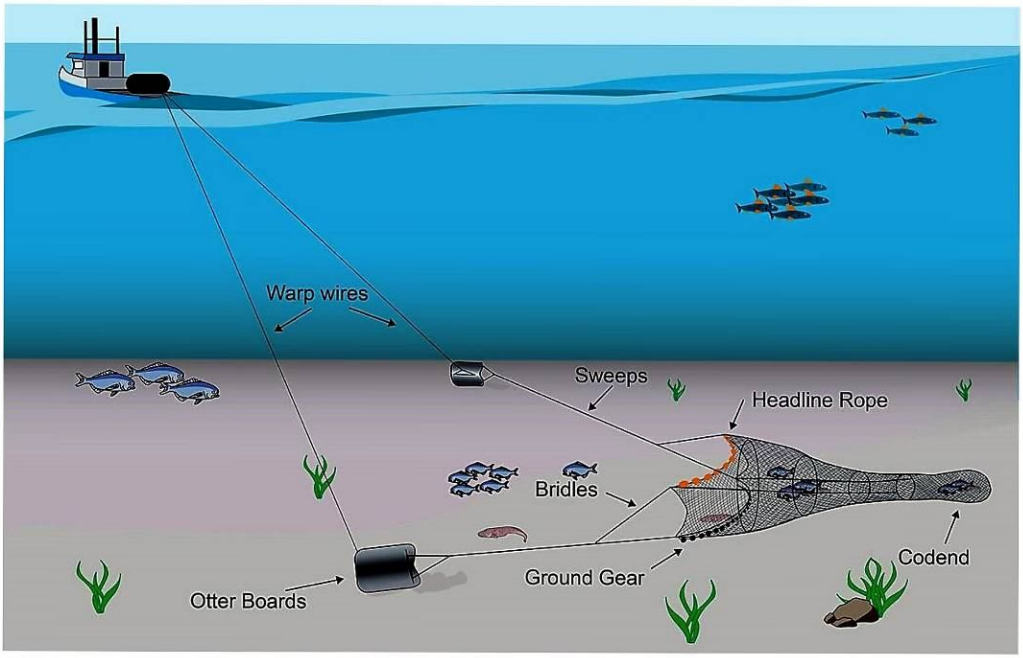
Structure of a simple trawl

All trawls, whether small are large for both bottom and mid water trawling are basically funnel shaped with extending sides in the front to form wings which will prevent the fish from escaping when the trawl is approach. The trawl body is divided into cod end, extension piece, belly, baitings (top belly) square, lower wings, top wings, flapper and chaffing gear.

Structure of trawl net

The trawls generally have a top canopy called the square extending forward from the top belly to prevent the fish from escaping over the top of the net. Panel sections are generally tailored from machine-made webbing. Top and bottom panels are attached to the head rope (head line) and the foot rope (ground line), respectively. Flapper is a suitably shaped piece of netting of smaller mesh size fitted in front of codend in such a way as to prevent the escape of fishes that has entered the codend. Most commonly used buoyancy elements are spherical floats which are attached along the head rope. Floats along the head rope and weighted foot rope keep the net mouth vertically open during operations. Rigid kites or flexible sheers devices are also used to maintain the vertical opening of the trawl mouth. Trawl mouth is kept horizontally open using rigid sheer devices known as otter boards (trawl doors) which are attached to the wings either directly or by bridles or sweeps. Chaffing gear is sometimes provided underneath the codend of trawls operated in rough grounds in order to protect the codend from abrasion.

Generally, 2 basic requirements are common to all trawlers. One is the need for “towing power” and the other is the need for a “winch” (or) “mechanically hauling system”. In order to have a good towing power, a trawler should have a reasonable draft (or) displacement and should have a large slow-turning propeller.



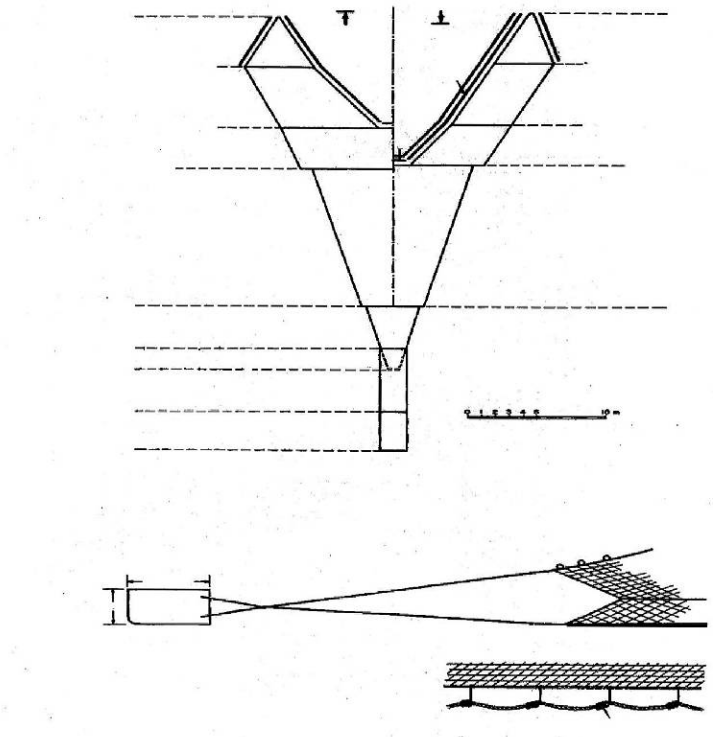


Fig. 1: Structure of Trawl Net

6.1.6.1. Cod End

"Cod end" is the trailing of the net where the fish are finally caught. The size of the mesh in the cod end is a determinant, of the size of the fish which the net catches. Consequently, regulation of mesh size is a common way of managing mortality of juvenile fishes in the trawl nets.[30]

6.1.7 Major Categories of Trawlers

Depending on the geographic origin, the type of fish the trawlers catch, the fishing method used and their architecture, the trawlers range in size, to open boats with inboard motors up to large freezer and factory trawlers.[31] The categories of the trawlers are Trigger trawlers, Beam trawlers, Otter trawlers, Pair trawlers, Side trawlers, Stern trawlers, Freezer trawlers and Wet Fish trawlers. Other trawlers deploy one or more parallel trawls kept apart horizontally, using otter boards. These trawls can be towed in mid water or along the bottom. Otter trawlers range in size from sailing canoes to super trawlers. Otter trawlers usually have two gallows at the stern with towing blocks. The towing warps run through these, each regulated by its own winch, medium and large trawlers usually have a stern ramp for hauling the trawl on to the deck. Some trawlers tow twin parallel trawls, using three warps each, warp with its own winch. Some Otter trawlers are also outrigger trawlers using outriggers to tow one or two Otter trawls from each side. Pair trawlers are trawlers which operate together trawling a single trawl. They keep the trawl open horizontally by keeping their distance when towing. Pair Trawlers operate both in mid water and bottom waters. Pair trawling is used by small trawlers in India at depths less than 20 m [35, 36.] In pair trawling two eleven meter/trawl boats are attached to a 15m wide trawler between the wings [37]Pair trawling achieves the spread of the net by having the warps between the two trawlers of the same or reasonably similar traction power. Layout of a typical pair trawler is similar to that of a side trawler. [31]

Side trawlers have the trawl deployed over the side with the trawl warps passing through blocks suspended from a forward gallows and another afterward gallows.

Until the late sixties, side trawlers were the most common deep sea boat used on North Atlantic Fisheries. These trawlers were used for a longer period than other kinds of trawlers but are now being replaced by stern trawlers[38].

Stern trawlers have trawls which are deployed and retrieved from the stern. Large stern trawlers often have a ramp though pelagic and small stern trawlers are often designed with a ramp. Stern trawlers are designed to operate in most weather conditions. A wet fish stern trawler stores the fish in ice or sea water which has been refrigerated. A freezer stern trawler stores the fish in frozen boxes or blocks and a factory stern trawler processes the catch. A pelagic stern trawler may use fish pumps to empty the cod end. Majority of the trawlers operating on the high seas are freezer trawlers. They have facilities for preserving fish by freezing. They are medium to large size trawlers with general arrangement as stern or side trawlers. Wet fish trawlers are next type of trawlers, where the fish is kept in the hold in fresh or wet covered with ice or ice in the fish hold. They must operate in areas close to their landing place, and the time such a vessel can spend in fishing is limited [39]

Bull trawling is yet another type of trawling. In this type of trawler, two boats are used and a net is towed between them. This method has the disadvantage as to the successful operation, there has to be full co-ordination between the two skippers which is not always forth coming. The two boats have to be in constant view of each other which would produce their operation at night time. And another disadvantage being that it would not be operated during strong winds [29]. Multipurpose vessels are trawler-gill nature, trawler purse-seine etc. These are vessels which are equipped for alternative use of two or more different gears without major modifications to the vessel's outfit and equipment. The lead of warps and pursing lines are assured by rollers, blocks, trawl gallows and purse davit with the lay out planned to reduce to minimum, the time needed for conversion from one type of fishing to another [37].

2.4.4 Otter Trawls

The use of otter boards gave the name "otter trawls". This modification gave way to bigger sized nets. The manual of hauling of the net as was done with the beam trawl was not possible especially with the introduction of the heavy otter boards. Thus mechanization was introduced in the form of strong winches [29]. The above mentioned are the various types of trawlers that are commonly in use in various parts of the world. For

the specific catch of a species of fish, the most suitable type of trawler is used. The earliest trawlers were used for bottom dwelling fishes like flat fishes [37]

6.2. Seine fishing techniques and its development

Seine fishing is a method of catching fishes employs a seine or dragnet. A seine is a fishing net that hangs vertically in the water with its bottom edge held down by weights and its top edge buoyed by floats. Seine nets can be deployed from the shore as a beach seine, or from a boat. Seines have been used widely in the past, including by Stone Age societies. For instance, with the help of large canoes, pre-European Māori deployed seine nets which could be over one thousand metres long. The nets were woven from green flax, with stone weights and light wood or gourd floats, and could require hundreds of men to haul[40].

Purse seining

This is the general name given to the method of encircling a school of fish with a large wall of net. The net is then drawn together underneath the fish (pursed) so that they are completely surrounded. It is one of the most aggressive methods of fishing and aims to capture large, dense shoals of mobile fish such as tuna, mackerel and herring. Purse seining for yellow fin tuna in the Eastern Tropical Pacific, specifically 'dolphin-fishing', where dolphins are deliberately encircled to trap the tuna swimming below them, is probably the most widely reported example of marine mammal by-catch. However, since the introduction of legislation to protect marine mammals in 1972 (Marine Mammal Protection Act) the number of yellow fin tuna taken in nets set deliberately on dolphins now only accounts for a very small proportion (3.3% in 1997) of tuna on the world market. The most stringent 'dolphin-friendly' standards are those developed by the Earth Island Institute (see www.earthisland.org for details) and HJ Heinz Corporation (the largest supplier of canned tuna in the world). Since their introduction in 1990 dolphin deaths in this area have been reduced by 98% to about 2-3,000 reported deaths per year. Companies participating in the EII project represent more than 90% of the world's canned tuna market

Seine netting

This is a bottom fishing method and is of particular importance in the harvesting of demersal or ground fish including cod, haddock and hake and flat-fish species such as plaice and flounder. The fish are surrounded by warps (rope) laid out on the seabed with a trawl shaped net at mid-length. As the warps are hauled in, the fish are herded into the path of the net and caught. Effectiveness is increased on soft sediment by the sand or mud cloud resulting from the warps' movement across the seabed. This method of fishing is less fuel-intensive than trawling and produces a high quality catch, as the fish are not bumped along the bottom as with trawling.

American Native Indians on the Columbia River wove seine nets from spruce root fibers or wild grass, again using stones as weights. For floats they used sticks made of cedar which moved in a way which frightened the fish and helped keep them together. [41]

Seine nets are also well documented in ancient cultures in the Mediterranean region. They appear in Egyptian tomb paintings from 3000 BC. In ancient Greek literature, Ovid makes many references to seine nets, including the use of cork floats and lead weights. [42,43,44] A common type of seine is a purse seine, named such because along the bottom are a number of rings. A line (referred to as a purse-line) passes through all the rings, and when pulled, draws the rings close to one another, preventing the fish from "sounding", or swimming down to escape the net. This operation is similar to a traditional style purse, which has a drawstring. The purse seine is a preferred technique for capturing fish species which school, or aggregate, close to the surface: such as sardines, mackerel, anchovies, herring, certain species of tuna(schooling); and salmon soon before they swim up rivers and streams to spawn (aggregation). Boats equipped with purse seines are called purse seiners.

These kinds of fishing techniques have developed from two different fishing methods – beach seine and lampara. Beach seines have been used through the ages almost all over the world. They are usually deeper than the depth of the water. The top edge is framed with a float line and lower edge with a lead line. It is set in a semi-circle at some distance from the shore and then hauled ashore onto the beach using long ropes. During hauling, the beach seine filters the whole depth of the water from the surface to

the bottom. As soon as the wing tips come within the reach of the fishermen they bring the lead line of both wings together in order to gather the fish towards the centre. The bunt part with the catch inside is the last part to be brought ashore. Purse seines evolved from beach seines in 1920s with the incorporation of a pursing arrangement in order to close the net at the bottom after surrounding the shoal of fish. This facilitated operation of net in deeper waters. Lampara – The term lampara stems from the Greek and Latin roots of the word lamp (Lampas, lampa), as this fishing method must have been associated with lights. In contrast to beach seines, lampara are true surround nets. They have rather short wings, a deep central bunt, and a lead line substantially shorter than the float line. It form a scoop shape during hauling. As early as 1863 Chinese fishermen were known to be using them for catching squid. In 1893 the first purse seiner Alpha started fishing sardine and mackerel in California. Purse seining fishing continued only for large fish like barracuda, yellowtail and White Sea bass. Since 1914 it has been also used for tuna. In 1940 purse seines for sardine fishery were introduced. In India only after 1977 purse seines were introduced and now have become a very important fishing gear for harvesting mackerel and sardines in the south west coast[45].

As this is one of the most advanced and efficient commercial fishing method for capture of shoaling pelagic species. It also used to catch the demersal fish such as cod by modifying its design to operate close to bottom. It probably catches the highest percentage of total world fish landings than any other single fishing method. Purse seines are used in both small-scale and industrial sectors. Advances in purse seining was supported by introduction of high tenacity synthetic twines of high specific gravity, improvements in vessel technology and gear handling equipment, such as fish aggregation techniques and acoustic fish detection and remote sensing techniques.

Purse seining Purse seining experiments were conducted in India by the erstwhile Indo-Norwegian Project as early as 1954 [46].Purse seining was introduced in Goa in 1957 [47] .Purse seining in the commercial small- scale mechanised sector was started in India in 1974 [48]. The Central Institute of Fisheries Technology (CIFT), Cochin developed and introduced a mini purse seine which came to be known as ring seine, for operation from the traditional motorized craft, during 1982-83, as an efficient alternative gear for operation from the traditional boat seine craft thangu vallom[49]. This gear had an overall

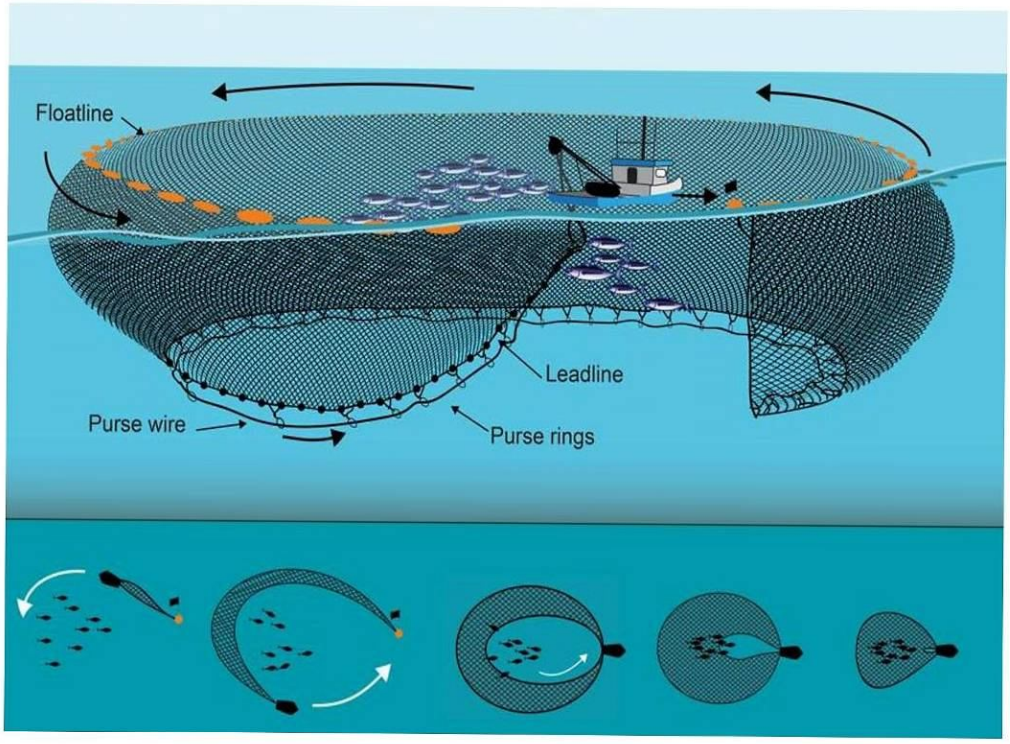
dimension of 250 x 33 m and was fabricated of polyamide knotless netting of 18 mm mesh size. This development has offered an efficient alternative gear for operation from the traditional boat seine craft thangu vallam. Parallel innovations have taken place in the traditional motorised sector, around this period, leading to the development of a number of variations of ring seines [50,51; 52]. Widespread operation of purse-seiners along Kerala, Karnataka and Goa coasts especially from the eighties had a profound influence on the marine fish production. Edwin (1997) conducted detailed investigations on the catch and effort, energy utilisation pattern, gear selectivity, economic efficiency and management aspects of ring seine fishery of south Kerala coast. Power block introduced by CIFT in Indian purse seine fisheries in 2012 is a significant development which has made purse seining easily possible by facilitating the hauling of the net with minimum man-power. The introduction of large mesh purse seine to reduce catch of juveniles and also to target large pelagic by CIFT is a success. [Another technology that has become highly popular among traditional lobster fishermen especially along the southwest coast of India was the new CIFT designed lobster trap which is 2.5 times more efficient than traditional traps in term of catches and also they last for 3-4 fishing seasons.

Structure of purse seine

Design, shape and rigging of the purse seines vary greatly, depending on the method of operation, gear handling, depth of operation, target species and vessel characteristics. A typical purse seine could consist of the following parts:

Bunt This is the section of netting where catch is concentrated prior to its removal by brailing into the vessel and is the last part of the net to be hauled in. Netting used for bunt should be stronger and made of thicker twines than other parts. The bunt is either placed at the end of the wall of netting or at the center, depending on the type of operation.

Main body This is the largest part of the net extending from the bunt which facilitates surrounding of the fish shoal during operations. It is constructed by joining together large



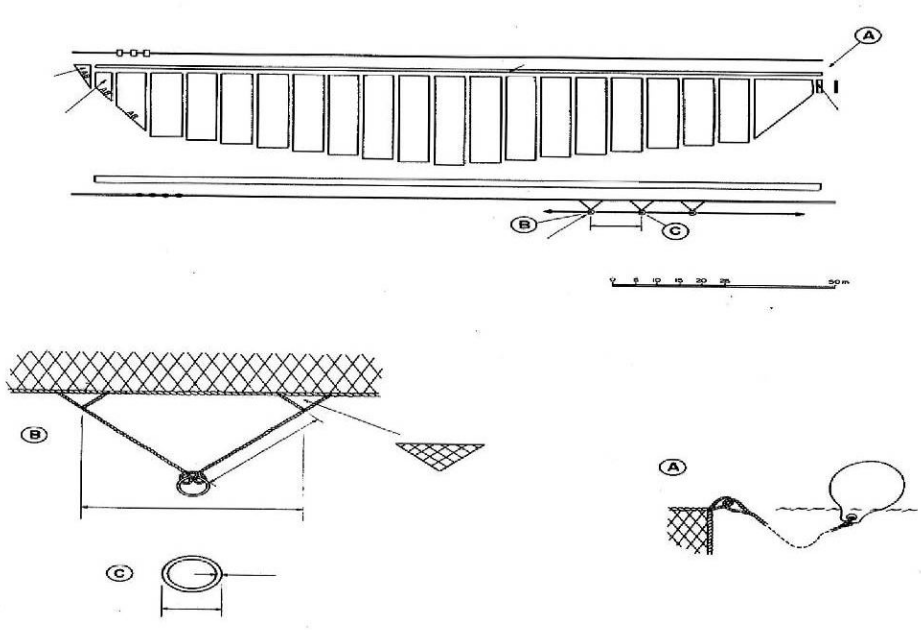


Fig.2: Structure of Purse Seine

sections of netting of mesh size appropriate for the target species. Relatively thinner twines are used in this section in order reduce the hydrodynamic resistance and increase the sinking speed during setting.

Selvedges Selvedge consists of a few rows of meshes of thicker and larger mesh size, provided along the upper, lower and side edges of the net body in order to protect the net from damages during operations.

Float line, lead line, side ropes The upper selvedge is attached to the float line (head rope) and the lower selvedge to the lead line (foot rope). Hanging ratio range from 0.5 to 0.9 depending on design. Hanging ratio is greater in lead line than in float line. Lead line is usually longer than float line by up to 10% or in some cases equal in length. Selvedges on the sides are attached to side ropes (gavel lines).

Bridles and tow line Bridles are ropes attached to float line and lead line on either end or are connected a tow line of sufficient length to facilitate setting and hauling operations.

Pursing arrangement: Purse line is used to close the bottom of the purse seine after surrounding the fish shoal. The purse line passes through purse rings attached to lead line by short lengths of ropes. The purse line must have good abrasion resistance and high breaking strength and its length is roughly 1.5 times the length of the purse seine. Purse rings are made of corrosion-resistant material such as brass or stainless steel.

Float and sinkers Sinkers are attached to the lead line to attain 1-3 kg.m-1 for small purse seines and up to 8 kg.m-1 for large tuna purse seines. Total buoyancy of the floats is maintained at 1.5 to 3.5 times the total under-water weight of the purse seine net and its appurtenances. Higher buoyancy is provided in the bunt area in order to counteract the sinking forces due to weight of the heavier netting in this area and the weight of fish while concentrating the catch.

FAD (Fish Aggregation Device) Associated Purse Seine

Various species of fish often congregate or associate with other living creatures (e.g. tuna associate with dolphins and whale sharks) or objects floating or suspended in the sea. This natural phenomenon has been exploited to attract fish to floating or suspended structures. Such structures can provide known locations for congregating fish, around

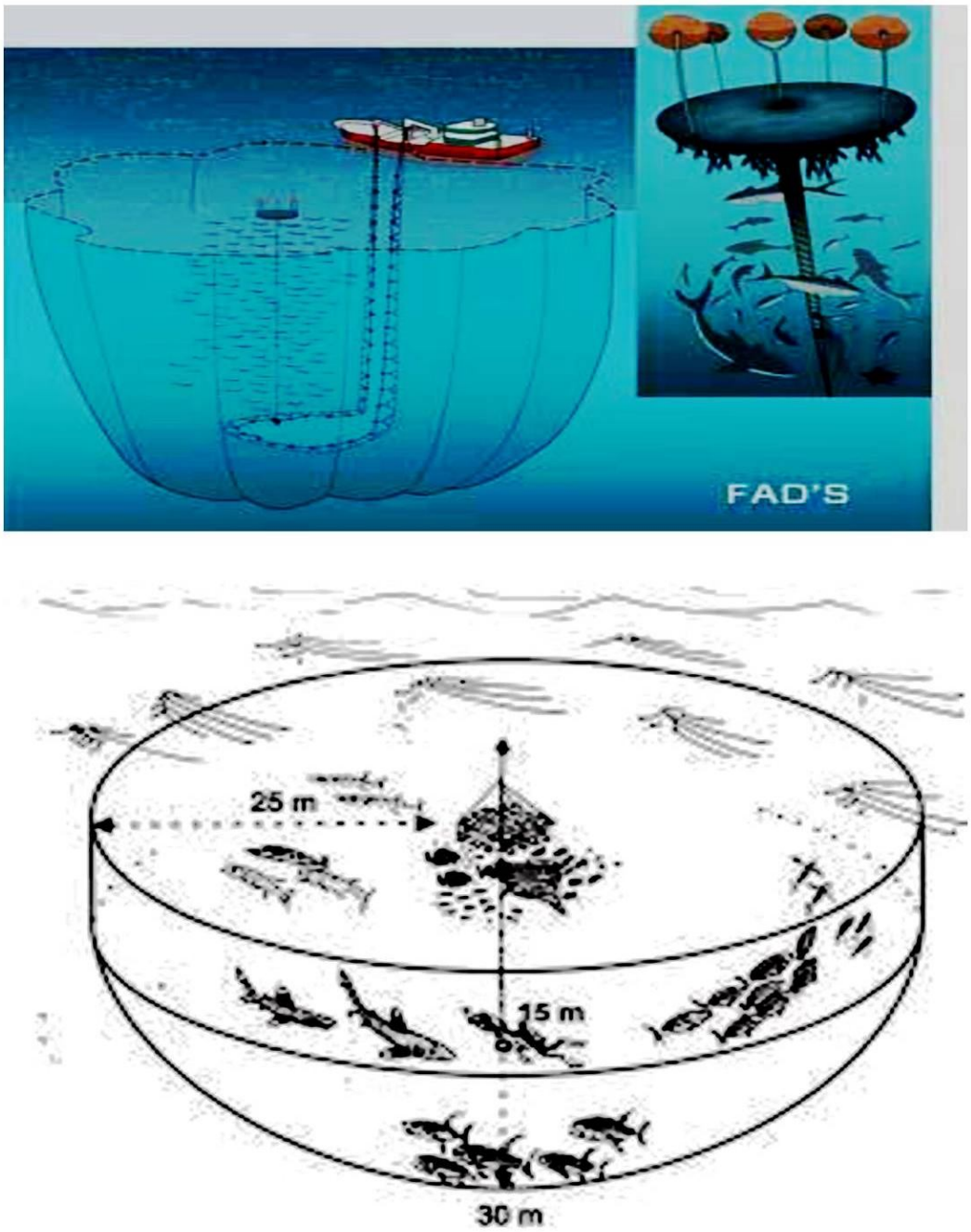


Fig.3: Fish Aggregation Device associated Purse Seine

which vessels can operate a wide range of fishing techniques including purse seines, pole and line or trolling. FADs may be used to concentrate fish in sufficiently high numbers which are then surrounded with a purse seine net. Fishermen using pole and line or trolling methods may use the boat from which they are fishing as a FAD.

Juveniles in particular are attracted to FADs. FADs are thought to have negative ecosystem effects and have been linked to changes in migratory patterns, growth rates and predation rates of affected pelagic species. Many juvenile fish are discarded in FAD associated purse seine fisheries and the FAD Purse seining method is also associated with by-catch of marine mammals.

Hook and line fishing Techniques and its development

Hand-line Fishing with lines and hooks is one of the oldest fishing methods. They may be used from a stationary or moving boat. The catch is of very high quality as the fish is usually live when brought aboard. Hand lining is also a highly selective fishery in terms of species and size. The method can be used while fish are spawning, as they will normally only bite after completion of spawning. Hand lining is used to catch cod and other demersal species and pelagic species such as mackerel, squid and tuna. In tropical waters hand lines are used to catch groupers and snappers. Because hauling is slow, mechanized (electrical or hydraulic) systems have been developed to allow more lines to be worked by a smaller crew.

Angling is a method of fishing by means of an "angle" (hook). The fish hook or similar device has probably been made by man for many thousands of years. Some of the earliest recorded fish hooks are from Palestine about 7000 BC. In 2011, archaeologists in the Jerimalai cave in East Timor discovered the world's oldest fish hook, a shell hook between 16,000 and 23,000 years old. [53] An early written reference to a fish hook is found with reference to the Leviathan in the Book of Job 41:1; *Canst thou draw out leviathan with a hook?* Fish hooks have been crafted from all sorts of materials including wood, animal [54] and human bone, horn, shells, stone, bronze, iron up to present day materials. In many cases, hooks were created from multiple materials to leverage the strength and positive characteristics of each material. Norwegians as late as the 1950s still used juniper wood to craft Barbet hooks. Quality steel hooks began to make their appearance

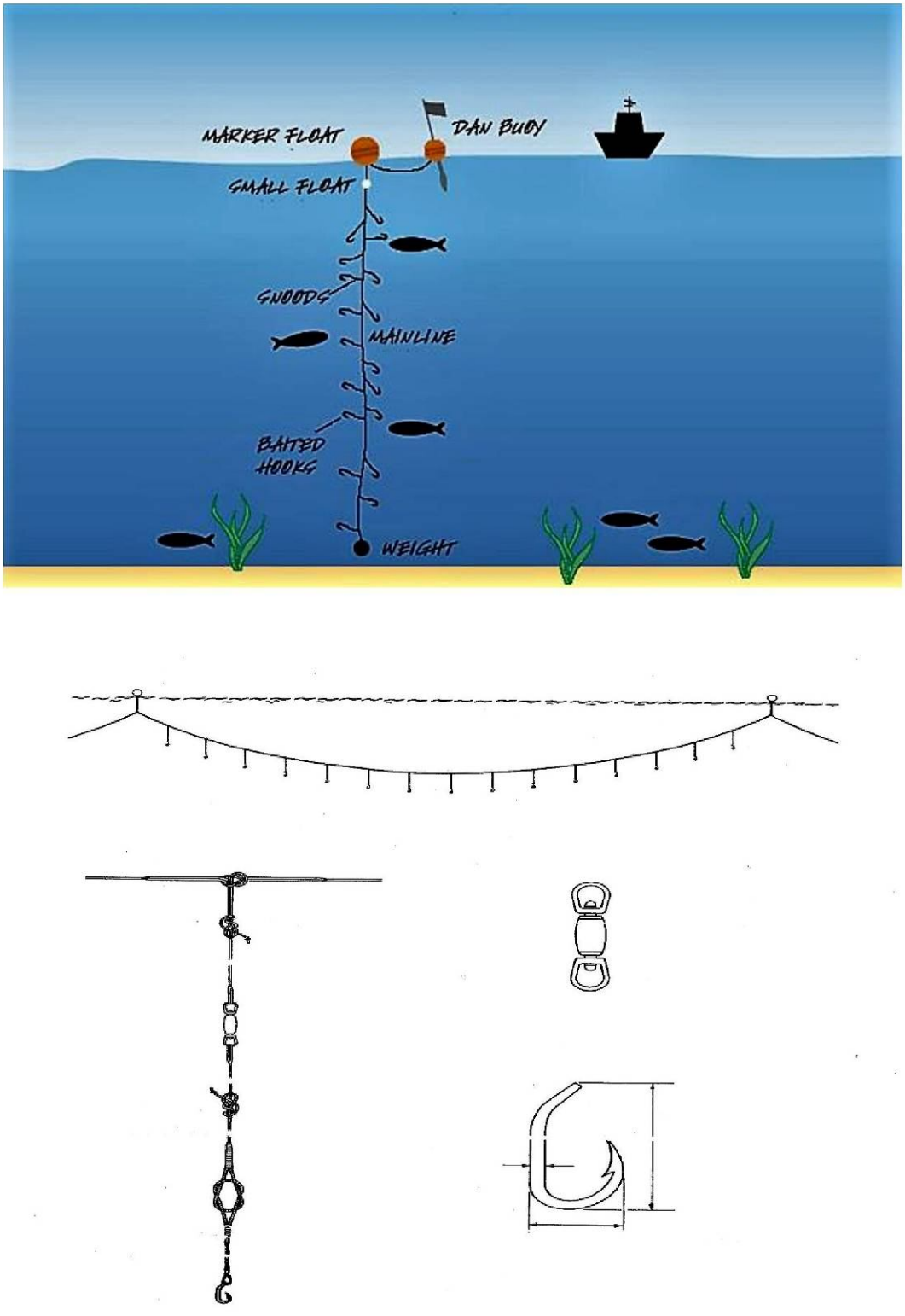


Fig. 4: Structure of Drop line

in Europe in the 17th century and hook making became a task for specialists. [55]. Fish hook or hook is a device for catching fishes either by impaling them in the mouth or, more rarely, by snagging the body of the fish. Fish hooks have been employed for centuries by fishermen to catch fresh and saltwater fish. In 2005, the fish hook was chosen by Forbes as one of the top twenty tools in the history of man[56]. Fish hooks are normally attached to some form of line or lure device which connects the caught fish to the fisherman. There is an enormous variety of fish hooks in the world of fishing. Sizes, designs, shapes, and materials are all variable depending on the intended purpose of the fish hook. Fish hooks are manufactured for a range of purposes from general fishing to extremely limited and specialized applications. Fish hooks are designed to hold various types of artificial, processed, dead or live baits (bait fishing); to act as the foundation for artificial representations of fish prey (fly fishing); or to be attached to or integrated into other devices that represent fish prey (lure fishing).

