Chapter III: Spread and Classifications of Bheri

3.1 Introduction

Bheri (local name in WB, India) is a unique and typical type of culture-fishery. This type of fishery is generally practiced in low land impounded with earthen embankments all round. Water is ingressed into the impounded area through typically built channel at convenient time-interval. It is found to be farmed all over the coastal states in India and even all over the globe though with different local names maintaining particular procedures during operation.

However, in India shrimp is the most valuable product in bheri-culture particularly in case of earning foreign currencies and the shrimps were available mainly from capture fisheries before 1950s. Then India was not in a position to have a considerable quantity of shrimps from culture-sources for exporting purposes and hence depended on capture or marine-yield. But the international market of this product was very much lucrative and the ongoing captured quantity was not found to be sufficient enough to meet the demand. Hence, India began to emphasize on more and more capture-shrimp by introducing sophisticated fishing gears, mechanics and efforts. But this had a limit and reached a plateau. Hence, to overcome this hurdle and augment exports, India found no other alternative but to adopt suitable measures to increase the cultured shrimps. Through various ways culture-shrimp production was being encouraged. Thus the bheri-practice got a special dimension in production of shrimp. But most of the bheries had been being cultured in traditional manners. Since 1980s India has been facing overcrowding in utilizing the coastal areas for aquaculture. In the recent past this aquaculture has boomed all over India to meet tremendous increase in demand of shrimp and shrimp-products in international markets and has been recognized as an industry fetching a considerable share of foreign exchange.

3.2 Spread of Bheri

Bheri-fishery has been going on since time immemorial. In China the aquaculture dates back to 4,000 years (Mukherjee et. al., 2007) and hence this type of pisciculture might have started in China during that period.

Of course, rice-cum fish culture which is the primary phase of bheri-farming is an age-old traditional practice in India and some of the South East and Far East Asian countries. In the year 1971 more than 100 countries practiced this system in 135 million hectare paddy-lands which was then declining (Ghosh, 1990). Though, modern shrimp and fish farming in impoundments, ponds, raceways and tanks had got started only in the early 1970s. Presently more than fifty countries contribute to running of commercial shrimp farms that may be called as bheri. In the eastern hemisphere Thailand, Vietnam, Indonesia, India and China are in the leading position of shrimp-traders and Malaysia, Taiwan, Bangladesh, Srilanka, Philipines, Australia and Myanmar have developed large industries. In the western hemisphere Mexico, Belize, Ecuador and Brazil are the leading producers and there are shrimp farms in Honduras, Panama, Colombia, Guatenama, Venezuela, Nicaragua and Peru. Shrimp production of USA, Japan and Western Europe is not so considerable. Saudi Arabia and Iran produce most farmed shrimp in the Middle East.

Table 3.2.1: Shrimp-Fishery around the World

Part of the Globe	Countries where cultured
Eastern Hemisphere	India, Bangladesh, Sri Lanka, Malaysia, Taiwan, Philipines, Australia, Myanmar, Thailand, Vietnam, Indonesia, China etc.
Western hemisphere	Mexico, Ecuador, Brazil etc.
Middle East	Saudi Arabia, Iran etc.

Source: Marine Products Export Development Authority (MPEDA), Ministry of Commerce & Industries, Govt. of India.

In India bheri-culture is practiced almost all over the coastal states though with different local name. Different agency and organization like Central Marine Fishery Research Institute (CMFRI), National Commission on Agriculture (NCA), Indian Institute of Management (IIM) etc had estimated the resource in India time to time and they found varied figures. However, India has an estimated potential area of 12, 40,000 hectares for brackishwater aquaculture, of which only 1, 57,000 hectares (13%) was utilized for the purpose in 2001-02 (Central Pollution Control Board, Govt. of India). This culture-based water impoundment is locally known as bhasabadha, gheri, jalkar or bheri in WB (30,000 ha), pokkali in Kerala (6,400 ha), gazanis in

Karnataka(4,800 ha), Kazanas in Goa (1,200 ha) and Saltpans or kharland in Maharastra (1,800 ha) (Biswas et. al., 1991 and Ghosh, 1990).

