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**INLAND FISHERY IN BANGLADESH:
PROSPECTS OF POND CULTURE**

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Section I

1. Introduction

Bangladesh, one of the poorest country in the world, is constrained by scarcity of per capita land and other resources but 'the inland fisheries resources of Bangladesh' are among the richest in the world with only China and India producing more inland fish than Bangladesh (Nuruzzaman, 1990). The geographic location of the country in the delta of mighty rivers system, climate and soil conditions demonstrate congenial atmosphere for inland fisheries and aquaculture.

Fish is attracted by all people at large due to its taste, high content of quality animal protein and digestibility. It provides vitamin A, vitamin D, minerals such as phosphorus, calcium and iron. High lysine and sulphur amino acid contents in it are very useful for complementing the high carbohydrate diets prevailing in Bangladesh. Evidences are there that some fish are effective in lowering blood pressure and preventing cardiovascular diseases (Kent, 1987).

Though fish is relatively costly with respect to vegetables and grains but it is cheaper than any other source of animal protein. It makes rice palatable and as such traditionally fish occupies its importance in a Bengali diet with the adage 'fish and rice go together as a fact of life in the food habit of an average Bengali family'.

The hunger and malnutrition have been critical issues in the contemporary Bangladesh and at times these are episodic towards famine. So, improved production technique, processing and distributing networks of food should be developed on the one hand and potentials of all food resources have to be optimally utilized considering comparative advantage. Exploring the potentials of fishery is the prima facie option in the socio-economic context of Bangladesh.¹

The purpose of this study is to highlight and augment the importance of pond culture in the context of inland fishery in the national economy which may yield impetus to the policy makers and other concerned people for sustained growth and development in the long run. This section is followed by successive other four sections. Section II deals with fishery in Bangladesh which includes data on fishery, yearly fish catch, fishermen in Bangladesh, demand of fish, fish export and share in GDP and productivity of inland fishery. Section III deals with the pond survey conducted in connection with the agriculture diversification study project where costs and returns get due importance. Section IV states the importance of pond culture and in Section V conclusions and recommendations are provided.

Section II

Fishery in Bangladesh

2.1 Data on Fishery

The data on fishery in Bangladesh is scanty and more so, skepticism prevails on the quality of data.² This is evident while one look at a time on yearly catch of fish, population, per capita monthly consumption of fish as estimated in Household Expenditure Survey by Bangladesh Bureau of Statistics and volume of fish & aquatic products exported from Bangladesh. Confusion for lack of quality data also prevails in almost all sectors in Bangladesh like other developing countries. But the trend of the data serves quite well for our analysis.

2.2 Type of Inland Fishery

Table 1 shows the type of inland fisheries in Bangladesh and area covered under each type. It appears that among the natural habitats of various fish species, flood lands rank first having 62.85% area of inland fisheries followed by rivers, canals and estuaries having 22.48% area and beels, haors/brors, dighies etc. comprise 9.27% area. Man made ponds and tanks cover 3.26% area, artificial reservoirs 2.01% and irrigation canal cover only 0.13% of total inland fisheries. Each type of fishery has its own significant contribution in the national economy inspite of the differentials in area.

2.3 Yearly Fish Catch

Table 2 shows the quantity of fish caught over the years 1973-74 to 1988-89. It appears that total catch of fish was far below satisfactory as yearly total catch declined upto the extent of 22% in 1975-76 and it remained at that reduced level for the rest of the seventies. In the eighties there were gradual increase of total catch but 1973-74 level was attained in 1987-88. This attainment of 1973-74 level is due to gradual increase of catch in marine fish during 1973-74 to 1988-89. In case of inland catch the scenario is not healthy at all. Inland catch sharply declined by a quarter of 1973-74 level in 1975-76 and the declining trend continued till 1980 and in eighties some poor increasing trend is seen but still 17% below the 1973-74 level of catch by 1988-89. The reasons for such decline in inland catch may be numerous. In this context Nuruzzaman (1990) points out that 'a high degree of destruction of traditional fish breeding and feeding grounds through irrigation, drainage and flood control measures along with the drying out of watery areas on a massive scale has created an adverse situation in which fish is becoming a scarce commodity. Also, he apprehends that flood control and drainage schemes will reduce annual catch of inland fish by 150,000 metric tons in the coming years. Flood control, drainage and irrigation activities have been identified as the major constraint to the maintenance of the open water fishery production (MPO Technical Report No. 17, March 1987). M. Youssouf Ali (1991) opines that (i) reduction of aquatic habitats due to natural siltation, (ii) water pollution caused by industrial effluents and wastes, (iii) pollution by domestic and municipal wastes, (iv) agro-chemical pollution and (v) over fishing due to revenue oriented management of all inland public water bodies, etc. are the major contributors for reduction of inland fish production.

2.4 Fishermen in Bangladesh

Fishermen community in Bangladesh are the poorest of the poor. They are traditionally backward, illiterate and landless. They have nothing but their hands to earn their livelihood by fishing. They sell their catch to buy grains and other necessities of life but their activities are also jeopardized by a strong chain of middlemen in the process of catching and marketing. Table 3 shows the number of fisherman and the growth trend over the years. It appears that overall increase of fishermen during 1972-73 to 1988-89 is 48.42 percent. In case of marine fishery the increase is 142 percent higher in 1988-89 compared to 1972-73 level and in case of inland fishery the increase is 18 percent higher though catch as shown earlier is 17 percent below during the same period which means the condition of fishermen in inland fishery is deteriorating.

2.5 Domestic Demand of Fish

Bangladesh Bureau of Statistics (BBS) conducts Household Expenditure Surveys (HES) and collect information on basic necessities of life and publishes report on HES periodically. From the HES of BBS (various years), expenditure elasticities for selected food items have been compiled in Table-4. It appears that expenditure elasticity of fish is higher in rural areas compared to urban areas. The expenditure elasticities in rural areas during the year 1981-82, 1983-84, 1985-86 and 1988-89 are respectively 1.21, 1.22, 1.28 & 1.21 which are high enough from the consumption point of view and the great majority (around 85% according to 1981 census) of people live in rural area. Also, expenditure elasticity of fish ranks first in rural area in the year 1983-84, 1985-86 & 1988-89 among the expenditure elasticities of

rice, wheat, potato, pulses, milk, mutton, beef, chicken and eggs. In urban area, the expenditure elasticity of fish is also near one or more. so, the evidences indicate a high demand of fish in domestic market compared to other food items.

Table 5 shows the per capita daily intake of protein for food groups cereals, potato, vegetables, pulses, milk & milk products, edible oils, meat, poultry & eggs, fish, condiments & spices, fruits, sugar & gur and misc. (others). It appears that fish is the second important item (after cereals) as the source of protein in Bangladesh in both rural and urban areas as revealed in the HES data of BBS.

Table 6 shows the percentage of monthly consumption expenditure on fish by rural and urban households. Urban households have higher expenditure share on fish than rural households. This is due to higher level of consumption both in quantity and quality. The average household budget share of fish varies from 7.78 - 10.75 percent in the consumption expenditure and share of fresh water fish (excluding dry & other fish) has been estimated to 82 percent of fish expenditure in the eighties of Bangladesh (HES, BBS).

Table 7 shows the per capita monthly consumption of fish in Bangladesh. It appears that per capita consumption of fish is higher in urban area than rural areas in all the survey years. On an average urban per capita consumption of fish is 31 percent higher than the rural consumption. Per capita consumption of fish in both rural and urban areas appears to increase since late seventies partly due to marine fish consumption. Marine fish

consumption in rural and urban areas account (2.34% and 1.79%), (16.93% & 25.16%) and (6.07% & 10.34%) respectively in the years 1981/82, 1985/86 and 1988/89 of total fish consumption, which indicate marine fish is gradually being considered as a food item for source of protein. As yearly catch of inland fish has substantially declined, marine fish has automatically takes its position in the dietary protein intake. If we consider HES (1988-89), BBS estimate of per capita monthly consumption of fish (1072 gms) to be accurate then per capita yearly consumption comes to be 12.864 kg.³. This estimate is quite low compared to that in Thailand (20.2 kg), Malaysia (47.6 kg), Philippines (33.4 kg), Sri Lanka (14.9 kg) and Burma (14.5 kg) but fish provides about 80 percent of the total animal protein consumption in the country (M. Yousouff Ali, 1991).

The population of Bangladesh has become almost double in 1991 compared to 1961 census and the inter-censal growth rates in the country have been estimated 2.48% (1961-74), 2.32% (1974-81) and 2.17 (1981-91), as shown in Table 8 and the inland fish catch has declined 20.56% during 1974-75 to 1988-89. If we assume population growth rate to be 2% by the year 2000 and the norm of per capita yearly fish consumption 12.864 kg constant (according to HES - 1988-89, BBS) then yearly domestic demand of fish will be as follows under the *ceteris paribus*.