Commonly referred to parts of a fish hook are: its point - the sharp end that penetrates the fish's mouth or flesh; the barb - the projection extending backwards from the point, that secures the fish from unhooking; the eye - the end of the hook that is connected to the fishing line or lure; the bend and shank - that portion of the hook that connects the point and the eye; and the gap - the distance between the shank and the point. In many cases, hooks are described by using these various parts of the hook.

There are a large number of different types of fish hooks. At the macro level, there are bait hooks, fly hooks and lure hooks. Within these broad categories there are wide varieties of hook types designed for different applications. Hook types differ in shape, materials, points and barbs, and eye type and ultimately in their intended application. When individual hook types are designed the specific characteristics of each of these hook components are optimized relative to the hook's intended purpose. For example, a delicate dry fly hook is made of thin wire with a tapered eye because weight is the overriding factor. Whereas Carlisle or Aberdeen light wire bait hooks make use of thin wire to reduce injury to live bait but the eyes are not tapered because weight is not an issue. Many factors contribute to hook design, including corrosion resistance, weight, strength, hooking efficiency, and whether the hook is being used for specific types of bait, on different types of lures or for different styles of flies. For each hook type, there

are ranges of acceptable sizes. For all types of hooks, sizes range from 32 (the smallest) to 20/0 (the largest).

Hook shapes and names are as varied as fish themselves. In some cases, hooks are identified by a traditional or historic name, e.g. Aberdeen, Limerick or O'Shaughnessy. In other cases, hooks are merely identified by their general purpose or have included in their name, one or more of their physical characteristics. Some manufacturers just give their hooks model numbers and describe their general purpose and characteristics.

The shape of the hook shank can vary widely from merely straight to all sorts of curves, kinks, bends and offsets. These different shapes contribute in some cases to better hook penetration, fly imitations or bait holding ability. Many hooks intended to hold dead or artificial baits have sliced shanks which create barbs for better baiting holding ability. Jig hooks are designed to have lead weight molded onto the hook shank. Hook descriptions may also include shank length as standard, extra-long, 2XL, short, etc. and wire size such as fine wire, extra heavy, 2X heavy, etc.

Single, double and triple hooks

Hooks are designed as either single hooks—a single eye, shank and point; double hooks—a single eye merged with two shanks and points; or triple—a single eye merged with three shanks and three evenly spaced points.

Double hooks are formed from a single piece of wire and may or may not have their shanks brazed together for strength. Triple hooks are formed by adding a single eyeless hook to a double hook and brazing all three shanks together. Double hooks are used on some artificial lures and are a traditional fly hook for Atlantic salmon flies, but are otherwise fairly uncommon. Triple hooks are used on all sorts of artificial lures as well as for a wide variety of bait applications.

Bait hook shapes and names

Bait hook shapes and names include the Salmon Egg, Beak, O'Shaughnessy, Baitholder, Shark Hook, Aberdeen, Carlisle, Carp Hook, Tuna Circle, Offset Worm, Circle, suicide hook, Long Shank, Short Shank, J Hook, Octopus Hook and Big Game Jobu hooks.

Fly hook shapes and names Fly hook shapes include Sproat, Sneck, Limerick, Kendal, Viking, Captain Hamilton, Barleet, Swimming Nymph, Bend Back, Model Perfect, Keel, and Kink-shank.

Points and barbs

The hook point is probably the most important part of the hook. It is the point that must penetrate fish flesh and secure the fish. The profile of the hook point and its length influence how well the point penetrates. The barb influences how far the point penetrates, how much pressure is required to penetrate and ultimately the holding power of the hook. Hook points are mechanically (ground) or chemically sharpened. Some hooks are barbless. Historically, many ancient fish hooks were barbless, but today a barbless hook is used to make hook removal and fish release less stressful on the fish. Hook points are also described relative to their offset from the hook shank. A curbed hook point is offset to the left, a straight point has no offset and a reversed point is offset to the right.

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Care needs to be taken when handling hooks as they can 'hook' the user. If a hook goes in deep enough below the barb, pulling the hook out will tear the flesh. There are three methods to remove a hook. The first is by cutting the flesh to remove it. The second

Stone Age fish hook made from bones

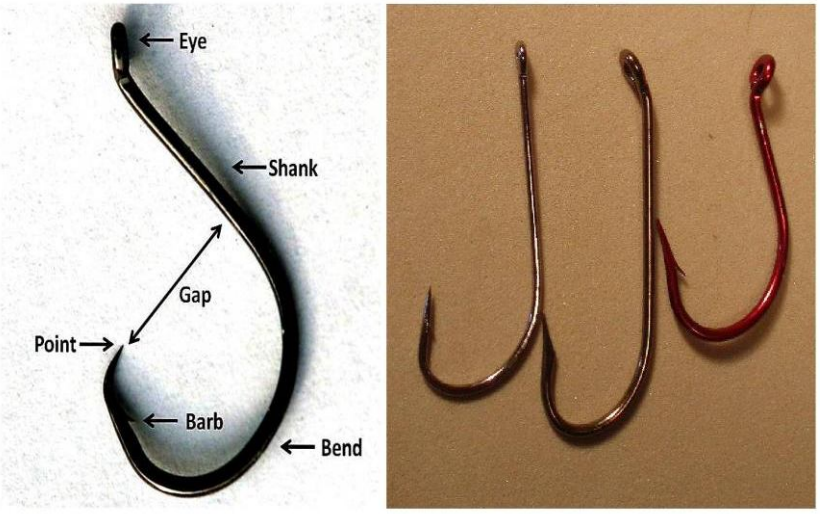


Fig.5: Hooks and its Parts

is to cut the eye of the hook off and then push the remainder of the hook through the flesh and the third is to place pressure on the shank towards the flesh which pulls the barb into the now oval hole then push the hook out the way it came in.

Hook point type

Hook points are commonly referred to by these names: needle point, rolled-in, hollow, spear, beak, mini-barb, semi-dropped and knife edge. Some other hook point names are used for branding by manufacturers.

Eyes

The eye of a hook, although some hooks are technically eyeless, is the point where the hook is connected to the line. Hook eye design is usually optimized for strength, weight and/or presentation. There are different types of eyes to the hooks. Typical eye types include the ring or ball eye, a brazed eye-the eye is fully closed, a tapered eye to reduce weight, a looped eye traditional on Atlantic salmon flies, needle eyes, and spade end no eye at all, but a flattened area to allow secure Snelling of the leader to the hook. Hook eyes can also be positioned one of three ways on the shankup turned, down turned or straight.

Size

There are no internationally recognized standards for hooks and thus size is somewhat inconsistent between manufacturers. However, within a manufacturer's range of hooks, hook sizes are consistent.

Hook sizes generally are referred to by a numbering system that places the size 1 hook in the middle of the size range. Smaller hooks are referenced by larger whole numbers (e.g. 1, 2, 3...). Larger hooks are referenced by increasing whole numbers followed by a slash and a zero (e.g. 1/0 (one aught), 2/0, 3/0...) as their size increases. The numbers represent relative sizes, normally associated with the gap (the distance from the point tip to the shank). The smallest size available is 32 and largest 20/0.

Different Types of Hooks

Artificial Hooks

Fig.6: Different Types of Hooks

These types of hook are usually attached to a line, and is sometimes weighed down by a sinker so it sinks in the water. This is the classic "hook, line and sinker" arrangement, used in angling since prehistoric times. The hook is usually baited with lures or bait fish.

Additional arrangements include the use of a fishing rod, which can be fitted with a reel, and functions as a delivery mechanism for casting the line. Other delivery methods for projecting the line include fishing kites and cannons, kontiki rafts and remote controlled devices. Floats can also be used to help set the line or function as bite indicators. The hook can be dressed with lures or bait. Angling is the principal method of sport fishing, but commercial fisheries also use angling methods involving multiple hooks, such as longlining or commercial trolling.

IT is the principal method of sport fishing, but commercial fisheries also use angling methods such as longlining or trolling. Catch and release fishing is increasingly practiced by recreational fishermen. In many parts of the world, size limits apply to certain species, meaning fish below and/or above a certain size must, by law, be released.

The use of the hook in angling is descended, historically, from what would today be called a "gorge." The word "gorge", in this context, comes from the French word meaning "throat." Gorges were used by ancient peoples to capture fish and animals like seal, walrus and birds. A gorge was a long, thin piece of bone or stone attached by its midpoint to a thin line. The gorge would be baited so that it would rest parallel to the lay of the line. When the game would swallow the bait, a tug on the line would cause the gorge to orient itself at right angles to the line, thereby sticking in the fish or animal's throat or gullet. Some laws and regulations require hooks to be barbless. This rule is commonly implemented to protect populations of certain species. A barbed hook could kill a fish if it were to penetrate the gills.

Line Fishing Techniques and its development

Long-lining

Long-lining is one of the most fuel-efficient catching methods. This method is used to capture both demersal and pelagic fishes including swordfish and tuna. It involves setting

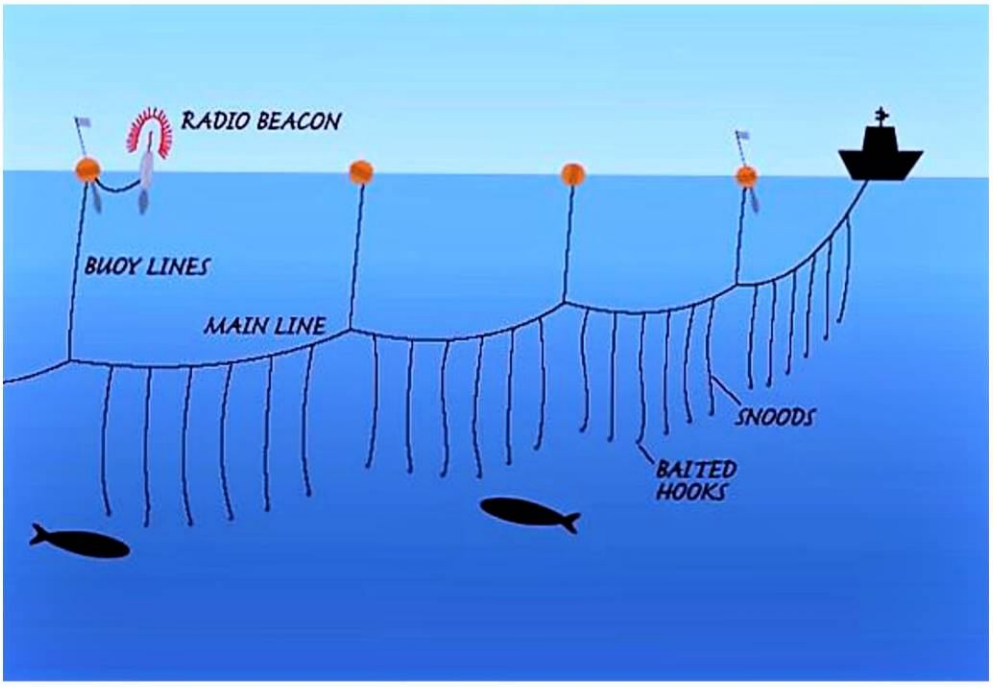
out a length of line, possibly as much as 50-100 km long, to which short lengths of line, or snoods, carrying baited hooks are attached at intervals. The lines may be set vertically in the water column, or horizontally along the bottom. The size of fish and the species caught is determined by hook size and the type of bait used.

Although a selective method of catching fish, long-lining poses one of the greatest threats to seabirds. Species such as albatross, petrels, shearwaters and fulmars scavenge on baited hooks, get hooked, are dragged underwater and drowned. The problem occurs whilst the baited hooks are on or near the surface i.e. before the hook sinks. Commonly the bait used is squid, the principal prey of many seabird species. Most globally threatened species, including the majestic wandering albatross, live in the Southern Ocean. A range of practical measures have been developed to help prevent seabirds being hooked and drowned on long-lines. These include bird-scaring streamers that flap and scare birds away, setting lines at night when most albatross do not feed and weighting the line so it sinks quickly, bird scaring water cannons and setting the line nearer the water surface rather than over the side of the boat, thus minimising the length of time the bait is visible/available. Any of these measures will contribute to reducing seabird by-catch. Ask your supplier if the long-line caught fish you buy has been caught using "seabird-friendly" methods. Of particular concern in some long-line fisheries are high catches of immature individuals of the target species and / or high catch rates of vulnerable / listed species such turtles, seabirds and sharks.

The most commonly used lining methods are hand-lines and long-lines. Hand-lines are mainly used by recreational fishers, though they are sometimes used for commercial species, such as southern bluefin tuna.

Long-lines consist of a main line running parallel to the bottom, with baited short lines (snoods) attached at intervals. The line is anchored at each end and held at the surface by floats. Long-lines are used to catch high-quality, high-value fish such as snapper.

Longline fishing is a commercial fishing technique. It uses a long line, called the main line, with baited hooks attached at intervals by means of branch lines called snoods (or gangions) [57] A snood is a short length of line, attached to the main line using a clip or swivel, with the hook at the other end. Longlines are classified mainly by where they are



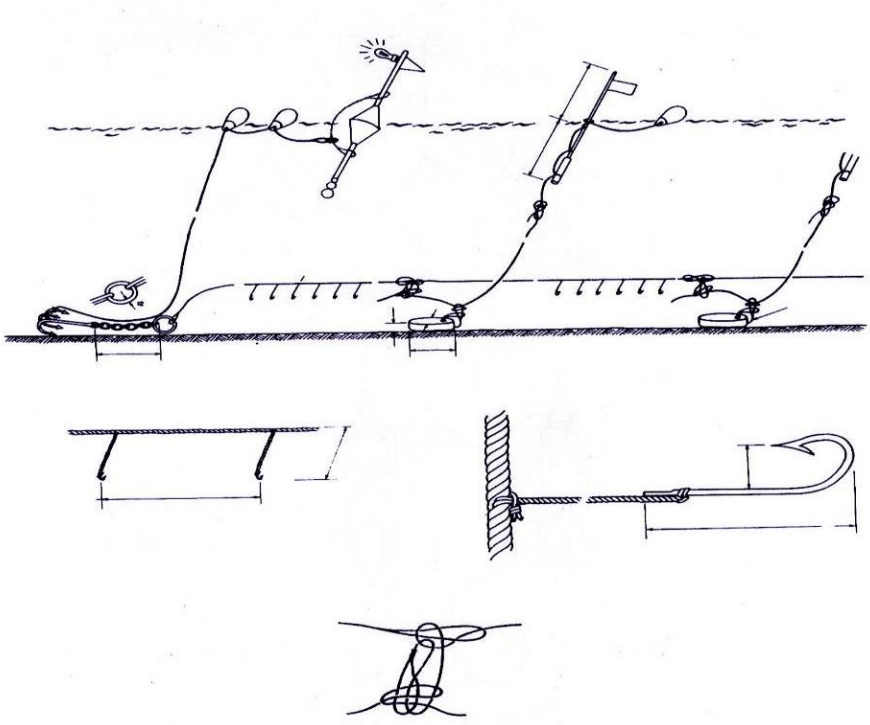


Fig7: Structure of long line

placed in the water column. This can be at the surface or at the bottom. Lines can also be set by means of an anchor, or left to drift. Hundreds or even thousands of baited hooks can hang from a single line. Long liners commonly target swordfish, tuna, halibut, stable fish and many other species[58].

In some unstable fisheries, such as the Patagonian tooth fish, fishermen may be limited to as few as 25 hooks per line. In contrast, commercial long liners in certain robust fisheries of the Bering Sea and North Pacific generally run over 2,500 hand-baited hooks on a single series of connected lines many miles in length[59].

Longlines can be set to hang near the surface (pelagic longline) to catch fish such as tuna and swordfish or along the sea floor (demersal longline) for ground fish such as halibut or cod. Long liners are fishing for sablefish, also referred to as black cod, occasionally set gear on the sea floor at depths exceeding 1,100 metres (3,600 ft) using relatively simple equipment. Longlines with traps attached rather than hooks can be used for crab fishing in deep waters.

Longline fishing is prone to the incidental catching and killing of seabirds, sea turtles, and sharks[60], but can be considerably more ecologically sustainable than some other commercially significant harvesting methods[61].

Pole and line Pole and line fishing (also known as bait boat fishing) is used to catch naturally schooling fish which can be attracted to the surface. It is particularly effective for tunas (skipjack and albacore). The method almost always involves the use of live bait (anchovies, sardines etc.) which is thrown overboard to attract the target species near the boat (chumming). Poles and lines with barbless hooks are then used to hook the fish and bring them on board. Hydraulically operated rods or automatic angling machines may be used on larger pole and line vessels.

Jigging Jigging is widely used to capture squid. A jig is a type of grapnel, attached to a line, which may be manually or mechanically jerked in the water to snag the fish in its body. Jig fishing usually happens at night with the aid of light attraction.

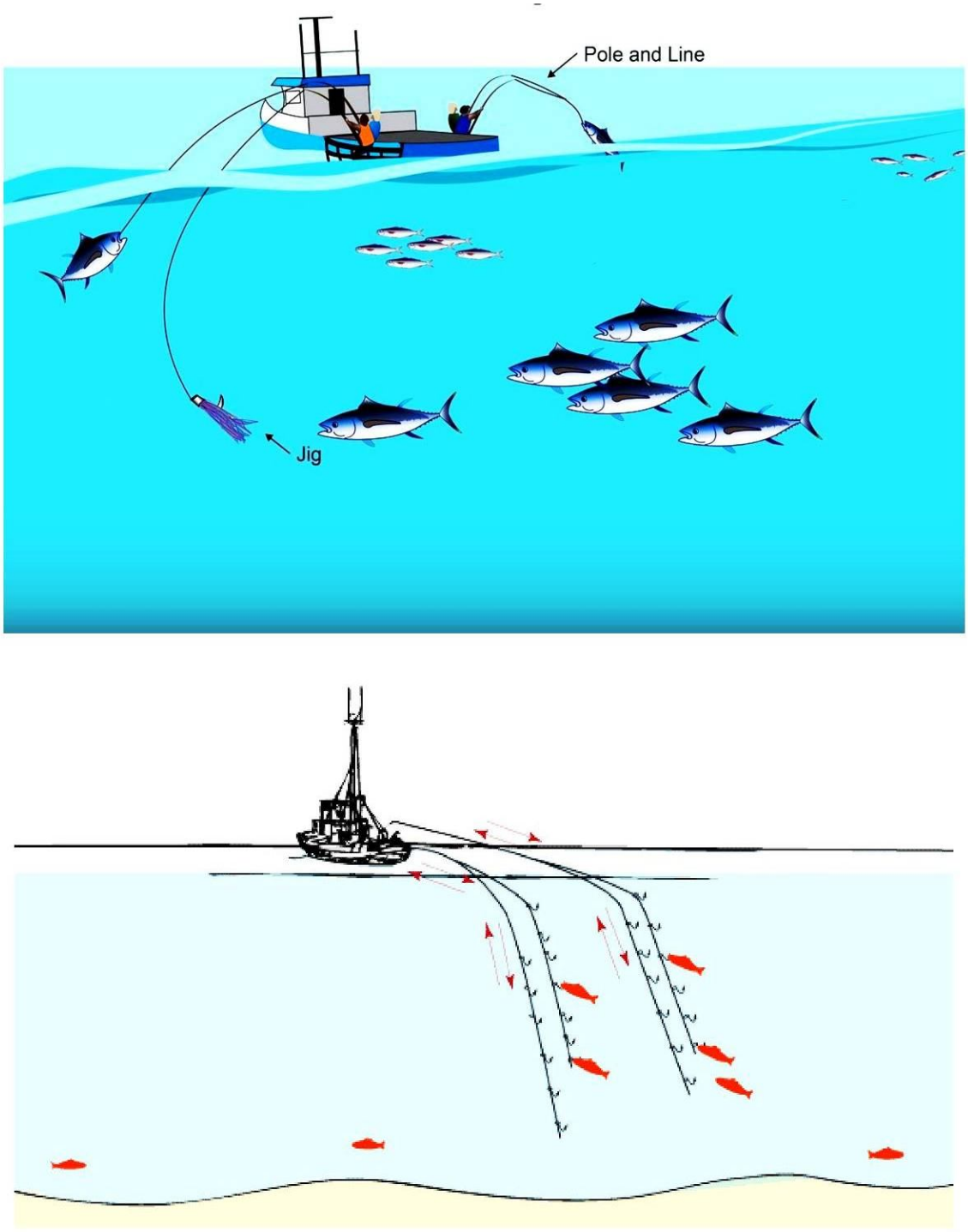


Fig.8: Pole and line and Jigging

Trolling - Trolling involves towing baited hooks or lures through the water. The method is particularly suited to the capture of pelagic predatory variety species of high individual value. Examples include tuna (albacore and skipjack), barracuda and salmon.

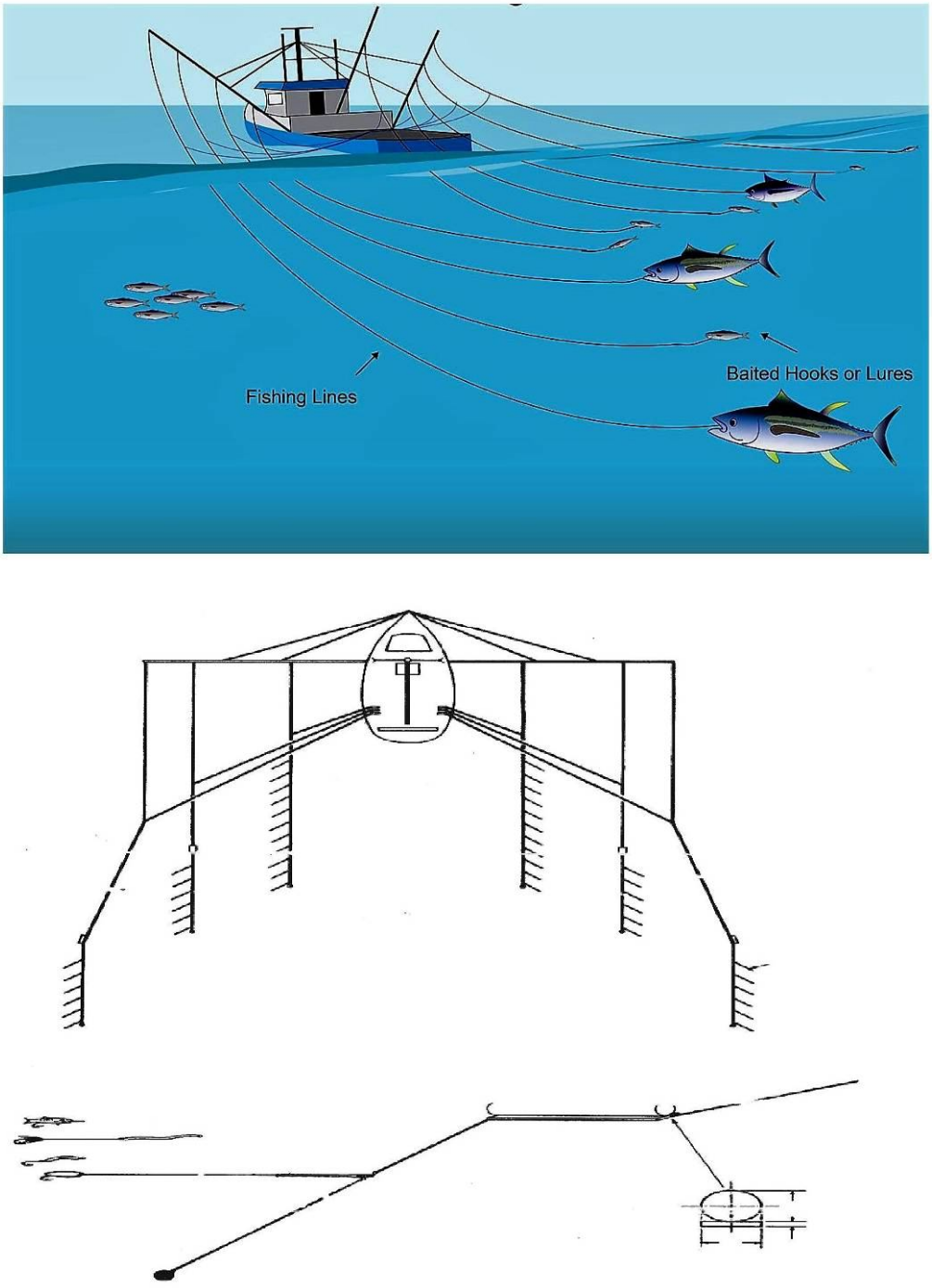


Fig.9.Structure of Trolling

Gill net Fishing Techniques and its development

Gill or Fixed nets:-Gill nets are walls of netting which may be set at or below the surface, on the seabed, or at any depth in-between. Gill netting is probably the oldest form of net fishing, having been in use for thousands of years. True gill nets catch fish that attempt to swim through the net, which are caught if they are of a size large enough to allow the head to pass through the meshes but not the rest of the body. The fish then becomes entangled by the gills as it attempts to back out of the net. The mesh size used depends upon the species and size range being targeted.

Drift net

A gill net that is allowed to drift with prevailing currents. Drift nets are not set or fixed in any way, are in fact 'mobile', and they are allowed to drift with the prevailing currents. Drift nets are used on the high seas for the capture of a wide range of fish including tuna, squid and shark, etc. Fishermen are, however, considering challenging the ban if 'pingers' (see below) are found to be successful in deterring marine mammals from entanglement and subsequent drowning in nets.

Tangle nets Tangle nets resemble gill nets but are slacker, shorter and have less flotation. This results in a looser-hung net that entangles species rather than gilling them.

Trammel nets Trammel nets are a wall of net divided into three layers. An inner fine-meshed net is sandwiched between two outer, larger meshed nets. The net is anchored at the base and floated by the headline, allowing it to hang vertically. The inner net is looser than the outer ones, ensuring that the fish become entangled within it.

Although static gears such as gill nets generally have less impact on the environment than mobile or towed gears they pose a particular problem for cetaceans (dolphins and porpoise). Methods to increase the 'dolphin-friendliness' of this fishing method include the attachment of acoustic devices or 'pingers' to the net to deter the animals; reducing the 'soak time',; i.e. the amount of time the net is left in the water; restrictions on the length of net used; and the introduction of closed areas to exclude fishermen from cetacean 'hot-spots'.

As gillnetting is a common fishing method used by commercial and artisanal fishermen of all the oceans and in some freshwater and estuary areas. “Gill nets are vertical panels of netting normally set in a straight line. Fish may be caught by gill nets in 3 ways: (1) wedged – held by the mesh around the body (2) gilled – held by mesh slipping behind the opercula, or (3) tangled – held by teeth, spines, maxillaries, or other protrusions without the body penetrating the mesh. Most often fish are gilled. A fish swims into a net and passes only part way through the mesh. When it struggles to free itself, the twine slips behind the gill cover and prevents escape. [62]

Gillnets are so effective that their use is closely monitored and regulated by fisheries management and enforcement agencies. Mesh size, twine strength, as well as net length and depth are all closely regulated to reduce by-catch of non-target species. Gillnets have a high degree of size selectivity. Most salmon fisheries in particular have an extremely low incidence of catching non-target species. [63]

Gillnets existed in ancient times as archaeological evidence from the Middle East demonstrates. [64] In North America, aboriginal fishermen used cedar canoes and natural fibre nets, e.g., made with nettles or the inner bark of cedar. [65] They would attach stones to the bottom of the nets as weights, and pieces of wood to the top, to use as floats. This allowed the net to suspend straight up and down in the water. Each net would be suspended either from shore or between two boats. Native fishers in the Pacific Northwest, Canada, and Alaska still commonly use gillnets in their fisheries for salmon and steelhead.

Both drift gillnets and set nets have long been used by cultures around the world. There is evidence of fisheries exploitation, including gillnetting, going far back in Japanese history, with many specific details available from the Edo period (1603–1868).[66]Fisheries in the Shetland Islands, which were settled by Norsemen during the Viking age, share cultural and technological similarities with Norwegian fisheries, including gillnet fisheries for herring[67]. Many of the Norwegian immigrant fishermen who came to fish in the great Columbia River salmon fishery during the second half of the 19th century did so because they had experience in the gillnet fishery for cod in the waters surrounding the Lofoten Islands of northern Norway[68]. Gillnets were used as part of the seasonal

round by Swedish fishermen as well[69]. Welsh and English fishermen gillnetted for Atlantic salmon in the rivers of Wales and England in coracles, using hand-made nets, for at least several centuries[70]. These are but a few of the examples of historic gillnet fisheries around the world.

Gillnetting was an early fishing technology in Colonial America, used for example, in fisheries for Atlantic salmon and shad. [71] Immigrant fishermen from northern Europe and the Mediterranean brought a number of different adaptations of the technology from their respective homelands with them to the rapidly expanding salmon fisheries of the Columbia River from the 1860s onward.[72] The boats used by these fishermen were typically around 25 feet (8 m) long and powered by oars. Many of these boats also had small sails and were called "row-sail" boats. At the beginning of the 1900s, steam powered ships would haul these smaller boats to their fishing grounds and retrieve them at the end of each day. However, at this time gas powered boats were beginning to make their appearance, and by the 1930s, the row-sail boat had virtually disappeared, except in Bristol Bay, Alaska, where motors were prohibited in the gillnet fishery by territorial law until 1951.[73]

In 1931, the first powered drum was created by Laurie Jarelainen. The drum is a circular device that is set to the side of the boat and draws in the nets. The powered drum allowed the nets to be drawn in much faster and along with the faster gas powered boats, fisherman were able to fish in areas they had previously been unable to go into, thereby revolutionizing the fishing industry.

During World War II, navigation and communication devices, as well as many other forms of maritime equipment (ex. depth-sounding and radar) were improved and made more compact. These devices became much more accessible to the average fisherman, thus making their range and mobility increasingly larger. It also served to make the industry much more competitive, as the fisherman were forced to invest more in boats and equipment to stay current with developing technology.

The introduction of fine synthetic fibers such as nylon in the construction of fishing gear during the 1960s marked an expansion in the commercial use of gillnets. The new materials were cheaper and easier to handle, lasted longer and required less maintenance

than natural fibers. In addition, multifilament nylon, monofilament or multi mono filament fibres become almost invisible in water, so nets made with synthetic twines generally caught greater numbers of fish than natural fibre nets used in comparable situations.

Nylon is highly resistant to abrasion and degradation; hence the netting has the potential to last for many years if it is not recovered. This ghost is of environmental concern. Attaching the gillnet floats with biodegradable material can reduce the problem.[74] However it is difficult to generalize about the longevity of ghost-fishing gillnets due to the varying environments in which they are used. This type of net was heavily used by many Japanese, South Korean, and Taiwanese fishing fleets on the high seas in the 1980s to target tunas. Although highly selective with respect to size class of animals captured, gillnets are associated with high numbers of incidental captures of cetaceans .