Table 3.2.2: Brackish Water Aquaculture in India and WB

Country/ State	Potential Area (ha)	Cultured Area (ha)	% of Cultured Area to Potential Area
India	12,40,000	1,57,000	12.66
WB	2,10,000	50,000	23.81

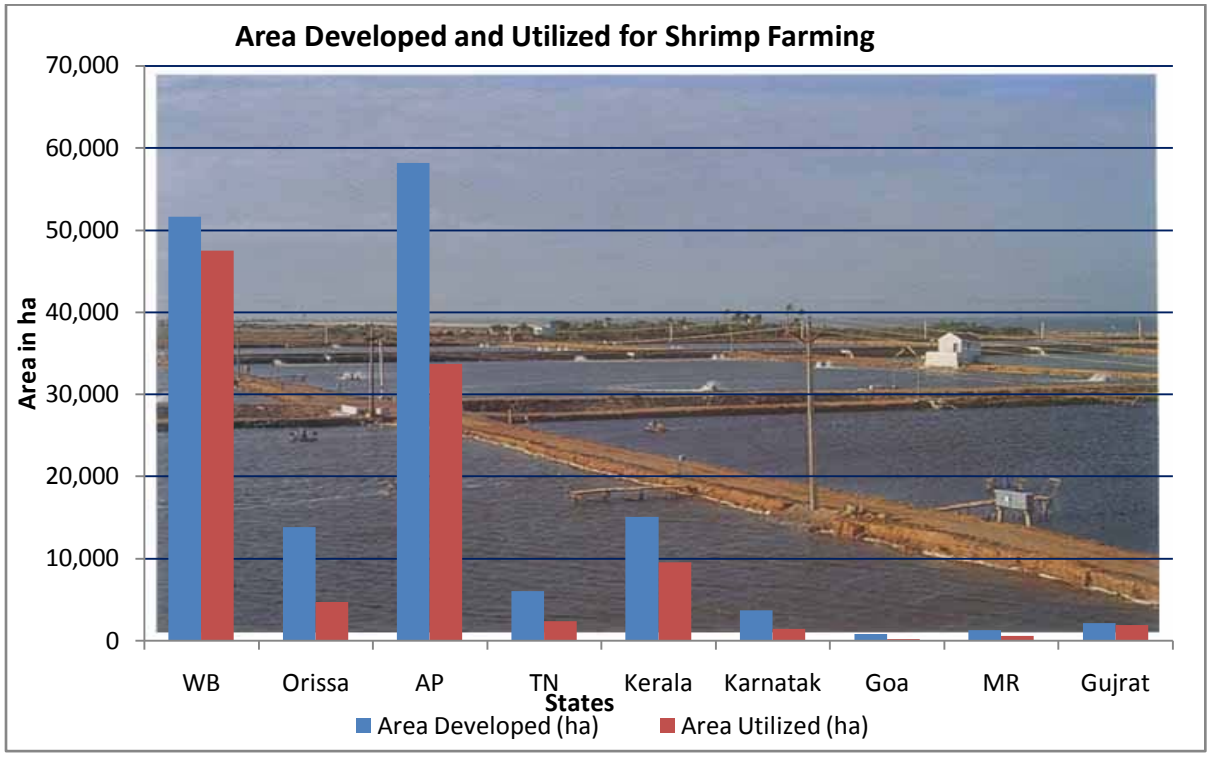
Source: Deptt. Of Fishery, Govt. of WB

Table 3.2.3: Details of Shrimp Farming in Different States in India in 2009-10

States	Area Developed (ha)	Area Utilized (ha)	Production (MT)	Productivity (MT/ha/Yr)
WB	51,659	47,488	33,685	0.71
Orissa	13,843	4,769	6,149	1.29
Andhra Pradesh	58,145.20	33,754	39,537	1.17
Tamil Nadu	6,109.33	2,381.49	2,702.38	1.13
Kerala	15,099.39	9,544.84	7,096.00	0.74
Karnataka	3,708.84	1,484	1,581	1.07
Goa	867	272	319	1.17
Marashtra	1,329.56	650.86	1,243.79	1.91
Gujrat	2,214.48	1,915.79	3,605.72	1.88
Total	1,52,975.80	1,02,259.98	95,918.89	0.94