Year	Population (in million)	Domestic Demand (in metric ton)
1991-92	107.99	13,89,183
1992-93	110.15	14,16,970
1993-94	112.35	14,45,270
1994-95	114.60	14,74,214
1995-96	116.88	15,03,544
1996-97	119.22	15,33,646
1997-98	121.60	15,64,262
1998-99	124.03	15,95,522
1999-2000	126.51	16,27,425

Nuruzzaman (1990) estimates that the total demand for fish in Bangladesh by the year 2000, assuming no changes in relative prices or in the use of fish for fish meal, might well exceed 1.5 million tons. So, our estimate of domestic demand is very close to the estimate of Nuruzzaman.

2.6 Fish Export and Share in GDP

One resource sector yet untapped with immense development potential is fish or aquaculture (Nuruzzaman, 1990). While we look at the investment and efforts made by both people and government we find augmentation of rice output by high yielding seed, chemical fertilizer, irrigation, pesticide, flood control, drainage, research etc., but fish culture claim not a small fraction of it except from time to time displaying in the national media about the government programmes of fish production. In spite of step mother attitude towards fishery, this sub-sector contribute quite significantly in the

national economy. At present and for the last couple of years fishery contributed nearly 3.5 percent of gross domestic product. Its share in GDP during 1973-74 to 1989-90 varies 2.8% to 6.5% as shown in Table 9. Table 9 shows the export earning of Bangladesh and share of fishery in export earning during 1973-74 to 1989-90. It appears that share of fishery in export earning has increased over time from low 2.26% in 1973-74 to 13.22% in 1986-87. Currently, export of fish and aquatic products including frog-legs, tortoises and shark-fins accounts for 12-14 percent of the total export earning of the country (M. Yousouff Ali, 1991). The contribution of shrimp is around two-third of total fish export.

2.7 Productivity of Inland Fishery

Table 10 shows the annual catch and productivity of inland fisheries. Capture (open water bodies) and culture (closed water bodies) fisheries, the broad heads of inland fisheries contribute respectively 72% and 28% of yearly catch.⁴ But the productivity of culture fisheries is higher than capture fisheries. The productivity of capture fisheries are either declining or stagnant as the rivers and estuaries in terms fish catch have been experiencing steady fall in productivity though it is the largest sector of inland fishery. The productivity of pond culture is more than five times than the productivity of rivers & estuaries and about fifteen times than that of flood plains. The average productivity of pond has been estimated at 971 kg/ha, but it is still far below than the potential since in some government managed fish farms in Bangladesh the maximum production so far achieved is 3500 kg/ha with multi-species carp culture and these yields can be even doubled with increased fertilizer and with improved feeds (Nuruzzaman, 1990).

Evidences are there that intensive carp culture in ponds in countries like Thailand, China & some states of India have registered yield rates upto the extent of 9000 kg/ha with improved management and intensive feeding. The lower rate of yield in Bangladesh ponds is due to traditional practice of stocking and poor management of ponds. The lack of knowledge for intensive culture through improved technology is the main constraint for lower yield rate.

Table 11 shows the area and productivity of pond. It appears that cultured (semi-intensive) ponds constitute 52.17% of total pond area and the productivity is 544 kg/acre only which is far below the potential level. The culturable ponds (30.51% area) and derelict ponds (17.32% area) have the productivity of only 279 kg/acre and 241 kg/acre respectively. While considering the high yield rate of ponds in the neighbouring countries and the greater price increase of fish in the country relative to other agricultural products, it is necessary to conduct an indepth study of ponds to identify the rational of pond culture economics.

Section III

Pond Survey

3.1 Survey Methodology

Agriculture Diversification, a collaborative joint study of IFPRI-BIDS earmarked the importance of fish culture in ponds and consequently pond survey was carried out in 58 villages of 36 upazilas in Bangladesh. The upazilas were purposively selected in conformity with the purpose of the other survey components of the Agriculture Diversification Study Project such that the selected upazilas represent various agro-economic zones, soil type, land elevations and cropping pattern zones.⁵ One pond was randomly selected from each of the selected villages where fish culture in pond is practiced semi-intensively.⁶ The owner or operator of the pond was intensively interviewed and a pre-designed structured questionnaire was administered by the Field Officers who are young and intelligent University graduates. The Field Officers recruited for the survey work were imparted two weeks training in the form of class lecture and field exposure before data collection from the field. Originally 58 ponds were surveyed and some inconsistency arose in the quality of data in case of 7 ponds due to non-cooperation of the respondents and as such we have confined our attention for analysis in 51 ponds only. Though the sample size appears to be relatively small but its coverage is entire Bangladesh and quality of data is good compared to the Survey of Ponds - 1982 (BBS, April 1984). BBS Pond Survey have deficiencies in data e.g. quantity and value of input use by type, quantity and value of labour use, value of sales, maintenance cost, renovation cost and man power used,

marketing cost etc., and as such while framing the pond survey questionnaire we have looked into these in all possible ways.

3.2 Pond Size and Yearly Catch

Table 12 shows the distribution of sample ponds by pond size and yearly catch. It appears that average size of the sample ponds is 0.64 acre having yearly yield (catch) per acre 788 kg. The size of pond and catch may be compared with other earlier studies as follows:

Chowdhury & Bhuiyan (1987) in Mymensingh Sadar Upazila in 67 sample ponds found pond size 0.45 acre having yearly yield 809 kg per acre which is very close to our estimate. The Survey of Ponds - 1982 (BBS, 1984) reports average pond size 0.21 acre of 25240 ponds having per acre catch 491 kg.⁷ Also, national per acre catch in pond in the years 1986/87, 1987/88 and 1988/89 have been reported to be 506 kg, 553 kg & 573 kg respectively (1991 - Statistical Year Book of Bangladesh, BBS).

It appears that small ponds having average pond size 0.30 acres are maximum (35.29%) in our sample which bears resemblance to the large survey of BBS (The Survey of Ponds - 1982) where around 80 percent ponds were of a size less than one-third of an acre. Our sample ponds have some bias for larger size due to purposively introduction of semi-intensive operation constraint of ponds in the selection of sample ponds. In terms of yearly catch per acre, the smaller ponds in our sample yield much higher than the larger ponds which was also reported in the larger survey of BBS (The Survey of Ponds - 1982).

3.3 Pond Composition

Composition of pond by various type of species is very important from productivity point of view. Research findings suggest composite culture as the most effective ways of fish culture in ponds which involves rearing of several species upto the extent of six carp species of both major carps (e.g. rohu, catla, mrigals, kalabaus etc.) and exotic carps (e.g. silver carp, grass carp, mirror carp etc. of Chinese origin). According to Shang, "composite culture or polyculture is the rearing of several species together to make more efficient use of the growing resources of fish food in the pond environment". There are two broad categories of fish: cannibals and non-cannibals. Pond culture relates only with the non-cannibals which may be further divided into three classes: plankton feeders, macrophytic (water weed) feeders and omnivorous. So, composition of pond depends on the type of pond and availability or supply of fish food in the pond. Unfortunately in Bangladesh the technology of food regime in pond is not well diffused to the farmers and further research is needed in this line for evolving the administration of food regime in the pond for appropriate pond composition.

The respondents of the sample ponds were asked to state percentage contents of fish species in their ponds. It may be stated in this regard that pond owner or operators released small fries collected from the vendors or market in 70.60% cases and as such it was neither possible to quantify in number or qualify exactly by type of species released and more so, they were neither fully aware about the growth potential of species nor ever periodically tested the growth of species by netting over time. So, perceived pond composition by type of species were recorded in the course of survey

work. Table 13 shows the composition of pond by type of species and also by pond size groups which seems to be apparently satisfactory for all size groups of pond and all ponds. The presence of others (species including various cat fishes and live fishes) in the composition create some disturbances in the awareness of composite fish culture among the pond owner/operators. If we look to each of the ponds, eight type of ponds by combination of species are noticeable and these are as follows:

- (a) 7 ponds each with only 5 carp species;
- (b) 15 ponds each with 4 carp species and other species;
- (c) 4 ponds each with only 4 carp species;
- (d) 2 ponds each with 4 carp species and shrimp;
- (e) 11 ponds each with 3 carp species and other species;
- (f) 1 pond having 3 carp species, other species and also shrimp;
- (g) 10 ponds each having only 3 carp species;
- (h) 1 pond having only 2 carp species and other species.

From the above classified ponds, type (a), (c), & (d) ponds may be regarded as the ideal ponds in terms of species combination which is only a quarter of total number of ponds.