Set gillnets

Set gillnets consist of a single netting wall kept vertical by a float line (upper line/head rope) and a weighted footrope. Small floats, usually shaped like eggs or cylinders and made of solid plastic, are evenly distributed along the float line, while lead weights are evenly distributed along ground line. The lower line can also be made of lead cored rope, which does not need additional weight. The net is set on the bottom, or at a distance above it and held in place with anchors or weights on both ends. By adjusting the design these nets can fish in surface layers, in mid water or at the bottom, targeting pelagic, demersal or benthic species. On small boats gillnets are handled by hand. Larger boats use hydraulic net haulers or net drums. Set gillnets are widely used all over the world, and are employed both in inland and sea waters. They are popular with artisanal because no specialized gear is needed, and it is low cost based on the relationship of fuel/fish.[75]

Encircling gillnets

Encircling gillnets are gillnets set vertically in shallow water, with the float line remaining at the surface so they encircle fish. Small open boats or canoes can be used to set the net around the fish. Once the fish are encircled, the fishers shout and splash the water to panic the fish so they gill or entangle themselves. There is little negative impact

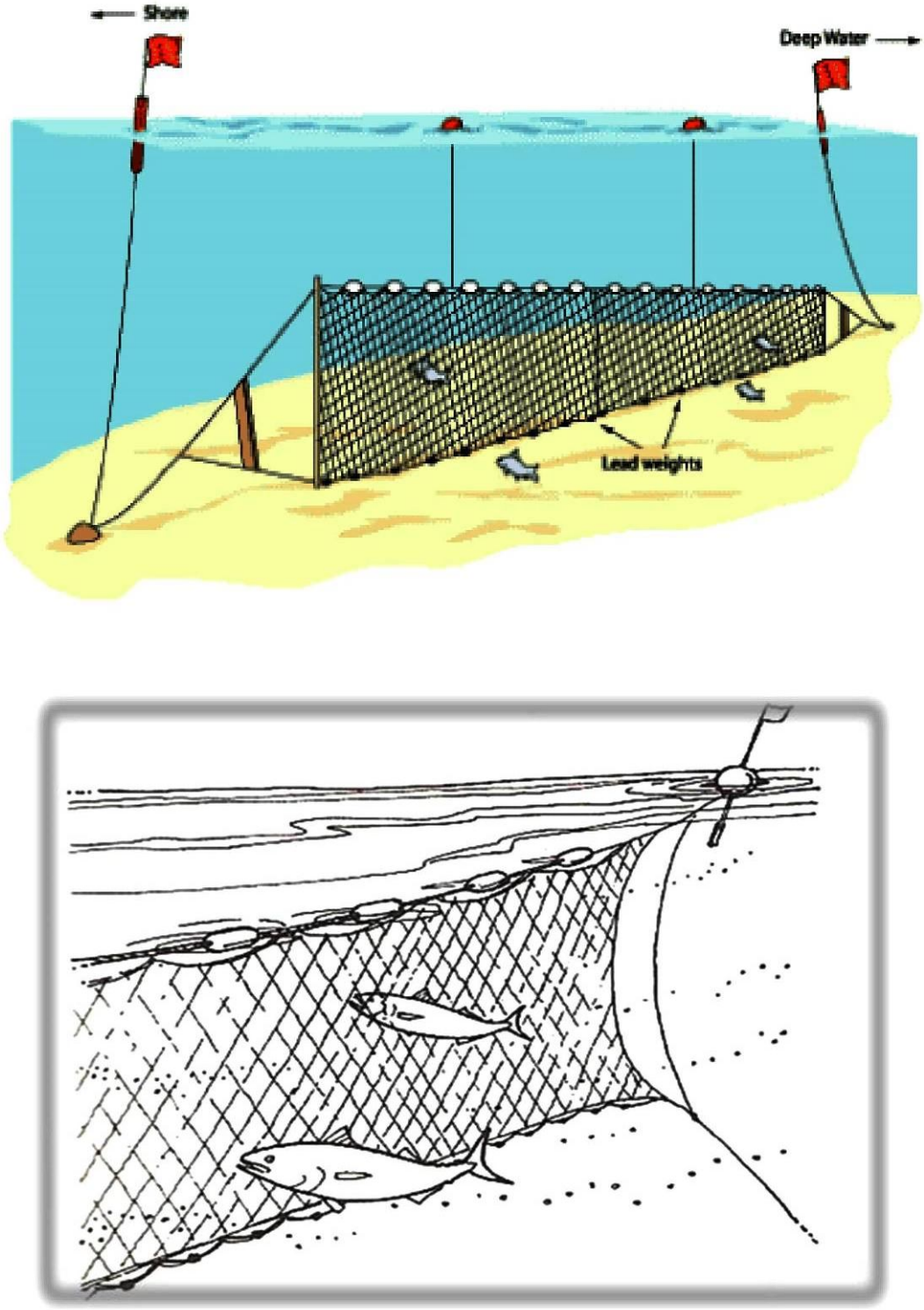


Fig.10: Structure of Gill nets

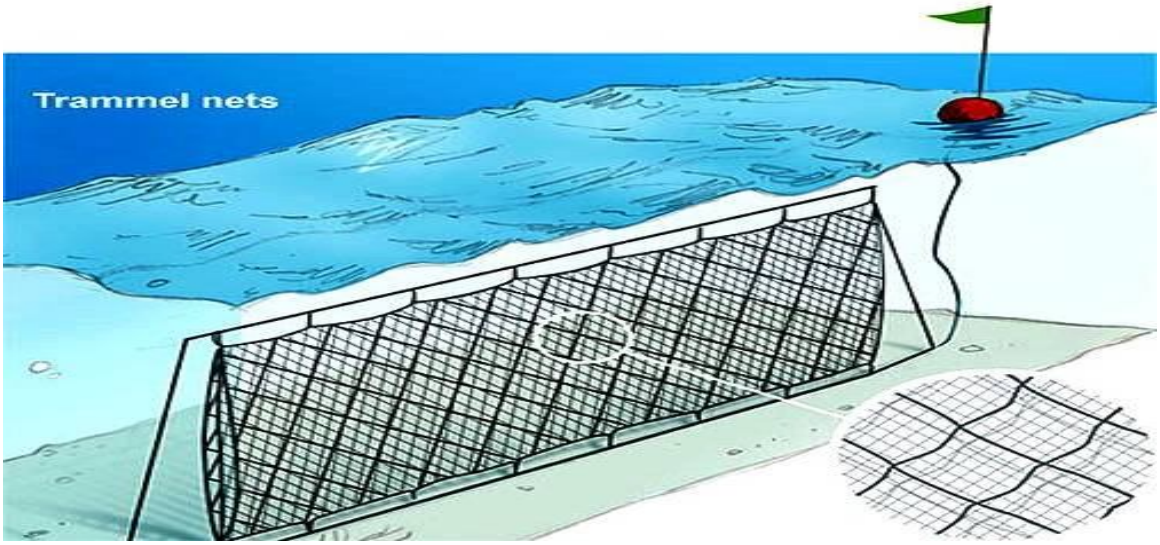
on the environment. As soon as the gear is set the scaring takes place and the net is hauled back in. The fish are alive and discards can be returned to the sea. Encircling gillnets are commonly used by groups of small-scale fishers, and does not require other equipment. [76]

Combined gillnets-trammel nets

This bottom-set gear has two parts:

1. The upper part is a standard gillnet where semi-demersal or pelagic fish can be gilled
2. The lower part is a trammel net where bottom fish can entangle.

The combined nets are maintained more or less vertically in the usual way by floats on the float line and weights on the foot rope. They are set on the bottom. After a time depending on the target species, they are hauled on board. Traditional combined nets were hauled by hand, especially on smaller boats. Recent hydraulic driven net haulers are now common. The gilled, entangled and enmeshed fish are removed from the net by hand. Of some concern with this method is ghost fishing by lost nets and by-catch of diving seabirds. Nets combined in this way were first used in the Mediterranean. [77]



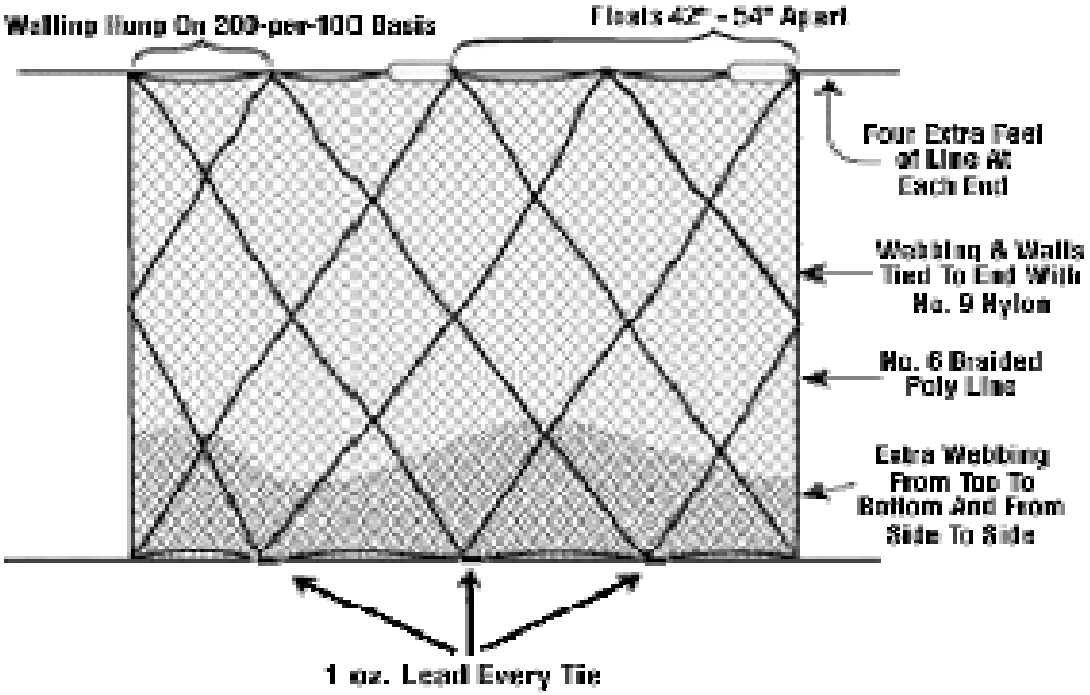


Fig.11: Trammel net

Drift gill nets

A **drift net** consists of one or more panels of webbing fastened together. They are left free to drift with the current, usually near the surface or not far below it. Floats on the float line and weights on the ground line keep them vertical. Drift nets drift with the current while they are connected with the operating vessel, the drift netter or drifter.

Drift nets are usually used to catch schooling forage fish such as herring and sardines, and also larger pelagic fish such as tuna, salmon and pelagic squid. Net haulers are usually used to set and haul driftnets, with a drifter capstan on the forepart of the vessel. In developing countries most nets are hauled by hand. The mesh size of the gillnets is very effective at selecting or regulating the size of fish caught. The drift net has a low fuel/fish energy consumption compared to other fishing gear. However, the issue of concern with this type of net is the by-catch of species that are not targeted, such as marine mammals, seabirds and to a minor extent turtles. The use of drift nets longer than 2.5 kilometres on the high seas was banned by the United Nations in 1991. Prior to this ban, drift nets were reaching lengths of 60 kilometres. However, there are still serious concerns with ongoing violations. [78]

Gillnets and entangling nets

The tangle net, or tooth net, originated in British Columbia, Canada, as a gear specifically developed for selective fisheries.[79] Tangle nets have smaller mesh sizes than standard gillnets. They are designed to catch fish by their nose or jaw, enabling by-catch to be resuscitated and released unharmed. Tangle nets as adapted to the mark-selective fishery for spring Chinook salmon on the lower Columbia River have a standard mesh size of 4-1/4 inches (10.8 cm.). Short net lengths and soak times are used in an effort to land fish in good condition. Tangle nets are typically used in situations where the release of certain (usually wild) fish unharmed is desirable. In a typical situation calling for the use of a tangle net, for instance, all fish retaining their adipose fins (usually wild) must be returned to the water. Tangle nets are used in conjunction with a live recovery box, which acts as a resuscitation chamber for unmarked fish that appear lethargic or stressed before their release into the water. [80, 81]

Fish traps techniques and its development

Trap fishing- A fish trap is a trap used for fishing. Which are made of nets and pots

Trap (nets)

Walls or compounds of netting are set out in a particular way and anchored to the seabed so that fish, once they have entered, are prevented from leaving the trap. In some cases, e.g. salmon traps, long leader nets are arranged from the shore to intercept migrating fish and guide them into the trap. Other species taken in traps include bass, herring and tuna.

The selectivity of trap nets is determined by the mesh size used. Undersized or unwanted fish may be returned to the sea alive. However, in many tropical or subtropical fisheries where there is a large mix in species and size range, many fish are likely to become gilled as they attempt to escape from the trap. Seabirds and mammals are also prone to becoming entangled in the nets.

Traps (Pots)

Pots (or creels) are small baited traps which can be set out and retrieved by the operating vessel. They are widely used on continental shelves in all parts of the world for the capture of many species of crustaceans and fish, together with octopus and shellfish such as whelks. Potting is a highly selective method of fishing, since the catch is brought up alive, and sorting takes place immediately, allowing unwanted animals to be returned to the sea, making the method potentially sustainable. However, in Britain, fishing effort in the potting sector is high, with currently no restrictions on the number and type of pot used or the amount of shellfish taken. Pots used to be constructed from ‘withy’ or willow, but are now constructed from plastic-coated or galvanised wire with nylon netting. This makes them virtually indestructible. Modern pots or ‘parlour pots’ are also more complex and fitted with ‘pot-locks’, making escape impossible for the crab or lobster entering it. These factors combined with mechanical hauling allow fishermen to haul more pots and to leave them on the seabed for longer, thus increasing efficiency and fishing capacity.

Fish traps may have the form of a fishing weir or a lobster trap. A typical trap might consist of a frame of thick steel wire in the shape of a heart, with chicken wire stretched around it. The mesh wraps around the frame and then tapers into the inside of the trap.

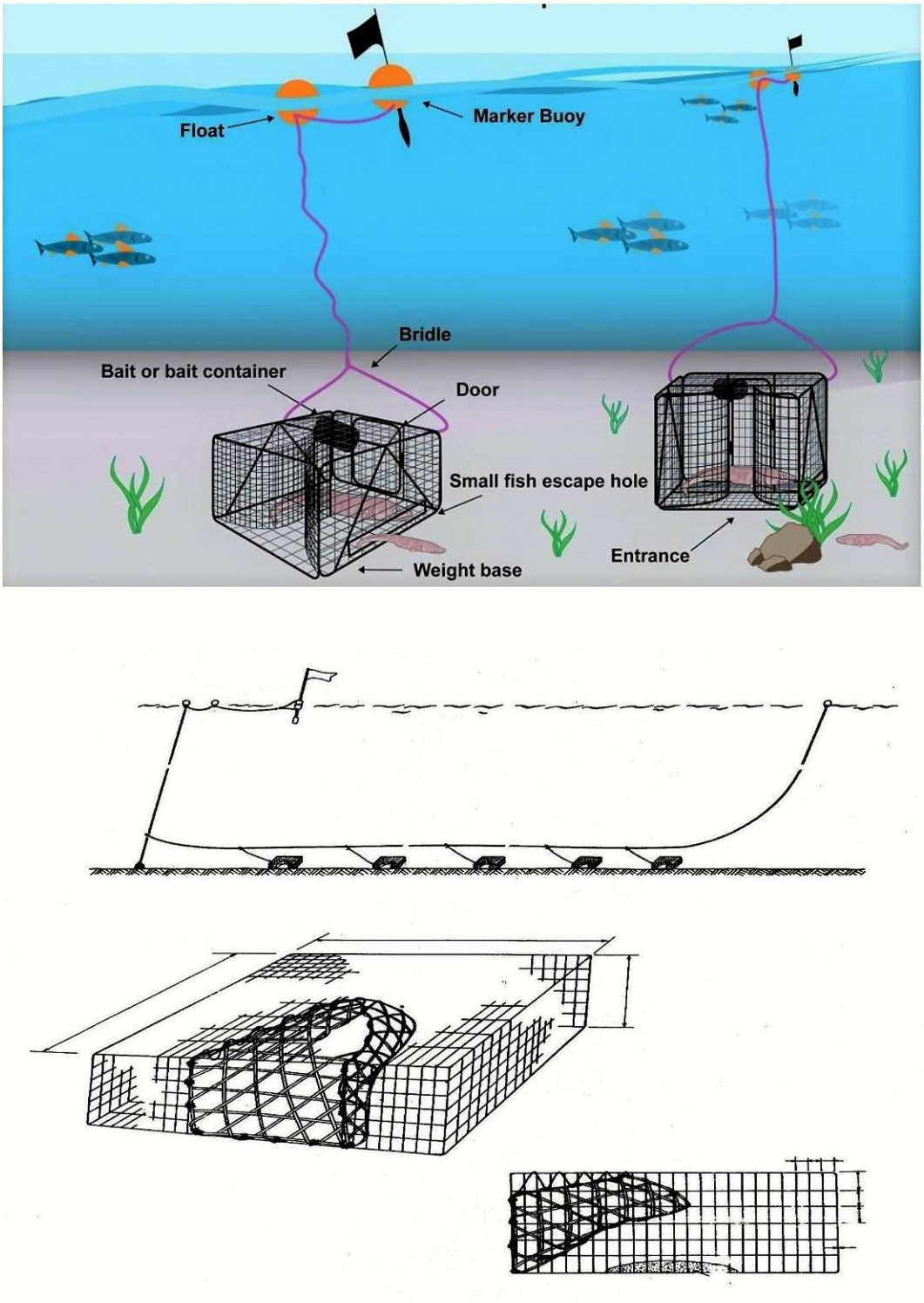


Fig.12.Trap fishing

When a fish swims inside through this opening, it cannot get out, as the chicken wire opening bends back into its original narrowness. In earlier times, traps were constructed of wood and fibre.

Traps are culturally almost universal and seem to have been independently invented many times. There are essentially two types of trap, a permanent or semi-permanent structure placed in a river or tidal area and bottle or pot traps that are usually, but not always baited to attract prey, and are periodically lifted out of the water.The Mediterranean Sea, with an area of about of 2.5 million km^2 (970,000 sq mi), is shaped according to the principle of a bottle trap. It is easy for fish from the Atlantic Ocean to swim into the Mediterranean through the narrow neck at Gibraltar, and difficult for them to find their way out. It has been described as "the largest fish trap in the world".[82]

The prehistoric Yaghan people who inhabited the Tierra del Fuego area constructed stonework in shallow inlets that would effectively confine fish at low tide levels. Some of this extant stonework survives at Bahia Wulaia at the Bahia Wulaia Dome Middens archaeologicalsite. [83].

In southern Italy, during the 17th century, a new fishing technique began to be used. The trabucco is an old fishing machine typical of the coast of Gargano protected as historical monuments by the homonym National Park. This giant trap, built in structural wood, is spread along the coast of southern Adriaticespecially in the province of Foggia, in some areas of the Abruzzese coastlines and also in some parts of the coast of southern Tyrrhenian Sea.

Indigenous Australians were, prior to European colonization, most populous in Australia's better-watered areas such as the Murray-Darling river system of the south-east. Here, where water levels fluctuate seasonally, indigenous people constructed ingenious stone fish traps.[84]. Most have been completely or partially destroyed. The largest and best-known are those on the Barwon River at Brewarrina, New South Wales, which are at least partly preserved. [85]. The Brewarrina fish traps caught huge numbers of migratory native fish as the Barwon River rose in flood and then fell. In southern Victoria, indigenous people created an elaborate system of canals, some more than 2 km long. The purpose of these canals was to attract and catch eels, a fish of short coastal

rivers (as opposed to rivers of the Murray-Darling system). The eels were caught by a variety of traps including stone walls constructed across canals with a net placed across an opening in the wall. Traps at different levels in the marsh came into operation as the water level rose and fell. Somewhat similar stone-wall traps were constructed by native American Pit River people in north-eastern California.[87] A technique called dam fishing is used by the Baka pygmies. This involves the construction of a temporary dam resulting in a drop in the water levels downstream allowing fish to be easily collected. [88]

Traditional fishing gears of West Bengal in artisanal sector

Total 20 types of net are extensively being used in estuarine and coastal areas of West Bengal, out of which gill nets (e.g., *Chhandi jal*) and bag nets (e.g., *Behundi jal*) are most commonly used in estuaries. Behundi jals are extensively used in winter fishing camps in estuarine and coastal areas of West Bengal. Traditional fishing gears with their technical specifications mentioned below**:**

Fixed net

1. **Behundi jal** This is basically a bag net. The main season of operation of this net is October to February and occasionally in monsoon. The shape of this net is conical with two long wings. The length overall, mouth and wing of this net are 23 - 46 m, 23 - 46 m and 6 - 8 m respectively. Mesh size ranges 7.5 cm at front, 5 cm at middle and 1.3 cm at cod end portion. The netting materials used for fabrication are polyethylene and polyamides. There are no floats or sinkers are used instead of these, bamboo sticks are used to fix this net which is operated by 8-10 fishermen. The major fish catch of this gear consist of locally called (*Pama pama*) Topse (*Polynemus paradiseus*), Pata (*Cynoglossus* sp.), Bhola (*Johnius* sp.), Phesa (*Setipinna phasa*), Late/Neheri (*Harpodon neherius*), Fite/Chhuri (*Trichiurus* sp.), Pangas (*Pangasius pangasius*) Chingri (various types of shrimp/ prawn) etc.
2. **Charpata jal** This is a kind of set-barrier gill net and its shape is rectangle. The net is operated throughout the year. The lengths and breadths of this kind of gear vary from 6 to 18 m and 2.5 to 3 m respectively. Mesh size ranges from 2 to 2.5 cm. The netting material used for this net is polyamide. There are no floats or sinkers.

Fig.13 Artisanal Traps

3. Bamboo stacks are used to fix the net. The net is operated by 4-6 fishermen. The major fish catch of this gear are (*Pama pama*), Pangas (*Pangasius pangasius*), Parsey (*Liza parsia*), Phesa (*Setipinna phasa*), Aar (*Aorichthys aor*) Bhetki (*Lates calcarifer*), Bhangon (*Mugil cephalas*) etc.

4. **Khalpata jal** The net is also rectangular in shape. The length and breadth of this net are 12 - 15 m and 3.5 - 4.5 m respectively. Mesh size ranges from 2 to 2.5 cm. The netting material used for this net is polyamide. There are no floats or sinkers. Bamboo stacks are used to fix the net. The net is operated by 6-8 fishermen. The operation season and major fish catch of this gear are same as Charpata jal.

5. **Charghera jal** The net is also a kind of set-barrier net which is rectangular in shape. The length and breadth of this net are 91 - 244 m and 4.5 - 7 m respectively. Mesh size ranges from 2.5 to 3.8 cm. The netting material used for this net is nylon. There are no floats or sinkers. Bamboo stacks are used to fix the net. The net is operated by 10-12 fishermen. The net is used throughout the year and major fish catch of this gear are Parsey (*Liza parsia*), (*Pama pama*), Pangas (*Pangasius pangasius*), Phesa (*Setipinna phasa*), Aar (*Aorichthys aor*) Khoira (*Gudusia chapra*), Bhola (*Johnius* sp.) etc.

i) Drift net

1. **Chhandi jal** The shape of this net is rectangular. The length of this net is about 300 m (50 pcs) and the breadth is 3 - 3.5 m. Mesh size ranges from 7.6 to 10.1 cm. The netting material used for this net is nylon. There are no floats or sinkers. The net is operated by 5-6 fishermen. The main seasons of operation of this net are monsoon and winter- June to March and occasionally in summer months. But, the intensity is greater in monsoon. The major fish catch of this gear is Ilish (*Tenualosa ilisha*).

2. **Sangley jal** The shape of this net is elliptical. The length and breadth of this net are 6 - 7.5 m and 4.5 m respectively. Mesh size ranges from 3.8 to 5 cm. The netting material used for this net is nylon. There are no floats or sinkers. The net is operated by 2-3 fishermen. The seasons of operation are same as the Chandi jal. The major fish catch of this gear is Ilish (*Tenualosa ilisha*).

Fig.14: Artisanal Nets

3. **Chata jal** The shape of this net is elliptical. The length and breadth of this net are 9 - 10.5 m and 6 m respectively. Mesh size is about 5 cm. The netting material used for this net is nylon. There are no floats or sinkers. The net is operated by 2-3 fishermen. The major fish catch of this gear is Ilish (*Tenualosa ilisha*).

4. **Fandi gunti** The shape of this net is rectangular. The length and breadth of this net are 60 - 90 m and 3 -3.5 m respectively. Mesh size ranges from 6.3 to 7.5 cm. The netting material used for this net is nylon. There are no floats or sinkers. The net is operated by 10-12 fishermen. Bigger varieties of fishes are caught by this gear.

5. **Sele jal** The shape of this net is rectangular. The length and breadth of each net are 3.5 - 4.572 m and 4.5 - 6 m respectively. Mesh size ranges from 15 to 25 cm. The netting materials used for this net are nylon or decron. There are no floats or sinkers. Each net is operated by 4 fishermen. Mainly Sele (*Polynemus tetradactylus*) fish is caught by this gear.

6. **Bin jal** This net is square in shape. The length of each net varies between 12 - 15 m. Mesh size ranges from 5 to 6.4 cm. The netting material used for this net is polyethylene. There are no floats or sinkers. Each net is operated by 6 fishermen. The main seasons of operation are November to June and occasionally in monsoon. Bigger varieties of fishes are caught by this gear.

ii) Drag net

1. **Ber jal** This is one kind of medium/ small sized seine net and the shape of this net is rectangular. The length and breadth of each net are 4.5- 6 m and 6-7.5 m respectively. Four to five pieces of this gear are operated at a time. Mesh size ranges from 2.5 to 6.3 cm. The netting material used for this net is polyamide. There are no floats or sinkers. Each net is operated by 4 fishermen. The net is operated in all the seasons except monsoon. All types of fish are caught by this gear.

2. **Kachal jal** This is a large sized seine net and the shape of this net is rectangular. The net is operated mainly in the coastal region of lower estuary. The length and breadth of each net are 12 – 18 m and 6 – 9 m respectively. Mesh size ranges from 2.5 to 3.8 cm. The netting materials used for this net are not known clearly. There are no floats

or sinkers. The each net is operated by 4-6 fishermen. The main season of operation of this net is November to February and occasionally in monsoon. The major fish catch of this gear are Bhetki (*Lates calcarifer*), Pungas (*Pungasius pungasius*), Ilish (*Tenualosa ilisha*), Phasa (*Setipinna phasa*),(*Pama pama*), Gurjaoli (*Lutjanus joni*), etc.

3. **Jangla jal** This is also a large sized seine net and the shape of this net is rectangular. The length and breadth of each net are 12 – 15 m and 6 - 9 m respectively. Mesh size ranges from 2.5 to 3.8 cm. The netting material used for this net is polyamide. There are no floats or sinkers. The each net is operated by 4-6 fishermen. The operation seasons, area and the major fish catch of this gear are same as Kachal jal, described earlier.

4. **Jagatbar jal** The shape of this net is rectangular. The length of each net is 1524 m or more and breadth is 3 – 9 m and it is used in several pieces. Mesh size of this net is about 2.5 cm. The netting materials used for this net is not clearly known. There are no floats or sinkers. Each net is operated by 20-30 fishermen. All types of fishes are caught by this gear.

5. **Chartana jal** The shape of this net is rectangular. The length and breadth of this net are 30 - 38 m and 2.5 - 3 m respectively. Mesh size ranges from 2.5 to 3.8 cm. The netting material used for this net is polyamide. There are no floats or sinkers. Each net is operated by 4-6 fishermen. The major fish catch of this gear are Bhetki (*Lates calcarifer*), Pungas (*Pungasius pungasius*), etc.

6. **Hatjali** The shape of this net is rectangular and it is made up of bamboo frame. The length and breadth of this net are 1 - 1.5 m and 0.5 - 1 m respectively. Mesh size ranges from 0.6 to 1.0 cm. The netting material used for this net is nylon. There are no floats or sinkers. Each net is operated by single fishermen. Bagda seeds are mainly caught by this gear.

iii) Cast net

1. **Khepa/ Khepla jal** The net is circular in shape. The radius of this net varied between 3.5 - 5 m and the mesh size ranges from 0.6 to 2.5 cm. Multifilament is

used as netting material. There are no floats but have sinkers. Each net is operated by single fishermen, throughout the year. Small and medium size fishes and prawns are caught by this gear.

2. **Bachari jal** The net is also circular in shape but bigger in size. The radius of this net varied between 9 - 12 m and the mesh size ranges from 2.5 to 7.5 cm. Multifilament is used as netting material. There are no floats but have sinkers. Each net is operated by two to three fishermen, throughout the year. Mainly cat fishes are caught by this gear.

iv) Lift net

1. **Seitki** The net is triangular in shape. The arm of this net varied between 1.5 – 3 m and the mesh of this net is very fine, like a mosquito net. Mainly monofilament is used as netting material. There are no floats and sinkers. Each net is operated by a single person but sometime two are found. Mainly children and women operate this type of gear. The net is operated throughout the year but mostly in the monsoon season. Mainly prawns and prawn seeds are collected by this net.

2. **Veshali** The net is also triangular in shape. The arm of this net varied between 10 – 20 m and the mesh size of this net is bigger than Seitki jal but very small in size i.e. 0.3 to 0.6 cm. mainly monofilament is used as netting material. There are no floats but sometimes sinkers are found. Each net is operated by a single person but sometime two are found. The net is so fitted that after removing the catch when the man removes his weight it sinks automatically. The net is operated throughout the year. Mainly small sized fish, prawns and prawn seeds are collected by this net.

Fig.15: Operation of Indigenous Traps -1

Fig.16: Operation of Indigenous net fishing

Fig.17: Traps

Fishing boat building technology and its development

The beginnings of boat building technology in India go back to the Third Millennium BC, to the Harappan times. The Harappans (or Indus Civilization) constructed the first tide dock of the world for berthing and servicing ships at the port town of Lothal [89]. The discovery of the Lothal port and dock in 1955 highlighted the maritime aspects of the Indus Civilization. At Lothal a trapezoid reservoir measuring on an average 214 x 36 meters has been excavated, and has been identified as a dockyard. It is riveted on all four sides with continuous dry masonry burnt-brick walls, 4-courses wide, which at its greatest extant depth reaches to 3m (but might have been originally much higher). The structure was stratigraphically connected to the old riverbed of Sabarmati. Towards the southern end there is a broad and relatively shallow gap. This has been supposed to be the inlet channel of the dock. Leading from the southern wall is a narrow brick water passage, said to have functioned as a spill channel, when fitted with a sluice-gate. According to S.R.Rao, the dock has been used in two stages, at the first stage it was designed to allow ships 18-20 meters long and 4-6 meters wide. At least two ships could simultaneously pass and enter easily. In the second stage, the inlet channel was narrowed to accommodate large ships but only single ships with flat bottoms could enter. The terracotta models of a boat from Lothal and engravings on Indus seals give some idea of ships going to the sea. Lothal is situated near Saragwala village, about fifty miles southwest of Ahmedabad. It lies in a level plain between the Bhogava and Sabarmati rivers and at present is some twelve miles from the Gulf of Cambay coast. The siltation rate of the Sabarmati delta is known to be rapid, so that in former times the site may actually have been nearer the sea. Lothal, with its large market and a busy dock, was a great emporium where goods from neighboring towns and villages, such as Rangpur, Kath etc. were sold in exchange for imported and locally manufactured ones. Lothal had developed overseas trade with the West Coast of India on the one hand and the Mesopotamian cities through the Bahrain islands on the other. Among the manufacturing industries of Lothal bead making, ivory and shell working and bronze-smithy were very important. For the land transport they used bullock carts and pack animals for long distance trade. For inland waterways, flat-bottomed boats of the type suggested by the terracotta models were used. In this connection it may be noted that even today flat-

bottomed boats made of reeds are used for carrying men and light goods. Perhaps the Harappans used similar boats in the lakes and rivers also. Trade on the high seas and along the coast was possible because the ships were fitted with sails.

Harappans not only built a unique dock but also provided facilities for handling cargo. There were other smaller ports such as Bhagatrav, Sutkagendor and Sutkakah, and perhaps a large one at Dholavira, all in Gujarat. An engraving on a seal from Mohenjodaro represents a sailing ship with a high prow; the stern was made of reeds. In the center, it had a square cabin. Out of five miniature clay models of boats one is complete and represents a ship with sail. The latter has a sharp keel, a pointed prow and a high flat stern. Two blind holes are also visible. One of them seen near the stern was meant for the mast, and the other on the edge of the ship may be for steering. In the second model, which is rather damaged, the stern and the prow were both curved high up as in the Egyptian boats of the Garzean period. The keel is pointed and the margins are raised. A hole made a little away from the center was meant for the mast. In this case, the prow was broken. Three other damaged models found at Lothal have a flat base and a pointed prow, but the keel is not pointed nor is there any hole for fixing the mast. Apparently these flat-based craft were used on rivers and creeks without sail, while the other two types with sail and sharp keels plied on the high seas and were berthed in the deep waters of the Gulf. Probably the canoe types of flat-based boats were the only ones, which could be sluiced at high tide. Another type of boat can be reconstructed from the paintings on two potsherds. It represents a boat with multiple oars. The Harappan ship must have been as big as the modern country crafts, which bring timber from Malabar to Gogha. On this analogy it can be assumed that a load up to 60 tons could be carried by these ships. The sizes of the anchor stones found in the Lothal dock also support this view [90,91]

It is a recorded fact that Pushyadeva, the ruler of Sindh (now in Pakistan) pushed back the formidable Arab navy attacks in 756 AD, which only indicates his marine prowess. The historical text *Yuktikalpataru* (11th Century AD) deals with shipbuilding and gives details of various types of ships. Boats used for different purposes were called by different names such as *Samanya*, *Madhyama* and*Visesha* for passenger service, cargo, fishing and ferrying over the river. The earliest reference to maritime activities in India

occurs in *Rigveda,* "Do thou whose countenance is turned to all side send off our adversaries, as if in a ship to the opposite shore: do thou convey us in a ship across the sea for our welfare" (*Rigveda,* 1, 97, 7 and 8).

The technology of boat building was a hereditary profession passing from father to son and was a monopoly of a particular caste of people. The local builders used the hand, fingers and feet as the units of measurements. In different places different kinds of boats were built for specific purposes. These boats may bear some similarity in material, techniques or in shape and size. For the construction of ship, the teak (*Tectona grandis*) wood is generally employed in India, though the selection of wood depends upon the nature and type of craft.