Source: Annual Report, 2009-10, Marine Products Export Development Authority, Ministry of Commerce & Industries, Govt. of India, Page 24.

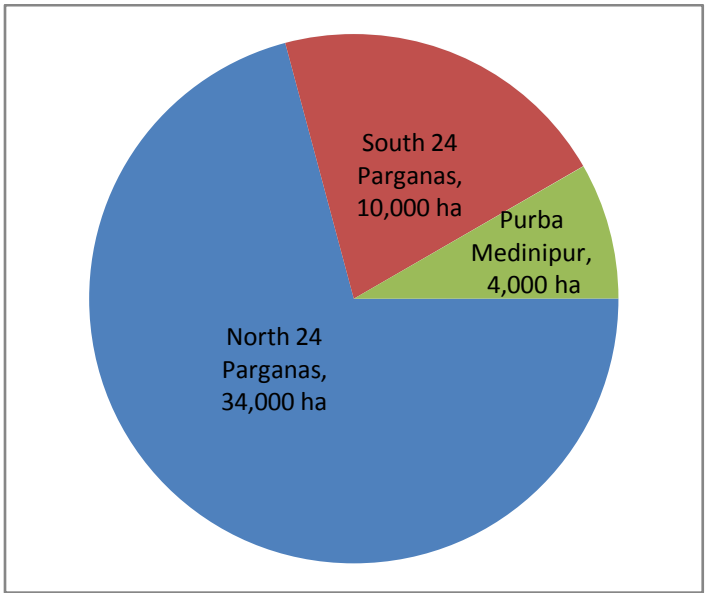
Diagram 3.2.1: Area Developed and Utilized for Shrimp Farming in Different States in India



Source: Annual Report, 2009-10, Marine Products Export Development Authority, Ministry of Commerce & Industries, Govt. of India, Page 24.

In WB bheri-fishery is in existence from time immemorial in the Hooghly-Matlah estuarine systems though beginning of scientific culture is a recent phenomena (mid 80's and by mid 90's) (NABARD's Initiatives) and the dominant product is Peneaus mondon or tiger shrimp i.e, bagda chingri . In WB brackishwater resource is estimated to be in the tune of 2,10,000 ha of which approximately a total of 50,000 ha (i.e. 23.81%) has presently been brought under culture-fishery. This type of aquaculture mostly exists in North 24 Parganas and then in South 24 Parganas (10,000 ha) and Purba Medinipur (4,000 ha) in terms of area. In North 24 Parganas district brackishwater bheries cover an area of about 34,000 ha and sewage-fed fishery exists in an area of approximately 200 ha in different block/municipality.

Diagram 3.2.2: Brackish Water Bheri-Fishery in WB



Source: The Director, Deptt. Of Fishery, Govt. of WB, Sector V, Salt Lake, Kolkata.

3.3 Classifications of Bheri

Farming procedure of bherie varies from country to country and even from locality to locality. Nature of geographical location and physical position also change from one place to another. However, these aquatic resources can be classified in several ways based on different criteria viz. nature or quality of water used, area covered, management & technology adopted permanency of operation, crops cultured, feeding criteria, sources of required seed-collection and so on. The classifications are described below in short.