3.4 Yearly Catch Versus Input Use

In the earlier sub-section we have stated that smaller ponds have higher rate of catch compared to larger ponds without mentioning any causal relationship. Table 14 exhibits the per acre yearly catch vis-a-vis value of input used per acre. It appears that per acre input use is much higher in

small pond group compared to larger pond groups and consequently the rate of catch is also higher in small ponds than larger ponds. So, it may be stated that higher level of yearly catch depends on higher level of input use and not to the size of pond but small size of pond may contribute to the higher productivity in the sense that these ponds may be managed well in terms of fertilizing the pond by input use and proper maintenance. The correlation coefficient between (a) per acre yearly catch and value of fingerlings, (b) per acre yearly catch and value of fish meal & medicine and (c) per acre yearly catch and total value of input used have been computed to 0.79, 0.89 and 0.97 respectively for t-test and we observe that correlation coefficient (a) is insignificant at 5% probability level but significant at 10% probability level, correlation coefficients (b) and (c) are significant at 5% probability level and (c) is significant even at 1% probability level.

Source of fingerlings, size of fingerlings, required number of fingerlings to be reared by type of species, availability and supply of fish-meal in the pond etc. altogether contribute for better yield in the pond. Table 15 shows some light in this regard. It appears from Table 15 that ponds where fingerlings of moderate size were released from private fish firm in appropriate numbers with moderate supply of fish meal and medicine, provide the highest catch per acre (1374 kg). The contributing factors for lower rate of yield in the pond appear to be as follows: (a) if the number of fry or fingerlings released in the pond increase or decrease by type of species than the required number, (b) there are deficit of fish food due to lack of supply in the pond, (c) lack of care for both pond and pond water and (d) inaccessibility of medical care for fish in case of disease. Table 15 shows

the distribution of sample ponds by source of fingerlings. A great majority, 62.8% pond owners/operators stock their ponds by fingerlings/fries collected from vendors. In many cases the vendors persuade the pond owners/operators to stock the pond with their supply of fry/fingerlings. The vendors themselves release the fry/fingerlings to the ponds and as such in many cases the pond owners are relieved from transport and labour cost for collection of fingerlings. But the fingerlings supplied by the vendors are of very small size and consequently these can neither be quantifiable in number while releasing in the pond and nor can be properly identifiable as a type of species. More so, the vendors supply may also contain wild species detrimental to the pond culture. Again, the very small size of fry/fingerlings causes high mortality. So, fry/fingerlings collected from sources other than hatcheries of private/government fish firm for stocking in the ponds phenomenally yield lower.

3.5 Type of Pond Operation and Yearly Catch

Yearly catch (production) has high correlation with input supply and it depends on quality of fingerlings and composition of pond by type of species but type of pond operation is also important for a good catch. It is the pond owner/operators who meet the detail requirements of pond culture right from the preparation or renovation of pond to the catching and marketing of fish. Table 16 shows the distribution of sample ponds by type of operation vis-a-vis value of input use and yearly catch. In our sample a great majority of ponds (56.9%) are operated by singular ownership followed by joint ownership (29.4% ponds), leased in singularly (9.8% ponds), and leased in jointly (3.9% ponds) as against singular ownership (46.26% ponds), joint ownership (52.37% ponds)

and others (1.37% ponds) as revealed in the B.B.S. survey (The Survey of Ponds - 1982, BBS, April, 1984). Among the four type of operators, best harvest 1207 kg/acre is accrued to the ponds where ponds are leased in singularly. This is so because the lessee has the entrepreneurial capability of taking risk for investing more in the input supply process than other pond operators. There is a common belief at large and also evidenced elsewhere in earlier studies that joint ownership of ponds is detrimental to pond culture but this norm is broken in our sample as we notice that per acre yearly catch is slightly higher in case of joint ownership than singular ownership. The reasons are not known but it may be due to awareness arising among the members of jointly owned ponds in terms of supply of better quality of fingerlings with appropriate species combination in the pond as revealed in our sample.

3.6 Depth of Ponds

Suitable depth of ponds are essential for rearing fish in the pond. According to BBS (Survey of Ponds - 1982) about 60 percent of the ponds were reported to have a maximum depth of between 5 and 10 feet while 30 percent had a maximum depth between 10 to 15 feet. In our sample we collected the minimum (during dry season) and maximum (during monsoons) depth of pond water and average depth was worked out. Table 17 shows the distribution of sample ponds by average depth of pond, input use, size of pond and yearly catch. It appears that smaller ponds are of lower depth compared to larger ponds but it is not clear whether higher depth of pond contribute significantly for greater yield. About 53 percent of sample ponds are found to have average depth of between 4 and 8 feet and about 12 percent of ponds are found to have average depth more than 10 feet. Per acre maximum catch (1018 kg) is found to have in

the ponds having 7 to 8 feet average depth. This moderate depth may be useful for living fish in the pond but how and to what extent depth of pond influences the growth or productivity of pond is beyond our scope in this study.

3.7 Costs and Returns

In the venture of any activity, from entrepreneurial point of view, costs and returns always have an important role. We have computed costs and returns from our sample ponds which are presented below.

3.7.1 Capital Cost of Average Pond (0.641 Acre) for Fish Culture

- (i) Present market value of pond (without fish & trees) = Tk. 75,000.00
- (ii) Average rent of pond per year for leased ponds = Tk. 2,152.78
- (iii) Large Scale Renovation (LSR):
 - Average time period of LSR (previous 6.79 + future 7.61) = 14.4 years
 - Imputed family labour cost (at the current 100% wage rate) = Tk. 118.98
 - Hired labour cost (for earth-cutting, building dikes for the pond, dewatering etc. by contractual arrangement and under own supervision i.e. 4062+3057) = Tk. 7,119.00
 - Fuel cost and rent of machine for dewatering/watering the pond = Tk. 209.80
 - Local material cost (swing basket, doon, spade etc.) for dewatering/watering = Tk. 28.43
 - Other cost of renovation (such as food, entertainment, conveyance etc.) = Tk. 48.04
 - Sub-total = Tk. 7,524.25
- Interest of LSR cost amount @ 18% per year for 7 years = Tk. 9,480.56
- Yearly cost component of LSR = $(7524.25+9480.56)/14.4$ = Tk. 1,180.89

(iv) Asset Cost:

Item	Average Cost (Tk.)	Durability	Annualised Cost (Tk.)
Basket/Container	54.70	2.168 yrs	25.23
Net	627.45	3.47 yrs	180.77
Torch	155.20	7.429 yrs	20.89
Others	1.96	4 yrs	0.49
Sub-total = Tk.			227.38

3.7.2 Variable Cost of Average Pond (0.641 Acre) Fish Culture

C1: Maintenance Cost of Assets:

- Annual maintenance cost of basket/container	=	Tk. 2.15
- Annual maintenance/repairing cost of net	=	Tk. 54.70
- Annual maintenance/repairing cost of torch	=	Tk. 4.96
- Annual maintenance cost of other asset	=	Tk. 0.58

(C1) Sub-total = Tk. 62.39

C2: Yearly General Renovation Cost (YSR):

- Imputed family labour cost	=	Tk. 162.47
- Hired labour cost	=	Tk. 286.21
- Material cost	=	Tk. 38.31

(C2) Sub-total = Tk. 486.99

C3: Fingerlings Cost:

Source	No. of fingerlings released	Cost of fingerlings (Tk.)	Cost per (000) fingerlings (Tk.)
Vendor	86667 (n=32)	47018	542.51
Market	8400 (n=3)	5700	678.57
Private fish firm	9260 (n=5)	6500	701.94
Govt. fish firm	31500 (n=10)	18800	596.83
Others	2000 (n=1)	1000	500.00
Total	137827 (n=51)	79018	-
Average	2702	1549.09	573.31

- Fingerlings cost (for 2702 fingerlings)	=	Tk. 1549.09
- Transport cost for procurement of fingerlings	=	Tk. 18.73
- Hired labour cost for procurement of fingerlings	=	Tk. 9.65
- Imputed labour cost for procurement of fingerlings	=	Tk. 6.11
- Container cost for procurement of fingerlings	=	Tk. 1.86
- Other cost (refreshment, contacting fish firm or hatchery)	=	Tk. 4.48

(C3) Sub-total = Tk. 1589.92

C4: Fish-meal:

Type of fish-meal	Qty. (Kg.)	Value (Tk.)	Purchased (Tk.)
Line	17.250	142.02	142.02
Oilcake	111.826	658.61	653.68
Bran/Atta	333.902	529.12	496.93
Dry-fish	2.216	73.88	73.88
Cow-dung	239.509	48.80	0
TSP/Urea/MP	18.137	94.88	94.88
Others	5.880	0.59	0
Sub-total:	728.720	(C4) 1547.90	1461.39

C5: Medicine cost = Tk. 45.0

C6: Transport cost for procurement of fish feed & medicine = Tk. 47.25

C7: Maintenance cost:

- Imputed family labour cost (for procurement of fish meal & medicine, fertilizing the pond by fish-meal and watching the pond) = Tk. 415.29
- Hired labour cost (for procurement of fish meal, fertilizing the pond by fish-meal and watching the pond) = Tk. 188.24
- Cost of battery for watching the pond at night = Tk. 48.51
- Cost of raft/stand/macha for watching the pond = Tk. 12.75