Technology

The traditional construction of a boat starts with the laying of a keel (keel is foundation beam for the boat and ship), a massive piece of wood supported on a branching stern about a foot above the ground at both ends. This is stepped to take the stern-post (rearmost part of a ship or boat) and also the stem post (the pointed front part of a ship or boat), all made of massive pieces of timber. The keel is laid first and later the planks or ribs are attached. Usually for the keel and stern one single piece of wood is always preferred. The planks are then fastened horizontally on either side of the keel. The planks join is edge to edge. Rudder is a flat broad piece of wood, which is mainly used for getting a forwards lead to the expected direction and is not seen in all traditional crafts. In some crafts the rudder is replaced by a paddle or oars, which function as a rudder. Paddle is a short oar with a broad blade at one or both ends and oar is a pole with a flat blade used in rowing. These are necessary for a straight and swift movement of the vessels. Generally all the ships use the wind power. In the ship the mast is fixed on ribs above the keel. The mast is made out of a timber tree but the builders prefer a bamboo piece, because of its suitability to make a mast long, and strong. Sail is a sheet of canvas spread to catch the wind and move a boat or ship forwards. It is used in traditional vessels; the shape of sail is triangular to make it easy to catch the wind. Sails are fixed to the mast with ropes. The sails are used mainly when the vessels are going to the mid sea, so that they can make use of the maximum wind energy.

Traditional Boat-building in various states of India

In India, there are various places that have the traditional boats and boat building technology. The Andhra coast is known for 4 types of traditional boats constructed for cargo transport, fishing and ferrying purposes, which are catamarans (teppa), dugout canoe, stitched-planks-built boats and

Nailed-planks-built boats. Generally the types of wood used for boat building in Andhra Pradesh are grannari karra (*Egesa: Acquicia canilotica*), arcini karra (*Melia dubia*), cinntha karra (*Albizzia* sp.), rai karra, teak, circini karra (*Anogeissus* sp.), mamidi karra (Mango: *Magnifera indica*), sal (*Shorea robusta*), Indian laural (*Terminalia tormentosa*) and maddi (*Alianthus malabarica*). Teppas are simple floating devices, but are the predominant traditional sea craft along the Andhra Pradesh. Some keeled planked boats locally called *padavas* are also common vessels along the Andhra coastline. In Andhra these traditional boats are constructed at Nellare, Prakaram, Godavari and Guntur districts.

Boats in Karnataka region are called by different names depending on their use. The smallest craft of this region is known as canoe (*hudi*), which is scooped out of a singletree trunk. The middle-sized craft is known as boat (*doni*) and the biggest craft is known as ship (*machchwa*). Most ships use wind power. The art of shipbuilding is a monopoly of a class of people known as *mestas* or *acharis* (carpenter). The type of wood used for shipbuilding is known as *kshatriya*, which is mentioned in *Yuktikalpataru*. The common wood used for shipbuilding is matthi, sagouy, teak, honne, undi and hebbals. Teakwood is used rarely because of its high coast.

Raft, dugout and plank built boats are the main traditional types in the Kerala coast. Raft is made of a number of roughly shaped logs fastened together in order to float down a river or to serve as a boat. Dugout is single log craft, which is scooped out in the middle. It is employed all over Kerala for catching fish. Planked built boats are further classified into 2 categories: one is stitched and the second is built with nailed planks. Stitched-planked built craft is manufactured by using coir and synthetic ropes. Generally, the types of wood used for shipbuilding in Kerala are alpassi, mullumurukku or panniclavu (*Ceiba pentandra*), perumaram/alanta (*Alianthus excelsa*), pilivaka (*Albizzia falcatria*),

malamurukku (*Samanea saman*), pilavu (*Artocarpus integrifolias*), mavu (*Magnifera indica*), ayini/annili (*Artocarpus hirsuta*), punna (*Callophyllum inophyllum*) and cadacci (*Grewia tiliaefolia*). The bending process is purely based on traditional method by applying a kind of fish oil or cow dung on the planks.

The traditional boat builders of Chilika region in Orisa are called Bindhani, Barhais and Biswakaramas (carpenters). They build small flat-bottomed boats known as *nauka* or *danga*. Sal is used for construction of nauka. The knowledge of boat building has come down as a family tradition. Bamboos are used as mast, locally called *gudda.*

The boat builders and ships have been depicted in the brick temple in the district of Midnapore, Birbhum and Bankura in Bengal. The vessels are classified as raft, dugouts and cargo carriers and are used for commercial purpose. Dinghy is a one-man passenger boat in Bengal. It is unique for its features and movement in the river. The boatman squats at paddling on the low sharp stem to maneuver in the zigzag path of the river. A neat cabin with semicircular roof occupies the space available in the middle of the boats. A tall bamboo mast is generally used for long distance travel. In Bengal, small boat is never used except as cargo carriers. The steering paddle is the most remarkable feature of the cargo carriers (*Malbahi nauka*).

Now a days, in Bombay there are no boat building yards to be found in or around, except may be at Varai and Versova. Available wild woods are commonly used for construction of boats and ships. They are not very expensive. The main types of wood that are utilized today are sal, babul, ain, bibla, jambul and punnai, but the teak wood is always the best for ship and boat building and is preferred in Bombay too. Ain wood is sometimes used for building a major portion of the boat. It is a hard wood and very similar to teak in its properties.

In Lakeshadweep, coconut tree is locally available in abundance, thus coconut wood is still used in local boats, but it is difficult to say with authority, what made early boat builders to use coconut wood. Coconut wood is now used for bulwarks, masts, cross

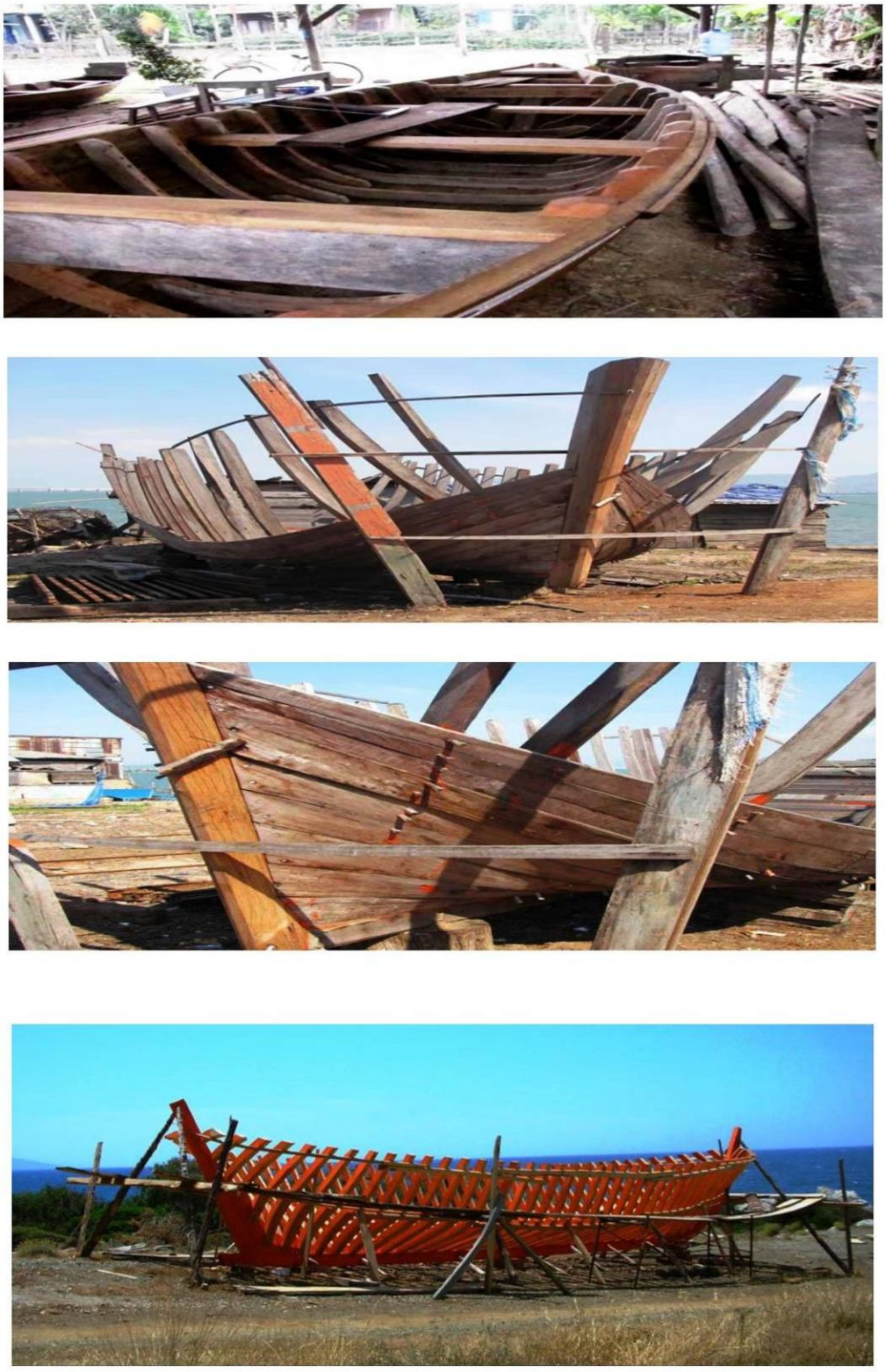


Fig.18: Stages of Boat construction

stays, sides ribs, etc. and for cabin removable thatched roofs etc. Mango or breadfruit tree wood is also used. Boats of Lakeshdweep can broadly be divided into two categories based on their use: trading vessels and fishing vessels. Bareues, odies, bandodies, dweep odam or valiya odam are some trading vessels and tharappan, odam, mas odi, odi jahadhoni, mahadha dhoni, kelukkam dhoni, allam dhoni or dhoni, ara dhoni are some fishing crafts and jhaha dhoni is a race boat in Lakeshdweep. Stand odam is the most widely used typical boat of Lakeshdweep. Boats in Lakeshdweep are not built for sale, but only for the use of islanders.

Indian boat technology and navigational knowledge goes back to the III Millennium BC. Traditional boat builders could make ships, which were fully sea-worthy and could sale to West Asia. But now all over India the traditional boat building technology is in a declining condition due to changes of technology and advancement in mechanized systems. This is best exemplified in Andhra Pradesh by the use of catamarans, which are being manufactured from synthetic materials in small-scale industries. These synthetic catamarans are now a day preferred by traditional fisher folk because of their longevity, payload, cost, range and easy manoeurability. Several manufacturing industries have come up in the Srikalulam and Ganjam districts of Orissa. There are hardly a few places in India such as Kakinada, Cuddalore, Beypore and Veraval engaged in construction of sea going vessels at present. Now a days traditional boats are only used for crossng rivers, coastal transport and fishing. It is however satisfying to note that traditional boat building technology is being harmoniously combined with modern technology to produce more efficient vessels.

Traditional fishing technology of Sundarban

The people of Sundarban and its adjoining areas are always very simple and poor. Traditionally they cannot think of a high and developed life. Their lives are mainly based on fish and Agriculture. These two means of living provide them with food and clothing. Traditionally each family got a small piece of paddy land which is not enough for them to maintain their family smoothly. They can depend on their agricultural land only two or three months as a result they had to seek other means to keep smooth existence of their lives. In order to save their lives from hunger and poverty they quietly entered into the nature and began to fight. They fought in different fields. Fishing was one of them.[**92**221]

From the story told by the forefather, at first the most simple and primitive form of fishing was Adopted catching the fish with bare hands. Next they began to use some simple tools like arrow, hook of different kinds and bamboo made implements like harpoons and spears. Sometimes fishing was accompanied with hunting. [93] Someone placed hunting before fishing while others took it different. The people of this region hunted fish as well as birds, Mammals and even water serpent. They also used to hunt frogs, turtles and tortoise for their need.

The fishing ground of the Sundarbans where the people of the locality would catch fish were of different sections –

a. Local people (near to the forest)

b. People of the adjoining areas (from different P.S. and villages)

c. People of the abroad and Far off districts &

d. The fishing ground may be classified into three or more zones.

At first it may be mentioned restricted zones, where fish catching needs permission from the forest departments. This zone is most liking zone as a fishing ground. Though they have to pay some taxes for fish catching. In order to earn their livelihood they would go to the remotest corner of the forest to collect ticket from the forest department and caught fish. In this process they would live in the forest for more than three or four months and caught fish with the help of indigenous Methods and techniques. In this phase of fish catching they (People) would take two or three boats of different size with them. [94] Each party was comprised of five or six persons. Everyone would work together for a common interest that is to earn their livelihood. Several Such parties were engaged in fishing in the Sundarban for a particular time. Every party would have taken two and three boats with them. One big other two were smaller in size. By using small boat – they (fishermen) would reach the remotest corner of the canal. The canal (usually was very narrow) would end in the " Chetali" that means the sandy tract (Some flat places of Sands) In this phase (the people) would use small boat made of plank of (2 inch) of Nut tree. The planks were tape like phenomenon. It is a wonderful kind of boat. [95]

A.Different Kinds of Boat How could they unite this plank together is a Question of surprise. But they did it. They would make this boat with the help of the Gum of Gub

fruit. Some dust of wood collected from saw mills and small nails or (tar kata). They also make

Doyel Boat The back side of this boat is like the Plume of the Doyel bird. Wooden planks are used to make this boat. These kinds of boats can be frequently seen in the canals of Sundarban. Two and three Men are required to catch fish by this boat. It can easily float in the shallow water of the narrow canal of Sundarban and Fishermen can easily reach to the "Chetali" i.e. (The end of the Canal) and can gather fish with hands. No nail or Spike is used to make this boat.

Thonga boat These kinds of boat are largely used in the canals lies interior of the Sundarban. The wooden planks and tarkata (nails or patam) are used to make these boats. They are also used to catch fish in the narrow canals of the Sundarban. Fishermen like this boat because they can go to the end of the canal without facing any kind of trouble under shallow water. These boats are suitable, they can overtake the Hidden danger under water caused by "Mura" (i.e. old sharpen back portion of the fallen tree.) not seen from the surface of the canal and can damage fishermen boat in the twinkle of an eye. These thonga boats are so strong in construction that they can break "Mura".

Donga boat One big tree's lower portion is needed to make this boat. Only the big stem is taken and with the help of Chejal wood is taken out and very simple boat is prepared without much labour. Fishing becomes very easy by using this boat. Fishermen can go anywhere interior in the Sundarban. This boat can float on very shallow water. Their boat is the remarkable sign of indigenous technology, which is largely used by the fishermen of Sundarban.

Dinghiees (Modern name canse) Planked hulls have been made for more than hundreds of years throughout the Sundarban and its adjoining areas. Their importance is diminishing but 80% of the fishermen are still using them. Several variations of planking are commonly used. In carved planking, the outside planking is laid edge to edge giving the hull a smooth surface. If the planks are very narrow (2.5- 4c.m wide) and wedged together with the edges fastened, the method is called strip planking. Marine glue is used to keep the seas water light. In clinker planking, each plank overlaps the upper edge of the plank below and is attached to it by nails driven from the outside. This variation is strong and flexible and is ideal for such small craft as dinghiees. Dinghiees are used for

several purposes. Fishermen use this boat to keep link with the big boat anchored in the big river or in the Bay of Bengal. Big boat which is anchored in the Big River is used as store room of the fishermen. Their necessary equipments are kept in this boat. Their drinking water, firstaid Box, Gears of different Kinds, Rice and other things are kept in it.

Dinghiees are suitable for catching fish in the canals and Khals. It can reach at the end of the canal as a result when fish are gathered on the chatra (Flat smooth place lies at the end of the Khal) The fishermen catch fish of different kinds with their hands and then they are classified according to their class and kinds. As the bottom part of the Dinghiees are flat, It can create pressure on the muddy bottoms of the Canal and the fish run in fear as a result they can accumulate on the (chetali) i.e. At the end of the canal the fishermen catch them quickly by hand. [96]

Vella or Bheya (modern name Raft) It is also an important kind of boat. Fishermen who live near Sundarban use this boat as apparatus to catch fish or crab Some 10 or 12 more than that stem of Banyan tree are jointly tied together. The Stems are not placed side by side, in order to make body thick. They are placed one upon another, so that they can float on the surface of the water easily. No nail or glue is used to make this boat. Sometimes some bamboos are used to make this vella. Bamboos are equally can serve the purpose of banyan tree. This indigenous practice has saved much labour and money of fishermen. Without costly wooden planks. Wire glue. Nails, boat can be made. They can move in big rivers as well as in the narrow ones. Crab catching has been very easy in the Sundarban areas by using this vella. One man is sufficient to row this vela across the river. One man can catch fish or crab by riding this boat. Such low cost technology is almost indigenous.

The system of catching fish and pisciculture is mainly depending on the physical labour – It also needs skill and techniques. The fishermen of the Sundarban have earned their knowledge and experience gradually from their forefathers. Nets and boats are main equipments of production. Two Kinds of the technologies were used for making fishing boats. The modern name rubetting and cauking method were unknown to them yet they knew the system. Wooden planks of the boat were joined by wooden screws, but later on iron Screws were used to join the pair of wooden planks. These kinds of boats were not suitable to catch fish in the saline water. So to make their business easy they followed

cauking method. Though they did not know the English name at that time. The system may be called native technology. The plank of woods were joined by the paste of jute, ashes of burnt wood, bulk of trees, and juice of Gub etc. Sometimes crumbs Or powder of wood were collected from the saw mill and were mixed with Gub juice. Thus preparing the mixture, it would be used to make the boat water proof. In Sundarban areas Sundari timber wood were sued to make boats. Shimuls, Shirish, Jam timber wood was cheap in comparison to others. These boats were kept in the ponds after manufacturing and then the Gub juice was coated on it to make it lasting. [97]

Sea going boats These were technically different. These boats are light. They can easily cross the barrier of the sands stocked on the mouth and estuaries. The middle part of these boats was swelled and the wooden plank of the boats was joined by coconut coir thread. Gub juice is use to make them water proof. Outside fishermen who come to the Sundarban for a fixed time use all these kind of boat. Seeing all these techniques of the old days the fishermen of Sundarban have learnt these technologies and they have applied them later in their culture. Gradually it had been part and parcel of their experience.

Chhandi The remarkable fishing boat is found in the Sundarban. Two or more boatmen used to row boat. With the help of seven ft. a.v.g. scull made of Shal or Sundari timber (wood). One side of it is flat, other side is convex. This boat is generally 80 ft. to 100 ft long and 30 - 40 ft. Broad. The chhandi net is used to catch Hilsa fish in the big rivers. The (Wooden body joined by the iron nails)

Bachari - another kind of fishing boat, these boats are prepared from **wooden** planks joined by the iron nails. Malos used to catch fish with the help of this garnet and bacharinet. These boats are comparatively longer in size. Mecho Bachari is another kind of boat. It is used to supply fish from Sundarban, Bay of Bengal and adjoining big rivers. A large part of these boats were separated by a wooden wall to keep the fishes alive. This boat is fifty feet long two boatmen carried the boat with oval shape of row or scul. A row was fixed in the roof of the hackery that is portable covering made of straw for a boat side of the hackery. The chief boatmen used to control the movement of the boats in course of journey.

Traditional fishing vessels are highly adapted to the fishing techniques and marine conditions of a specific region. This coordination between structure and function is not

without problem, however small fishing boats often have a limited range of operations and are unsafe. They may lack structure to store and protect the catch. The high – Quality timber used for boat construction in many tropical areas is increasingly scarce. Thus, in some regions there may be a stimulus for modifications in vessel design and construction materials. The oldest propulsion technique, wind power, is being reintroduced in a number of small scale fisheries. Sails may be used as the main means for propulsion or to assist an engine. Fishermen can take advantages of the winds, thus saving fuel and reducing operating casts. [98]

Variety of Nets Some traditional fishing technologies are found among the fishermen of Sundarban. All these technologies are very wonderful by nature. Local fishermen, who live near the forest i.e. adjoining villages, catch fish by the method of their own. They have had of their own technologies. Sometimes they follow the techniques of others who come to the forest for sometimes from abroad. So the fishing technologies of their own should be discussed. They are now rich in this matter. Because they have borrowed much from the professional fishermen of abroad who are not native [99]29 Yet their own technologies have some stricking features. Before going to discuss their fishing technologies, their activities regarding Sundarban should be highlighted because it is more interesting no doubt. The worshipping of Ganges, manasa, Dakshinrai, Banbibi and Gazi Saheb in Sundarbans gave them strength and self-confidence at the time of Natural calamity.[100] They have earned from their ancestors the knowledge of fish hunting, movement and nature of the fish. Before Entering Sundarban they use handkerchief taken from pir – baba of Dargah [101]. They take it around their neck – and be careful about tigers and snakes. These handkerchiefs diets are very often dipped in glue like substance which helps to keep snake away from them. Only Baba knows this Glue like substances. So this technology is a secret one. Sometimes the fishermen take green coconut and ripe bananas from Darga. They use these fruits sanctified by mantras before catching fish. In this process a secret technology works. When they throw these fruits into the river, some 'Kharshuna' fishes come to the sound producing centre in a shoal; The fishermen quickly cast their net from the boat and catch them easily. [102]32

Fishermen of Sundarban use homemade technology more interesting than anything else. In order to catch fish in the narrow canals or Khals, they need to keep tigers away from the spot. They usually take the help from the Bwalli (expert in

Sundarban area and adept in Mantras) [103] two Bwallis walk through the banks of the canals whereas fishermen begin to catch fish at the bottom of the narrow canal. They cannot see the upwards, from where tigers may attack them in the twinkle of an eye. Two Bwallis who walk through the banks of the canals make a significant noise through their Mantras 'They Utter to their utmost voice "Satreur Buke Maro Bajro Kali Dohai Ma Kali Dohai Ma kali". The forest echoed and reechoed as soon as they utter this peculiar sound[104]. Not only tiger but every animal begin to run in fear. Thus at the time of low tide fishermen catch fish without any fear in the narrow canals. My field work in the Sundarban areas indicated much kind of nets and fishing Apparatus us which are broadly used by the fishermen have been gradually describe below.

Long line Connected with hundreds of short baited line–Doone (Specially used for catching crabs) The simplest form of (Fishing) specially crab hunting requires only a long line connected with hundreds of short baited line In Sundarban areas it is called " Gach doone" or "Thopa" the small lines which is one ft. long is baited with a piece of fish are tied with the long line at a gap of same space. Then it is cast into the water, and thus crabs are caught. But in catching fish hooks and lines are used. This simplest form of fishing requires only a line and a baited hook. The line is cast into the water where the fish supposedly are; the fish take the bait and are hauled in. Lines may be cast by indigenous method. The line is turned round with a stone and thrown from the shore into the water Hook and line fishing is inexpensive and easy. Almost any boat or shore line can be used and the catch is of high quality. [105]

Line & Set lines- The fishermen of Sundarban use line fishing method. They make it more efficient by using multiple hooks on a line. They attach these in pairs to form balanced line. Three or more fishermen use an increased number of lines and hooks to catch fish.

They also use Set lines. In this case the number of lines deployed without requiring the constant present of the fishermen. They check it regularly because predators, will devour any fish caught if the lines are not promptly recovered. They set fishing rods in shallow water or on the beach - Japanese and Italian fishermen use sailing rafts to tow long lines away from this boat. But fishermen of Sunderban use them on the beach from the period when the Sun was very old.

Hooks and lines, Set lines, loglines with multiple hooks – all are used by the Sundarban fishermen. But the difference is that they always remain near the shore, even they put them on the water less sandy tracts to catch tortoise, and Kathas. They use long lines with hooks in the shallow canals to catch "Pangash fish" In this case they use the bait the fruit of Bain to allure the pangash fish. The using of Bain fruit is their own technology-Bainfruit has a peculiar scent which attracts such kind of fish. As perfect bait bain fruits are valuable to the fishermen of Sundarban. The fishermen of Sundarban use medium long lines of baited hooks at the Surface, mid water, at the bottom or vertically in the water column. The whole method depends upon the choice of fishermen. Hook and line fishing methods offer a number of advantages. They involve small capital and invest slight energy. Species and size can be selected by the position of the hook in water column. The hook size, the bait type and size depend on the experience.

Lift nets Sundarban fishermen also use lift nets. From small boat or from the shore of the river Fishermen bait the net area and wait for fish to gather. At night they use torches and lamps to attract fish. In the narrow canals and Khals this type of Net is very effective to catch fish in the Sundarban area. Poor fishermen can use them according to their will. "Vasail net" is belonging to this class. The front part is made in such a way that no catch can escape easily. As soon as the net is lifted from the water, a barrier made of (Thread and stick) is automatically closed. As a result fish cannot go out. This front barrier is the device made by the fishermen of Sundarban.

The fishermen of Sundarban use "Chhandi jal" to catch Hilsa fish. Chhandi jal is used in the big rivers. It is quadrangle and its size is 36' x 24' about 30nets was thrown in the river from the "Chhandi boat" But the Sundarban fishermen use different kind of Boats. Bricks or stones were tied on the lower part of the net at a difference of 20 ft. gaps. So that the lower parts of the net sink into the water, 2ft. long swelled bamboos were fixed on the net so that topmost part of the net remained floating. To make the net durable and strong. Juice of gubs tree is used for coating the string of the net. [106] From the idea of "Chhandijal" The Sundarban fishermen have discovered two other kind of nets which is completely based on their own style. The names of these two nets are **'Chatajal' and 'Shangla jal'.**

Both the nets are used to catch Hilsa fish. They are like the scooping nets. In order to use chatajal fishermen of this area take the help of a small "Dinghiee boat" The mouth like structure of 'chatajal' is flattened with a bamboo rod which is called Tuni. Sitting on the prow of the boat one fishermen go ahead smoothly at low ebb. When catches are caught he shut up or closed the net by doing inactive the tuni and thus the fishes are caught inside the net. But "Shangla net" is a bit different. It is also like Chatajal but fully dipped in water. A thread is connected to its pocket and the upper part remained to the hand of the helmman, when fish is caught he gets hint and close the net to catch fish. These Chatajal and Shanglajal are the creation of Sundarban fishermen. They individually catch Hilsa fish by this net. [107]

Cast Net (Khepla Jal) Cast nets are used mainly by the fishermen of Sundarban. One man can use it without any boat. It can be easily cast from the shore or can be used from a Dinghiee boat**.** The Upper portion of this net is like "Close Ghagra". The lower portion is flat and the upper portion is narrow and tightly tied with a strong rope. Iron made or sometimes ware burn mud 'Khati" is tied in row with the lower part of the net. So that It can go instantly to the battom of the khal or pond as soon as it cast from the shore or bead. In Sundarban areas it is known as Kheplajal. These nets are favourite nets of the poor fishermen of the Sundarban area. The hole of these nets was ½ to 1 inch. Round portion of the net was made in such a way that a pocket was formed which was called 'Ghai'. When the nets were drawn to the shore by the fishermen the pocket of the net were used to be full of different species of fishes of different size.

Berejal or Scooping nets These are used by the Malo fishermen. They are not the permanent inhabitants of Sundarban. They go to Sundarban mainly in the rainy season and stays 5 or 6 months. A team of fisher men was formed with elderly and experienced fishermen. Sometimes they also permanently reside there but a very few. Various types of traps made of iron hooks & bamboo sticks were also used in the adjoining villages & among the village society of the Sundarban for fish hunting. They have inherited the knowledge of throwing spear and trapping from their forefathers.

Polo, charo & Daur were the famous among the traps used in the Sundarban areas. Polo is used by a large number of fishermen. Village community used to catch fish with Polo in the canals & Beels in the summer. When narrow canals & small creeks

are dried up the poor fishermen use it in the shallow water & catch fish with this trap like structure. It works wonderfully in the muddy water, where no other technology is effective. In the muddy water, where no other technology is effective.

Charo It is another important trap like instrument made of bamboo. A Box like trap. It is generally used in all the seasons. In the winter when the current of a small canal becomes less strong, and water reduced the fishermen of the Sundarban used it to catch different kind of fish. Its opening is made in such a way that a catch can go in but cannot get out from it. All the structures are finely made of bamboo strips & ropes. It is very thin. Fishermen can carry 20 to 30 of these instruments at a time on their shoulder.

Daur - Hallow bamboo pieces of 2 ft. long are used for this purpose. These Daur is widely used in Sundarban areas, at ebb –tide when water level in the canal becomes shrinked a fishermen keeps the "Daur" (a trap like apparatus) at the bottom of the canal. During the time of high tide. The fish of different kinds enter into it & stays considering it a safe place for them. In the meantime, when water level downs the fishermen take them up from the bottom of the canal & catch the fish from inside the "Daur". At the time of raising it from the bottom two hands should have been placed cautiously so that no catch can be fled from it.

Atto is another kind of indigenous trap like apparatus widely used to catch fish in the Sundarban areas. It is made of bamboo sticks & ropes. Fish can enter into it but cannot get out, just like the "Charo". They are put in the shallow water stands on the sandy tracts. Five or four Attos are kept in a row where thin & weak current passes. They are specially used on char, khal, Beel, & other places near the banks of the canals.

Lafa Lafa is another indigenous technology of catching fish in the Sundarban area. Adjoining paddy field near Sundarban are full of different kinds of fish. When two plots of paddy field are separated with a shallow small marshy tract, the lafa is then only useful way to be used to catch fish from that region. The marshy tract which separates the two plots is made in such a way that fish can jump from the current & fell on it & be gathered them scatter on the artificial way in a heap. A dawn fishermen of this region can collect fish from the lafa without any trouble – no nets, no traps are needed to catch fish. Only the lafa itself acts as a trap.

"**Dhona It** is another important technology to catch fish in the rivers of Sundarban. The " Dhona" is made of bamboo. The lower part (generally ½ ft. long) of a bamboo fitted with a handle to make the apparatus for catching fish. The Dhona is repeatedly pushed up & down into the river water from the prow of a boat & when the foam is floating on a large scale, the pangash fish come in a shoal & begin to eat foam at that time cast net called " Khepla jal" is thrown & the fish is caught in a large scale. The is a wonderful Means of catching fish in this region. [108]

Komar Komar is another technique of Indigenous technology to catch fish from the river of the Sundarban areas. In the big river where the current is very strong, the 'Komar' can be used as a perfect means of catching fish. Some dry branches of trees are gathered in the water of the river near the shore where current stands still. The heaps of Dry branches are kept for a month or more. The fish of different Kinds take shelter in the heap & begin to stay for some time. After a month or more than that. The Komar is surrounded by the net specially prepared to Suck –out Komar & the standing fish from the Komar is caught. The Komar can be placed at different points of the same river. This system played an important role among the fishermen of this region.

Applying the juice of Batulia fruit This technique is mother technique of Sundarban area to catch fish. The scent of the juice of Batulia fruit is irritable & poisonous. Batulia trees are grown in the Sundarban area & its fruits are abundantly got there. The fruits are placed under (Dheki) Husking pedal & its juice are taken out & kept in a tumbler. When the river bed & paddy field are joined with a effluent, the juice of Batulia fruit is poured through the mouth of the effluent lies in the paddy field. The strong irritable juice of the Batulia fruit Begin to pass through current of the effluent & drives away the fish to the down. The net is placed in such a way that no catch can be fleed. Thus especially Kan Magur, & koi fish are caught in a large scale by this process. The catch thus run into an unimaginable amount & this surprising process attracts the notice of all.

'Dogra' or white 'Gule' caught with the help of toe.

The sand bank of the river of the Sundarban areas is full of alluvial mud holes. These holes are the suitable habitat of Dogra fish or white 'Gule'. These fish abundantly found in the region & they like to live in the muddy holes of the sand bank. They are very tasty to eat. The poor people walk across the sand bank of the river & turn out the muddy

holes with the help of the toe & easily catch them at the time of low tide. Fishermen's wives can carry out this operation for two or three hours at a time & come back with the bags full of Dogra fish.

Kharshuna fish catch, with the harpoon Kharshuna very handsome looking fish move across the surface of the river water in the Sundarban areas. Their eyes are very big. They run in a shoal. They are very quick in their movement. They can flee under the cast net in the twinkle of an eye. Fishermen cast harpoon from throw of the boat & pierce two or more at a time[109]39

Drag net Another important net used largely in the rivers of Sundarban areas. It looks like sack, screen shaped drag net is also found. This net usually becomes 20/25 hands wide. Sometimes two or three nets of these kinds are joined together to put into the river water. The part which remains to the up side of the water level are fitted with strong coarse Rope to which the 'tora' of 'shola' are tied so that it can be easily floated on the water surface. The lower part similarly fitted with strong durable rope to which some weight of brick piece is tied, so the whole net remains vertically in the water. To catch big fish at the same time small ones may be caught by drag thin net in the river. [110]

Boat Vasal jal The net is triangle in shape, two long & thin bamboos are taken. Then they are tied together keeping in the form of X, 18 inch or 20 inch up from the below of the bamboo poles. It is tied with the handle & spread out like the sails of the boat. It is dragged with the help of a boat. Sometimes it can be used by the hands where current is not very strong.

Dara net Another important kind of net of Sundarban areas. It is also triangular in shape. Two boats are needed to use these nets. The net is put in the silent or stillness of the current of the river. An anchor like structure named Kata usually made of wood are used to keep the net under water. Tongi is fitted on the mouth of the net. Fishermen sitting on the Prow of the boat touched Tongi with the help of the hand & try to understand the position & movement of the fish inside the net under water. Especially Big vetki fish of Sundarban areas are caught by this method.