A) Based on Nature of water used

Based on the characteristics or nature of water impounded the bheri can broadly be classified in to the following three categories:

1) Saline or brackishwater bheries,
2) Non-salinewater bheries and
3) Mixedwater bheries

1) Saline or brakishwater Bheries: This type of bheries is recognized in the tidally flooded areas over the estuaries i.e, where saline or brackishwater is available. Tidal brackishwater from the nearest and feasible source is ingressed into the bheries by gravity flow or pumps or by a combination of these two as per requirement and necessary operation is carried out. All the

bheries in estuarine zones in India including bheries in North 24 Parganas, South 24 Parganas and East Medinipur of WB fall in this class.

Depending on the degree of salinity the salinewater bheries can further be subdivided in to the following three groups.

a) Low-salinewater bheries: In these bheries salinity never exceeds 10 ppt and are situated in the northern tracks in 24 Parganas (North) which are farthest from the sea face and hence are less influenced by tidal amplitudes.

b) Medium-salinewater bheries: Salinity of water of these bheries generally varies from 10 to 20 ppt. They usually exist in the southern tracks of 24 Parganas (North) district.

c) High-salinewater bheries: In these bheries salinity rises even above 20 ppt. These bheries usually exist in South 24 Parganas where tidal influence is mostly observed (Saha et. al., 1986).

However, salinewater bheries are generally cited, irrespective of degree of salinity, in the low lands outside the river course or more specifically not located within the two banks of the rivers. This is the usual location-scenerio of so called salinewater bheries. Though there is observed some exception in North 24 Parganas district. In the immature or delta-forming areas of the district the rivers sometimes shift their course forming chars opposite to the site of main flow. Again, the river-bundhs (banks) are frequently damaged by natural calamities such as cyclonic storms like aila, over-rains, overflowing of the rivers etc and new bundhs in semilunar shape are made just back-side of the existing ones on more stable land leaving a considerable land area discarded inside the river-courses i.e., between the two banks of the rivers. These lands or the chars are sometimes utilized by bheri-farming making dykes just at the other sides and they may be called river-site bheries. Based on this criterion salinewater bheries are of two types:

a) River Site Bheries: The bheries which are cited within the course or between the banks of a river fall in this group and they might have been regarded as the oldest form of present days' bheries in North 24 Parganas and

b) Non-River Site Bheries or main stream salinewater bheries.

2) Non-salinewater bheries: These bheries bear no connection with saline water, rather sweat (and hence non-saline) water is used for culture-purpose and hence they can be termed as non-salinewater bheries. The non-salinewater bheries can further be sub-categorised as a) sewage-fed and b) fresh water bheries.

a) Sewage-fed bheries: These bheries are fed with municipal, industrial and/or domestic effluents or sewages. The East Calcutta Wetlands (ECW) in the eastern outskirt of Kolkata City which is declared as Ramsar site exhibits as a unique example of this type of bheries.

However, depending on the degree of sewages these bheries can further be divided in to the following three sub-categories (Ghosh, 2002).

i) The bheries which receive strong sewage,

ii) The bheries fed with moderately diluted sewage and

iii) The bheries receiving diluted sewage.

b) Fresh water bheries: These bheries are fed with fresh (i.e., non-saline and non-sewage) water. Mountain valley culture, terrace type culture, zabo culture etc that uses sweet and non-sewage water in hilly areas of north-eastern India are typical examples of fresh water bheries.

3) Mixedwater bheries: There also exist some bheries which are fed with saline water mixed with sewages. The bheries on both the sides of the Bidyadhari River after Kulti Lock Gate near Machhibhanga, Haroa, Minakhan, Malancha etc fall in this group.

B) Based on Area Covered:

Bheri can be divided in large, medium and small sizes depending on the area covered. In North 24 Parganas bheri ranges from few cottahs to hundreds of bigha. Though the scientific bheries are invariably smaller in size.