(C7) Sub-total = Tk. 664.79

BEST AVAILABLE DOCUMENT

C8: Catching cost:

- Hired labour (including fishermen's premium)	=	Tk. 1144.54
- Imputed family labour wage	=	Tk. 290.57
- Rent of net	=	Tk. 60.59
- Other cost of catching fish (food, contacting fishermen, entertainment etc.)	=	Tk. 1.37

(C8) Sub-total = Tk. 1497.07

C9: Marketing cost:

- Basket/container cost	=	Tk. 29.80
- Hired labour cost	=	Tk. 17.06
- Imputed family labour cost	=	Tk. 11.04
- Transport cost by rickshaw	=	Tk. 8.04
- Transport cost by rickshaw - van	=	Tk. 17.06
- Transport cost by launch/boat	=	Tk. 5.49
- Toll	=	Tk. 16.78
- Ice	=	Tk. 2.75
- Broker's commission	=	Tk. 80.80

(C9) Sub-total = Tk. 188.82

Total Variable Cost (C1+C2+C3 + C9) = Tk. 6130.13

3.7.3 Production of Fish Per Pond (Pond size = 0.641 acre):

- Own consumption	=	67.29 Kg.
- Yearly sales	=	437.93 Kg.
- Yearly catch of fish	=	505.22 Kg.
- Fish stolen (as reported)	=	19.57 Kg.
- Potential production	=	524.79 Kg.
- Average sales price per Kg.	=	Tk. 41.57
- Value of potential production (524.79 X 41.57)	=	Tk. 21815.52
- Value of actual catch of fish (505.22 + 41.57)	=	Tk. 21001.99

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3.7.4 Summary of Costs & Returns of an Average Pond (pond size = 0.641 acre)

Fixed Cost - (A)

- Interest (10%) on the present market value of pond=	Tk. 7500.00
- Yearly cost component for large scale renovation =	Tk. 1180.89
- Annualised asset cost	= Tk. 227.38

(a) Total: Tk. 8908.27

Fixed Cost - (B)

- Let us assume all the ponds are leased in and in that case rent of leased pond (average pond = 0.641 acre) per year will be equals to	= Tk. 2103.48
- Yearly cost component for large scale renovation =	Tk. 1180.89
- Annualised asset cost	= Tk. 227.38

(b) Total: Tk. 3511.75

(c) Total Variable Cost = Tk. 6130.13

(d) Output Value (actual catch) = Tk. 21001.99

(e) Potential Output Value = Tk. 21815.52

3.7.5 Net Returns:

I. (d) - (a) - (c)	= Tk. 5963.59
II. (d) - (b) - (c)	= Tk. 11360.11
III. (e) - (a) - (c)	= Tk. 6777.12
IV. (e) - (b) - (c)	= Tk. 12173.64

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3.7.6 Catching and Marketing Cost and Net Revenue Earned per kg.

Items	Sales in pond premise	Sales to local paikers	Retail sales	Sales in distant market	All sales
1. No. of ponds	22	26	1	3	51
2. Average yearly catch (Kg.)	436.51	541.92	189.60	628.00	505.22
3. Average home consumption (Kg.)	56.56	77.44	-	58.00	67.29
4. Average share of fishermen for catching fish (Kg.)	20.94	29.46	-	34.33	26.07
5. Value of fishermen's share (4) (Tk.)	859.17	1225.54	-	1506.40	1083.73
6. Labour days for catching	4.72	10.00	9.70	14.00	8.15
7. Value of labour days (Tk.)	228.12	420.00	582.00	490.00	352.75
8. Rent of nets (Tk.)	26.36	97.31	90.00	0	60.59
9. Sales (Qty. in Kg.)	379.95	464.48	189.60	570.00	437.93
10. Sales price per Kg. (Tk.)	41.03	41.60	43.00	43.88	41.57
11. Value of sales (Tk.)	15589.35	19322.37	8152.80	25011.60	18204.75
12. Marketing cost:					
- Basket/container		41.92	250.00	63.33	29.00
- Hired labour cost		27.69	0	50.00	17.06
- Imputed family labour cost		15.89	30.00	40.00	11.04
- Transport cost by rickshaw		15.77	40.00	0	8.04
- Transport cost by rickshaw. van			26.54	0	60.00
17.06					
- Transport cost by launch/boat		7.69	0	26.67	5.49
- Toll		27.31	0	48.67	16.78
- Ice		0	0	46.67	2.75
- Broker's commission		130.61	218.00	169.00	80.80
Sub-total:	0	291.49	538.00	504.34	188.82
13. Per Kg. cost of catching (Tk.) [(5) + (7) + (8)]/(2)	2.55	3.22	3.54	3.18	2.96
14. Per Kg. cost of marketing (Tk.) (12)/(9)	0.0	0.63	2.84	0.88	0.43
15. Per Kg. net revenue (10-13-14) (Tk.)	38.48	37.75	36.62	39.82	38.18

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3.8 Other Characteristics of Sample Ponds

- The average size of the sample ponds is found to be 0.6409 acres having range 0.20 - 1.65 acres.
- In normal years, average highest length of water surface from the bottom of the pond is 9.86 feet with the range 5 - 18 feet and the average lowest length of water surface from the bottom of the pond is 5.31 feet with range 3 - 10 feet.
- The leased ponds have been contracted for fish culture on an average 3 years before for an average period of 4.57 years. The range of lease period is 3 - 7 years. The average size of leased pond is 0.655 acres with range 0.20 - 1.32 acres. The payment (rent) per year for the leased pond is Tk. 2152.78 on an average.
- The pond owners/lessee reported that they have been releasing fry/fingerlings in their ponds in almost every years for the last 10.88 years on an average. Large scale renovation such as dewatering, earth work etc. was made on an average 6.79 years before our survey date and in future such renovation is expected to be made after 7.61 years which means renovation cycle is 14.40 years. Apart from this general renovation such as cleaning the aquatic weeds from the pond, repairing the pond dyke where applicable etc. is done in all ponds every year.
- Dewatering for renovation was made in 27 (52.94%) ponds and in case of 20 ponds machine was used for dewatering while in 7 ponds dewatering was made by traditional local resources such as 'doons', swing baskets etc.
- Hired permanent labour is engaged for maintenance of ponds in 3 (5.9%)

cases whereas pond is watched either by family members or hired labourers in case of 12 (23.5%) ponds. The theft of fish from the ponds have been perceived by 23 (45.1%) enterprises and the extent of fish stolen is reported to be on an average 19.57 kg which is 3.53% of potential output.

- The respondents were asked about the quantity of fry or fingerlings released in their ponds, source of procurement and their purchase price. None of them are found to release fries but the released fingerlings are mostly of very small size ranging from 2 Cm. to 4 Cm. Sources of fingerlings procurement are vendors (62.8%), market (5.8%), private fish firm (9.8%), government fish firm (19.6%) and other sources (2.0%) at a cost of Tk. 542.51, Tk. 678.57, Tk. 701.94, Tk. 596.83 and Tk. 500.00 respectively per thousand of fingerlings. The price of fingerlings vary not only with the sources but also with size, type of species and time of release. The vendors in most cases are found to release the fingerlings in the ponds relieving the pond owners from transport, container and labour cost for procurement of fingerlings. The number of fingerlings released in an average pond (0.64 acre) is 2702 which is in the high side and as the size of fingerlings is very small the survival rate of fingerlings is only 68.72%. In an ideal case 3000 fingerlings of 4 - 6 Cms. in length are required per acre pond where survival rate is around 95%. So, lack of expertise is prevalent in most of the pond owners/operators causing wastage of resources and lowering the productivity of pond.
- Different types of fish feed in combination are generally used in various ponds. The purchase is 91.8 percent to total value of fish feed supplied in the pond. It has been reported that in 45 ponds 17029 kg. bran/atta

(B), in 41 ponds 5703 kg. oilcake (O), in 29 ponds 880 kg. lime (L), in 26 ponds 12215 kg. cowdung (C), in 15 ponds 925 kg. TSP/Urea/MP(F) in 2 ponds 113 kg. dry fish (D), in 1 pond 300 kg. compost (C) and in 11 ponds medicine (M) at a cost of Tk. 2295 were used. The distribution of sample ponds by specific combination of fish feed supplied to the ponds are as follows:

Fish feed combination	No. of pond
L,O,B,C,F,M	1
L,O,B,D,F,M	1
L,O,B,D,M	1
L,O,B,F,M	2
L,O,B,C,F	2
L,O,B,C,M	1
L,O,B,C	7
L,O,B,M	3
L,C,F,M	1
L,O,B,F	1
O,B,C,F	1
O,B,F,M	1
L,B,C	3
L,O,B	2
O,B,C	4
O,B,F	5
L,O,C	1
O,C,M	1
O,B	7
L,B	1
B,C	1
L,C	1
B (only bran/atta)	1
C (only cow-dung)	2
Total	51

- Average yearly consumption of pond fish in the household is 67.29 kg. and it is 13.3% of yearly fish catch from the pond. Frequency of fish catch for household consumption is 19.82 and number of times fish caught in large scale for marketing appears to be 2.04 on an average. The share of fishermen for catching fish from the pond is 26.07 kg. which is around 6% of their catch.