“Hetcha Jal”

During the period of spring, the river passes through the Sundarban becomes furious. Strong current is seen. At the time of low ebb, water hyacinth, Outer body of the green coconut, broken pieces of wood & many other things float through the current of the rivers of Sundar ban. By this time Galda Chingri, Chati Chingri,& mashna chingri take shelter under all these float age. The fishermen use Hetcha jal to catch them. They take Whole float age in their net & easily get their catch with float age. Hetcha Jal is a kind of Strainer largely used by this time. On both the day of the new moon & the day of the full moon when small crab floats at a large number. The Fishermen catch them from the prow of the Dinghiee boat by using this “Hetchajal”.

Behundi jal

Behundi Jal is very important jal in the Sundarban region to catch fish both during low tide & high tide. These are mostly rectangular or conical in shape & of wide variety of sizes. These nets are fixed in the tidal regions of inshore waters during the low tide will stakes floats & sinkers. The high tide brings the fish in the net & when the tide recedes the fish are trapped.

A group of fishermen put their nets in a row & jointly do their operation to catch fish in the rivers. Twenty or more boats jointly carry out their works. Individual fishermen try individually to catch fish by this net. These kinds of nets are used actively throughout the year. Sitting in a separate room of the dwelling house fishermen’s wife can make this net with synthetic fibres & yarn & can provide them to their husband when they need. The method is very popular though the catch by these nets are mixed in nature & mostly of small size. [111]

Khal Patta Jal

Enclosing a portion of sand tracts or estuaries by means of bamboo screen or walls of netting to capture fish by either draining the enclosed area at low tide or by operation of cast nets or dip nets is a common practice all over the Sundarban region. The fishermen of Sundarban area tactfully enclose a portion of “Char” (Sandy tract or estuaries) they push the net in the mud in such a way that no fish can trace it, as a result they enter into the range of net at the time of low – ebb & when water level rise– up & floats the banks

the fishermen upraise the net from the hiding place & surround the estuaries by means of net. Thus at the time of low-ebb. The catches are automatically caught without much labour.

Char Patta jal

Char Patta is mainly made of Bamboo Screen or & walls .It is also very popular method in the Sundarban areas. Sometimes this method is modified into. Bush fishing, when the bamboos Screen are used to enclose areas with bushes to attract fish.

Long line & hand lines

Lines are made of Cottons, synthetic fibres, yarn & the line fishing is employed in a variety of ways using baited hooks Chain hooks are used to catch big fish. These two methods can be used without boat. One or two fishermen can do the operation from the shore without much risk. The line is kept intact to the ground with the help of a bamboo or wooden handle so that it cannot be separated from the shore. The fisher men throw (it) the baited hook with weight to the far sea or river & thus make them sink quickly. As soon as the baited hook reaches the bottom the fish swallow them & are caught. [112]42

Koch or harpoon

Another indigenous technique apparatus to catch fish in the Sundarban areas fishermen can catch fish with this apparatus without facing much complexity. It has been familiar from the ancient period in this region. The fishermen can make it without much labour and cost. Koches are of different kinds.

1. Iron mouth with multiple stings fitted with wooden handle.
2. Iron mouth with one sting fitted with wooden handle.
3. Short iron blade with several sting fitted with long bamboo handle & ropes
4. Long iron rod with pointed mouth.
5. 25 inch -130 inch heavy iron rod, sharpen mouth tied with long rope can be thrown from a long distance.

During the period of rainy season especially at dawn when the water of the river or pond becomes clear & fresh that is in the stagnant water. The fish of big kinds like to float on the surface of clear water the fishermen take the koch of first kind (Iron mouth with

multiple sting fitted with wooden handle.) These had multiple sittings and pierce the fish with it. The plus point of this apparatus is this if it touches the body of the catch; the catch can never flee from the sting.

Apparatus (1+2) both can be used according to the choice of the fishermen. It can be used in the shallow, muddy water to catch shoal fish during summer in the river or canals. The third kind Koch is another important technique to catch fish. This apparatus can be used from the prow of the "Dinghiee" boat in the Sundarban areas. At the time of low ebb, when the current of the rivers remains medium. The fishermen stand on the prow of the boat with this apparatus in hand. The Dinghiee boat proceeds in front and the fishermen follow the movement of the fish big or medium kind, if any trace of fish is marked the fishermen throw it from the boat in the direction of the catch and pierce them easily. As the koch is tied with a rope, it can never be lost. Even at a long distance it can pierce the catch.

The fourth kind Koch can be used only by the hand. In the muddy shallow water where there is shoal fish, big bain and other of these kinds, these apparatus is very active there. Sometimes the mouth of this apparatus is bent or curb. They can be pushed in the hole of the crab usually found to the banks of the rivers. As the Apparatus has crooked mouth it can easily enter into the hole and draw the crab outside of it. Fishermen can bring out the crab from the hale of the shore by repeatedly pulling and pushing the apparatus in the crab hole and lastly get the catch. The fifth kind Koch is rarely found. Only expert fishermen use it from a long distance "shishu" "Shosh" are the main preys of these apparatus. [113]

There are many other kinds of net are found at canning. The local people are using them. They told me about the fishing nets. They are Tayar Sutor Jal, cot sutor jal, plastic sutor Jal, Chali, Vebdi jal, Malipati, Gherpata, ChaysoPata, charshogherpata, Ghuni Jal (Catching Chingri) & chakun jal etc. [113]

Overall view of the development of fishing industry in India and West Bengal

Marine fish production of India which was only 0.5 million tonnes (mt) in 1950, increased to 3.07 mt in 2010, contributing 38% of the total fish production and 79% of the capture fish production. Total fisheries production of India has increased from 739,817 t in 1950 to 9,348,063 t in 2010, recording 1263.56% growth. During the

financial year 2011-12, for the first time in the history of Marine product exports, the export earnings from India have crossed USD 3.5 billion. This growth was primarily due to the introduction of various improved fish harvesting systems in India. In the marine fisheries sector, there are 194,490 crafts out of which 37% were mechanized, 37% were motorized and 26% were non-motorized. The introduction of outboard motors has transformed the face of traditional fishing activities and has brought about changes in the existing craft and gears operated in this sector. Motorisation of country craft in Kerala began only in the early 80s even though experimental projects on motorisation were tried much earlier. Purse seining experiments were conducted in India by the erstwhile Indo-Norwegian Project as early as 1954. Currently many fishing vessels process the catch onboard and are equipped with fish finding equipment and sophisticated navigational aids. From the efficient catchability of fishing gear, selectivity and responsible fishing has emerged the viable solution for fishing in the inshore region. Adoption of the Code of Conduct for Responsible Fisheries by FAO has set out the principles and international standards of behaviour for responsible practices in order to ensure long-term sustainability of the aquatic fishery resources, protection of biodiversity, energy conservation and environmental safety. Approaches in responsible fishing practices include prevention of excess fishing capacity and destructive fishing practices and adoption of scientific management in order to ensure long-term sustainability of the resources; development and promotion of selective fishing gear and methods which would minimise fishing mortality of non-target species and protected species and ensure biodiversity; development and promotion of ecofriendly fishing gears which would minimise negative impacts on environment; energy conservation in harvesting operations; and enhancement of resources by introduction of artificial reefs and fish aggregating devices, and restoration of coastal fishing grounds from negative impacts of environmental pollution and eutrophication.

Table . 6.1:

Total Marine, Inland Fish Production in`000tons achieved after progress has been made in Fishing Technology and its transfer from1950-2012 in India

(in`000tons)

Sl.No	Year	Marine	Inland	Total Production
1	1950-51	534	218	752
2	1955-56	596	243	839
3	1960-61	880	280	1160
4	1965-66	824	507	1331
5	1970-71	1086	670	1756
6	1973-74	1210	748	1958
7	1979-80	1492	848	2340
8	1980-81	1555	887	2442
9	1981-82	1445	999	2444
10	1982-83	1427	940	2367
11	1983-84	1519	987	2506
12	1984-85	1698	1103	2801
13	1985-86	1716	1160	2876
14	1986-87	1713	1229	2942
15	1987-88	1658	1301	2959
16	1989-90	2275	1402	3677
17	1990-91	2300	1536	3836
18	1991-92	2447	1710	4157
19	1992-93	2576	1789	4365
20	1993-94	2649	1995	4644
21	1994-95	2692	2097	4789
22	1995-96	2707	2242	4949
23	1996-97	2967	2381	5348
24	1997-98	2950	2438	5388
25	1998-99	2696	2602	5298

Continued.,

Total Marine, Inland Fish Production in`000tons achieved after progress has been made in Fishing Technology and its transfer from1950-2012 in India

(in`000tons)

26	1999-00	2852	2823	5675
27	2000-01	2811	2845	5656
28	2001-02	2811	2845	5656
29	2002-03	2990	3210	6200
30	2003-04	2941	3458	6399
31	2004-05	2779	3526	6305
32	2005-06	2816	3756	6572
33	2006-07	3024	3845	6869
34	2007-08	2920	4207	7127
35	2008-09	2978	4638	7616
36	2009-10	3104	4894	7998
37	2010-11	3250	4981	8231
38	2011-12	3372	5294	8666
39	2012-13	3321	5719	9040

With the assistance from R&D organizations the fishers in India are in a constant quest for improvements in their day to- day fishing activities that lead to their economic empowerment.

With the increased vessel capabilities, availability of more efficient gear systems, electronic navigation and acoustic fish detection equipment, areas of operations of the mechanised fishing fleet has expanded over the years, resulting in increased fish production in India. With the assistance from R&D organizations the fishers are in a constant quest for improvements in their day-to-day fishing activities that lead to their economic empowerment.

West Bengal has been able to secure the leading position in fish production for seven successive years and has been rewarded accordingly by the Central Government as best productivity award. West Bengal is the only state in India, where fishes have been cultivated in every kind of water bodies i.e. brackish water, sweet water, sewage water and marine water as well.

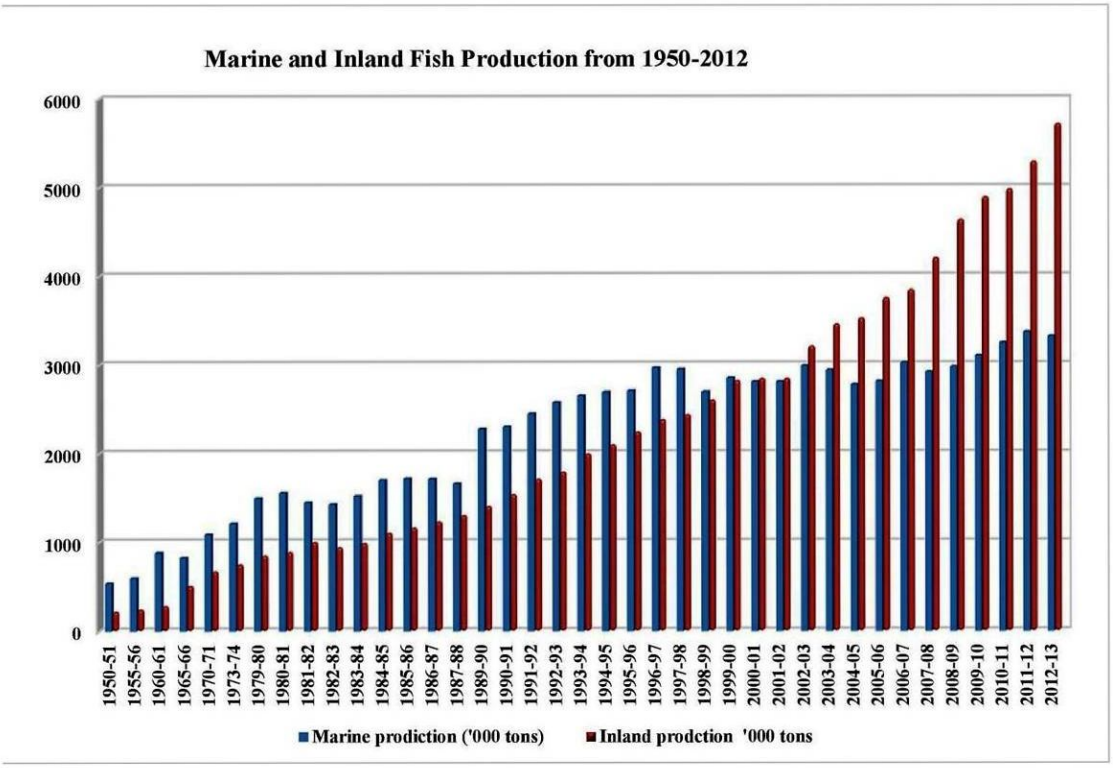


Fig.19: Marine and Inland Fish Production from 1950-2012

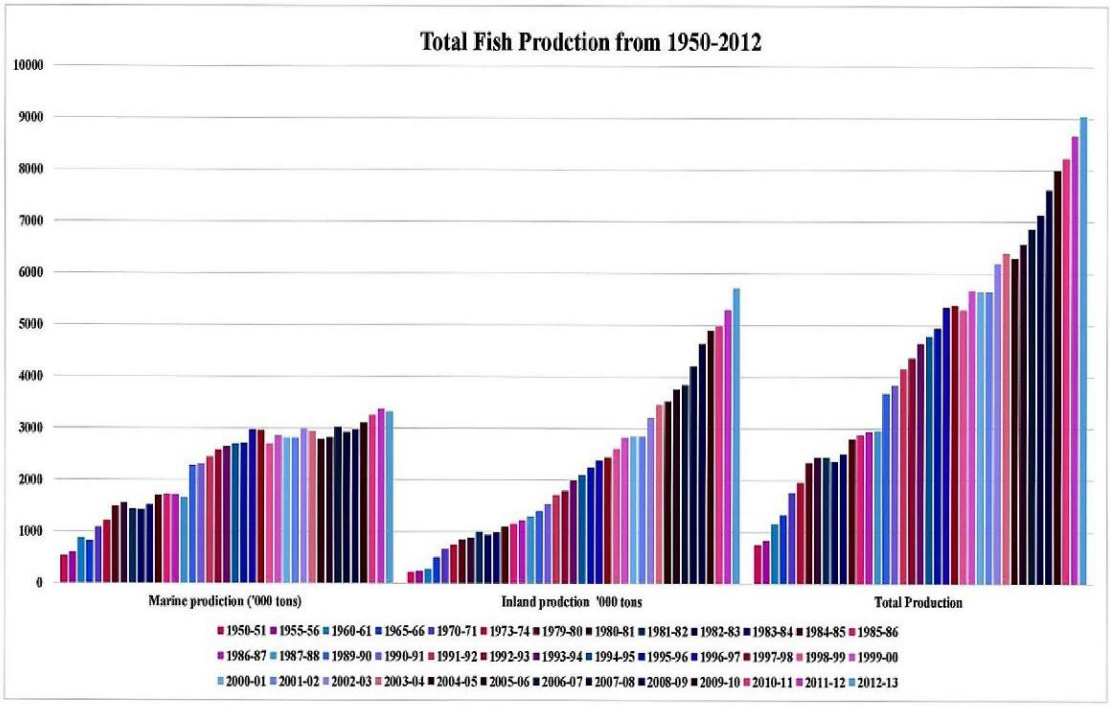


Fig.20: Total Fish Production from 1950-2012

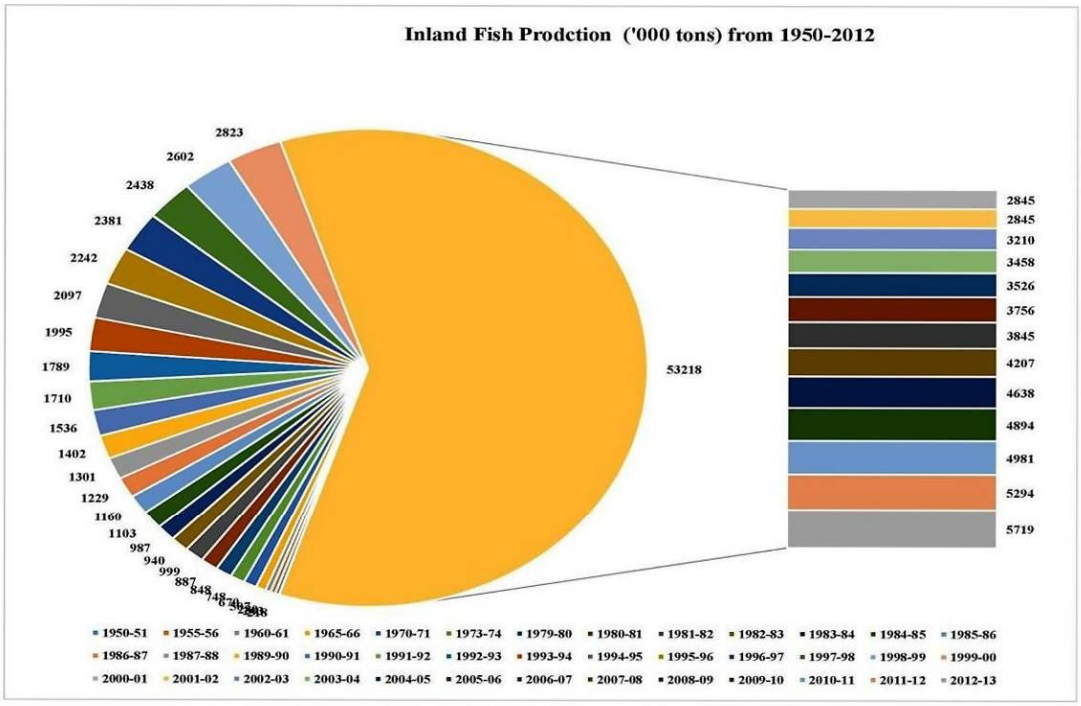


Fig.21: Inland Fish Production (‘000 tons) from 1950-2012

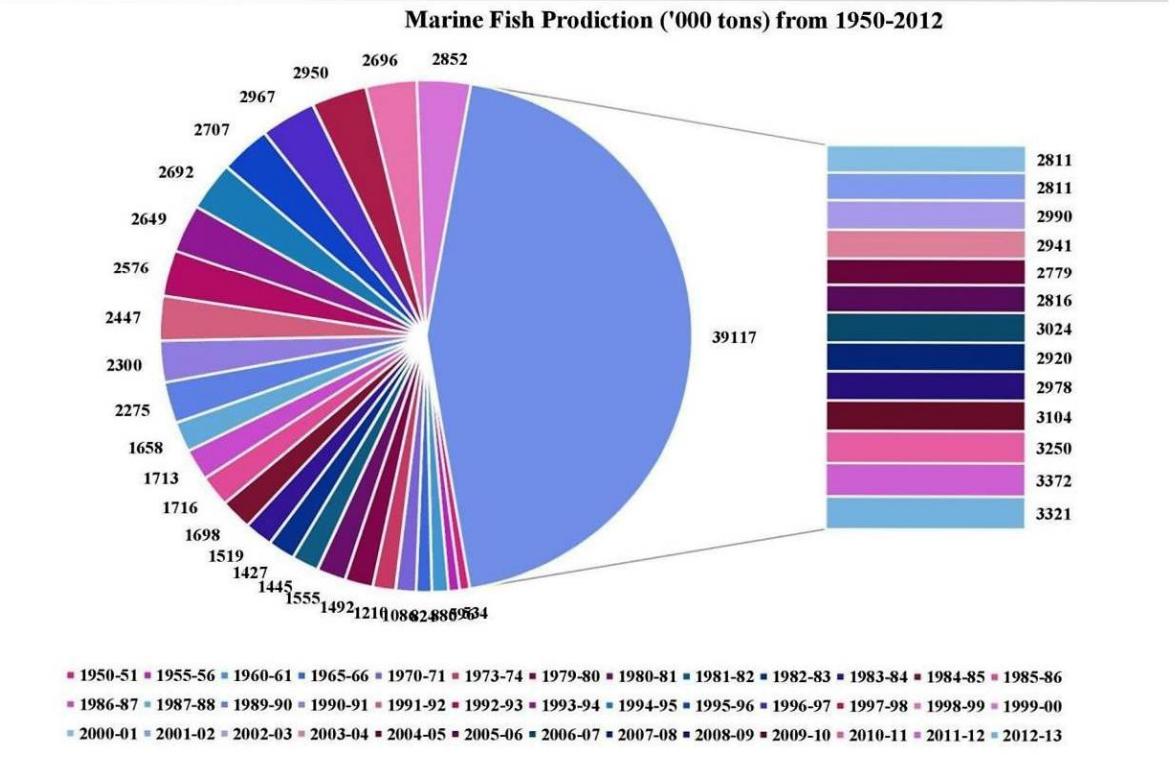


Fig.22: Marine Fish Production (‘000 tons) from 1950-2012

The total production of inland fish was 15.30 Lac ton and marine fish was 2 Lac Ton. Apart from the fact that they are mainly consumed in the state, a large amount of inland and fish is exported to Delhi, Uttar Pradesh, Madhya Pradesh, Bihar and other adjoining states. Export of Marine Fish beyond boundaries of the country earned a handsome revenue of Rs.700 crore in the year 2009-10. West Bengal occupies the 4th position in the country in terms of export of sea food products. Fishes are exported primarily through Kolkata and Haldia Port to Japan followed by Vietnam and China. Exports to Japan only aggregates to a total annual revenue of Rs.650 crore. Out of the total exports 90% are shrimps and the rest includes ornamental fish, crab, fresh water prawns. About 78% of the fish catch in the state is marketed as fresh or chilled and forms staple food for the population and inland landing centres. About 6% of the catch is used for drying and curing. Frozen fish production accounts for 12% and about 4% is used for reduction to fish meal. In the wake of changing lifestyles, value added fishery products of different descriptions as 'convenience food' is also gaining popularity in the markets. The range of value added fishery products processed in the country include extruded products, battered and breaded products, surimi and derivatives, pickles and curried products in restorable packing. There is no much evidence of development in marine fishing industry sector except development of ports and harbours and enlargement of artisanal fishing methods.

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CHAPTER- VII

Comparative Study with Japanese Fishing Technology

Japan (Japanese: 日本 Nippon [nip̚põɴ] or Nihon [nihõɴ];formally 日本国Nippon-koku or Nihon-koku, "State of Japan") is an island country in East Asia. Located in the Pacific Ocean, it lies to the east of the Sea of Japan, the East China Sea, China, Korea and Russia, stretching from the Sea of Okhotsk in the north to the East China Sea and Taiwan in the south. The kanji that make up Japan's name mean "sun origin", and it is often called the "Land of the Rising Sun".

Japan is a stratovolcanic archipelago of 6,852 islands. The four largest are Honshu, Hokkaido, Kyushu and Shikoku, which make up about ninety-seven percent of Japan's land area. The country is divided into 47 prefectures in eight regions. The population of 126 million is the world's tenth largest. Japanese people make up 98.5% of Japan's total population. Approximately 9.1 million people live in the core city of Tokyo,[1] the capital city of Japan, which is the sixth largest city proper in the OECD and the fourth leading global city in the world.[2]The Greater Tokyo Area, which includes Tokyo and several surrounding prefectures, is the world's largest metropolitan area with over 35 million residents and the world's largest urban agglomeration economy.

A Paleolithic culture around 30,000 BC constitutes the first known habitation of the Japanese archipelago. This was followed from around 14,000 BC (the start of the Jōmon period) by a Mesolithic to Neolithic semi-sedentary hunter-gatherer culture, who include ancestors of both the contemporary Ainu people and Yamato people,[3,4] characterized by pit dwelling and rudimentary agriculture.[5] Decorated clay vessels from this period are some of the oldest surviving examples of pottery in the world. Around 300 BC, the Yayoi people began to enter the Japanese islands, intermingling with the Jōmon.[6] The Yayoi period, starting around 500 BC, saw the introduction of practices like wet-rice farming, [7] a new style of pottery, [8] and metallurgy, introduced from China and Korea [9.]

Japan first appears in written history in the Chinese Book of Han.[10] According to the records of the three kingdoms, the most powerful kingdom on the archipelago during the 3rd century was called Yamataikoku. Buddhism was first introduced to Japan from

Baekje, Koreaand was promoted by Prince Shōtoku, but the subsequent development of Japanese Buddhism was primarily influenced by China.[11] Despite early resistance, Buddhism was promoted by the ruling class and gained widespread acceptance beginning in the Asuka period(592–710).[12]

The Nara period (710–784) of the 8th century marked an emergence of the centralized Japanese state centered on the Imperial Court in Heijō-kyō (modern Nara). The Nara period is characterized by the appearance of a nascent literature as well as the development of Buddhist-inspired art and architecture[13]. The smallpox epidemic of 735–737 is believed to have killed as much as one-third of Japan's population.[14]. In 784, Emperor Kanmu moved the capital from Nara to Nagaoka-kyō before relocating it to Heian-kyō (modern Kyoto) in 794. This marked the beginning of the Heian period (794–1185), during which a distinctly indigenous Japanese culture emerged, noted for its art, poetry and prose. Murasaki Shikibu's the Tale of Genji and the lyrics of Japan's national anthem Kimigayo were written during this time.[15] Buddhism began to spread during the Heian era chiefly through two major sects, Tendai by Saichō, and Shingon by Kūkai. Pure Land Buddhism (Jōdo-shū, Jōdo Shinshū) became greatly popular in the latter half of the 11th century.

Japan is an island country located along the East Asian mainland, in front of Russia, North Korea, South Korea, China and Taiwan. It is surrounded by the Sea of Japan (to the west), the Sea of Okhotsk (to the north), the north-western Pacific Ocean (to the east), the East China Sea and the Philippine Sea (to the south). Japan has a total land area of 378 000 km² and more than 6000 islands. Four main islands constitute ca. 97% of Japan's land area (from north to south): Hokkaido, Honshu, Shikoku and Kyushu. In addition, there are numerous smaller islands. Most of them form the Ryukyu Islands (south-west from Kyushu to Taiwan), the largest of which is Okinawa, and the Izu and Bonin (Ogasawara) Islands (south of Tokyo). The body of water separating Honshu, Shikoku and Kyushu is known as the Seto Inland Sea.

The Japanese coastline is 29,751 km long. The continental shelf around the archipelago is 20 to 30 km wide, with the shelf break at an average depth of 140 meters. Continental shelves are broader in the Sea of Japan along the coast of south-western

Fig.1.Japans Geographical Map

Honshu to Kyushu, and around northern Hokkaido (Figure 1). East of Honshu the seafloor morphology is marked by the 9000 m deep Japan Trench, created by the subduction of the oceanic Pacific plate beneath the continental Okhotsk plate.

Japan's 12-nm territorial waters and 200-nm Exclusive Economic Zone (EEZ) cover an area of 4.47 million km², which is the sixth largest in the world and covers 12 times the area of Japan's land. As regards territorial claims; Japan is involved in three island disputes with its neighbouring countries Korea, China/Taiwan, and Russia.

Japan plays a leading role in global fisheries, both as one of the world's top producers and as a major importer of fishery products. Surrounded by some of the most productive fishing grounds on earth, teeming with a wide variety of resources, Japan has long been a most important fish consumer and has developed an exquisite fish-rich food culture.

Japan ranked fourth in the world in 1996 in tonnage of fish caught.[16] Japan captured 4,074,580 metric tons of fish in 2005, down from 4,987,703 tons in 2000, 9,558,615 tons in 1990, 9,864,422 tons in 1980, 8,520,397 tons in 1970, 5,583,796 tons in 1960 and 2,881,855 tons in 1950.[17] In 2003, the total aquaculture production was predicted at 1,301,437 tonnes.[18] In 2010, Japan's total fisheries production was 4,762,469 fish.[19] Offshore fisheries accounted for an average of 50% of the nation's total fish catches in the late 1980s although they experienced repeated ups and downs during that period.

Coastal fishing by small boats, set nets, or breeding techniques accounts for about one third of the industry's total production, while offshore fishing by medium-sized boats makes up for more than half the total production. Deep-sea fishing from larger vessels makes up the rest. Among the many species of seafood caught are sardines, skipjack tuna, crab, shrimp, salmon, pollock, squid, clams, mackerel, sea bream, sauries, tuna and Japanese amberjack. Freshwater fishing, including salmon, trout and eel hatcheries and fish farms,[20] takes up about 30% of Japan's fishing industry. Among the nearly 300 fish species in the rivers of Japan are native varieties of catfish, chub, herring and goby, as well as such freshwater crustaceans as crabs and crayfish.[21] Marine and freshwater aquaculture is conducted in all 47 prefectures in Japan.[18]

Japan maintains one of the world's largest fishing fleets and accounts for nearly 15% of the global catch,[22] prompting some claims that Japan's fishing is leading to depletion in fish stocks such as tuna.[23]Japan has also sparked controversy by supporting quasi-commercial whaling.[24].

The Japanese Fisheries Agency states that the Basic Fisheries Plan was developed by the Japanese government in 2007, and claims that the government is working to establish longstanding, strong fisheries and fishery practices by promoting the overall restoration of the fishery industry. This can be accomplished by promoting surveys and research into fishery resources, the promotion of international resource management in international waters, promoting international cooperation within the international fishing grounds, and improving the living environments for all aquatic life in inland waters, while at the same time promoting aquaculture. This restoration consists of many different phases to include the restoration and management of high-level fishery resources. Other priorities of the Japanese government include continuing to develop new technologies to improve fishery operations, whether incorporating new workplace needed technologies, or creating and exploiting intellectual properties. Also, at the top of the list is the reorganization of the fish labor industry organizations from the top down. The government provides support to the fishery operators groups by helping to acquire the equipment necessary to reduce fuel consumption, through the introduction of energy saving operating systems. In order to maintain a strong work force in the fishery industry, the government has programs to encourage college students to look into the industry as a possible career path. This includes supporting activities that provide the opportunity to experience stationary net fishing and aquaculture. The government also provides the respective employees with job information from fisheries worldwide while holding job seminars with well recognized companies in the Japanese fishery business. There is also a government sponsored onsite training program for individuals planning to make a career in the fishery industry. The fisheries in Japan are governed by the Japanese Fisheries Agency.

The Fisheries Agency is organized into four departments: Fisheries Policy Planning Department, Resources Management Department, Resources Development

Department, and Fishing Port Department. The Fisheries Policy Planning Department is in charge of the planning of policies concerning the fisheries, and all administrative matters that go along with the organization. The Resources Management Department plans the continuous development of Japan's fisheries. The Resources Development Department is in charge of the scientific research and development in the field of fisheries. The Fishing Port Department is the base for fishery production activities and also the basis for the distribution and processing of the marine products.

Trawl Fishing and its development

Mechanized trawling requires a vessel that is powerful enough to tow a large net through the water at a reasonable speed (typically 2-4 knots) and therefore the development of trawling did not generally take place until after the development of steam-powered vessels in the latter part of the nineteenth century, although a limited amount of beam trawling using sail-powered vessels was undertaken, including that by Japanese fishers in Manila Bay. It was at this time that the “first industrialization” of fisheries began in the British Isles. At first, steam-powered vessels were used to tow fishing boats out to fishing grounds and take catches to markets, but later the power of steam engines was harnessed to drive fishing boats and haul in nets. The most important fishing gear at this time was the trawl net, which fishers employed to capture the abundant demersal populations of the English Channel and then of the North Sea. As the fishery expanded the beam trawl, which is kept open by a beam at the entrance to the net, was quickly replaced by the otter trawl, which is kept open by the flow of water over the otter boards (or “doors”) on the tow lines as the boat pulls the net through the water. In the late 1800s British trawlers moved further and further into the North Sea to maintain their catches, but fishing companies made great profits, as the income from the sale of fish to the rapidly growing market far outweighed the cost of sailing to more distant fishing grounds.

Medium trawl fisheries (operating east of 130°E longitude)

This type of fisheries was started in the 1910's by introducing the hand purse fishing by powered boats instead of non-powered ones. By virtue of their higher efficiency and the stabilized catches, the medium trawler fisheries became

popular all over the country within a relatively short time. The fisheries operated in the fishing areas east of 130°E longitude is known as "trawl fisheries east of 130°E" or "medium type trawl fisheries." About 2,000 boats are engaged in fishing and 488,000 tons were fished in 1955; thus the medium trawl fisheries is increasing its importance.

Kinds of fish caught by this type of fisheries vary with the fishing area. Among the leading species are flounders, codfish *(Gadus macrocephalus),* iaska pollack *(Theragra chalcogramma),* skates and rays, dogfish *(Squalus suckleyi)* and the like sharks, rockfish, rockcod *(Sebastolobus macrochir),* sand-fish *(Arctoscopus japonicus),* gurnard *(Chelidonichthys kumu),* sea robin *(Lepidotrigla spp.),* croakers *(Nibea argentata),* "NIGISU" *(Argentina semifasciata),* etc. These are popular daily food fish in the country. Alaska pollacks, dogfish, and croakers are either boiled or broiled—the most popular type of cooking in Japan. Most of the fish processed into fish paste are fish caught by this type of fisheries (fish paste manufacturing plants are usually found in the fishing ports for the trawl fisheries operating east of 130°E).