C) Based on Permanency:

The bheri may be perennial or non-perennial. The bheries which are cultured round the year and year after year without drying up in intermittent culture period are called perennial bheries. On the other hand bheries which are dried up in between consecutive culture seasons are called non-perennial bheries. The East Calcutta Wetlands (ECW) is a unique example of perennial bheries. Beside this most of the bheries in North 24 Parganas fall in this group where different types of fishes and prawns are reared up year after year without any drying-break (for preparation). Though there are some farmers in the district who sometimes make the bheries dried up before commencing the next season for the sake of having better productivity.

D) Based on Variety of Crops Cultured:

The bheri can again be divided based on the variety of products cultivated. First of all they can broadly be classified as:

1) Integrated Culture and

2) Non-integrated Culture

1) Integrated Culture: Paddy-cum-fish as an integrated culture is an age-old practice in India and some Southeast and Far East Asian countries. Japan started rice-based fish cultivation after suspension of trawl-fisheries in the post world war period. Depending on season, location, terrain, species of fish/prawn etc these integrated culture can further be sub-categorized as:

a) Synchronous type culture: This culture is prevalent in Indonesia, Philipines, Taiwan, Japan etc where fish is farmed during cultivation of paddy.

b) Sequential type culture: This type of bheri-culture is prevailing in some places of North 24 Parganas district. In this system agro-crop and prawn along with fish are grown sequentially i.e, only paddy is cultivated during kharif seasons when enough shower of rain is available for proper irrigation and in the summer seasons prawn and fish are cultured.

c) Sequentio-synchronous type culture: This is a combination of sequential and synchronous culture where fishery is carried out round the year and any other type of crop is cultivated in a particular season along with pisciculture (as integrated farming). The traditional paddy-cum-fish culture in North 24 Parganas is a unique example of such culture where paddy is cultivated during monsoon periods along with perennial pisciculture.

d) Terrace type culture: This type of integrated culture is seen in Lower Subansiri district of Arunachal Pradesh. Terraces are prepared in the main valley. Fish channels are dug across the terrace. The streams of nearby hills are tapped, channelized at the rim of the valley and diverted to the terrace fields. The farmers grow wet rice, integrated with fish culture in terraces and finger millets on the terrace bunds. In order to maintain and regulate water supply to the fields, the surrounding hills are covered with forests.

e) Zabo culture: It is an integrated culture found popular in Phek district of Nagaland where forestry, agriculture, fishery and animal husbandry are combined. The word “zabo” means impounding of water in local language. Here forest land is practiced on the top of the hill, water-harvesting tanks in the middle and cattle yard and paddy fields at the lower side. The forest cover serves as water source for the tanks. Cattle, pigs, poultry birds are sometimes let loose in the forest. The cattle yard is constructed on a little lower side of the water-harvesting pond. The water from the pond is passed through the cattle yard before taking it to the rice field for irrigation. The water carries with it the dung and urine of the animals to the agricultural fields. This serves as good source of nutrition for the crops. Only one crop of rice is grown and the common local variety is “Tanyekemucah”. Majority of the farmers practise fish culture in their wet rice fields.

f) Mountain valley type culture: In some hilly areas of northeastern India water accumulates in the valley from adjoining slopes and flows down the valley. Selective as well as wed fishes are integratedly cultured here with some dwarf variety of paddy. Fish harvesting is done at the end of rice-season.

2) Non-integrated Culture: But most of the present days' bheries in WB and particularly in North 24 Parganas are not involved with paddy or any other crops, i.e, they are non-integrated in nature and they can further be sub-divided as:

a) Mono-culture: Here one species of shrimp (preferably in selective procedure) or different species of fishes is cultured and it is practiced in all scientific bheries in WB and in vast spill area near Kolkata City (ECW) respectively.

b) Bi-culture: Here one species of shrimp (preferably in selective procedure) and different types of fishes are reared simultaneously but with varying densities depending on season and requirement.

c) Mixed culture: Various species of prawns and fishes are grown at the same time but with different densities depending on seasons and requirement. Almost all the saline water bheries in North 24 Parganas are of this type.