- Fish is marketed locally in most case. The large volume of fish is sold to the local paikers (53.8%) followed by to the fishermen in pond premise (37.6%) and retail sale in local market is only 0.9%. Sales to distant market constitute 7.7% of sales. In case of only one pond the catch is sold both to local paiker, and in retail. Sales in pond premises to the fishermen in 22 cases, to local paikers in 26 cases, to distant market in 3 cases and to retail sale in only one case are found to catch average sales price Tk. 41.03, Tk. 41.60, Tk. 43.88 and Tk. 43.00 per kg. respectively. The price is highest in case of sales in distant market followed by retail sales, sales to local paikers and sales to fishermen in pond premises. But if cost of catching and marketing is accounted together then it appears in terms of per kg. net revenue that sales in distant market is most profitable followed by sales in pond premise to the fishermen and sales to local paikers. Retail sale is least profitable to enterprise due to high marketing cost.

- The price of pond (size 0.64 acre) without fish and trees are estimated at Tk. 75,000 for an average pond and the value of per decimal flat land is estimated at Tk. 977.51 in the sample pond villages.

- Apart from fish culture, the pond is being used for other purposes too and the respondents were asked to state the extent of pond water use. The pond is used for duckery in 75% cases, bathing purposes 96% cases, washing utensils 75% cases, livestock bathing 24% cases, domestic use for cooking 55% cases and as a source of irrigation water for homestead or adjacent land in 27% cases. Use of pond as drinking water, an irony of fate for the nation in the last decile of twentieth century, is found in case of 2 ponds at the villages of Chunarughat Upazila in the district of Hobigonj.

Section IV

Importance of Pond Culture

According to George Kent, "on a per capita basis people in developed countries use more than three times as much fish as people in developing countries - 34 kilograms as opposed to 10 kilograms. People in developed countries consume more fish, but they consume more of all kinds of food, so in terms of their nutrition they can not be said to rely on that fish. People of less developed countries, however, tend to be far more dependent on fish because it accounts for a far higher proportion of their animal protein intake".

In Bangladesh fish provides about 80 percent of total animal protein but per capita consumption of fish is much lower than Thailand, Malaysia, Philippine, Sri Lanka and Burma but fish provides about 80 per cent of the total animal protein. The population of Bangladesh has increased at the rate of 2.32% during 1974-1981 and at the rate of 2.17% during 1981-1991 annually. The inland fish catch has declined 17% during 1973-74 to 1988-89 but inland fishermen has increased 18.25% during the period 1972-73 to 1988-89. HES of BBS reveals that per capita intake of protein from fish, percentage of household consumption expenditure on fish, per capita consumption of fish etc. all have increased. The share of fishery in GDP is around 3.5% in recent years and share of fishery in total export earnings has increased from 2.26% in 1973-74 to around 12% in late eighties. So, on all these scores, fishery has emerged as an important sector in the national economy.

Recent reviews of the Bangladesh fisheries sector by a World Bank team in 1983 and an FAO/UNDP team in 1985 have concluded that inland fisheries and aquaculture offer the greatest potential for achieving the development objectives.⁸

The national objectives for fisheries, as stated in the Fourth Five Year Plan are: (a) to increase fish production and improve nutritional standards; (b) to expand employment opportunities in fisheries and ancillary industries (by about one million additional full-time and part-time jobs); (c) to improve the socio-economic conditions of fisherfolks, fish farmers and others engaged in the sector; (d) to increase exports; (e) to improve environmental conditions and public health and (f) to increase GDP. These objectives were rhetorically expressed in the previous Five Year Plans too but success is still far away to achieve. Evidences are there that during eighties though total fish production (catch) in the country has experienced a slow increasing trend but inland capture (flood plains) which constitute more than 50% of national fish production has declined but substantial increase is looked into inland culture (pond culture and coastal aquaculture) fishery and marine fishery.⁹

In spite of the relatively low current levels of per capita domestic fish consumption, prevention of a further decline over next 15 years is a major challenge where flood control and drainage schemes are apprehended to reduce substantially in inland fisheries catches by 150,000 metric tons annually (Nuruzzaman, 1990, Youssouf Ali, 1991 and MPO Technical Report No. 17, 1987).

Marine fish production has increased steadily from 88,000 MT in 1973/74 to 233,000 MT in 1988/89. There is disagreement about the standing and harvestible stocks of marine fishery but experts agree that marine sector in Bangladesh suffers from overfishing and overcapitalization and has limited growth potential.¹⁰

So, it is the prima facie important policy option to intensify the inland culture fishery in Bangladesh. The price of fish (both wholesale and retail) though vary by season, location, type and size but the general trend is that fish prices are increasing at a faster rate than the prices of other basic food items since the demand and supply gap is widening due to population increase. Evidences are there that pond aquaculture is more profitable than rice culture and experts are of the opinion that rice cultivation is less profitable than aquaculture. As fish prices increase faster than rice prices, so it is expected that pond culture will be more profitable. In our sample, we observe average yearly catch is 505.22 kg. per pond. If we assume that ponds have no rental value and assuming average sales price than net returns per year per acre pond (subtracting annualised large scale renovation cost, maintenance cost of assets, family & hired labour cost, input and other operating costs e.g. catching, marketing etc. for pond culture) on an average comes Tk. 21359 which is much higher than net returns arising out of any combination of crops cultivated in a plot of one acre land in Bangladesh during a calendar year. Though there is no doubt about the importance and profitability of pond culture but the practice of pond culture in the country is still at a lower level. Out of total pond area in Bangladesh, 52% pond

areas are being semi-intensively cultured in the recent years giving around 544 kg. yield per acre (Table 11) and in our sample ponds we find that yield per acre varies from 515 kg. to 1374 kg. (Table 15). Based on pond culture trials in the Noakhali area, Ameen (1987) reports that the 2470 kg/ha (i.e. 1000 kg/acre) to 3,700 kg/ha (i.e. 1497 kg/acre) of fish can be produced with a simple semi-intensive management practices.¹¹ According to the BBS survey (Survey of Ponds - 1982), about 80% of the ponds were never prepared before release of fries, about 90% of the ponds were never fertilized, in 41% ponds no spawn/fry was released and the purchase of fry was made from vendors in over 80% cases resulting low yield rates of pond. But pond fishery production in Bangladesh can be doubled from the present level of about 150,000 m. ton (1987/88) to between 2,96,000 and 3,35,500 m. ton in 2010 (World Bank, Report No. 8830-BD).

Section V

Conclusion and Recommendation

The pond culture in Bangladesh has enormous potentials. If a pond is carefully prepared free from predators and the operator/farmer scientifically and optimally stocks his pond, maintain the pond with sufficient supply of feed, control disease of fish then there is no reason for a good harvest amounting 1500 kg/acre per year. But the technology that is available to the experts and researchers does not properly reach the farmers.

The people of the country who can fight with supreme sacrifices for achieving national independence and can oust an autocratic ruler, can also improve their condition by exploiting the available natural resources in all possible ways. If this is true, why our people will be lagging behind? Our farmers have very well coupled in time with the modern rice technology though vast majority of them are illiterate and have been feeding the country. If they can coup with the rice technology, they will also be able to coup with the available technology of pond culture. Whatever investment and financing is made for cereal production, only a very small fraction of it is made for fish production. Lack of institutional facilities, lack of coordination among the line agencies, lack of credit facilities coupled with lack of knowledge and technical know-how have contributed to the poor and no maintenance of pond by the farmers. If proper training can be imparted to the farmers, supply of fry/fingerlings from government fish firm or private hatcheries can be

ensured, necessary institutional credit mechanism can be developed and delivered in time, adequate infrastructure which includes road connection, transport, storage and marketing facilities can be developed along with the assistance of fish husbandry and veterinary services then the wastage will be reduced to a great extent on the one hand and on the other, the productivity will increase near to the optimum level and it is possible that in future most of the pond owner in Bangladesh may harvest an average 1500 kg fish per acre of pond. If we assume that all the derelict ponds will be rehabilitated by excavation in phases for intensive fish cultivation and all the culturable and semi-cultured ponds will be brought under intensive cultivation by 2000, then it is expected that ponds in Bangladesh will provide more than 0.54 million metric tons of fish which will bridge the supply-demand gap quite comfortably. Again the increased production in ponds will reduce the over fishing pressure on open water bodies that will consequently increase the brood stocks in open water bodies for higher natural yield of fish in the flood plains that will ultimately increase the total inland catch for higher GDP and export.