Fishing areas for the trawl fisheries range all around Japan and the trawl fishing ports are scattered throughout the country. Surrounding sea bottom of Hokkaido, the Pacific Ocean north of the main island of Japan and the Japan Sea west of the main island are particularly notable for the abundance of fish-catch as well as for a goodly number of trawlers engaged in fishing operation.

Small-scale local fishery for shrimp and prawns has existed for centuries and continues to form a large proportion of the world's shrimp fisheries.[25a] Trawling increased in scale with the introduction of otter boards, which use the flow of water to hold the trawling net open, and the introduction of steam-powered vessels, replacing the earlier sail-powered boats.[25b] Both of these developments took off in the 1880s, and were soon applied to shrimp fisheries, especially following the research effort of the Norwegian marine biologist Johan.[25c] Over time, the original open skiffs, 5–8 metres (16–26 ft) long, were replaced by decked boats, to which diesel engines were added, allowing the boats to reach an average of 18 m (59 ft).[26]

In the southwestern part of the Pacific Ocean and in the western part of the Japan Sea, a trawl is dragged usually by a set of two boats, but by a single boat in the other fishing areas. It is usually to use a wooden boat of 15 to 60 gross tons, but the size of a boat varies with the fishing areas. Most of the larger boats of 50 gross tons and over are used in fishing area in the surrounding sea of Hokkaido and on the northern part of the Pacific Ocean along the main island of Japan. For medium trawl fishing operation one requires a license from the USA. Minister of Agriculture and Forestry. In order to minimize the friction with the coastal fisheries, restriction is laid on some fishing techniques, areas, and seasons. It is the established policy to give no more fisheries license. Medium trawlers are becoming larger in size. Fishing areas fit for medium trawl fisheries are usually confined to the sea of less than 300 fathoms deep. Due to the limited area of such continental shelves in Japan's surrounding sea east of 130°E., it gives rise to keen competition among fishermen.

In view of this the government is making effort to develop fishing areas in deep seas or encouraging trawl fisheries to convert to other type of high seas fisheries (mainly tuna and skipjack fisheries).

Powered trawlers of less than 15 gross tons are known as small-type trawlers. About 22,000 small trawlers are engaged in fishing operation chiefly in the Seto Inland Sea, Tokyo Bay, Isa Bay, Mutsu Bay, and the Ariake Sea and 117,720 tons of fish are caught every year. Reflecting the food shortage immediately after the war, it showed a rapid increase in the number of small trawlers. As a result, although fish catch per boat was on the increase year after year the fishermen faced an intense competition. In view of this, the reduction in the number of boats has been enforced since 1951[27]

The profitability of steam trawlers and their ability to land large amounts of food to feed the growing urban populations of Europe planted the idea in the minds of a few entrepreneurs and officials that trawling might prove just as successful in the Southeast Asian waters. The first person to consider the possibility of capturing demersal fish in Southeast Asian waters by means of a trawler was apparently a Captain Eddie, the

captain of a steamship. During discussions with British officials in 1894 Captain Eddie proposed that he be granted a monopoly on trawling in the waters around Penang and off the coasts of Perak and Selangor for two to four years and that he would pay the government a certain sum for the privilege. Eddie had experimented with a trawl net and had apparently had very good results, but he dumped his catch before returning to port and said he would not reveal where he had fished or what he had caught or order a steam trawler from England until the Government agreed to his request. The areas for which he had requested to be granted a monopoly had great potential for trawl fishing, but because they had so little information to go on and they were in any case reluctant to grant a monopoly, officials refused Eddie's request and no one took up his idea of trawling in this area for many years.

The design of trawl nets may have some precedence in the fixed nets, known as *payang*, that were used off the coasts of Japan in the nineteenth century to catch small and medium-sized pelagic fish. These nets were similar in design to a trawl net, with wings and a "cod end" and the upper part of the net supported by floats and the lower edge secured with weights. These nets, however, were not towed nets but fixed or lift nets. Therefore, perhaps their greatest importance in the development of trawling that was to come in the future was to provide the net making skills and familiar net patterns for manufacturing towed trawl nets.

As mentioned earlier, Japanese fishers had been operating beam trawls from sail-powered vessels in Manila Bay since about 1900 and, in the late 1920s, this fishery began to expand as the fishing companies operating there introduced diesel-powered vessels. By the early 1930s, virtually all of the beam trawlers had diesel engines and the trawlers had extended their operations well beyond Manila Bay. This expansion of activities prompted one of the first suggestions that trawling was adversely affecting other fisheries when Filipino fishers in San Miguel Bay complained to the President of the Philippines that the Japanese trawlers were reducing fish stocks, a claim that was supported by subsequent research. However, trawling activities in San Miguel Bay continued and, by 1980, 89 trawlers of various sizes were operating there. However, by this time, demersal stocks in the area, and other trawl grounds in the Philippines, had been depleted (in 1980, estimates of trawlable biomass in San Miguel Bay were only 1600 tonnes, about 20 percent of what

the estimate was in 1948) and trawl operations had become economically marginal. No further significant growth of the industrial trawl fishery therefore occurred although trawling from dugouts, using very small nets, expanded gradually from the 1950s onwards and helped in maintaining a small trawl fishery for demersal species in the Philippines, which continues today [28]

Japanese fishing companies were also active in developing offshore pair- and otter-trawl fisheries in the 1930s in other areas of Southeast Asia, particularly in the waters around Taiwan, the South China Sea and off the coast of Viet Nam, including the Gulf of Tonkin where between 1935 and 1937 these trawlers caught an average of 11000 tonnes per year, mainly of species such as yellow back bream (*Taius tumifrons*) and other bream species. In addition, Japanese trawlers operated as far south as Sarawak and were also based in Singapore, apparently fishing in areas as far south as the northwest coast of Australia.

In contrast to most other fishing activities in the region at the time, these Japanese trawlers did not land their catches in the countries where they were taken but, rather, landed the frozen product to markets in Japan and Taiwan. These Japanese trawlers, together with Japanese operations in the Philippines constituted, therefore, the main trawling activities in Southeast Asia by the late 1930s since none of the surveys by European Governments or entrepreneurs had resulted in a viable trawl fishery using European-type trawlers. Following the Second World War, demersal fish landings in the region recovered quickly to pre-war levels, despite the problems of the limited supply of vessels, fishing gear and other equipment.

Purse Seine fishing and its development

Purse seine fisheries developed out of hand purse seine fisheries by non-powered boats. This type of fisheries was most important in the past when sardines migrated actively. Purse nets are extensively used in the capture of large schools of small fish such as sardine, horse mackerel, etc., found on the coast and large schools of these larger fish migrating on the off-shore, such as mackerel, skipjack, tuna, etc. Purse seine fishing is operated throughout the country, though

differs somewhat according to fish species. Most of the purse seine boats shift from one fishing ground to another according to the fishing season.

A purse seine is designed to be set around a school of fish and so arranged that after the ends have been brought together, the bottom can be closed so that fish cannot escape from it. The upper edge of the net is supported by oblong floats and the lower edge is weighted by oblong weights through which the purse line passes. The name of "purse seine" is derived here from. Sometimes a special bag net is attached to the purse seine for the convenience of the capture of fish. The size of a purse seine is generally represented by the length of a float line. There are various sizes of nets ranging from a minimum of 180 meters to a maximum of 2,700 meters.

Schools of fish are detected by the presence of birds flying over them, jumping of fish, bubble formation, color of water, or plankton's phosphorescence emanating from schools of fish, etc. Schools of fish are sometimes lured into the net with the means of fishing lights or baits and the bottom of the net is closed by tightening the ring wire attached to the purse line. At the same time, both of wing nets are lifted up to the boat, thus bringing together the ends of the net For fishing in the coast or in the wavy off-shore, one boat is used, but two-boat operation is considered more suitable to catch schools of swift fish because the time for fish driving and for hauling the net can be cut by half.

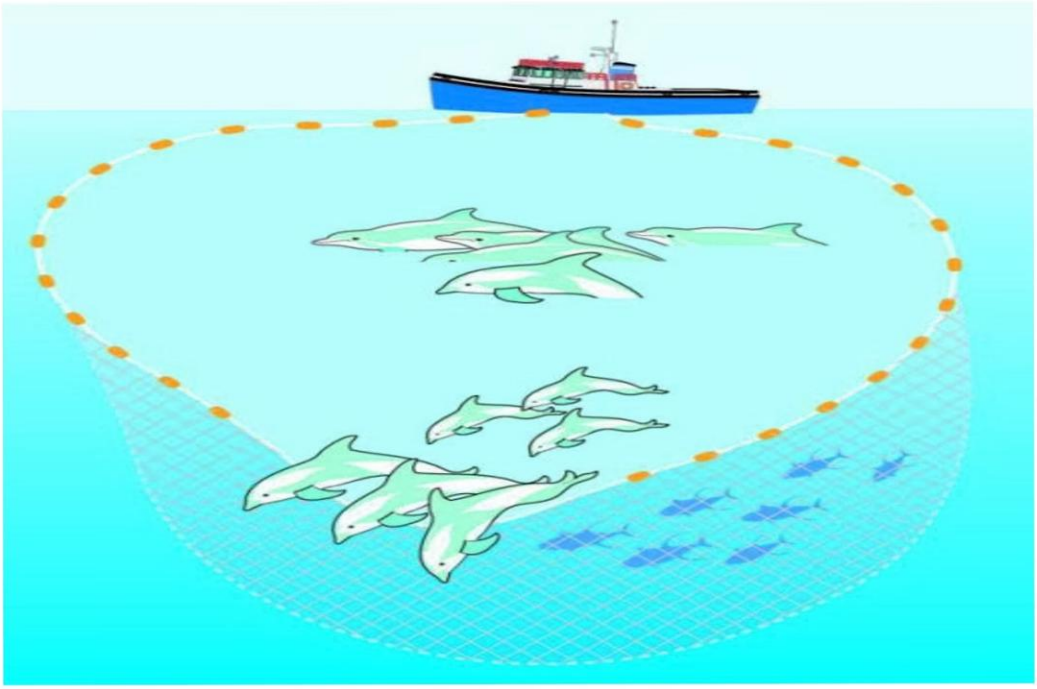
In 1956, the total units operated in the purse seine fisheries numbered 4,064 and catches amounted to 697,140 tons, 15 per cent of the total catches in Japan, of which 60 per cent is credited to sardine.

For the purpose of export increase in skipjack and tuna into the US which was opened again after the war, two-boat expeditions to off-shore fishing area have recently become active under the stimulus of the tuna seine fishing of the U. S. type. The size of a purse seine fishing boat is becoming larger and net hauling operation has been mechanized. There appeared 200 gross-ton class boats, but most of the boats measure 20 tons. Fishing nets and ropes have come to be made

out of synthetic fibers. As a result, the cost for dyeing or drying to prevent ropes and nets from deterioration was saved and they can be used longer.

In addition, fish finders, radars, etc. have been brought into wide use since the end of war. At present, nearly 3,500 fish-finders are installed in fishing boats, thus fish catching capacity per unit is increasing. Consequently, in some fishing areas it showed a decrease in the number on fishing boats in operation.

The catch in 1941 recorded 844,860 tons or 22 per cent of the total catch. Purse seine fishing boats were engaged in fishing in the coastal Sea of Japan and in Korea off-shore. Even now, sardine purse seine fisheries are one of the leading fisheries, comprising 8,266 boats (103,902 tons) operated by 132,000 people and the total catch amounted to 743,000 tons in 1955. Among fish species caught by purse seine are sardines, horse-mackerel, mackerel, skipjack, tuna, albacore *(Germo germo),* etc., but the first three are major ones. These are consumed fresh, some are boiled and dried, and a goodly part is made into canned sardines for export purposes.



Purse Seine fishing

Fig.2:Purse Seine fishing

The principal fishing areas are horse-mackerel and mackerel fishing area in the west coast of Kyushu; sardine fishing area in the Bungo Channel between Kyushu and Shikoku; and fishing area for sardine, horse mackerel, mackerel, skipjack, tuna, and albacore in^ the northern part of the Pacific**,** Ocean along the main island. (Before 1940, sardine fishing area in the northern part of Pacific Ocean along the main island was the most fruitful one, but due to the diminishing migration of sardines, the same fishing area came to be surpassed by the fishing areas in the coast of West Japan). Structure and size of fishing boats and fishing gear used for purse seine fisheries in the respective areas vary according to the conditions of each fishing area, e. g, tidal current, depth of sea, waves, etc. Even in the same fishing types of fishing gear are used according to the fish species.

At present, purse seine fisheries are classified administratively into four types: large type designated medium type, medium, and small type medium and small type according to the size of boats and scope of operations. The first two types must obtain license for fishing operation from the Minister of Agriculture and Forestry and the remaining two from the respective prefectural governors. The maximum limitations are placed thereon and various restrictions are also placed on fishing areas and operating areas, thus ensuring a certain amount of fish-catch per boats.

However, as the annual catch of sardines has shown decrease from the pre-war level, the purse seine fisheries are generally depressed. In order to tide over such depression, efforts have been made to catch fish on off-shore and to raise the operating efficiency by means of large-sized or western-style ships. In West Japan, fishing boats of 60 to 80 gross tons have been built one after another and almost all the fishing units are equipped with wireless apparatus and fish finders.

Skipjack and tuna fisheries

Skipjack and tuna fisheries have developed into typical pelagic fisheries under the government encouragement given since the 1900's to pelagic fisheries, powered-boat building, and construction of fishing port installation. In 1939, fishing boats numbered 1,107 (53,561 gross tons), but due to the war it decreased

to 373 boats (28,226 gross tons) in 1845, or to 33 per cent in number and to 52 per cent in tonnage of the prewar levels. In 1955, it increased to 1,825 boats (176,243 gross tons) the catch amounting to 321,000 tons, surpassing the pre-war peaks.

The contributing factors are: (1) as a result of the postwar prohibition of arctic fisheries, skipjack and tuna fisheries on the Pacific Ocean has become important and the investments in this type of fisheries were expedited; (2) gradual relaxation of limitations of fishing area in the Pacific Ocean during the Occupation by the Allied Powers and the increased possibilities for expeditions into the Indian Ocean and the South Pacific Ocean after the peace treaty; and (3) increasing demand for tuna from the USA and other countries.

Although US vessels had been purse seining for tuna in the eastern Pacific Ocean (EPO) since the early 1950s[29], Japanese purse seine vessels were the first to actively fish for tuna in the WCPO, beginning in the 1960s in Japan's coastal "home waters". Between 60 and 70 small vessels (50 to 200 GRT) was fishing by the end of that decade. Purse seine test fishing in tropical waters, to fish outside the summer home water season (May-September), began in 1960 [30]. In the early to mid-1970s, larger vessels (499 GT, 349 GRT) were constructed and, recognizing the year-round availability of tuna in equatorial waters, began exploratory fishing on logs, mostly in waters near Papua New Guinea (PNG). These offshore vessels (6 to 7 single and group seiners) took over 15,000 t in 1971, with vessel numbers and catch steadily increasing during the 1970s as fishing techniques in the clearer deeper thermocline waters were improved. By 1979, 17 vessels were taking over 60,000t of fish. The fleet continued to grow, peaking in 1988 at 39 vessels (34 single and 5 group seiners) catching over 200,000t. Vessel numbers (and other aspects of fishing operations) were restricted by Government decree to 32 single purse seine vessels until 1996, when 7 group seiners were withdrawn in favour of three additional single purse seiners. Numbers have remained at around that level (35) since that time. Group seiners continued to fish in equatorial waters until the mid-1990s, and still operate in the home water fishery. The small vessel coastal fleet has declined to around 20 vessels in recent years.[31; 32]. The historical high catch was achieved in 1998, when 35 single purse seine vessels caught 275,000t. Vessel size (LOA, GRT) and age Japanese single purse seine vessels have traditionally been of standard size (349 GRT,

499 GT class) with several larger vessels built from time to time. No reliable data are available throughout the time series on vessel length (LOA) which seems to vary between 51 and 66m LOA. The group seiners were smaller and of similar size, at 30- 31m LOA and 116 GT. All vessels were built in Japan, replaced regularly and sold accordingly to established guidelines. At present (2003), 20% of vessels fishing are less than 10 years old, and only 23% older than 20 years, with an average age of 14 years.

Fishing operations initially fishing almost exclusively on log sets, the Japanese fleet gradually adapted to free school fishing, through the use of deeper nets and other technology developed originally by the U.S. fleet. By 1988, approximately equal proportions of sets were made on free schools and logs, a pattern which persisted through most of the 1990s until a shift to fishing drifting FADs beginning in 1998. Equal numbers of sets were made on free and associated schools in recent years, but in 2002, the fleet considerably reduced FAD fishing (15% of total sets). The fleet has operated through a series of bilateral access agreements in the region, as well as fishing high seas areas, and has generally operated in more western areas than other fleets, although there has been no access agreement with PNG since 1987.[33]

Primarily due to expanding Japanese tuna catches in the 1950s, the California-based pole-and-line fishery (almost 300 vessels) experienced severe financial difficulties. The fleet survived largely through technical innovations that led to the feasibility of using purse seine gear for capturing tuna. In the subsequent years nearly 100 California bait boats were converted to purse seiners and new tuna purse seiners were constructed. The technique later was taken up by Japanese tuna fishermen for use in temperate waters off Japan. By the late 1960s between 60 and 70 small Japanese tuna purse seine vessels (50 to 200 GRT) were fishing seasonally.[34;35]

Tuna purse-seining in tropical waters was another matter. The characteristically clear water and deep thermocline in the equatorial Pacific create conditions unfavorable for purse-seining – the tuna schools tended to be smaller, faster-moving, and dive deeper than in the eastern Pacific or off Japan. The government of Japan and subsequently that of the United States of America sponsored many experimental purse-seining expeditions to the equatorial Pacific area. The Japanese persisted and were the first to have success.

The main innovation was the pre-dawn setting of deep nets around logs in the area between Micronesia and Papua New Guinea. By the late 1970s there were several fully commercial Japanese and American purse seine operations in the western equatorial area of the Pacific Islands.

One of the major purse seine operational patterns concerns disposal of the catch. The Republic of Korea, Taiwan (Province of China) and China transship their catch onto to large carrier vessels, and do so mostly in ports of the Pacific Island countries. The Japanese return all catch to Japan. The USA fleet and most vessels from the Philippines that operate in the Pacific Islands offload the bulk of their catch directly to canneries.

Stick-held Dip Net Fishing

Stick-held dip net is one of the floating lift nets. The net is square and shallow bag-like one. The stick-held din net is thrown overboard in a certain fishing ground and schools of fish are lured by fishing lights, feed etc. This net was designed by converting a fixed net into a net of movable type. The stick-held dip nets are used mainly for the capture of sardine horse mackerel, mackerel, pacific saury, etc. Pacific saury is mostly fished in this net.

PACIFIC SAURY

History of the Fishery

In California, interest in fishing Pacific saury (*Cololabis saira*) n as initiated in the 1950's, when the decline in abundance of Pacific sardine caused fisherman and processors to look for substitute species which could be used to make fish meal. Sporadic landings of saury record made in San Pedro. Where the fish were resumed into oil and meal. In the late 1960's and early 1970's. Japan. The Solicit Union and the U.S. became interested in harvesting saury off the US. West coast because western Pacific stocks had fallen to all-time low levels. Fishing trials by U.S. researchers and fisherman were conducted north of Monocracy, where larger saury recorks more common. Most of these trials. which involved the use of purse sciences and a Japan's fishing method using light attraction together with a hip of blanket net (called bo-uke mi), were largely unsuccessful. Japanese saury fishing vessels rich fished the west coast around the same time were a little more successful. From 1969 through 1972 the). caught 507, 3,600.

1.430, and 77 tons. Japanese vessels were larger than those of the U. S. and used maltreating lamps with 50 kilowatts of power. Catch's per unit of effort were not considered high enough for economical fishing, however. Rough seas off the Oregon and Washington coasts. and scarcity of dens concentrations or large saw. were blamed for the low catch rate. The fish averaged just eight to nine inches in length and had a low oil content.[36]

The number of operating units reaches 2,223 with the total catch of 310,004 tons or 66 per cent of the total catch in all lift nets ml Japan. All the fish caught are landed at fishing ports still fresh. As the net is flexible, it takes the form of a shallow bag. The upper edge of the net is supported by a bamboo stick instead of floats and the lower edge of the net is weighted by weights and attached with lifting ropes.

The upper edge of the net supported by a bamboo stick is stretched out with poles from the stem and stern on the port side and then lift lines are dropped overboard. The net takes the form of shallow bags as the boat drifts at the mercy of the wind or current. A school of fish is attracted by fishing lights or feeds on the starboard are induced into the] net and then lift lines and side lift lines are pulled up quickly.

Stick-held dip net fishing boats are grouped into two: (1) 30 to 601 gross-ton class boats and (2) 100 to 150 gross-ton class ones. The former; serve also as drag net fishing boats and the latter as skipjack fishing ones. There are no stick-held dip net fishing boats exclusively used for Pacific saury. From the economic and seaworthy viewpoints, boats of 75 to 100 gross tons are regarded as best.

Pacific saury fishing season is confined to the months from September to December. The fishing season is determined according to the fish resources and migration habit. At present, the candle-power of electric light to be used is restricted within. 10 k. w. The structure of a Pacific saury stick-held dip net. In deciding the fishing season, the southward migration of Pacific saury can be tracked from, the condition of fishing areas, particularly from the sea water temperature distribution chart. Because the Pacific saury fishing season comes

next to the skipjack fishing season, the northern-most black currant has been surveyed fairly well at the end of the skipjack fishing season.

Fishermen look for the fish jumping in the fishing ground. They wait for the schools of fish at night with a help of a search light or fishing light. When fish in large schools are found out, the boat slows down and stops and the search light is put out. After the fish got used to the boats lights on one side board are put out and the net is dropped overboard. After the net has been spread, two fishing lights of 500w each are lighted over the central part of the net and the fishing lights on another board are put off in turn. Thus schools of fish are induced from one board to another and the net is hauled up. From the viewpoint of photo taxis of fish, red colored lamps have recently been brought into use often.

In view of the fact that Pacific saury migrates on the surface waters, surface lights are used in Pacific saury fishing, while for the capture of horse mackerel and mackerel, underwater fishing lights are mostly used.

Fixed Net Fishing

Leading nets are set across the migrating passage along the coast so as to induce a school of fish into the bag net set at the off-shore side end of the leading net. Among the leading nets are large nets set in the sea of 100 meters deep, e.g., a yellow tail fishing net, and a small pound net with a cube-shaped bag set on the coast of 5 meters deep. Among leading nets there is a long net stretching over as far as 4,000 meters off-shore. In the fixed net fishing, fishermen have to wait for migration of a school of fish. In view of the design of a net, it is not easy to keep the proper form of a large-sized net in case where the current is swifter than nautical mile. Costs for a trip to and from the fishing ground and for fish/searching are saved and the fishing can be met with great success by selection of fishing ground.[37]

Two parallel nets over a quarter mile long are set in relatively shallow water on the edge of the steeply dropping floor of Toyama Bay. The nets taper and rise together at their tip. Using their boats, the fishermen drive fish into a gate that opens into the tapered corral of the nets. It's almost like a cattle drive! The fish are then herded into the net's

shallow tip, where they're scooped up with long-handled nets. The catch suffers a minimum of trauma.

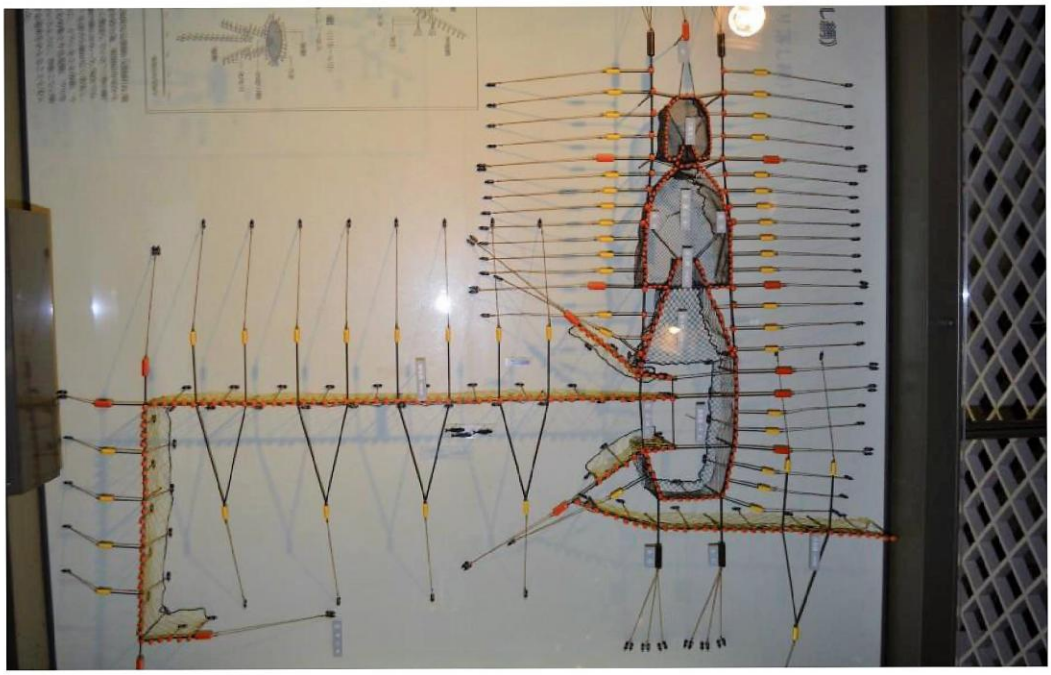


Fig.3: Fixed Net Fishing

Pole and Line Fishing

Pole and line is a simple method of catching tuna with hook and line attached to a long pole. The fishing method is comprised of two interlinked fisheries; one for live bait and one for tuna. The target species of pole and line fisheries are skipjack, albacore or yellowfin tuna. In skipjack fisheries, between 70-100% of the final catch is the target species.20,21 Most of the remaining catch is other species of tuna, including juvenile yellowfin, which is mostly kept on board and used for local consumption. Skipjack are caught from free-swimming schools or around FADs and seamounts. Schools of skipjack prefer to swim close to the ocean surface seeking prey; when they find it they enter a "feeding frenzy", during which they will bite anything that moves in the water, including the hook of a pole and line.

When live bait is released into a school of skipjack, the hungry tuna displays this same feeding frenzy behaviour, and the tuna are easily caught one after the other. The fish are either landed within hours of catch, or stored in ice or frozen in brine on board the vessel.

Numerous different types of fishing boat can be used for pole and line fishing. In the Maldives, for example, the fishing is done from the stern, whereas Japanese-style boats fish from the bow. An average-sized vessel uses up to 20 poles at a time.

Bait fisheries target various species of small pelagic fish such as sprats, anchovies, caesio or juvenile fusiliers. Fishing operations are mostly at night, with a typical night-baiting exercise taking place near a beach or lagoon reef (or inside an atoll) in water between 4-20 metres deep. Bait fish are attracted by use of a light. Once the school surfaces and forms a tight aggregation, a net is quickly hauled and the bait dumped into the flooded hull or a holding tank. Developing aquarist skills to keep bait fish alive is one of the biggest technological challenges of the pole and line fishery. Both the fishing distance from bait fish grounds and the time the fishing boat can stay at sea catching tuna are determined by how long the bait fish lives. Commonly-used techniques enable bait to be kept alive for around seven days[38], although Japanese long-range pole and line fleets are reportedly able to keep their catch alive for as long as three months[39].

It would also appear that the longer bait can be kept alive, the fewer are needed during tuna fishing operations, as fishermen will use them more sparingly to extend the time they can stay out at sea[40].

Pole and line fishing is to jingle, for fish one by one. The pole and line fishing is grouped into three types: pole and line. hand line and trolling. Except such pelagic fisheries as skipjack and horse mackerel pole and line fishing, other pole and line type fishing is very small-scaled, but is the mainstay of small-scale fisheries among the coastal fisheries.

A pole has a fishhook. The pole and line fishing is convenient for quick and exact motion of fishhooks and for alleviating the impact given by the fish captured.

Skipjack and mackerel pole and line fishing is the typical one. The number of units operated in skipjack pole and line fisheries (comprising pelagic and coastal fisheries) total led up to 5,378 with the total catches of 161,203 tons. Among the pelagic fishing boats, there are a few as large as 280 gross tons.

A school of fish are first lured by baits and angled on a one-pole one-fish basis in a short time. In the case of mackerel pole and line fishing, efficiency is so high that it is angled at the rate of one fish per capita per second in most cases, live baits are used. Jig or oiled baits are also used Minced meat and juice of fresh and fishing lights are used in order to lure a school of fish.

A fishing boat using live baits is equipped with a live bait pool There are many holes in the pool through which sea water circulates freely It is a striking feature of the Japanese live bait pools that sea water is kept in circulation naturally. Sardine live bait pools are installed in skipjack fishing boats. Care is taken so that there is constant supply of fresh[1] sea water.

Pole and Line Fishing

Fig. 4: Pole and line Fishing

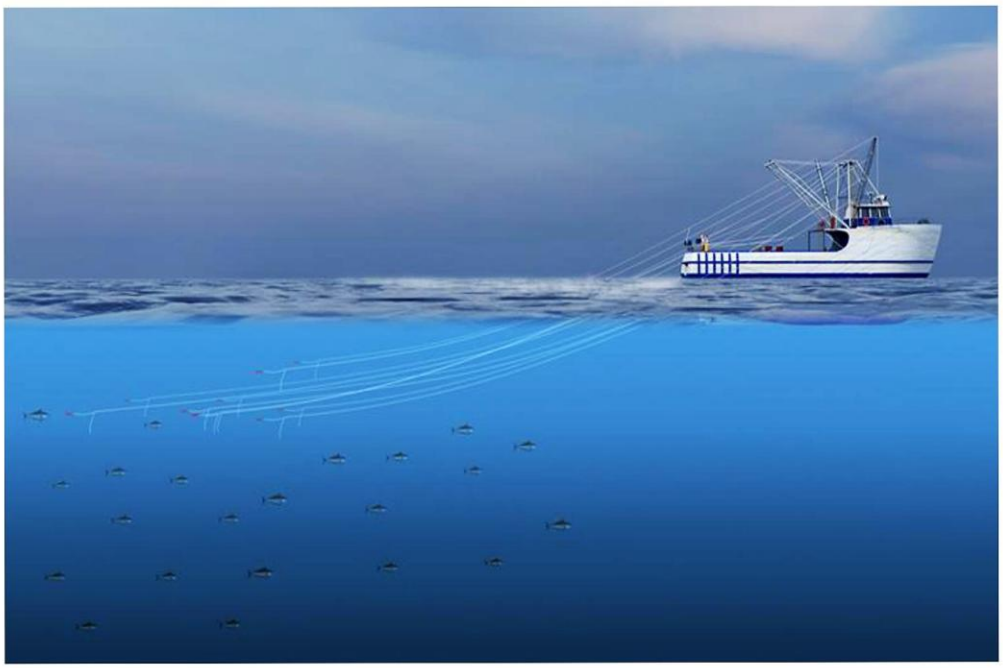
The size of fishhook varies according to the fish species. Most of the fishhooks are barbed ones. Fishhooks used for skipjack and mackerel pole and line fishing have no barbs because as soon as the fish are angled the hooks must be removed quickly from them In skipjack pole and line fishing, jigs are mostly used according to the state of a school of fish. In skipjack angling, water sprinkling.is generally practiced. This is considered a sort of camouflage to let the skipjack think as if there were a great many living sardines. Skipjack angling is practiced during the day time while mackerel angling is clone mostly at night.

Hand line consists of line, hook, and weight. The hand line is used mainly to angle for fish living in mid sea and sea bottom. This is a very small-scale fishing, in the same range as the yellowtail angling with charm | baits. ; Squid angling is most typical among hand line fishing. The number of units operated in squid angling is 52,609 with the total catches of 269,837 I tons. Squid angling is operated at night by using fishing lights. A set of (8 two lines attached with 5 to 10 jigs each is used by one angler. In the 9 case of 30 gross-ton class boat, a crew usually consists of nearly 20 members.

Trolling Fishing Techniques:

Trolling is practiced on a small scale like India. Professional trolling is practiced generally by 2 to 10 gross-ton class boats to angle for yellowtail, Spanish mackerel *(Sawara niphouia,),*skipjack, mackerel, young tuna, etc. Fishing techniques vary according to the boat. In general, a boat sails in a fishing ground trolling the line attached with baited hooks, keeping the baits in the state as if they were swimming. For this type of fishing, jigs are generally used. In the case of a small boat it trolls 4 to 10 lines usually.

In dropping the lines overboard, supporting bamboo sticks are used; direful attention must be paid to the length or height of each line so as to prevent the lines from entangling one another at the time of lifting up the catch.