E) Based on Sources of Seed:

The bheri-culturists used to stock juvenile shrimp and fish for rearing purposes. The fingerlings are brought from wild stock or hatcheries (man-made). Based on these sources of seeds bheries can be divided in to the following two groups:

1) Bheries stocked with wild seeds

2) Bheries stocked with seeds of hatcheries (artificial) and

3) Bheries stocked with seeds of mixed sources

1) Bheries stocked with wild seeds: In these bheries natural or wild seeds are reared up. The Hooghly-Matlah estuarine system is one of the famous breeding and hatching grounds of innumerous species of shrimps and fishes in the world. The ready-to-spawn shrimps and fishes usually breed in the nearby sea where the eggs are hatched. Then the grown up nauplii, larvaes or postlarvaes go scatter in to the nearby rivers and canals for their suitable shelter and livelihood. The post larvaes of shrimps particularly of commercially profitable P. mondon are then caught

by the rural and poor folks (women and children particularly) from the shallower estuaries, rivers, canals etc at Canning, Diamond Harbour, Nurpur etc which then reach to the bheri-cultivators through different stages of traders or dalals to be stocked as selected species of shrimps. Apart from this, in almost all the traditional bheries in WB wild seeds of different varieties of shrimps and fishes enter into the bheries with ingressed water which are then grown up commercially along with poured seeds.

2) Bheries stocked with seeds of artificial hatcheries: The wild stock of seeds is not sufficient enough to meet up the requirement of the farms' demand and hence a good number of prawn and fish-hatcheries have grown up nation-wide. In WB the fish-hatchery is centered on Naihati-Ichhapur belts which supply the fish-fingerlings of different species for commercial stocking and rearing purposes in bheries, ponds etc. Whereas prawn-hatchery is not so common and conventional in WB and it has grown up in southern India particularly centering on Madras. The pin of shrimp incubated in those artificial hatcheries are used by the bheri-farmers all over WB

3) Bheries stocked with seeds of mixed sources: Depending on the availability of seeds in quality-time in sufficient quantity and the cost meant for it, almost all the bheri-farmers in North 24 Parganas used to stock both type of seeds sequentially or simultaneously and those bheries can be termed as bheries stocked with mixed sources of seeds.

F) Based on Feeding Criteria:

For growing aqua-crops bheri-farmers usually use different types of supplementary feeds with varying doses depending on quality of water, healthiness & growth-rate of crops, availability of feeds and funds, timings of harvesting etc. Though there are a very few traditional bheries particularly in the southern-most Sundarban without using any supplementary feeds, rather the grown up prawns & fishes live on natural foods. Again in the ECW the bheries use supernatant portion of different effluents and sewages. Hence based on the feeding criteria the bheries can be sub-divided in to the following four groups:

1) Bheries fed with natural foods only,

2) Bheries fed with supplementary feeds along with natural foods,

3) Bheries using effluents and sewages and

4) Bheries using feeds of any combinations of the three above.

G) Based on Management & Technology Adopted:

Since time immemorial the low lands of Sundarban have been being used for fish and shrimp culture by letting in saline water from nearby and convenient rivers, canals, backwaters, creeks etc. Such pisciculture has substantially been improved in the state in respect of preparation of field, management & technology used during operation etc during mid 80's and by mid 90's. Based on these techniques the bheries can be divided into the following major classes:

1) Traditional

2) Improved traditional

3) Extensive

4) Semi-Intensive and

5) Intensive

1) Traditional: In this culture no such suitable preparation of field and dykes is done. The tidal water along with natural seeds like larvae of *P. mondon, P. indicus, P. semisulcatus, Metapenaeus monoceras, M. brevicornis* etc are ingressed, no measure for selective stocking is done and no supplementary feed is applied. The fingerlings of different fishes like Liza parsia, L. tade, Mugil cephalas, Rinomugil corsula, Lates calcarifer, Mystus gulio etc naturally enter into the fisheries. Only the saline water is let into the low lands and natural and scampi crops are harvested as deemed fit round the year. Hence, this culture can be described as "trap and culture" method in large and shallow impoundments or paddy fields. This system is still prevailing in lower parts of the Sundarban where low lands remain fallow during summers and the available water gets very saline.