But the target is not easy to achieve. It involves a lot of social, cultural and economic constraints. So, concerted efforts should be evolved socially and politically. The whole-hearted efforts of concerned Ministries, line agencies and institutions including financial institutions, political parties and their workers, NGOs, traders, fishermen community and people at large need to be integrated at various level with the objective in mind. If the agencies/partners of development are committed to their goal and assignment then it should not be a difficult proposition to achieve the target.

The Upazila should be the focal point of pond culture development. In each upazila both public and private hatcheries should be developed for adequate supply of quality fry and fingerlings to each of the pond owners. The Upazila Fishery Office in collaboration with the local NGOs, Bank officials & local elites may conduct training programmes and operate demonstration ponds for dissemination of knowledge in polyculture technology where participants will be the pond owners and unemployed young people with some basic education. The Union Parishad Chairman/Members may contribute in identifying and motivating the pond owners, group of unemployed young men for participation in the training programmes and also for access to institutional credit. In each bank branch too, one special officer/personnel should be designated for studying the feasibility of pond who will initiate supervised credit. The U.P. members and Chairmen may be entrusted with the responsibility that no pond whether derelict or not will remain unutilised. In this connection enactment is required with the help of political parties or parties in the parliament that all ponds must be cultured. In case of derelict pond sufficient soft credit should be provided by the banks for excavating the pond and also for cost of inputs during the course of fish rearing in the pond. The pond which will yield best in terms of production may be given unionwise incentive in the form of waiving the interest of loan and the best pond in the upazila may be given incentive in the form of waiving interest and also part of loan money. The best pond culturists in the districts may be sufficiently given incentive and honour in the form of prize. In case of non-ability of pond owner or absentee land-lord, the pond whether derelict or not should be leased to any other person or group of persons who are able to culture ponds with the intervention of union parishad. The union parishad may be given

special power to impose certain amount of penalty in case of failure of pond owners to culture in their ponds at a reasonable period of time. If the union parishad takes the initiative in collaboration with the upazila fishery office & bank officials that at least one pond will be promoted for culture among the culturable and derelict ponds in each village in the initial year and if the efforts are intensified in the following couple of years then the farmers will be automatically induced to culture in their ponds and in that process it is expected that all ponds will yield significantly by 2000 year.

There are around 300 NGOs of various size and capacity spread over the whole country. The NGOs may take proper initiative for promoting pond culture by motivating, organizing and financing, where possible to the pond owners, fishermen and unemployed youth. Grameen Bank has the success story of motivating and organizing the landless poor people for gainful activity. In promoting pond culture, Grameen Bank may have the pioneering role for successful implementation of pond culture programmes through its dedicated work forces.

The successful pond culture programmes will generate employment opportunity to the landless poor, fishermen, intermediaries and market agents and the extent of employment generation will be around 2 million man years. The demand for the fishing equipments e.g. nets, baskets, containers etc. will generate further employment opportunity among the village poor women. Moreover ancillary industry like ice mill, cold storage, packaging & refrigerated transport services will develop which will also increase employment opportunity.

Apart from employment opportunity, the successful pond culture programmes will increase not only income of the associated people but will also promote the nutritional status of people at large for both rural and urban area and the nation as a whole.

Table - 1
Inland Fisheries in Bangladesh, 1982

Types	Number	Area	
		(in acre)	(%)
Ponds & tanks	1767128	3,62980	3.26
Dighis, Beels & Haors etc.	60097	10,32100	9.27
Artificial reservoirs	-	2,24000	2.01
Rivers and canals		20,50200	18.41
Flood lands		70,00000	62.85
Estuaries		4,53000	4.07
Irrigation canal		15000	0.13
Total	-	1,11,37000	100.00

Source: Statistical Year Book of Bangladesh, 1991, BBS (Based on the estimates from (i) Survey of Ponds - 1982, BBS, (ii) Directorate of Fisheries and (iii) UNDP).

Table - 2
Quantity of fish caught by type in Bangladesh

(Thousand m. tons)

Year	Fish caught by types		Total
	Inland	Marine	
1973-74	732	88	820
1974-75	733	89	822
1975-76	545	95	640
1976-77	541	100	641
1977-78	533	110	643
1978-79	527	118	645
1979-80	524	122	646
1980-81	525	125	650
1981-82	556	130	686
1982-83	583	141	724
1983-84	589	165	754
1984-85	586	188	774
1985-86	587	207	794
1986-87	597	218	815
1987-88	599	228	827
1988-89	608	233	841

Source: Statistical Year Book, (various years) BBS (Based on the estimates made by Directorate of Fisheries).

Table - 3
Number of Fishermen in Bangladesh

Year	Fishermen		
	Inland	Marine	Total
1972-73	650,000	210,000	860,000
1973-74	666,000	220,000	880,000
1974-75	600,000	200,000	800,000
1975-76	600,000	200,000	800,000
1976-77	618,000	206,000	824,000
1977-78	709,000	290,060	999,060
1978-79	716,970	312,000	1028,970
1979-80	723,781	334,000	1057,781
1980-81	695,000	411,995	1106,995
1981-82	700,500	439,669	1140,169
1982-83	705,950	456,950	1162,900
1983-84	707,000	463,000	1170,000
1984-85	715,000	450,000	1185,000
1985-86	719,000	475,000	1194,000
1986-87	735,177	485,687	1220,864
1987-88	751,718	496,615	1248,333
1988-89	768,632	507,788	1276,420
Percent Increase (72-73 to 88-89)	18.25	141.80	48.42

Source: Statistical Year Book of Bangladesh, 1991.

Table - 4

Expenditure Elasticities for Selected Food Items by Rural/Urban Residence

Commodity	1981-82		1983-84		1985-86		1988-89	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Rice	0.64	0.29	0.82	0.38	0.54	0.18	0.61	0.25
Wheat	0.26	0.01	0.15	0.24	0.14	0.23	0.10	0.14
Potato	1.44	0.77	1.00	0.61	0.98	0.48	0.92	0.67
Pulses	1.88	1.18	1.08	0.71	0.92	0.52	0.87	0.65
Milk	2.62	1.29	1.36	1.28	1.25	1.16	1.11	1.13
Mutton	1.34	1.46	1.06	0.94	0.40	0.69	0.83	0.72
Beef	1.87	0.99	0.96	0.88	0.56	0.83	0.95	0.76
Chicken	2.22	1.71	0.74	1.28	0.76	0.81	0.79	0.88
Eggs	1.44	1.56	0.92	1.12	1.01	1.07	0.86	1.09
Fish	1.21	0.93	1.22	1.06	1.28	0.97	1.21	1.00

Source: Household Expenditure Survey, BBS (various years).

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Table - 5

Per Capita Daily Intake of Protein for Food Groups by Survey Year

(Figure in gms.)

Food Groups	1981-82		1983-84		1985-86		1988-89	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Cereals	36.76 (66.26)	38.17 (58.90)	38.62 (63.65)	34.99 (55.66)	39.80 (62.94)	34.45 (52.72)	40.22 (63.54)	35.54 (52.06)
Potato	0.74 (1.33)	1.03 (1.99)	1.02 (1.61)	1.60 (2.54)	1.33 (2.10)	1.94 (2.97)	1.08 (1.70)	1.63 (2.39)
Vegetables	1.77 (3.19)	1.95 (3.01)	1.99 (3.28)	2.61 (4.15)	3.09 (4.89)	3.73 (5.71)	4.01 (6.33)	5.42 (7.94)
Pulses	3.65 (6.58)	5.14 (7.93)	6.47 (10.66)	5.48 (8.72)	4.84 (7.65)	5.23 (8.00)	5.68 (8.97)	6.34 (9.29)
Milk & Milk-products	0.54 (0.97)	1.19 (1.84)	0.88 (1.45)	1.82 (2.90)	0.86 (1.36)	1.34 (2.05)	0.73 (1.15)	1.27 (1.86)
Edible Oils	0.66 (1.19)	0.79 (1.22)	1.01 (1.67)	1.06 (1.69)	1.23 (1.95)	1.32 (2.02)	1.60 (2.53)	2.85 (4.17)
Meat, poultry & Eggs	2.26 (4.07)	5.45 (8.41)	2.01 (3.31)	4.32 (6.87)	1.98 (3.13)	4.22 (6.46)	1.93 (3.05)	3.31 (4.85)
Fish	6.48 (11.68)	8.33 (12.85)	6.13 (10.10)	8.09 (12.87)	7.58 (11.99)	9.66 (14.78)	7.09 (11.20)	10.68 (15.64)
Condiments & spices	0.73 (1.32)	0.84 (1.30)	1.64 (2.70)	1.79 (2.85)	1.41 (2.23)	1.66 (2.27)	1.46 (2.31)	1.75 (2.56)
Fruits	1.03 (1.86)	0.51 (0.79)	0.38 (0.63)	0.47 (0.75)	0.69 (1.09)	1.02 (1.71)	0.38 (0.60)	0.55 (0.81)
Sugar & Gur	0.25 (0.45)	0.82 (1.27)	0.03 (0.05)	0.14 (0.22)	0.01 (0.02)	0.01 (0.02)	0.01 (0.02)	0.01 (0.01)
Misc. (Others)	0.61 (1.10)	0.58 (0.89)	0.50 (0.82)	0.49 (0.78)	0.41 (0.65)	0.84 (1.29)	0.19 (0.30)	0.55 (0.81)
Total	55.48 (100.0)	64.80 (100.0)	60.68 (100.0)	62.86 (100.0)	63.23 (100.0)	65.42 (100.0)	63.30 (100.0)	68.27 (100.0)

Note: Figures within parentheses indicate column percentage.