Trolling Techniques

Fig. 5: Trolling Techniques

Recently, low frequency electric shock device has come into use for this fishing in order to troll the lines under mid-sea water. The lines are attached with electric cords to kill the catch when they bite, by transmitting low frequency electric shock current. The total Japanese fishing boats at the end of 1955 numbered 415,58 (1,331,311.93 gross tons), but 65.3. % of the total consisted of small non powered boats of average less than one gross ton and the powered one were only 144,421 (1,070,363.87 gross tons) out of which 81.7% are the small boats of less than five gross tons. Even the powered boats are made of wood to the extent of 99.4%', not to speak of the non-powered ones, Although the percentage of steel ships is very low, the total tonnage thereof constitutes 31.1% of the total tonnage for powered boats and the steel boats average 313 gross tons. In the case of the large boats, steel boats are overwhelmingly great in number, while wooden powered boat are only 51.5 tons on the average.

Among the main engines used for powered fishing boats are electric ignition engine, hot bulb engine, diesel engine, diesel engine attached with supercharger, and steam engine. Electric ignition engines are predominant with 54.0% of the total, followed by hot bulb engines are diesel engines, with 32.3% and 13.6% respectively.

Longline fishing and its development

Horizontal longline fishing for pelagic species evolved in Japan during the nineteenth and early twentieth centuries. Sailboats equipped with hemp longlines would venture as far as 30 nm offshore from Japan in search of tuna and billfish. By 1912 there were over 100 registered sailboat tuna longliners in Japan. The first diesel powered steel longline vessels did not appear until the early 1920s. The longlines were hauled by hand until 1929 when the first mechanical lure line hauler was developed.

Longline fishing was introduced to the rest of the Pacific Ocean in the 1930s by Japanese fishermen. By 1939 there were about 70 Japanese longline boats of between 60 and 270 gross registered tons (GRT) operating in the western and central Pacific Ocean from bases in Palau, Chuuk, and the Northern Marianas. At about the same time descendants of Japanese immigrants in Hawaii introduced what was called ‘flag line fishing’ to local

fishermen. It was called flag line fishing because the mainline was marked by a series of flags on bamboo poles supported by glass floats. During World War II (1941 to 1945) fishing activities were curtailed in the Pacific Ocean, but after the war they resumed again when restrictions to vessel movements were lifted. By the early 1950s, after abolition of the MacArthur Line (this was the name for the occupation force's blockade which was set at 24°N and 165°E in 1946), there were close to 100 Japanese longliners operating in the western and central Pacific Ocean. Several fish bases were established throughout the Pacific to service the longline and pole and line vessels.

In the 1960s there were over 200 Japanese longliners operating throughout the Pacific: boats of 30 to 100 GRT in the Trust Territories, or Micronesia, boats of 100 to 200 GRT operating further east, and boats up to 400 GRT operating as far east as French Polynesia. Until the late 1960s most of these longliners were targeting albacore for the canneries and the catch was frozen at sea. In the early 1970s the Japanese longline fishery switched to more equatorial tunas and began fishing for sashimi grade bigeye and yellowfin tunas. Korean and Taiwanese boats soon began to replace the Japanese boats in the longline albacore fishery. The combined Korean and Taiwanese fleet numbered in the hundreds of boats and operated in Samoa, Vanuatu and Fiji Islands. In the late 1970s these boats also began switching to the sashimi tuna fishery, 1980 was the peak year for fishing for the Asian fleet operating in the western and central Pacific Ocean -4647 boats landed 208,696 mt of bigeye, yellowfin, albacore, and skipjack tuna. By 1997 there were more longliners (4886) operating in the western and central Pacific Ocean, but fish landings totaled only 179,535 mt.[41]

Longline fishing is a commercial fishing technique. It uses a long line, called the main line, with baited hooks attached at intervals by means of branch lines called snoods (or gangions)[42]. A snood is a short length of line, attached to the main line using a clip or swivel, with the hook at the other end. Longlines are classified mainly by where they are placed in the water column. This can be at the surface or at the bottom. Lines can also be set by means of an anchor, or left to drift. Hundreds or even thousands of baited hooks can hang from a single line. Longlines commonly target swordfish, tuna, halibut, sablefish and many other species.[43.]

In some unstable fisheries, such as the Patagonian tooth fish, fishermen may be limited to as few as 25 hooks per line. In contrast, commercial longlines in certain robust fisheries of the Bering Sea and North Pacific generally run over 2,500 hand baited hooks on a single series of connected lines many miles in length[44]. Longlines can be set to hang near the surface (pelagic longline) to catch fish such as tuna and swordfish or along the sea floor (demersal longline) for ground fish such as halibut or cod. Longlines fishing for

sablefish, also referred to as black cod, occasionally set gear on the sea floor at depths exceeding 1,100 metres (3,600 ft) using relatively simple equipment. Longlines with traps attached rather than hooks can be used for crab fishing in deep waters.

Longline fishing is prone to the incidental catching and killing of seabirds, sea turtles, and sharks,[45] but can be considerably more ecologically sustainable than some other commercially significant harvesting methods. [46]

The Hawaii based longline fishery for swordfish was closed in 2000 over concerns of excessive sea turtle bycatch, particularly loggerhead sea turtles and leatherback turtles. Changes to the management rules allowed the fishery to reopen in 2004. Gear modification, particularly a change to large circle hooks and mackerel type baits, eliminated much of the sea turtle bycatch associated with the fishing technique. It has been claimed that one consequence of the closure was that 70 Hawaii based vessels were replaced by 1,500-1,700 longline vessels from various Asian nations, but this is not based on any reliable data. Due to poor and often nonexistent catch documentation by these vessels, the number of sea turtles and albatross caught by these vessels between 2000 and 2004 will never be known. Hawaii longline fishing for swordfish closed again on 17 March 2006, when the bycatch limit of 17 loggerhead turtles was reached. In 2010 the bycatch limit for loggerhead turtles was raised, but was restored to the former limit as a result of litigation. The Hawaii based longline fisheries for tuna and swordfish are managed under sets of slightly different rules. The tuna fishery is one of the best managed fisheries in the world, according to the UN Code of Responsible Fishing, but has been criticized by others as being responsible for continuing bycatch of false killer whales, seabirds, and other non-targeted wildlife, as well as placing pressure on depleted bigeye tuna stocks.

Commercial longline fishing is also one of the main threats to albatrosses. Of the 22 albatross species recognized in the IUCN Red List, six are threatened, and nine are vulnerable.[47] The IUCN lists three species as critically endangered; The Amsterdam albatross, the Tristan albatross and the waved albatross. The remaining four are near threatened. Albatrosses and other seabirds which readily feed on offal are attracted to the set bait, become hooked on the lines and drown. An estimated 100,000 albatrosses per year are killed in this way. [48]

Traditional Fishing Techniques

Ayu fishing

Ayu fishing is one of the several narrowly defined styles of fishing in Japan. Ayu fishing was practiced by Samurai as long as 430 years ago. It uses very long rods (5–7 meters) and fly, but fly-casting is not required. Ayu fishing originated at least 430 years ago [49]. when anglers discovered they could dress their flies with pieces of fabric and use those to fool the fish. The art became more refined as the samurai, who were forbidden to practice martial arts and sword fighting in the Edo period, found this type of fishing to be a good substitute for their training: the rod being a substitute to the sword, and walking on the rocks of a small stream good leg and balance training. "Only the samurai were permitted to fish. So, the samurai who enjoyed ayu fishing would take sewing needles and bend them themselves, and make their own flies by hand.

Ayu fishing may be done with lures or with a live decoy. As ayu fish are very territorial, they are likely to attack the live decoy fish used as bait [50].

Fly fishing and weir fishing (Yana) for Ayu is a popular summer pastime in Japan and a good example of a Japanese traditional fishing method. The Ayu fish (a small Japanese river trout) is a unique genus. Ayu fish are amongst the Japanese people's favorite fish. The fish have a sleek body and when broiled with salt are tastier than many other species. To Japanese people, the word Ayu conjurs up images of summer, the countryside, and good taste. They have a lifespan of only 1 year and are found in the many fast flowing rivers of Japan. Unfortunately dam construction has seriously affected their habitat, although it should be noted that the impact of dams and other man-made structures on the Ayu is one of the causes of the growing environmental awareness in Japan.

1. Ayu Fishing with "Yana"

Most people who catch Ayu do so at a Yana. A Yana is a small weir made of wood and stone, with a fish trap (a type of fishing net) attached to it that is made of bamboo, reeds or other suitable materials. The opening of the fishing season is good for a barbecue of freshly grilled Ayu with salt and miso (bean paste) and cold beer.

The origins of yana are unknown, though the Ainu (Japan's indigenous people) and the Japanese have long raised these fish and harvested annual catches. This fishing technique is not restricted to Japan, and was widely practised across the Eurasian continent wherever the environment suited.

The basic method used is to funnel the water of a river so that it passes over a small weir, usually less than a meter high. A platform (typically made from bamboo) is then built below the weir, so that the water and smaller inhabitants of the river pass through the gaps and continue downstream. By placing the poles of the platform close enough together, any fish washed over the weir will then be trapped and easily caught by people fishing there. It is of course possible to fish for Ayu using a rod and reel, and there are many such enthusiasts. However, catching Ayu with a rod and reel though can take a lot of patience and skill [51].

The Technique:

The Ayu eat organic plants attached to pebbles or rocks on the river bed. Ayu are very territorial, and each fish tries to maintain a territory of about 10 to 20 square meters (approx 105 to 210 square feet). They will attack any other fish that enter their territory. An experienced angler takes this behavior into consideration and uses other Ayu as bait ("invaders").

Ayu Fishing 1

Fig. 6: Ayu Fishing 1

The trick is to attach 3 to 4 hooks to the underside of a baited Ayu, using the gills to secure the line. The fish is still alive and able to swim, though weakened. The angler then looks for an Ayu grazing in the waterweeds. Japanese streams are usually not very deep, and an Ayu will usually forage in the shallower areas or slower flowing parts of a stream away from the thalweg (the thalweg is the deepest and therefore fastest flowing part of.

the stream as a result of the "pool and riffle" sequence) as there will be more organic matter available to eat. The next step is to guide the bait (invader) fish using a very long rod into the territory of the Ayu. The Ayu will naturally regard the bait as an invader of its territory (especially if another Ayu is used as bait). Initially the Ayu will keep an eye on the bait fish to see if it will respect its territory (ie swim away once it realizes that this part of the stream is "taken"). As the invader will of course not leave the territory (because the angler will keep it in there using the rod) the Ayu will attack in an effort to drive the invader off and so protect his feeding area.

The attacks involve charging and ramming the belly of the bait fish. Since the bait fish is alive and struggling but unable to leave the territory (due to the rod), it is usually only a matter of time before the Ayu is hooked. Because the bait fish will repeatedly try to escape the attacker (and in doing so pull the hooks along beneath). The fish that has just been caught is usually hooked on the shoulder (and so not badly hurt), but to prevent further injury you shouldn't reel them in use a net and bucket. After retrieving both fish from the stream, the next step is to switch the exhausted bait fish for the newly caught Ayu. This then becomes the new bait/invader fish - this is the unique aspect of Ayu fishing. The process is then repeated, each time with the newly caught fish replacing the exhausted invader.

Being Japan, and since the Ayu season is summer, the sociable thing to do next is have a barbecue. As with fish caught at a "Yana", you skewer the fish through the mouth with a sharp kebab-stick. Once grilled salt lightly and start eating[52].

Ayu Fishing 2

Fig. 7: Ayu Fishing 2

Tenkara fly fishing

Tenkara fly fishing (Japanese: テンカラ, literally: "from heaven", or "from the skies") is a traditional type of fly fishing practiced in Japan. Primarily used for mountain stream trout fishing, tenkara is one of the most popular methods of angling among freshwater mountain anglers in Japan. It has been virtually unknown outside Japan until the first company to introduce and popularize tenkara outside Japan, Tenkara USA, was founded in April 2009 in San Francisco, California. However, new companies including Tenkara Rod Co., Temple Fork Outfitters, Wet fly Back Country, Dragon tail Tenkara, Tenkara Tanuki now offer additional rods to suit the needs of different anglers. [53]

Tenkara fishing originated in Japan at least 200 years ago. The first reference to tenkara fly-fishing was in 1878 in a book called "Diary of climbing Mt. Tateyama" written by Ernest Mason Swatow, an able linguist and British diplomat during the early modernization of Japan[54]. Tenkara fly-fishing originated with professional fishermen in the mountain streams of Japan who found it an effective method of catching the local fish, Yamame, Iwana and Amago[55] It is a traditional type of fly fishing practiced in Japan at least 200 years ago. Primarily used for mountain stream trout fishing, tenkara is one of the most popular methods of angling among fresh-water mountain anglers in Japan. Tenkara fly-fishing originated with professional fishermen in the mountain streams of Japan who found it an effective method of catching the local fish,

Originally the rod was simply a bamboo/cane rod, which was cut and treated, but unlike contemporary western bamboo rods, they were not "manufactured" (i.e. split and glued back together). Unlike in the western fly-fishing tradition where anglers used heavy wooden rods, in Japan anglers always used bamboo, which is readily available and very light. Because of its light weight, Japanese anglers were able to use very long bamboo rods and reach as far as needed without the need to develop reels for the short rods developed in the west.

Tenkara fly fishing

Fig.8: Tenkara fly fishing

Tenkara has been virtually unknown outside of Japan until the first company to introduce and popularize tenkara outside of Japan, Tenkara USA, was founded in April 2009 in San Francisco, California.

Tenkara fishing can be seen as a streamlined counterpart to western fly-fishing. The equipment is designed to direct focus to the actual fishing and catching of the fish, not to cause a major preoccupation with the equipment. Only a rod, tenkara line and fly are necessary for tenkara fishing (no reel is used).

The appeal of tenkara is its elegant simplicity. There are also other advantages of using the long tenkara rods when fishing in mountain streams, primarily the lightness of the line and delicate presentation. A long rod allows for precise placement of the fly on small pools and allows for holding the fly in place on the other side of a current.

The other main advantage of using the long tenkara rod is precise control for manipulation of the fly.

Rod: A very long and flexible rod (usually telescopic) is used in tenkara fishing. The rods normally range from 3.3 to 4.5 meters long (11 ft to 15 ft). These rods were originally made of bamboo, but are nowadays made with carbon and/or fiber glass. They also have a handle similar to fly-fishing rods that can be made of wood (the more prized rods) or cork.

Line: As in fly-fishing, it is the tenkara line that propels the weightless fly forward. In tenkara, the traditional and most commonly used line is a tapered furled line (twisted monofilament), of the same length or slightly shorter than the rod. The main advantage of furled lines is the delicate presentation and ease of casting. Alternatively, a tenkara "level" line can be used. Level lines are specially formulated fluorocarbon adjusted to the desired length. They are easier to cast against the wind. The traditional tenkara line has a loop of braided line at its thicker end. This braided line is used to tie the tenkara line directly to the tip of the rod by using a cow hitch (aka: girth hitch) knot. The line at the rod's tip needs to have a stopper knot, which will hold the cow hitch in place. It is a very secure method to attach the line.

Tippet: This is the same as a regular fly-fishing tippet, and is used to connect the fly to the line (which is too thick to tie directly to the fly). Usually between 30 cm to 1 meter of tippet is added to the end of the line. This is typically referred to in Japanese as "hea" (for hair).

Fly: Artificial flies are used in tenkara fly-fishing. These are tied with thread, feathers and sometimes fur as in western fly-fishing. Traditionally a special reverse hackle wetfly

is used. In Japan it is known as "kebari". These traditional Japanese flies differ from most Western flies, in that the hackle is tied facing forward [56].

Cormorant fishing

Cormorant fishing is a traditional fishing method in which fishermen use trained cormorants to fish in rivers. Historically, cormorant fishing has taken place in Japan and China since about 960 AD.[57] It is described as a method used by the ancient Japanese in the *Book of Sui*, the official history of the Sui Dynasty of China, completed in 636 AD. This technique has also been used in other countries but is currently under threat in China.[58, 59, 60]

To control the birds, the fishermen tie a snare near the base of the bird's throat. This prevents the birds from swallowing larger fish, which are held in their throat, but the birds can swallow smaller fish. When a cormorant has caught a fish in its throat, the fisherman brings the bird back to the boat and has the bird spit the fish up. Though cormorant fishing once was a successful industry, its primary use today is to serve the tourism industry.

The types of cormorants used differ based on the location. In Gifu, Japan, the Japanese cormorant (*P. capillatus*) is used; Chinese fishermen often employ great cormorants (*P. carbo*).[61] Darters (*anhinga*), which are very close relatives of cormorants, are also used for this fishing technique on occasion.

Cormorant fishing, called ukai (鵜飼) in Japanese, takes place in 13 cities in Japan. The most famous location is Gifu, Gifu Prefecture, home to cormorant fishing on the Nagara River, which has continued uninterrupted for the past 1,300 years.[62.] Cormorant fishing in Seki also takes place on the Nagara River, but it is called "Oze cormorant fishing" (小瀬鵜飼 Oze Ukai). Only the cormorant fishing masters in Gifu and Seki are employed by the emperor and called Imperial Fishermen of the Royal Household Agency.

Ukai is a traditional fishing method which uses trained cormorants to catch river fish such as sweet fish (ayu). This type of fishing has been around for over 1300 years, most prominently along the Nagaragawa River in Gifu City, where the master fishermen have official patronage from the emperor. Today, ukai takes place in the summer months in about a dozen rivers across Japan, including: **Nagaragawa River,** Gifu City, May 11 to October 15, **Hozu River**, Arashiyama, Kyoto City, July to mid-September (2016: 7/1 to 9/23), **Uji River**, Uji City, July to September (2016: 7/1 to 9/30)

Ukai is practiced by master fisherman working from long wooden boats. Each fisherman leads about a dozen cormorants on leashes who swim alongside the boat and dive under the water to catch fish by swallowing them whole. The fish are kept in a special pouch in the cormorant's throat to be retrieved later and are prevented from being swallowed by a snare around the neck of the bird. Each boat has a large fire that hangs from its bow to provide light for the boatmen to steer and the birds to fish by.

The fisherman, known as an "Usho", manages the cormorants to catch fish. Visitors can not only enjoy the sight of this unusual fishing technique but also relish the tasty sweet fish that have been caught. That is why Ukai has often been presented in front of the noble families. These days, the activity is a major tourist attraction and the fishermen still wear the same old-fashioned clothing when Ukai was performed for the Imperial family. On summer evenings, in the light of burning torches, the cormorant fishermen get on small wooden boats and handle masterfully more than ten birds at once with their distinctive calls. Diving, swimming and catching sweet fish in the light of flaming torches, the cormorants enchant the audience. The Process of Cormorant fishing is as follows[63].

Process of Cormorant fishing -1

Fig. 9: Process of Cormorant fishing -1

Process of Cormorant fishing- 2

Fig. 10: Process of Cormorant fishing-2

Process of Cormorant fishing- 3

Fig. 11: Process of Cormorant fishing-3

Process of Cormorant fishing- 4

Fig. 12: Process of Cormorant fishing-4

Process of Cormorant fishing- 5

Fig. 13: Process of Cormorant fishing-5

Artificial reefs

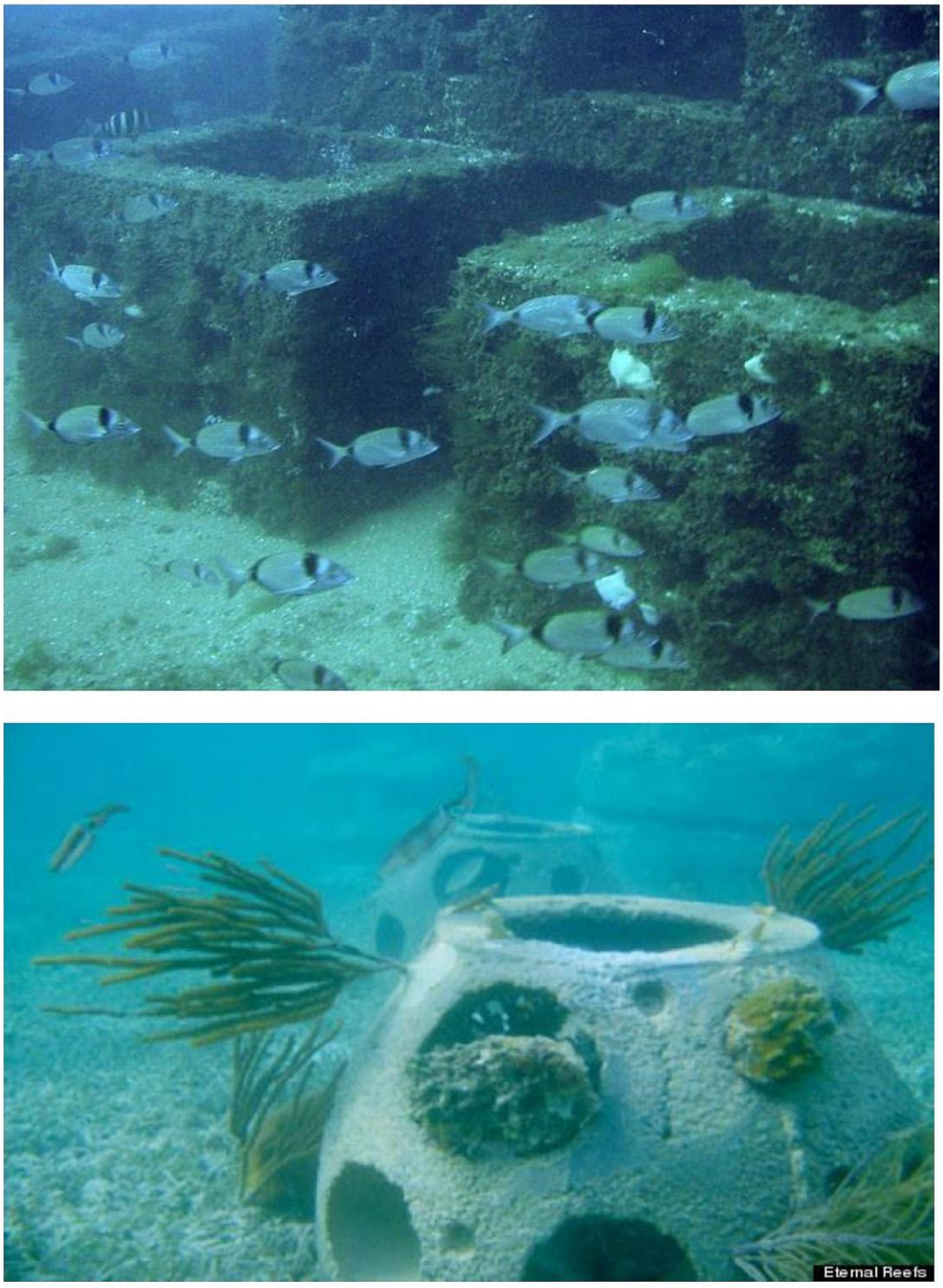
An **artificial reef** is a human-made underwater structure, typically built to promote marine life in areas with a generally featureless bottom, to control erosion, block ship passage, or improve surfing. Many reefs are built using objects that were built for other purposes, for example by sinking oil rigs (through the Rigs-to-Reefs program), scuttling ships, or by deploying rubble or construction debris. Other artificial reefs are purpose built (e.g. the reef balls) from PVC or concrete. Shipwrecks may become artificial reefs when preserved on the sea floor. Regardless of construction method, artificial reefs generally provide hard surfaces where algae and invertebrates such as barnacles, corals, and oysters attach; the accumulation of attached marine life in turn provides intricate structure and food for assemblages of fish.

The construction of artificial reefs is thousands of years old. Ancient Persians blocked the mouth of the Tigris River to thwart Indian pirates by building an artificial reef,[64] and during the First Punic War the Romans built a reef across the mouth of the Carthaginian harbor in Sicily to trap the enemy ships within[65] and assist in driving the Carthaginians from the island.

Artificial reefs to increase fish yields or for alga culture have been used at least since 17th-century Japan, when rubble and rocks were used to grow kelp, [66] while the earliest recorded construction of artificial reef in the United States is from the 1830s when logs from huts were used off the coast of South Carolina to improve fishing. [67]

Since at least the 1830s, US fishermen used interlaced logs to build artificial reefs. More recently, castaway junk, such as old refrigerators, shopping carts, ditched cars, out-of-service vending machines replaced the logs in ad hoc reefs. Officially sanctioned projects have incorporated decommissioned subway cars, vintage battle tanks, armored personnel carriers and oil drilling rigs. [68]

Artificial reefs are used to increase sustainable fishing activities on the coastline of Japan, which depends heavily on the sea for food. Since the Middle Ages Japanese fishermen used immense bamboo structures to enhance the proliferation of fish.[69] The



Artificial reefs

Fig. 14: Artificial reefs

first artificial reefs for which records have been kept dates back to 1650and written records show that the reefs were in use between 1789 and 1801.

Since 1930 Japan has subsidised the installation of artificial reefs especially from 1952. The Japanese government continues to invest in research and development and financing of major projects.70 It is a true maritime development program with interests and significant investment of around one billion euros per year. They build both shallow water reefs (called "tsukiiso") for shellfish and seaweeds and deeper water reefs (called "gyosho") for finfish.[70] In addition to the roles of hatchery, nursery, and shelter, the reefs serve as relays for sea bream which are produced in the hatcheries and released into open water near the artificial reefs that are home to the adult fish. [71a]

Japanese scientists have evidence that specifically designed shallow water reefs can improve survival and growth of juvenile abalone.[71b] While the Japanese have been putting millions, and in recent years billions, of dollars into developing sophisticated techniques to create new habitat and increase seafood production.[72a] Japan, and more recently Taiwan,[73a] have put most of their effort into specifically designed and constructed units. Since 1930, Japan has granted subsidies for the construction of various types of reefs. In 1952, Japanese artificial reef research and construction efforts intensified and since then they have continued to expand and improve their program. Artificial reefs are used by the Japanese to improve coastal fisheries. They build both shallow-water reefs (called "tsukiiso") for shellfish and seaweeds and deeper water reefs (called "gyosho") for finfish[71c] Japanese scientists have evidence that specifically designed shallow water reefs can improve survival and growth of juvenile abalone.[72b] While the Japanese have been putting millions, and in recent years' billions, of dollars into developing sophisticated techniques to create new habitat and increase seafood production ,[73b] the United States has pursued a less sophisticated and much more frugal approach. States and local groups have been responsible for most of the reef construction to date, often with limited budgets [74] Scrap materials, because of the low cost, have been used extensively in the United States[75], while Japan, and more recently Taiwan[71d] have put most of their effort into specifically designed and constructed units.

Gear Type	Catch	Typical Vessel that Uses Gear	Notes
Purse seine			
	Mainly skipjack and small yellowfin are caught by purse seine gear. Most catch is for canning.		About 80 percent of the tuna catch in the Pacific Islands region is by purse seine gear. Most of the purse seine catch is taken within 5 degrees of the equator.
Longline			
	Most tuna caught are large size yellowfin, bigeye, and albacore. The prime yellowfin and bigeye often are exported fresh to overseas markets. Most of the albacore is for canning.		About 13 percent of the tuna catch in the Pacific Islands region is by longline gear. There are two major types of longliners: (1) relatively large vessels with mechanical freezing equipment (often based outside the Pacific Islands), and (2) smaller vessels that mostly use ice to preserve fish and are typically based at a port in the Pacific Islands.
Pole-and-line			
	Mainly skipjack and small yellowfin are caught by pole-and-line gear. Most catch is for canning or producing a dried product.		About 7 percent of the tuna catch in the Pacific Islands region is by pole-and-line gear. In the 1980s several Pacific Island countries had fleets of these vessels, but most no longer operate due to competition with the more productive purse seine gear. Most of the catch by this gear is made in Asian waters.
Troll			
	Large-scale trolling targets albacore for canning.		Large-scale tuna trolling is carried out by some vessels based in the Pacific Islands. The actual fishing activity occurs in the cool water to the south of the region.

Source: Gillett 2004.

Summary of Important Fishing Gears and Fishing Methods

Fig. 15: Summary of Important Fishing Gears and fishing Methods

FISHING BOATS

Fishing vessel is a boat or ship used to catch fish in the sea, or on a lake or river. Many different kinds of vessels are used in commercial, artisanal and recreational fishing. According to the FAO, there are currently (2004) four million commercial fishing vessels.[76a] About 1.3 million of these are decked vessels with enclosed areas. Nearly all of these decked vessels are mechanised, and 40,000 of them are over 100 tons. At the other extreme, two-thirds (1.8 million) of the undecked boats are traditional craft of various types, powered only by sail and oars. [76b] These boats are used by artisan fishers.

It is difficult to estimate the number of recreational fishing boats. They range in size from small dinghies to large charter cruisers, and unlike commercial fishing vessels, are often not dedicated just to fishing.

Prior to the 1950s there was little standardisation of fishing boats. Designs could vary between ports and boatyards. Traditionally boats were built of wood, but wood is not often used now because it has higher maintenance costs and lower durability. Fibreglass is used increasingly in smaller fishing vessels up to 25 metres (100 tons), while steel is usually used on vessels above 25 metres. Engines are being gradually replaced by diesel engines. This trend is somewhat true of electric ignition engines. Electric ignition engines are used mostly for small boats of less than five gross tons. Hot bulb engines are used for fishing boats up to 20 gross tons, but those over 70 to 80 gross tons are equipped with diesel engines. In addition, diesel engines attached with superchargers are being used for many of fishing boats due to the recent tendency in the use of large-sized fishing boats. Steam engines are used for special type and old-fashioned fishing boats, and no new ones are equipped with this type of engine.

In the cases of coastal and off-shore fisheries, it can be pointed out that non-powered fishing boats are becoming replaced by powered one's year after year and that powered boats are becoming increasingly great in size and in horse power. The tendency is especially noticeable in the pelagic fishing boats, but a steady progress has been made even in the case of small fishing boats. For instance, the electric ignition engines of, v efficiency have been replaced by small type diesel engines, or modern apparatus such as radiotelephone set, fish finder, etc. have been installed. Thus constant improvement has

been made. The size of fishing fleet by type of fisheries varies according to the size and grade of fishing boats. The percentage for each type of fisheries size of fishing boats can be grouped into three categories: non-powered boats, powered boats of less than five gross tons, and powered boats of more than five gross tons,

In the post-war years, the use of fish finders is becoming increasingly great. At present, although the number of the sea water powered boats equipped with fish finders reaches only 18.8 per cent, about 5,000 vessels in number, they are on the rapid increase. Fish finders are now used mostly for such types of fisheries as coral net, trawlers, and medium trawler west of 130°E, followed by pole and line, tuna and skipjack fisheries, etc. However, by means of the present fish finders, only the crowded fish on the surface or in underwater can be found out, but various kinds of fish at the bottom of sea cannot be well found out yet. Fish finders, therefore, are being used mainly for judging the configuration of the sea bed. The research of a highly efficient fish finder available for each type of fisheries is now under way. In the event of its completion, it will show rapid increase in the number of fishing boats to which improved fish finders will be installed. In view of the fact that fishing grounds are becoming farther away year after year, research of various devices for heat control within a hatch is now under way. Cork boards have been generally used as heat insulating material, but plastics have recently been brought into trial use. Since it has been proved effective to paint plastic on the surface of lining boards of a hatch, this method has been adopted widely. Out of the total fishing boats of more than 20 gross tons, 7.7 per cent of them 'are equipped with refrigerators. In the case of pelagic fishing boats of 'more than 100 gross tons, the number of fishing boats equipped with refrigerators. constitutes as high as 56.8 per cent. Ammonia, Freon, are used as refrigerants. High speed and multi-cylinder refrigerators come into use recently. Thus the efficiency of refrigerators will further be promoted. For smaller fishing boats, there is nothing particular except fish finders as equipment for fish-catching, but in the case of larger-size pelagic fishing boats, a variable pitch propeller is equipped in order that a boat may be so that it is difficult to solve this problem immediately. Together with the advance in the scientific study, legislation suitable to cope with the situation will have to be established so that the fisheries resources will be protected.

Traditional fishing Crafts

Traditionally, many different kinds of boats have been used as fishing boats to catch fish in the sea, or on a lake or river. Even today, many traditional fishing boats are still in use. According to the United Nations Food and Agriculture Organization (FAO), at the end of 2004, the world fishing fleet consisted of about 4 million vessels, of which 2.7 million were undecked (open) boats. While nearly all decked vessels were mechanised, only one-third of the undecked fishing boats were powered, usually with outboard engines. The remaining 1.8 million boats were traditional craft of various types, operated by sail and oars.[76c]

Early fishing vessels included rafts, dugout canoes, reed boats, and boats constructed from a frame covered with hide or tree bark, such as coracles.[77a] The oldest boats found by archaeological excavation are dugout canoes dating back to the Neolithic Period around 7,000-9,000 years ago. These canoes were often cut from coniferous tree logs, using simple stone tools.[77b,78] A 7000-year-old sea going boat made from reeds and tar has been found in Kuwait.[79] These early vessels had limited capability; they could float and move on water, but were not suitable for use any great distance from the shoreline. They were used mainly for fishing and hunting.