2) Improved traditional: This is the improved version of traditional system where field-preparation and maintaining of dykes is done almost scientifically. The caught seeds from wild resources or the hatchery-seeds of shrimp and fishes or a combination of these two are cultured generally. Allowing of seeds through ingressed water is restricted essentially. Stocking is done selectively with a view to expand commercial profit. Water is exchanged on tidal effect only. Supplementary feeds, fertilizers, chemicals are applied but not methodically or scientifically. Water and soil parameters are seldom tested. Almost all the bheries in North 24 Parganas are of this type.

3) Extensive: It is the upgraded phase of the improved traditional culture and is characterized by almost scientifically preparation of pond after drying at the end of final harvesting with individual inlets and outlets, culturing fish-prawn only (and not any paddy) with low and medium stocking density (30,000 to 50,000 and 50,000 to 1,00,000 per ha), application of supplementary feeding and organic & inorganic fertilizers, necessary chemicals etc., exchange of water by gravity flow and/or pumps, stocking and harvesting in multiple occasions, complete draining during harvesting, etc. in addition to the techniques adopted in the improved traditional systems. Here selective method of stocking is practiced invariably.

4) Semi-Intensive: This is the improved extensive culture with more scientific practices. Here the ponds are of sufficiently small in manageable size and almost uniform (usually 0.5ha) and only shrimp is cultured. The bheri-floor is made slightly slanting to ease the de-siltation process. Ponds are well prepared and managed with latest scientific procedures. Only the hatchery seeds are stocked. Stocking densities range from 1,00,000 to 2,50,000 seeds per ha. The growth rate of shrimp and condition of water, soils and crop are constantly well monitored round the tenure and remedial actions are taken accordingly, water-exchange is done regularly with the help of diesel or motorized pumps on requirement to maintain optimum quality and quantity (4 to 5 feet), i., e., proper water management is done. Specially prepared high energy feeds, fertilizers, chemicals etc are applied after assessment. Artificial aerators are used for maintaining proper oxygen concentration in the water. Harvesting is done once and only once at the end of each culture-tenure and culture is done 1/2 time/s per year depending on various factors like economic solvency of the investor, healthiness of the pond, frequency of culture in the previous year, availability of seeds, out breaking of diseases in the pond etc. In this system mortality rate of PL

is very low and productivity is high but at the cost of higher environmental loads. In East Medinipur almost 4,000 ha of such culture is done. There exists no such bheri in South 24 Parganas. Within the jurisdiction of Hasnabad block in North 24 Parganas (about 5 KM south to Hasnabad town) there is found some such type of bheri-fishery localy known as “pond fishery”.

5) Intensive: It is the improved system of the semi-intensive ones and latest in respect of scientific culture. This requires higher investment to achieve higher productivity under controlled conditions. The pond size is too small (0.03 to 0.1ha) having water depth of 60 to 150cm. Stocking density ranges from 5,00,000 to 10,00,000 seeds per ha. Well balanced high energy feed formulated with high protein is used to grow the shrimp more rapidly. This type of practice is found to be high risky owing to the problem of pollution and therefore, intensive farming is not popular and not practiced in India despite of high returns.

PHOTOGRAPHS OF DIFFERENT TYPES OF BHERIES

Plate 3.1: A Traditional Bheri

Plate 3.2: An Improved Traditional

BheriPlate 3.3: Aeration in a Semi-Intensive Bheri

Plate 3.4: An Intensive Bheri

Plate 3.5: A River-Side Bheri

Plate 3.6: A Paddy cum Fish Culture Bheri

Plate 3.7: Sewage Leading to a Bheri

Plate 3.8: A Sewage-fed Bher