Source: Household Expenditure Survey, BBS (various years).

Table - 6

Percentage of Household Monthly Consumption Expenditure on Fish

Year	Rural				Urban				Bangladesh
	Fresh water fish	Sea water fish	Dry fish and others	All fish	Fresh water fish	Sea water fish	Dry fish and others	All fish	All fish
1965	-	-	-	8.09	-	-	-	8.53	8.13
1973/74	-	-	-	7.58	-	-	-	8.34	7.66
1981/82	6.42	0.14	0.51	7.07	8.62	0.18	0.31	9.11	7.38
1985/86	7.51	1.87	1.07	10.45	8.32	3.16	0.97	12.45	10.75
1988/89	7.14	0.37	0.68	8.19	10.12	0.99	0.44	11.56	8.70

Source: Household Expenditure Survey, BBS (various years).

Table - 7

Per Capita Monthly Consumption of Fish (in gms) in Bangladesh

Year	Rural				Urban				Bangladesh
	Fresh water fish	Sea water fish	Dry fish and others	All fish	Fresh water fish	Sea water fish	Dry fish and others	All fish	All fish
1965				905				1008	944
1973/74				821				849	824
1976/77				561				840	589
1981/82	774	19	19	812	1036	19	9	1064	850
1983/84	-	-	-	868	-	-	-	1185	916
1985/86	793	177	75	1045	933	345	93	1371	1094
1988/89	893	60	35	988	1352	160	36	1548	1072

Source: Household Expenditure Survey (various years), BBS.

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Table - 8

Inter-Censal Growth Rate of Population in Bangladesh, 1951 - 1991

Census Year	Population (in million)	Growth Rate (exponential)
1951	44.17	-
1961	55.22	2.26
1974	76.40	2.48
1981	89.91	2.32
1991	107.99	2.17

Source: Statistical Year Book of Bangladesh 1991, Bangladesh Bureau of Statistics.

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Table - 9

Share of Fish and Aquatic Products in the Total Export of Bangladesh
(1973-90) and Share of Fishery in GDP

Year	Total Export (million taka)	Fish and Aquatic Products Exported from Bangladesh		Share of Fishery in GDP at current price (%)
		Value in (million taka)	Share in Total Export (%)	
(1)	(2)	(3)	(4)	(5)
1973/74	2983.3	67.46	2.26	4.8
1974/75	3114.9	61.56	1.98	3.8
1975/76	5551.7	231.56	4.17	5.4
1976/77	6670.1	294.28	4.41	6.5
1977/78	7178.2	267.93	3.73	5.3
1978/79	9631.8	533.22	5.54	4.8
1979/80	10996.6	698.08	6.35	4.1
1980/81	11484.2	712.60	6.21	3.6
1981/82	12386.9	1137.36	9.18	2.8
1982/83	18015.5	1812.34	10.06	3.1
1983/84	20135.6	2224.29	11.05	3.4
1984/85	26005.5	2443.02	9.39	3.0
1985/86	27396.2	3611.45	13.18	3.1
1986/87	33682.1	4453.14	13.22	3.4
1987/88	41161.1	5075.09	12.33	3.5
1988/89	42686.1	5240.53	12.28	3.6
1989/90 (July-April)	40414.0	4240.11	10.49	3.5

Source: Compiled from the Monthly Statistical Bulletin of Bangladesh and Statistical Year Book of Bangladesh (various volumes), BBS.

Table - 10

Annual Catch and Productivity of Inland Fisheries

Type of Fishery	1985-86		1987-88		1988-89		Average catch (M. tons) (85-89)	Percentage of catch (85-89) (85-89)	Average productivity (Kg/ha)
	Total catch (M. tons)	Productivity (Kg/ha)	Total catch (M. tons)	Productivity (Kg/ha)	Total catch (M. tons)	Productivity (Kg/ha)			
A. Capture									
1. Rivers including estuaries	206712	200	183817	178	181140	176	190556	35.74	185
2. Sundarban	-	-	8066	-	6416	-	7241	1.21	-
3. Beels	45258	396	45610	399	47019	412	45962	7.66	402
4. Kaptai lake	2433	35	4068	59	3439	50	3313	0.55	48
5. Flood lands	187396	66	182037	64	186126	66	185186	30.85	65
Capture total	-	-	423598	-	424140	-	432258	72.01	-
B. Culture									
1. Ponds	123804	842	149423	1017	155012	1055	142746	23.78	971
2. Baors	968	176	1254	228	1321	241	1181	0.20	215
3. Shrimp farms	19951	228	25248	269	27172	251	24124	4.02	249
Culture total	144723	-	175925	-	183505	-	168051	27.99	-

Source: Statistical Year Book of Bangladesh, 1991, BBS (based on Catch Assessment Survey).

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Table - 11
Area and Productivity of Ponds in Bangladesh

Type of Pond	Pond Area (in acre)	Productivity (Kg/acre)			Average
		1986-87	1987-88	1988-89	
Cultured	189358 (52.17)	505.40	553.40	573.40	544.17
Culturable	110735 (30.51)	288.52	263.77	284.56	278.95
Derelict	62887 (17.32)	241.21	245.25	237.30	241.25
All	362980 (100.00)	393.62	411.66	427.07	410.78

Note: Figures within parenthesis indicate column percent.

Source: Statistical Year Book of Bangladesh, 1991. Estimates were drawn from SPARRSO report and Catch Assessment Survey of Ponds.

Table - 12

Distribution of Sample Ponds by Pond Size and Yearly Catch

Size of Pond (in acre)	Percentage of Ponds (%)	Average Pond Size (in acre)	Yearly Catch	
			Per Pond (in Kg)	Per Acre (in Kg)
Upto 0.40	35.29	0.2978	367.22	1233.11
0.41 - 0.60	19.61	0.5430	399.90	736.46
0.61 - 0.80	19.61	0.7020	561.50	799.86
0.81 - 1.00	11.76	0.9267	556.50	600.52
1.01 - 1.20	5.88	1.1033	675.00	611.80
More than 1.20	7.84	1.5025	1044.50	695.17
All	100.00 (n=51)	0.6410	505.22	788.17

Source: IFPRI-BIDS Survey, 1991.

Table - 13

Sample Ponds by Pond Size and Pond Composition by Type of Species

Size of Pond (in acre)	Percentage of Ponds (%)	Pond Composition by Type of Species							
		Rohu (%)	Katla (%)	Mrigal (%)	Silver Carp (%)	Grass Carp (%)	Shrimp (%)	Others (%)	All (%)
Upto 0.40	35.29	28.92	20.97	17.15	20.61	1.69	-	10.67	100.00
0.41 - 0.60	19.61	28.15	24.08	16.54	15.16	1.85	7.77	6.45	100.00
0.61 - 0.80	19.61	34.49	33.66	10.52	11.55	4.54	-	5.24	100.00
0.81 - 1.00	11.76	23.72	26.67	19.87	8.48	11.26	3.07	6.94	100.00
1.01 - 1.20	5.88	28.11	26.91	26.22	7.56	-	-	11.20	100.00
More than 1.20	7.84	32.67	34.62	12.09	11.28	1.34	-	8.00	100.00
All	100.00	29.88	27.64	15.85	13.68	3.39	1.60	7.96	100.00

Source: IFPRI-BIDS Survey, 1991.

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Table - 14

Distribution of Sample Ponds by per Acre Yearly Catch, Pond Size
and per Acre Value of Input Used

Size of Pond (in acre)	Percentage of Ponds	Per Acre Yearly Catch (in kg.)	Value of Input Used per Acre			
			Fingerlings (Tk.)	Fish Meal (Tk.)	Medicine (Tk.)	Total (Tk.)
Upto 0.40	35.3	1233.11	3022	4399	214	7635
0.41 - 0.60	19.6	736.46	2357	1581	18	3956
0.61 - 0.80	19.6	799.86	2918	2296	28	5242
0.81 - 1.00	11.8	600.52	2146	1248	34	3428
1.01 - 1.20	5.9	611.80	1994	2212	30	4236
1.21 & above	7.8	695.17	1830	2729	93	4652
All	100.0	788.17	2417	2415	70	4902

Source: IFPRI-BIDS Survey, 1991.