The development of fishing boats took place in parallel with the development of boats built for trade and war. Early navigators began to use animal skins or woven fabrics for sails. Affixed to a pole set upright in the boat, these sails gave early boats more range, allowing voyages of exploration

According to the FAO, at the end of 2004, the world fishing fleet included 1.8 million traditional craft of various types which were operated by sail and oars.[79a] These figures for small fishing vessels are probably under reported. The FAO compiles these figures largely from national registers. These records often omit smaller boats where registration is not required or where fishing licences are granted by provincial or municipal authorities[79b] Indonesia reportedly has about 700,000 current fishing boats, 25 percent of which are dugout canoes, and half of which are without motors.[80][6] The Philippines have reported a similar number of small fishing boats.

Traditional fishing boats are usually characteristic of the stretch of coast along which they operate. They evolve over time to meet the local conditions, such as the materials available locally for boat building, the type of sea conditions the boats will encounter, and the demands of the local fisheries.

Artisan fishing is small-scale commercial or subsistence fishing, particularly practices involving coastal or island ethnic groups using traditional fishing techniques and traditional boats. This may also include heritage groups involved in customary fishing practices. Artisan fishers usually use small traditional fishing boats that are open (undecked) and have sails; these boats use little to no mechanised or electronic gear. Large numbers of artisan fishing boats are still in use, particularly in developing countries with long productive marine coastlines.

Raft

A raft is a structure with a flat top that floats. It is the most basic boat design, characterised by the absence of a hull. The classic raft is constructed by lashing several logs, placed side by side, to two or more additional logs placed transverse to the others. In many Asian countries, the rafts are similarly constructed using bamboo.

In shallow waters, rafts can be punted with a push pole. They can be used as stealthy platforms for fishing shallow waters around lakes. In sheltered coastal waters, anchored or drifting rafts can become effective fish aggregating devices. Payaos were traditional bamboo rafts used in Southeast Asia as aggregating device. Fishermen on the top of the raft used hand lines to catch tuna.[81].Pontoon boats, and to some degree the punt, can be viewed as modern derivatives of rafts. Boats, rafts and even small floating islands have been made from reeds. Reed rafts can be distinguished from reed boats, since the rafts are not made watertight. The earliest known boat made with reeds (and tar) is a 7000-year-old sea going boat found in Kuwait.

The Uros are an indigenous people pre-dating the Incas. They live, still today, on man-made floating islands scattered across Lake Titicaca. These islands are constructed from totora reeds.[82]Lake Titicaca, part belonging to Bolivia and the rest to Peru, is 3810 meters above sea level.[83]Each floating island supports between three and ten houses, also

built of reeds. The Uros also build their boats from bundled dried reeds. These days some Uros boats, used for fishing and hunting seabirds, have motors.

Reed boats were constructed in Easter Island with a markedly similar design to those used in Peru.[84][11] Apart from Peru and Bolivia, reed boats are still used in Ethiopia [85]and were used until recently in Corfu.[86]

Coracles

Coracles are light boats shaped like a bowl, typically with a frame of woven grass or reeds, or strong saplings covered with animal hides.[87]The keel-less, flat bottom evenly spreads the weight across the structure reducing the required depth of water often to only a few inches. Coracles have been used, and to a degree are still used, in India, Vietnam, Iraq, Tibet, North America and Britain.[88] Coracles in Iraq are called quffa. Their history goes back to antiquity where they appear on sculptured panels in Assyrian palaces constructed between 700 and 900 BC. These panels are now in the British Museum. Herodotus visited Babylon in the 5th century BC, and wrote a long description of the coracles he encountered there. Traditionally, quffa were framed with willow or juniper and covered with hides. The outside was coated with hot bitumen for waterproofing. These coracles have been in use, at least until recently, around Baghdad and on the Tigris. Some of the Iraq coracles are very large.[89]

Coracles are known to have been in use in Britain in 49BC when Julius Caesar encountered them.[90]They are still used in Wales, where they were traditionally framed with split and interwoven willow rods, tied with willow bark. The outer layer was an animal skin, such ashorse or bullock hide, with a thin layer of tar for waterproofing. Today tarred calico or canvas, or simply fibreglass can be used.[91,92] Different Welsh rivers have their own designs, tailored to the flow of the river. The Teifi coracle, for instance, is flat bottomed, as it is designed to negotiate shallow rapids, common on the river in the summer, while the Carmarthen coracle is rounder and deeper, because it is used in tidal waters on the Tywi, where there are no rapids[93].Coracles can be effective fishing vessels. When operated skilfully, they hardly disturb the water or the fish. Welsh coracle fishing is performed by two men, each seated in his coracle and with one hand holding the net while with the other he plies his paddle. When a fish is caught, each hauls

up his end of the net until the two coracles touch and the fish are secured. Many coracles are so light and portable that they can easily be carried on the fisherman's shoulders.

In Vietnam, elegant coracles constructed with bamboo, are still used from many beaches, such as at Nha Trang, Phan Thiết and Mui Ne. The coracles are towed in a line behind a motor boat, like beads on a string, to their fishing ground. There the fisherman lay fishing nets in the sea before another tow returns them with their catch,

A canoe is a small narrow boat, usually pointed at both bow and stern and normally open on top, though they can be covered. A dugout is a canoe hollowed from a tree trunk. The oldest known canoe is the dugout Pesse canoe found in the Netherlands.[94] According to C14 dating analysis it was constructed somewhere between 8200 and 7600 BC. This canoe is exhibited in the Drents Museum in Assen, Netherlands. Another dugout, almost as old, has been found at Noyen-sur-Seine [95]. The oldest known canoe found in Africa is theDufuna canoe, constructed about 6000 BC. It was discovered by Fulani herdsman in Nigeria in 1987[96]. During the Iron Age residents of Great Britain used dugouts for fishing and transport. Two ancient dugouts discovered in Newport, Shropshire are on display at Harper Adams University in Newport. In 1964, a dugout was uncovered in Poole Harbour, Dorset. The Poole Logboat, dated to 300 BC, was large enough to accommodate 18 people and was constructed from a large oak tree.

Best known are the canoes of the Eastern North American Indians. These, often elegant canoes, were not dugouts, but were made of a wooden frame covered with bark of a birch tree, pitched to make it waterproof [98]. Typically canoes are propelled with paddles, often by two people. Paddlers face in the direction of travel, either seated on supports in thehull, or kneeling directly upon the hull. Paddles can be single-bladed or double-bladed. A pirogue is a small, flat-bottomed boat of a design associated particularly with West African fishermen[99] and the Cajuns of the Louisianamarsh. These are usually dugouts, and are light and small enough to be easily taken onto land. The design allows the pirogue to move through the very shallow water of marshes and be easily turned over to drain any water that may get into the boat. The pirogue is usually propelled by paddles with one blade. It can also be punted with a push pole in shallow water. Small sails can also be used. Outboard motors are increasingly being used in many

regions. The log canoe of Chesapeake Bay is in the modern sense not a canoe at all, though it evolved through the enlargement of dugout canoes.

For stability in rougher waters, canoes can be fitted with outriggers. One or two small logs are mounted parallel to the main hull by long poles. In the case of two outriggers, one is mounted to either side of the hull. These are called outrigger canoes.

Many of the fishing boats in Indonesia and the Philippines are double-outrigger craft, consisting of a narrow main hull with two attached outriggers, commonly known as jukung in Indonesia and banca in the Philippines[100].

The jukung is of Balinese origin, one of many genre of Pacific/Asian outrigger canoes. The considerable stability provided by the outriggers means that the jukung copes well with a lateen (triangular) sail. While the lateen sail presents some difficulties in tacking into the wind, requiring a jibe, the jukung is superb in its reaching ability and jybe-safe running. They are usually highly decorated and bear a marlin-like prow.

A traditional catamaran consists of two canoes, or vakas, joined by a frame, formed of akas. Catamarans were used by the ancient TamilChola dynasty as early as the 5th century AD for moving their invasion fleets. Since then, they have been widely used for fishing in South East Asia and Polynesia.

Kayaks are generally differentiated from canoes by the sitting position of the paddler and the number of blades on the paddle. In a kayak the paddler faces forward, legs in front, using a double bladed paddle. In a canoe the paddler faces forward and sits or kneels in the boat, using a single bladed paddle. In some parts of the world, such as the United Kingdom, kayaks are considered a subtype of canoe. Continental European and British canoeing clubs and associations of the 19th Century used craft similar to kayaks, but referred to them.

Planking

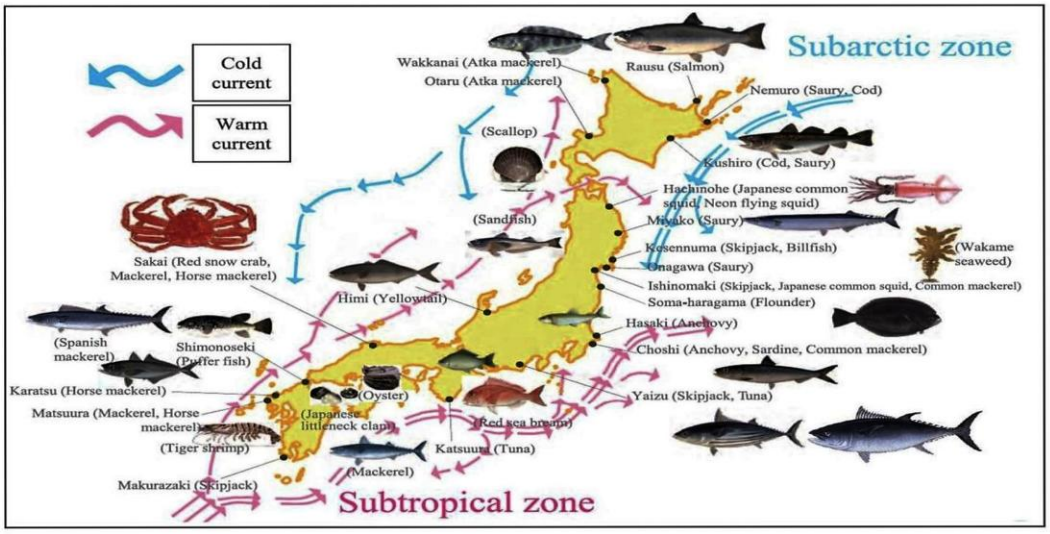
building boats from planks meant boats could be more precisely constructed along the line of large canoes than hollowing tree trunks allowed. It is possible that planked canoes were developed as early as 8,500 years ago in Southern California.[101]. By 3000 BC, the Egyptians knew how to assemble planks of wood into a ship hull. [102] They used

woven straps to lash planks together and reeds or grass stuffed between the planks to seal the seams. An example of their skill is the Khufu ship, a vessel 143 feet (44 m) in length entombed at the foot of the Great Pyramid of Giza around 2500 BC and found intact in 1954. Further development was the use of timber frames, to which the planks could be lashed, stitched or nailed. With the use of frames, it is possible to develop carvel-style and clinker-style planking (in the USA the term lapstrake is used instead of clinker). Scandinavians were using clinker construction by at least 350 BC.[103]

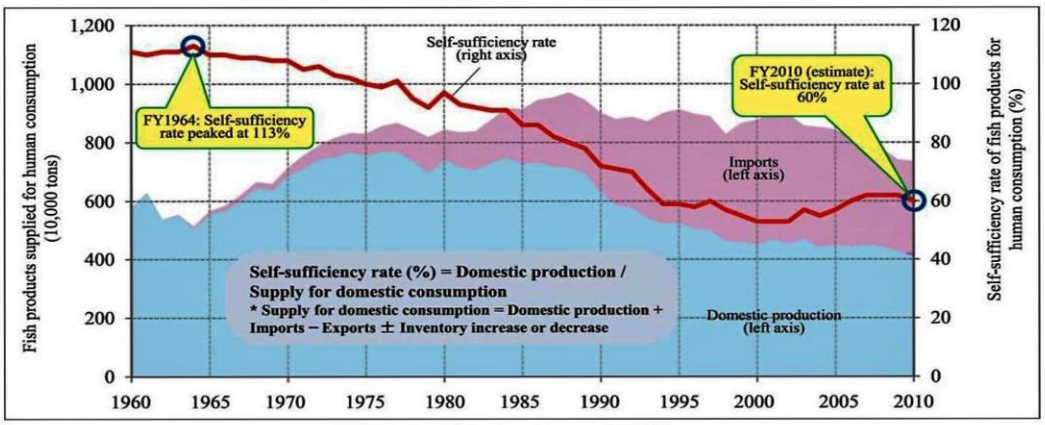
Carvel construction dates back even earlier. The design of the luzzu is believed to date back at least to Phoenician times. A luzzu is a double-ended carvel-built fishing boat from the Maltese islands. Traditionally, they are brightly painted in shades of yellow, red, green and blue, and the bow is normally pointed with a pair of eyes. These eyes may be the modern survival of an ancient Phoenician custom (also practiced by the ancient Greeks); they are sometimes (and probably inaccurately) referred to as the Eye of Horus or of Osiris. The luzzu has survived because it tends to be a sturdy and stable boat even in bad weather. Originally, the luzzu was equipped with sails although nowadays almost all are motorised, with onboard diesel engines being the most common.

Conclusion:

Japan is an island country located along the East Asian mainland, in front of Russia, North Korea, South Korea, China and Taiwan. It is surrounded by the Sea of Japan (to the west), the Sea of Okhotsk (to the north), the north-western Pacific Ocean (to the east), the East China Sea and the Philippine Sea (to the south; Figure 1). Japan has a total land area of 378 000 km² and more than 6000 islands. Four main islands constitute ca. 97% of Japan's land area (from north to south): Hokkaido, Honshu, Shikoku and Kyushu. In addition, there are numerous smaller islands. Most of them form the Ryukyu Islands



Source: Fisheries Agency (2012b)



Source: Fisheries Agency (2012b)

Consumption of fish products per capita per year (1961-2007)

	1961	1970	1980	1990	2000	2005	2006	2007
Japan	50,4	61,3	65,5	71,2	67,2	61,5	58,0	56,9
China	4,9	4,6	5,3	11,5	24,5	25,7	26,0	26,5
United States	13,0	14,5	15,4	21,1	21,7	23,9	24,7	24,1
EU (27 countries)	14,5	17,1	16,6	20,1	21,0	22,2	22,1	22,0
India	1,9	2,8	3,1	3,8	4,5	4,8	5,2	5,1
World average	**9,0**	**10,9**	**11,5**	**13,5**	**15,7**	**16,5**	**16,6**	**16,7**

Source: Fisheries Agency (2011a)

Fig. 16: Fish Resource distribution and their Consumption pattern

(south-west from Kyushu to Taiwan), the largest of which is Okinawa, and the Izu and Bonin (Ogasawara) Islands (south of Tokyo). The body of water separating Honshu, Shikoku and Kyushu is known as the Seto Inland Sea.

Japan is a predominantly temperate humid country with four distinct seasons, but the climate varies greatly from cool temperate in the north to subtropical in the south. Japan is mostly mountainous, with the highest peak of Mt Fuji reaching 3776 m. As more than 70% of the land is covered by mountains and forest, the habitable zones are mainly located in coastal areas and have high population densities. Japan's total population is 128 million (2010), out of which 13 million people live in the Tokyo Metropolis (not including outer areas of Tokyo). With a population density of 343 inhabitants/km2 (2010), Japan is one of the most densely populated countries in the world. .Japan is a constitutional monarchy and parliamentary democracy, in which the Emperor is head of state. The current emperor Akihito acceded to the throne in 1989. The highest legislative body is Japan's Parliament (*Kokkai*), divided into the upper house (242 seats) and the lower house (480 seats). Parliamentary elections take place every four years for the lower house, and every three years for half of the upper house members As regards administrative structures, Japan is currently divided into 8 regions and 47 prefectures (Figure 2). Each prefecture consists of cities and districts (further subdivided into towns and villages). The prefectures, cities and districts have representatives in the local assembly and a directly elected governor or mayor.

Japan is surrounded by some of the world's richest fishing grounds: The Northern Pacific, which includes Japan's EEZ, accounts for almost 23% of the global fish production. Several factors promote a wide variety of marine resources in waters around Japan .

- The cold nutrient-rich current Oyashio flowing south collides with the warm current Kuroshio flowing north off the eastern coast of Japan, which creates a high productivity ecosystem.
- A suitable habitat for bottom fish is provided by the relatively broad continental shelves along the coasts of Hokkaido, the Tohoku region (north-eastern Honshu)and the San'in region (south-western Honshu), down to a depth of ca.

200 m. Also, by the terrace-shaped shallow areas of the Yamato Bank and the Musashi Bank in the Sea of Japan

- The East China Sea and many inner bays around Japan (such as Funka Bay insouthern Hokkaido, Ise Bay in southern Honshu, Ariake Sea and Yatsushiro Sea,both in western Kyushu) provide good conditions for abundant fishery resources due to high amounts of nutrients supplied from land areas.

The diversity of fish and shellfish in Japan is such that more than 3300 fish species are found in its waters. No single species constitutes dominant catches, and 80% of Japan's total catch volume is shared among 24 species (Figure 5). For a comparison, in Norway and in Iceland 5 and 6 species respectively account for 80% of the total catch volume. Most of Japan's fisheries production comes from its EEZ (offshore and coastal waters).

Using the abundant resources, Japan has long developed a fish-rich culinary culture. With a per-capita fish consumption of 56.9 kg (2007), Japan is one of the world's top fish consuming countries. Although the traditional dietary habits of the Japanese people based on rice and fish have changed with the increasing consumption of meat and dairy products, fish products still provide 40% of the animal protein supply. Therefore. Japan plays a leading role in global fisheries, both as one of the world's top producers and as a major importer of fishery products. Surrounded by some of the most productive fishing grounds on earth, teeming with a wide variety of resources, Japan has long been a most important fish consumer and has developed an exquisite fish-rich food culture. The high diversity of Japan's seafood resources is reflected in the great complexity of its multiple-layer fisheries management system. As a result, Japan's self-sufficiency rate3 for fishery products has declined from 113% in 1964 to 60% in 2010. A number of factors are pointed out as causes: the constant decrease of the number of fishery enterprises and employees, rising fuel-costs, insufficient conservation measures for some species in Japan's EEZ as well as a lack of international cooperation for controlling fish stocks, particularly migratory fish species.

Moreover, the March 2011 catastrophic earthquake and tsunami and the Fukushima nuclear accident ravaged Japan's fisheries, destroying fishery and aquaculture facilities

and fishing vessels on the Pacific coast, particularly in the prefectures Iwate, Miyagi and Fukushima. The subsequent Fukushima nuclear accident has caused concerns over the safety of fishery products, which further damaged the fishing sector and the economy of local communities.

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CONCLUSION

In course of analysing the importance of this work, it will be clearly proved that pisciculture is an industry where the aboriginal technology of fish catching existed strongly side by side with modern scientific technology. But there were limitations also. Only the economic globalization could not improve the socio-economic conditions of the fishermen. There should be a mixture of indigenous technique of fishing with that of modern technology which is the only possible solution of the problems. Age-old rights of the fishermen over the fisheries should be recognised. Panchayat and co-operative of the fishermen should look after the interests of the fishermen.

Many of the fishermen in developing countries are locked into economic systems that result in relative poverty. Although the technologies they use have evolved in accord with indigenous biological resources and socio-economic realities, there may be opportunities for improvement. Existing technologies from other developing regions might be transferred to these fisheries and some of the technological advances from industrialized countries might benefit artisanal fishermen. This report describes some of these innovative fishing technologies for the fishermen, administrators of fisheries, development assistance groups, and others concerned with fisheries. The objective is to establish new contacts, to examine alternative fishing technologies, and after careful planning, to encourage application in new areas.

While recognizing the diverse problems faced by the small scale fisherman in the third world, this report primarily addresses technological considerations. Innovative, relatively in expensive technologies that, under some circumstances, might help fishermen will be described. Although not necessarily the newest, most sophisticated developments, these techniques may have already found successful application in a specific region. A technology might be successfully adapted to a new area if it solves a specific problem, causes no ecological or social problems, and is economically feasible and desired by the community it is intended to serve. Successful applications of new mechanical or fabrication technologies also require training, service support, and locally available components and spare parts.

This is an attempt to cover economic and technological aspects of fishing in West Bengal (1950-2008): A comparative study has been made with Japanese fishing technology giving basic ideas and progress made in fresh water, brakish water, Marine fisheries, fishing technologies (both indigenous and Japanese) including catching methods, the crafts and gears used for catching fishes together with fish spoilage, different kind of boats which they use to catch fish. Japanese fishermen use a very modern technology. Their every system is based on smooth ground and they have done improvement. The work shows every modern technology they use in their field.

The work also clarifies various preservation methods, Ethnic origin of the fishermen, socio-economic aspects and to improve their condition, the need of fishermen, cooperative societies, Trade, marketing of fishes and the function of the labourers and Brokers. Indian Fisheries Act, contribution of women in Fisheries sector, children in aquaculture related work which is extremely hazardous, the need of statistics in fisheries development, various international conventions concerning fisheries and marine resources are also dealt. Geomorphological condition of West Bengal a big Lesson also have been illuminated in a chapter of this work.

It (this research) will help us to know the peculiar geophysical, socio-economic and cultural history of South and North 24 Parganas (Specially sundarbans), which is quite different from other parts of West Bengal. The geophysical aspects namely geology, soil, land formation and climate have kept it secluded from the neighbouring areas. The land has been well described as a "Sort of drowned land, broken by swamps", intersected by a thousand of river channels, and maritime back waters. Only those species which were suitable under this biotic condition could withstand this environmental effect. Various mangrove species, about the plant diversity it can be said that the area encompasses a variety of plants including trees, shrubs, grasses, epiphytes and lianas. They are mostly evergreen, and possess more or less similar physiological and structural adaptations. The diversity of animal life in Sundarbans is very vast. There are The Royal Bengal Tiger, hungry and cruel alligators, rhinoceros, deer, pigs and migratory birds are found everywhere. All these increase the natural beauty of sundarban. It is the place which is called the "gift of nature".

Geology of sundarbans has largely influenced the life and character of the people. Constant fight with natural calamities makes them daring and hard working. They are religious and superstitious because their too much dependence on nature. Agricultural difficulties, caused by salinity of water, heavy dependance on a single crop and lack of industry compel the villagers to ruin forests for wood, honey and fish, in an effort to try and eke out a meagre living. Man and nature are interdependent. It was a case of symbiosis. Sundarban fisheries have been brought under careful supervision for the maintenance of continuous supply of fish in Calcutta market.

West Bengal being the 'land of Water' is a famous region in the Indian sub-continent for the production of tasty and delicious fishes. Numerous rivers, creeks, estuaries, khals, beels, baors and tanks were the chief producers of fishes. The pre-colonial state had less attention to the management and the ownership of the fisheries. But management of the fisheries became a serious matter to the colonial government. After the partition of Bengal in 1947, West Bengal continued to manage the fisheries of the state with the colonial measures. After the partition, West Bengal had to face a serious fish crisis due to the migration of East Bengalis. West Bengal Government adopted a series of new acts in order to bring the uncultured and derelict fisheries under state control. The W.B. Govt. also introduced scientific pisciculture to increase the production of fishes. There is a major shift in the management of the natural resources like fisheries.

In 1954, West Bengal comprised a territory of 34194.1 square miles where the internal fisheries constituted a significant portion. Besides the internal fisheries, West Bengal had a coastal belt of 158 KM except the Hooghly Matla estuaries. State Govt. had modified some of the acts and regulations adopted by the colonial state in order to cope with the post-colonial situation. There were two types of laws relating to the fisheries. Earliest colonial law relating to the fisheries of Bengal i.e. the private fisheries protection Act 1889 (Bengal Act II of 1889) had been amended by the West Bengal govt. in 1959 and this act came to be known as the private fisheries protection (Amendment) Act 1959 (W.B. Act XXI of 1959).

The earliest act relating to the fisheries adopted by the West Bengal Govt. is the Waste lands (Requisition and utilization) Act 1952 (W.B. Act IV of 1952). But the

West Bengal Estates acquisition Act 1953 (W.B. Act I of 1954) had brought fundamental changes to the land structure and agrarian relation of the state. In order to acquire more water area under the possession of the state and improve and develop the fisheries, West Bengal Govt. had adopted another act in 1965 called the West Bengal Fisheries (Requisition and Acquisition) Act 1965 (W.B. Act XXX of 1965).

The state govt. was more concerned about the planning and Development of Fisheries. The first five years plan (1951-52 to 1955-56) for West Bengal had allotted Rs. 154.47 lakhs for the Development of Fisheries. The second five year plan (1956-57 to 1960-61) had drastically reduced the total plan provision for the development of the fisheries. The third five year plan (1962-67 to 1965-66) had proposed Rs. 204.83 to be spent for the development of fisheries of West Bengal. The fourth five year plan (1969-70 to 1973-74) had proposed a sizable amount of Rs. 295.29 lakhs to be spent for the development of the fisheries in order to solve the fish crisis of the state. So In order to permanently solve the fishery problem of the state, West Bengal Govt. had decided to appoint a committee in 1972 which would prepare a Master plan for all round development of fisheries in the state including the socio economic upliftment of the traditional fishermen of the state.

The fifth plan (1974-75 to 1978-79) had stressed on certain schemes for fishery development which are identical with the schemes of the Master plan. The West Bengal inland fisheries Act (Act XXV of 1984) and Rules (1985) was the first serious step taken by the left front Govt. for the sustainable development of inland fisheries of the state. This Act was amended in 1998 as West Bengal inland Fisheries (Amendment) Act, 1998. It is beneficial to protect the Marsh land of the state. It says that no water body more than five katahs in size can be converted. 47.5 hectare marshland has been protected under this act till 2001-2002.

Human society, primitive or modern, is not static. It changes; however slow the pace. It is responsive, like living organisms, to various forces. It moulds itself according to pressures visible or invisible. These forces bring about changes in the social structure as well as in the mental attitude of the people in a society. An attempt is now made to examine the Forces which are at work in bringing about changes in the life style of the fisher folk, their attitudes, their identities, their rituals and beliefs, ceremonies, recreation and economic activities.

The country should not forget that fishermen is an economic community. They live in different regions suitable to earn their livlihood. They have never enjoyed a respectable position in the society. An age old notion that they are the members of the low caste has been prevailed throughout the subcontinent. They are giving Honey (good fish) but getting no money (prestige). After the partition the dream of Indian unity among the castes had been shattered and brother had been torn from brother, what is worse, at the very moment of 20^{th} century is no doubt a communal orgy, accompanied by indescribable brutalities is consuming thousands of lives.

Thus the sense of joy which should have been overwhelming and unlimited has been mixed with pain and sadness. The traditional fishermen of Bengal are considered as outcaste and untouchable. Not only the fishermen community, other low castes like barber, cobbler even the Muslims are neglected, yet they are the back-bone of the Economy of the country. They are fighting for bringing the Economic prosperity.

They are no longer the members of SC/ST community. The time has come to illuminate the true identity of Fishermen of Bengal. They are the Bangas. Govt. are sanctioning grant and aid on the name of SC/ST but the very name SC/ST should have to be abolished. They are Bangas like the people of other communities of Bengal. Their true identity and exact position should be restored, and only then Fisheries and disbalancing fishing industries will get new life which will be helpful to bring a smooth Economic prosperity in the country.

A majority of the fishermen of the villages live in families which are nuclear in nature, although in theory, most of them support the joint family system. The breaking down of this traditional system is partly due to urban influences and partly to the inevitable result of migration. As in all other communities, the status of women from the fishing families is definitely inferior to that of men. They never enjoy economic freedom. Perhaps the women folk of the fishing communities have accepted male domination as part of their life. The dowry system has affected the tradition of early marriage. Economic forces compel the fishermen to break the traditional practice of giving their daughters in marriage before puberty. The fishermen are punctilious in the observance of the rituals and rites connected with the Fishing

operation. They observe them for the protection of their lives as well as for a good haul.

The catchers despatched the fishes caught in the fishing grounds to the local markets or sold to the middlemen. They then forwarded them to the aratdars of the towns or cities and from aratdars to the markets. Both the fresh and dried fish markets were to be controlled by them. The marine fish market in West Bengal is also inefficient, unregulated and unorganized. The type of market is value chain marketing system. Iced fish is transported to the main markets in Calcutta, Diamond Harbour and kharagpur by light commercial vehicles and trucks. Some fish is also transported by launches as well as by rail in 24 parganas district. The income from fishing is unstable. Indebtedness has become chronic in the life of the fishing communities. This is mainly due to the nature of their occupation. Mahajans concede loans to the fishermen without security of any kind. The owners of the boats give advances to the hired labourers which is adjusted from the sale proceeds.

The fishermen generally use four types of nets such as stationary net, floating net, cast net and drag net. They are called sele or khute jal, chhandi jal, khepla jal and hat jali. The fishermen have adopted now synthetic fibre instead of cotton yarn for economy and greater durability. This reflects a change in outlook and adaptability to modern technological innovations. The sele jal is used for sele Fishing during winter in the Bay of Bengal while the chhandi jal is operated during the rains for Hilsa fishing in the Hooghly. Fishing particularly sea-fishing is a highly specialised job which requires a sound knowledge of the marine environment.

The matter of increasing income of fishermen improving their living conditions, organizing fishery Co-operatives comes under social science. Development of fishery to increase fishery production by introduction of new fishing gears, motorization, is one side of the development. But the real development and the role of Government to increase income of fishermen for betterment of their living conditions particularly for small scale fishery, where fishermen engaged are poor and their living conditions are miserable, was particularly stressed in the last session of Indo-Pacific fisheries council held in Kyoto, Japan in May 1980.

Before taking any concrete steps by the Government it is necessary to locate the nature of socio-economic problems the fishermen are facing. Their living

conditions are inhibited for the following reasons poor management of fishery resources, Absence of fishing harbours, Absence of fish auction market, Absence of fishery co-operative society, lack of ice supply. Poor condition of road to consuming areas and lack of side jobs during slack season of fishery. By adopting all these policies through technology regarding fisheries and fisherman the fortune of our country can be improved.

It may be said in a nutshell that the lot of this poor section needs an all round improvement. They are not an isolated class, but they are the members of the whole state. They are also an important part of the total mass of people. They are not a separate class. Their social, Economic and religious total development will remove their poverty. The development of a particular facets will aggravate the problem. Above all, with the upliftment in all sphere of their life, the advanced fishing technology will be more helpful to fight against their age old problem poverty which is a curse on their lives.

Since the turn of the century the Japanese society and technology based economy have speedily modernised the lot of the fishermen. Hope, this research will bring a through change in fishermen's life style in our country. It will be helpful to develop all aspects of the life of the Inhabitants of West Bengal, India as well as of the World.

Pisciculture is the kindred of agriculture. This is agrarian economy as a whole. One sustains the other. This is typical of Bengal economy. Therefore I have thought it is important to investigate the ecology, economy and technology of fishing .Naturally ecology has been studied in depth as estuary of all fish in riverine Bengal.

In the next phase comes the economy. It comprises of the catch, its marketing through a chain of middlemen and its final loss or gain. I have found this fish market extremely fragile. The fishermen behind fishing have also been studied from their family background to their manhood in fishing. In the improvement of fishing economy, technology has a big role to play in catching, storing and despatch as a merchandise. Japan is a trend-setter in this field. As a matter of course the comparison between India and Japan has become imperative. My case study is West Bengal which is even geographically comparable with Japan. There is much to learn from Japanese experience. I have highlighted the accessibility and absorption in our economy for

the ultimate benefit to Indian society and particularly Bengal. The poor quality of life of Bengal fishermen has to be improved by adopting some of the aspects of Japanese fishing technology.

On the whole I have tried to do justice to the subject by tapping all methods and sources by field studies and ransacking of government records. I hope the result of my investigation will go a long way to eradicate their abject poverty due to lack of resources and utter ignorance. My chapters will reveal the interconnection and interpenetration of the overall thesis.

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There are both published and unpublished materials.

The thesis is based on various archival sources i.e. Government reports, gazetteers, minutes, census reports, guide books, memoirs, various other available data and field works in different places and Market.

Printed books, journals, reports and periodicals form the major part. Important information may be available from the magazine, records, pamphlets, internet, News papers, memoirs etc. some of the outstanding books and articles are the constructive part of the thesis.

West Bengal University of Animal and Fishery sciences, central Inland fisheries Research Institute at Barrackpur both of the institutions have assisted by giving suitable catalogues.

The research is mainly based on the field work. Prolonged interviews with many fishermen, Aratdar, Boat owner, Middlemen, Boat and Net maker have enriched the writings. Many relevant appropriate clues have been obtained through the discussion with them. It is needless to say that many aged Fishermen expert on the implements and techniques specially used in sundarban and adjoining areas have given much knowledge regarding the subjects. The experience and Data collected from wholesale fish market and Aratdar have also furnish the thesis to a great extent. Friendly mixing with the experienced field oriented fishermen can be remembered with gratitude. More over some personal field experiences of our fore fathers who passed their lives in such Environment have illuminated the materials. Some Japanese friends and professors had also helped me a lot in this regard.

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