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Table - 15

Distribution of Sample Ponds by Source of Fingerlings, Value of Input Used per Acre and per Acre Yearly Catch

Source of Fingerlings	Percentage of Ponds	Average Pond Size (in Acre)	Value of Input Used per Acre				Yearly Catch per Acre (in kg)
			Fingerlings (Tk.)	Fish Meal (Tk.)	Medicine (Tk.)	Total (Tk.)	
Vendor	62.8	0.635	2314	2641	32	4987	792
Private fish firm	9.8	0.434	2995	4380	459	7834	1374
Govt. fish firm	19.6	0.777	2420	1509	64	3993	694
Market	5.8	0.7433	2556	1268	67	3892	515
Others	2.0	0.200	5000	6075	-	11075	745
All	100.0	0.641	2417	2415	70	4902	788

Source: IFPRI-BIDS Survey, 1991.

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Table - 16

Distribution of Sample Ponds by Type of Operation, Value of Input Used per Acre and Yearly Catch

Type of Operation	Percentage of Ponds	Average Pond Size (in Acre)	Value of Input Used per Acre				Yearly Catch per Acre (in kg)
			Fingerlings (Tk.)	Fish Meal (Tk.)	Medicine (Tk.)	Total (Tk.)	
Singular Ownership	56.9	0.6155	2308	2243	42	4593	750
Joint Ownership	29.4	0.6607	2509	1406	17	3932	775
Leased in Singularly	9.8	0.6180	2703	7474	445	10622	1207
Leased in Jointly	3.9	0.920	2500	1022	-	3522	527
All	100.0	0.6410	2417	2415	70	4902	788

Source: IFPRI-BIDS Survey, 1991.

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Table - 17

Distribution of Sample Ponds by Average Depth of Pond, Yearly Catch Per Acre and Value of Input Used per Acre

Average Depth of Pond (in feet)	Percentage of Ponds	Average Pond Size (in Acre)	Yearly Catch per Acre (in kg)	Value of Input Used per Acre			
				Fingerlings (Tk.)	Fish Meal (Tk.)	Medicine (Tk.)	Total (Tk.)
4.1 - 5.0	5.9	0.400	776	2133	2545	-	4678
5.1 - 6.0	13.7	0.6357	776	1938	2011	27	3976
6.1 - 7.0	33.3	0.5788	787	2421	2780	130	5331
7.1 - 8.0	15.7	0.5388	1018	2668	3578	107	6353
8.1 - 9.0	15.7	0.7013	670	2319	2354	7	4680
9.1 - 10.0	3.9	0.860	1015	2791	2123	58	4972
10.1 - 11.0	5.9	1.100	598	2273	659	61	2993
11.1 & more	5.9	0.7533	785	3186	2268	44	5498
All	100.0	0.6410	788	2417	2415	70	4902

Source: IFPRI-BIDS Survey, 1991.

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Table 2.1

Procurement Prices and Farmgate Prices of
Rice, Wheat, and Sugarcane

Year	Rice (Medium)		Paddy (Aman)		Wheat		Sugarcane	
	Procurement Price	Wholesale Price	Procurement Price	Farm-gate Price	Procurement Price	Farm-gate Price	Procurement Price	Farm-gate Price
1973-74	1945.92	2831.00	1203.65	1688.90	n.a.	2079.63	160.75	160.43
1974-75	3215.07	5779.00	1982.63	2964.43	n.a.	3804.94	214.34	319.87
1975-76	3215.07	3382.00	1982.63	1921.27	1929.04	1546.19	267.92	279.51
1976-77	3215.07	3023.00	1982.63	1965.46	1982.63	2148.52	267.92	281.48
1977-78	3590.17	3877.00	2250.55	2131.79	2143.38	2197.73	281.32	297.23
1978-79	3643.75	4216.00	2304.14	2880.77	2304.14	2216.43	334.90	337.58
1979-80	4420.73	5857.00	2813.19	2939.82	2813.19	2783.34	334.90	374.98
1980-81	4554.69	4770.00	2947.15	2854.20	2947.15	2999.86	401.88	409.43
1981-82	5090.10	6060.00	3322.20	3336.46	3322.20	3643.53	455.50	444.86
1982-83	5628.00	6700.00	3616.90	3608.10	3616.90	4018.52	455.50	444.86
1982-84	6028.20	7450.00	3858.10	4359.05	3858.10	3914.19	455.50	455.69
1984-85	6617.70	8250.00	4420.30	4042.14	4340.00	4160.24	535.80	522.61
1985-86	6832.00	6620.00	4554.70	4456.49	4554.70	4551.70	643.00	656.47
1986-87	7100.00	9160.00	4688.60	5255.66	4032.60	5216.26	669.80	672.21
1987-88	8251.00	9970.00	5358.00	4844.00	5358.00	5201.00	669.80	683.00
1988-89	8664.60	9810.00	5626.40	5608.64	5626.40	5717.59	736.70	767.33
1989-90	9071.20	9920.00	5894.80	5487.83	5894.30	6177.72	964.50	1080.72
1990-91	9900.00	10550.00	6430.00	5579.09	6430.15	6162.00	n.a.	920.00

Source: B.B.S. Statistical Yearbook, various issues.

Note: n.a. - not available.

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FOOTNOTES

1. See for examples: George Kent, Fish Food and Hunger - The Potential of Fisheries for Alleviating Malnutrition, Westview Press Inc, (1987), USA; Poulter, J.P. and J.G. Disney, The Handling, Processing and Marketing of Fish in Bangladesh, Bulletin No. 1, Overseas Development Natural Resources Institute, London, U.K. 1987; M. Youssouf Ali, Towards Sustainable Development: Fisheries Resource of Bangladesh, Bangladesh Agricultural Research Council, Dhaka, 1991.
2. If we consider per capita monthly consumption of fish from the HRS of BBS as a reliable estimate than estimated total consumption of fish in Bangladesh exceeds by 34% in 1981/82, 37% in 1983/84, 62% in 1985/86 and 60% in 1988/89 than the yearly catch (both inland and marine) in the corresponding years as revealed in the Statistical Year Book, BBS (based on the estimates made by directorate of fisheries). Yearly consumption of fish is estimated by multiplying population (adjusted by growth rate of population) by the per capita yearly consumption of fish from HRS, BBS.
3. This estimate (12.864 kg/per capita/year) of HRS (1988-89), BBS appears to be high compared to M. Youssouf Ali's (1991) national estimate (7.6 kg/per person/year in 1987-88). Again while considering the 1988-89 catch (both inland & marine) then per capita availability in 1988-89 becomes only 8 kg.
4. The estimates conflict with the earlier estimate of B.B.S as 'The Survey of Ponds - 1982, Bangladesh Bureau of Statistics (April, 1984)' report states that ponds account nearly 40 percent of total inland fish catch, 25 percent came from dighis, beels, baors etc., and about 30 percent from the rivers [Page (iii), para 6].

5. For details, please see Appendix A: 'Zoning of Bangladesh (prepared by Sajjad Zohir)' and Appendix B: 'Selection of Study Area for Collection of Production and Marketing Data (prepared by Sajjad Zohir & K. Bhuiya)' in the context of Agriculture Diversification Project (1991-92), BIDS.
6. The definition of semi-intensive fish cultivation may have its diversity but for our purpose we have assumed the following criteria of a semi-intensive pond: (a) The fry/fingerlings are released in the pond for the last 4-5 years, (b) Extra labour is used in maintenance of pond, (c) Fertilizer or fish meal is being used for growth of fish, (d) Fish is being reared as a source of income to the owner/operator, and they have some basic knowledge of carp species, (e) The predators fishes are removed before releasing fry/fingerlings in the pond.
7. The Survey of Ponds - 1982 (EBS, 1984) reports catch of predatory fish like Boal, Pangash, Fali, Chital etc. constituting around 4% of total catch but no catch of exotic carp (Chinese origin) and as a result it is presumable that the presence of predators in the fish population of ponds contribute reduction in the yield of ponds.
8. See, A.K.M. Nuruzzaman, 'Perspectives on Fisheries Development in Bangladesh', BARC, Dhaka, 1990.
9. See, Bangladesh Fisheries Sector, Review, Report No. 8830-BD, World Bank, March, 1991.
10. See, John C. Marr Associates (1986) and Chowdhury (1988).
11. Features of semi-intensive management are very close to our definition and it includes: (a) Optimal stocking and harvesting, (b) Polyculture, (c) Control of predators, disease and weeds, (d) Fertilization and (e) Supply of low-quality feed.

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